Hemispheric Laterality and Cognitive Style

Christine J. Kuchler
HEMISPHERIC LATERALITY
AND
COGNITIVE STYLE

by
Christine J. Kuchler
Bachelor of Arts, University of Chicago, 1971
Master of Education, Marquette University, 1974

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This Dissertation submitted by Christine J. Kuchler in partial fulfillment of the requirements for the Degree of Doctor of Philosophy from the University of North Dakota is hereby approved by the Faculty Advisory Committee under whom the work has been done.

(Chairman)

This Dissertation meets the standards for appearance and conforms to the style and format of the Graduate School of the University of North Dakota, and is hereby approved.

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ABSTRACT

The purpose of the present study was to determine the nature and degree of relationship between cerebral "hemispheric style" and several traditional dimensions of "cognitive style." A large battery of laterality preference, cognitive style, verbal and nonverbal ability, and selected additional tests was administered to 97 (52 female, 45 male) right-handed undergraduate volunteers, with subsequent analysis of relationships among the measures by simple correlation, factor analysis, and multiple regression methods.

Laterality measures included the Zenhausern, Verbalizer-Visualizer Questionnaire, and a lateral eye movement observation measure. Data analyses utilized individual laterality test scores as well as a composite "laterality index." Eleven cognitive style tests were administered, including measures of field independence, distractibility, complexity, flexibility, and other dimensions. Additional tests administered included measures of verbal and visual synthesizing ability, anxiety, repression-sensitization, and social desirability.

The main findings of the study were as follows: (1) intercorrelations of the cognitive style measures were generally very low, ranging from .00 to -.54; (2) Only one cognitive style factor reliably emerged, accounting for about 10% of the common cognitive style test variance. This factor was called "Open vs. Closed-Mindedness" and was defined
primarily by Dogmatism, Rigidity, and Ambiguity Tolerance scores; (3) Maximum multiple prediction of individual and composite laterality scores from individual cognitive style tests, cognitive style factor scores, and additional scores accounted for 11% to 25% of laterality variance; (4) Sex differences were nonsignificant on all measures with the following exceptions: Females performed the Stroop Test more quickly, were "narrower categorizers" on the Category Width Scale, and obtained higher trait anxiety scores than males.

General conclusions drawn were that hemispheric and cognitive style, as measured in the present study, are largely unrelated, and that individuals manifest considerable diversity in cognitive style. The findings caution against oversimplification and overgeneralization in reference to both hemispheric and cognitive style and their interrelationship. Low intercorrelations of measures within both domains do call into question the adequacy of available tests of these constructs and suggest the need for further test development based upon current neuropsychological knowledge.
CHAPTER ONE: INTRODUCTION

In 1950, Adorno and his associates (Adorno, Frenkel-Brunswik, Levinson, & Sanford, 1950) published *The Authoritarian Personality*. Also in that year, H. A. Witkin published a rather brief report on a newly adapted and standardized "embedded figures test," which extended previous findings in the area of individual differences in perception, and which eventuated in delineation of a perceptual style called field independence. And in his 1950 presidential address to the American Psychological Association (Guilford, 1950), Guilford presented his structure-of-intellect model of creativity, which was largely responsible for stimulating a sevenfold increase in creativity research over the next two decades (Taylor, 1975). These and other seemingly unrelated threads of investigation were to become interwoven approximately a quarter century later, upon the unlikely framework of findings related principally to the brain functioning of intractable epileptics, stroke patients and brain-injured individuals.

In the following chapter, the convergence of these various lines of research will be traced. The common denominator of various dimensions of cognitive control, cognitive style, perceptual style, certain aspects of the creative personality and process, and finally, of differential modes of brain hemispheric function, will be revealed as an emphasis upon structural individual differences in human information.
processing. Such structural models stress individual consistencies in the mode or manner in which cognitive activities proceed; i.e., the way in which information is selected, organized, and processed. Structural differences are to be contrasted with individual consistencies in thought content, such as a particular set of beliefs, attitudes, memories, or other concepts which may influence attention deployment and cognition. The structural view does not deny the relevance of past learning (leading to such consistencies in thought content). However, this view does hold that structural factors will determine in part the kind of content that is processed and retained by the individual, and moreover, that these structural factors can be identified and studied independently of cognitive content variables.

During the past twenty years, neuropsychological studies have greatly expanded our knowledge of differential capacities of the two human cerebral hemispheres. While it had long been known that the left hemisphere is specialized for speech and language functions in most individuals, only relatively recently have two general additional insights been achieved: (1) that the right, so-called "minor" hemisphere appears to be specialized, for certain types of nonverbal information processing, and (2) that each hemisphere appears to be specialized, not only for a specific information mode (e.g., verbal vs. nonverbal), but also in terms of
processing mode. The verbal left hemisphere appears to be particularly adept at any type of task requiring sequential analysis, temporal discriminations, and motor sequencing—all of which are clearly necessary for but not limited to linguistic functions. The processing mode of the right hemisphere, on the other hand, is of a holistic, configurational, nonsequential and perhaps "intuitive" type. The right-hemispheric processing mode is well-suited (but again, not necessarily limited) to the visuo-spatial, melodic, and emotional tone perception and expression tasks at which it normally excels. The emerging neuropsychological view of functional hemispheric asymmetry stresses differential hemispheric processing styles (analytic, linear, sequential vs. holistic, configurational, and parallel), with logical but only secondary consideration of the type of information (verbal vs. nonverbal) processed most efficiently in these ways.

The neuropsychological concept of "cognitive style" is thus a fairly recent formulation. However, other investigators, working within other theoretical contexts, have been utilizing and investigating the construct of "cognitive style" for some time. Operationally, cognitive style has been measured by a variety of personality, perceptual, and intellectual tests—all of which purport to measure individual differences in cognitive style (vs. ability) and structure (vs. content). The question may then naturally arise:
What is the nature and degree of relationship between "cognitive style" in the neuropsychological sense, and traditional measures of cognitive style? While both hemispheres of the normal brain are presumed to be capable of the differential functions described above, the neuropsychological notion of cognitive style suggests that individuals differ in their relative degree of reliance upon (or preference for) one hemispheric processing mode or the other. Might this "hemispheric preference," or preferred style of information processing, provide an explanation at the neuropsychological level of observed stylistic differences in higher-order problem-solving, cognitive-perceptual task performance, and even some aspects of personality functioning? Research in this area is far from the stage of investigating causality in brain-behavior relationships. However, a necessary first step in this direction is exploration of the degree of relationship between the variables of interest, and this is the major purpose of the present study.

In the chapter to follow, traditional concepts and measures of cognitive style will be reviewed, with particular emphasis upon those dimensions of cognitive style relevant to the present study. This will be followed by an overview of the research related to functional brain hemispheric asymmetries in both pathological and nonpathological subject groups. Neuropsychological findings will then be related to
the traditional cognitive style literature, with delineation of the purposes of the present study.
In this chapter, the general concept, historical origins and range of referents of the term "cognitive style," will be presented. This overview will include discussion of the issues of cognitive style vs. ability, and of value judgments as applied to some presumably value-free cognitive style dimensions. The overview will be followed by literature surveys of the cognitive style dimensions of particular relevance to the present study.

Next, the research demonstrating functional asymmetries of the human brain will be reviewed. This literature will be reviewed separately, for those studies involving pathological (e.g., unilateral brain lesions, commissurotomy or "split-brain" patients, unilateral focus epileptics, and psychiatric patients) vs. nonpathological subject groups. The theoretical rationale for relating these findings in the area of neuropsychology to the area of cognitive style will follow, with review of studies which have directly investigated this possible relationship between differential brain hemispheric function and individual differences in cognitive style.

Finally, the purposes of the present study will be described. The hypothesized interrelationships of the cognitive style dimensions included in this study will be stated, as well as their expected relationships to a composite index of laterality.
As Nathan Kogan (1973) has observed, "a discussion of the historical origins of the construct of cognitive style would be no less than a history of cognitive psychology" (p. 160). This broad construct has come to subsume such diverse earlier constructs as "perceptual attitudes," "perceptual styles," "cognitive attitudes," "cognitive controls," and "systems principles" (Gardner, Holzman, Klein, Linton & Spence, 1959; Goldstein & Blackman, 1978). Most generally speaking, the notion of cognitive style is based upon the assumption of cognition as a mediating process between environmental events and individual response (the S-O-R model). More specifically, what is common to all definitions of cognitive style and its historically precedent constructs is an emphasis upon the structure as opposed to the content of thought (Goldstein & Blackman, 1978).

This structural emphasis is apparent in the following sample of definitions of cognitive style:

... the characteristic, self-consistent modes of functioning which individuals show in their perceptual and intellectual activities. (Witkin, Oltman, Raskin & Karp, 1971, p. 3).
... a person's typical modes of perceiving, remembering, thinking and problem-solving. (Messick, 1970, p. 188)
... consistent individual differences in ... ways of organizing and processing information and experience. (Messick & Associates, 1976, pp. 4-5)
... the manner in which an individual receives, processes, and uses information. (Ragan, Back, Stansell, Ausburn, Ausburn, Butler & Huckabay, 1979, p. 1)
In addition to an emphasis upon structure (and consequently upon consistency and stability), the various definitions also emphasize modes, ways, or manner of information processing—that is, an emphasis upon style as opposed to ability or proficiency.

Whereas the [ability domain] is concerned with level of performance—high (or accurate) at one extreme and low (or inaccurate) at the other—cognitive styles are purported to deal with the manner in which individuals acquire, store, retrieve, and transform information. (Kogan, 1976, p. 105)

Kogan notes that the theoretical distinction between cognitive ability and style is frequently blurred in practice. Several tests which purport to measure cognitive "style" are indeed scored according to accuracy vs. inaccuracy of performance. "The term style employed to designate such performance may be something of a misnomer" (Kogan, 1973, p. 161).

The appellation "style," in addition to supposedly connoting a variable independent of ability, also has become a favored term due to its implication of freedom from value judgment. That is, stylistic differences are presumably differences of type; styles do not imply distinctions of better or worse, good or bad, adaptive or maladaptive, except possibly in relation to their specific application. Yet again, Kogan (1973) has identified a class of cognitive styles which, even though not based upon veridicality of performance, are nevertheless consistently valued more at
one pole than the other of the dimension. In practice, it is a small class of cognitive styles indeed for which matters of veridicality are irrelevant and to which no value judgments are assigned. "These are the cognitive styles that are most purely stylistic" (Kogan, 1973, p. 161). And even in these cases, interpretive controversy is lively (especially, it seems, when sex differences are involved), creating the impression of a struggle to impose differential valuing of the poles even when evidence is lacking to do so (cf. Bieri, 1969).

Cognitive style research, then, is far from a "value-free study of cognition," as it is typically characterized. While current investigators may prefer to adopt a neutral, nonjudgmental frame of reference (particularly those operating from a neuropsychological perspective which accepts relative superiority of each brain hemisphere in the performance of different functions), a brief consideration of the theoretical frameworks from which traditional tests of cognitive style were formulated will reveal the reasons for value biases. Tests of dogmatism, ambiguity tolerance, and rigidity evolved from study of the authoritarian personality (Adorno et al., 1950). While these tests were attempts to separate the structural aspects of authoritarianism from any particular ideology (e.g., fascism and anti-Semitism), the fact that any such structural component was believed to lead to "antidemocratic" attitudes and behavior provides an obvious basis for
the greater valuing of particular poles of the dimensions. Also, workers in this area were psychoanalytically oriented, so that there were theoretical as well as political reasons to favor the more flexible, tolerant and nondogmatic individual. These characteristics were interpreted to be consistent with a less rigid defensive psychological makeup and relative freedom from underlying intrapsychic conflict.

Conceptual differentiation and constricted-flexible control, as well as tolerance for unrealistic experiences, leveling-sharpening, and focusing, were originally termed "cognitive controls" and "control principles." These variables were conceived and studied at the Menninger Foundation by Gardner and his associates (1959) within an ego-psychoanalytic theoretical framework. The "control" terminology reflects the theoretical postulate of ego control; the ego psychology viewpoint is revealed in the group's emphasis upon "conflict-free" functions and upon adaptation:

The possibility that "conflict-free" cognitive functions are idiosyncratically organized in individuals has not yet been explored by psychoanalysis. It is precisely in this respect that the concept of cognitive control, with its provision for adaptively adequate yet various modes of encountering reality, may prove a useful addition to the theory. (Gardner et al., 1959, p. 9)

Again, despite the reference to "adaptively adequate yet various" modes, the underlying theory requires some degree of differential valuing of the dimensional extremes. For example, flexible control is clearly more effective and adaptive than constricted control (as measured by the degree
of susceptibility to interference). Similarly, individuals low in conceptual differentiation, and those more inclined toward "leveling" in memory organization, function at a more primitive developmental level in these areas, according to the theory.

Field independence (and the related dimensions of impulsivity-reflection and distractibility) has roots in developmental, perceptual (Gestalt) and psychoanalytic theory. From any and all of these orientations, the individual capable of more precise field articulation and perceptual disembedding is also theoretically the more advanced and mature. This view is supported by evidence which indicates a general increase in field independence through childhood to young adulthood (Witkin et al., 1971). Similarly, cognitive complexity—whether of the type based upon Kelly's (1955) personal constructs theory or upon the conceptual systems theory of Harvey, Hunt, and Schroder (1961)—is regarded as a more sophisticated state of development than cognitive simplicity. Although Kogan has remarked that "psychologists concerned with individual differences very likely score at the complex end of a complexity vs. simplicity dimension" (1976, p. 98), it seems likely that complexity is valued more on theoretical than personal grounds.

The previous discussion reveals that different dimensions of cognitive styles have been developed from diverse (although predominantly ego-psychological) theoretical orientations.
Thus there exists no commonly accepted, well-defined and theoretically integrated set of cognitive styles. The present review led to identification of over twenty proposed dimensions of cognitive style, but major reviewers usually limit discussion to nine or ten of the most well-known (Goldstein & Blackman, 1978; Kogan, 1971; Messick, 1970; Ragan et al., 1979). Messick's 1976 review, however, included discussion of eighteen. Automated computer searches which were completed for a recent review of the cognitive style literature yielded approximately 3500 citations (Back, Stansell, Ragan, Ausburn, Ausburn, & Huckabay, 1979). Certainly this is a domain of lively research interest, although one remarkably lacking in integration (cf. Goldstein & Blackman, 1978).

For purposes of the present study, a large number (ideally, all) of the cognitive style dimensions identified to date were to be measured. However, selection of a subset of representative cognitive style tests was necessitated by the following factors: (a) meaningful statistical analysis imposed some constraints upon the number of measures to be included, given sample size limitations; (b) available tests needed to meet some semblance of psychometric soundness and also needed to be a commonly accepted measure of the dimension in question. In addition, the relative ease and speed of administration were considered, as well as nonaversiveness of the measures. This last consideration ruled out inclusion of either of two tests of leveling-sharpening (a variable of
some interest) because subjects reportedly find both of these lengthy measures to be "quite monotonous . . . fatiguing and boring" (Gardner et al., 1959, p. 18). Given these constraints, measures were obtained for each subject on eleven cognitive style dimensions. These dimensions, and the tests utilized to measure them, are individually reviewed below.

Dogmatism

Dogmatism, or "closed-mindedness," is "(a) a relatively closed cognitive organization of beliefs and disbeliefs about reality, (b) organized around a central set of beliefs about absolute authority which, in turn, (c) provides a framework for patterns of intolerance toward others" (Rokeach, 1954, p. 195). Rokeach emphasized the structural aspect of dogmatism, independent of any specific set of beliefs, and thus differentiated it from other measures of authoritarianism such as the original Fascism (F) scale of Adorno and his associates (1950). This structural emphasis classifies dogmatism as one of the earliest dimensions of cognitive style.

The Rokeach Dogmatism Scale was revised four times. The final revision, Form E, has 40 items (Rokeach, 1960) and is most often used in research. Reliability is generally high for adult and high school populations, with the Dogmatism scale achieving a test-retest correlation coefficient of .55 even over a five-year interval (Vacchiano, Strauss, & Hochman, 1969). The scale is apparently unaffected by a

The research literature has been supportive of the central proposition of Rokeach, that dogmatic persons are highly resistant to change (Ehrlich & Lee, 1969). High-dogmatics (HD) make more errors in learning new word-pairs than low-dogmatics (LD). They rate novel musical systems (e.g., Schonberg as opposed to Brahms) more negatively than low-dogmatics. In fact, across three media (painting, music, and literature), high-dogmatics like popular art significantly more than classical art, and classical art significantly more than avant-garde (whereas LD subjects appear to like all esthetics equally well). In a simulated bargaining game, regardless of assigned role as union or management representative, high-dogmatics were more resistant to compromise than LD counterparts, resolved fewer issues and were more likely to view compromise as defeat. HD psychiatric patients are hospitalized longer than LD psychiatric patients, possibly a consequence of greater resistance to change (Ehrlich & Lee, 1969).

Relationships of dogmatism to other personality scales also indicate relative cognitive inflexibility and change resistance (Vacchiano et al., 1969). Higher dogmatism is associated with lower tolerance, flexibility and security on the California Psychological Inventory, with higher need for Succorance and lower needs for Change and Intraception.
on the Edwards Personal Preference Inventory, and with conformity, restraint and conservatism on the 16PF test. Additional studies reviewed by Goldstein and Blackman (1978) showed significant positive correlations of dogmatism to Intolerance of Ambiguity as measured by both Budner (1962) and MacDonald (1970), and with the Gough (1975) Rigidity scale.

Dogmatism has been positively related to anxiety and with various degrees of maladjustment as measured by the 16PF, the Mooney Problem Checklist, the Personal Orientation Inventory and MMPI Scales, F, K, D, Pt, and Si (Vacchiano et al., 1969). Two studies reviewed by Vacchiano and others showed dogmatism to be associated with sensitizing rather than repressing defenses on the Repression-Sensitization scale. This finding seems to conflict with another study they reviewed showing high positive correlations of dogmatism with denial, and high negative correlations with depression, in a group of 32 males who were gradually losing their sight. Despite the positive correlations of dogmatism with various measures of psychopathology, two different studies did not reveal any relation between school counselor dogmatism and effectiveness, and dogmatism was positively correlated with a measure of adaptive regression in a group of creative artists (Vacchiano et al., 1969).

The review of Goldstein and Blackman (1978) also included evidence that, as expected, high-dogmatics have been shown to be more influenced by authority than low-dogmatics.
in a number of studies. Two studies indicated that dogmatism affects judgment accuracy as well: low-dogmatics are able to judge the dogmatism level of others more accurately than high-dogmatics!

Results have been more equivocal in the area of perceptual correlates of a dogmatic cognitive style (Goldstein & Blackman, 1978; Vacchiano et al., 1969). High- and low-dogmatics consistently differ in synthesizing ability (as measured by Block Designs) but not in analytic ability (as measured by the Embedded Figures Test). However, interesting interaction effects have been noted and summarized by Vacchiano and others (1969):

It would appear that the influence of dogmatism (as a cognitive style) upon perceptual functioning is limited. The hypothesis that dogmatism and field dependence are unrelated can be fairly well supported. Perceptual synthesis, though, seems to be a function of both dependency and dogmatism. Field-dependent-HD groups have the most difficulty with synthesizing; field-independent-LD's, the least. (p. 266)

Some of the inconsistent findings noted above may be due in part to the relatively statistically "impure" nature of Rokeach's Form E Dogmatism Scale. Steininger and Lesser (1974) compared five factor-analytic studies of the Dogmatism scale and selected the 15 items which consistently emerged (13 items in four or five studies, two items in two studies). The resulting 15-item scale correlated from .86 to .92 (p < .01) with the original scale's total score for four different subject groups. Although prior studies have shown high-dogmatics
to more likely be rightist in political orientation (e.g., Karabenick & Wilson, 1969), Steininger and Lesser found dogmatism to be unrelated to conservatism-liberalism, possibly because they studied nonstudent as well as student groups.

Ambiguity Tolerance and Rigidity

The related dimensions of ambiguity tolerance and cognitive rigidity, like dogmatism, emerged from studies of the authoritarian personality in the late 1940's. They also were the result of theoretical efforts to isolate content-independent, structural individual differences which could account for prejudice and ethnocentrism, including but not limited to the phenomenon of fascism.

Based on her studies of ethnic prejudice at the Institute of Child Welfare at the University of California, Else Frenkel-Brunswik (1949) described the emergence of her concept of ambiguity intolerance as follows:

Starting from the observation that some of her subjects were able to tolerate emotional ambiguities better than others, the writer became involved in the question of whether this attitude of intolerance of more complex, conflicting, or otherwise open structures extends beyond the emotional and social areas to further include perceptual and cognitive aspects proper. (p. 114)

Perceptually, Frenkel-Brunswik found ambiguity intolerance to be related to a "prolonged clinging to the first impression" (p. 129), and cognitively, to difficulty in changing mental set on both a verbal arithmetic and spatial task. It also appeared to be related to a reluctance to think in terms
of probabilities in a probability-learning task.

Frenkel-Brunswik, writing from a psychoanalytic orientation, believed that "rigidity of attitudes constitutes a counterbalance to underlying conflicts often verging on chaos" (p. 132), and she also noted the relevance of parental influence upon the formation of this cognitive style:

Data on the parents of the children in the rigid, intolerant group reveal that it is their feeling of social and economic marginality in relation to the group to which they aspire from which ensues the desperate clinging to external and rigid rules . . . It is this rigid adherence to norm which furnishes the key to an understanding of all the various avoidances of ambiguities listed in this paper. (pp. 118-119)

Early attempts to develop an independent scale of ambiguity tolerance were not successful. Goldstein and Blackman (1978) report that a 1958 review of twelve different measures of ambiguity tolerance was discouraging: Of the 66 intercorrelations, only seven were significant, and of these seven, two were in the wrong direction. A more promising scale, by Budner (1962), was questioned by MacDonald (1970) on the basis of its high correlation with another measure of ambiguity tolerance with a demonstrated internal consistency of .08. Budner's scale had, however, shown a degree of validity by correlating in expected fashion with conventionality, belief in a divine power, church attendance, dogmatism about one's religious beliefs, and attitudes with authoritarianism and expressed attitudes of idealization of and submission to parents.

Rydell and Rosen (1966) constructed an ambiguity tolerance
scale with a test-retest reliability of .71 (one month) and .57 (two months). MacDonald (1970) increased the length of the Rydell and Rosen scale from 16 to 20 items, thereby increasing its split-half reliability in his sample from .64 to .86; his retest reliability was estimated at .63 ($p < .01$) for a six-month interval. The MacDonald scale of ambiguity tolerance correlated positively with performance on a complex Scrambled Words test ($r = .33, p < .01$), and negatively with authoritarianism (the F Scale) ($r = -.30, p < .01$), Rokeach Dogmatism ($r = -.42, p < .01$), Gough Rigidity ($r = -.41, p < .01$), and church attendance ($r = -.24, p < .01$). It was unrelated to Marlowe-Crowne social desirability response bias ($r = .02$). Goldstein and Blackman (1978) regard the MacDonald scale as one of the most promising scales of ambiguity tolerance, and this was the measure utilized in the present study.

Rigidity is related to ambiguity tolerance, both theoretically and empirically, and yet most researchers in the area take some pains to distinguish them. Cognitive rigidity is defined as "a continuation of former behavior patterns when a change in the situation requires a change in behavior for more efficient functioning" (Goldstein & Blackman, 1978, pp. 39-40), whereas intolerance of ambiguity is "the unwarranted imposition of structure when the situation is unstructured" (p. 40). Frenkel-Brunswik (1949) used the terms interchangeably.
As in the case of ambiguity tolerance, many early measures of rigidity were all independent (uncorrelated). However, the Gough Rigidity scale (1975) has become commonly accepted as the criterion measure and presently constitutes the Flexibility subscale of the California Psychological Inventory (Gough, 1975), scored in reverse. Gough (1975) reports one-year test-retest reliabilities of .67 and .60 for high school female and male samples, respectively, and a 7 to 21 day test-retest reliability of .49 for male prisoners. MacDonald (1970) reports a six-month test-retest reliability of .57 (p < .01) for the Gough scale, with a sample of male undergraduates. The validity of the scale is demonstrated by its correlations, when scored in the direction of flexibility, of -.48 with staff ratings of "rigidity" of graduate students, -.36 with staff ratings of "rigidity" of medical school seniors, and -.58 with F-scale (authoritarianism) scores of college undergraduates (Gough, 1975). As reported earlier, MacDonald (1970) reported a correlation of -.41 (p < .01) between Gough Rigidity and his ambiguity tolerance scale.

Since the MacDonald scale accounts for about 17% of the variance in Rigidity scores, it is clear that the dimensions are related but not identical. Therefore, the Gough Rigidity scale was included in the present study.

Origence-Intellectance

In 1947, George Welsh constructed a 200-item nonverbal figure preference test to diagnose psychopathology. Factor
analysis revealed a simplicity/symmetry vs. complexity/asymmetry factor. Subsequently, an expanded (400-item) version of the test was administered to a sample of 37 artists and art students, and a group of 150 nonartists. A 65-item scale was empirically derived to reliably differentiate the artists, who tended to prefer the complex items, from nonartists, who tended to prefer the simple, symmetrical items. Hence the scale came to be known as the Barron-Welsh Art Scale (Barron, 1952; Barron & Welsh, 1952). In attempting to interpret the results, Barron and Welsh (1952) suggested that artists may favor certain principles of composition, or they may resemble one another in personality. "Or, again, there may exist some higher-order determinant of both artistic taste and personality style, with both of the lower-order variables having found expression in these test scores" (p. 201). Subsequent studies with the Art Scale tended to support the notion of complexity-simplicity preference as a personality dimension (Barron, 1953a, 1953b). Figural complexity preference consistently related positively to personal tempo, verbal fluency, impulsiveness, expansiveness, and "breakdown of repression," among other variables and consistently negatively to rigidity and constriction, impulse control by repression, politico-economic conservatism, subservience to authority, ethnocentrism, and social conformity (Barron, 1953a). Also, "Independents" as identified in an experiment planned and conducted by Solomon Asch, were found to prefer the complex Art
Scale figures to a significantly greater extent than "Yielders" ($p < .01$). Thus complex figure preference was also shown to be related to independence of judgment in a peer-pressure situation (Barron, 1953b).

Thus from a measure originally designed to be a psychodiagnostic tool came a scale with ever-increasing generality. It has continued to be used frequently as a criterion measure in studies of artistic creativity (see Welsh, 1975, pp. 60-69 and 205-227, for an extensive review). However, even the early studies described above revealed cognitive dimensions (and obvious perceptual dimensions, by the nature of the scale) which may be important structural determinants of test performance. Also, the Art Scale is a genuine preference (vs. ability) test, and as such it is indisputably a measure of style as opposed to aptitude (cf. Kogan, 1973).

Welsh (1980) developed "Origence" (WOR) and "Intelligence" (WIN) subscales of the full-length, 400-item Welsh Figure Preference Test (WFPT) to supplant two earlier forms of the Art Scale. WOR and WIN were empirically derived from the WFPT responses of gifted adolescents grouped on the two dimensions on the basis of personality and vocational interest test scores. WOR correlates highly with the original Art Scale ($r = .95$), due in part to a substantial item overlap in the scales. Low WOR scorers "prefer and are more at home in an explicit and well-defined world which can be grasped by the application of objective rules" (Welsh,
1980, p. 26), while high WOR scores "find congenial an implicit and open universe which they can structure in their own subjective way" (p. 26). Intellectance (WIN) is conceptualized as a concrete vs. abstract dimension. "The dimensions are conceptually independent and the scales are statistically uncorrelated but are most useful when scored and interpreted conjointly" (p. 10).

Welsh characterizes the High Origence-Low Intellectance individual as a non-conforming, impulsive, extratensive "imaginative type," often interested in artistic, literary and esthetic matters. Conversely, the Low Origence-High Intellectance scorer is interpreted as a conventional, logical, introversive "intellectual type," who tends to score higher on standard IQ tests. Although the model also generates two additional categories in the typology (High Origence-High Intellectance "Intuitive Type" and Low Origence-Low Intellectance "Industrious Type"), only the first two types are relevant to the present study.

Welsh (1980) notes that, since the WOR dimension can be measured by the original Art Scale, earlier studies utilizing the latter can be interpreted in the framework of his newer, two-dimensional model. Thus, the studies reviewed above which involve the Art Scale showing figural complexity preference to positively correlate with personal tempo, verbal fluency, impulsivity, and nonrepression, and to negatively correlate with cognitive rigidity, conservatism, conformity
and repression are of relevance. Also, in a small exploratory study conducted by the writer (Kuchler, Note 1) with twelve female undergraduates, Barron-Welsh Art Scale scores were found to correlate positively with cognitive flexibility (the Gough Rigidity scale scored in reverse; $r = .64, p < .02$) and negatively with Spielberger Trait Anxiety ($r = -.58, p < .04$). Art Scale scores were unrelated to Spielberger State Anxiety, before or after administration of a modified, group Rorschach measure. On the Rorschach, Art Scale scores correlated significantly negatively with common detail (D) responses ($r = -.60, p < .03$), with Pure Form Accuracy ($F + %; r = -.63, p < .02$) and with overall Form Accuracy ($X + %; r = -.78, p < .002$).

**Field Independence**

Whereas the related cognitive styles of dogmatism, ambiguity tolerance and rigidity emerged from studies of authoritarianism, and origence and intellectance have their roots in creative personality research, field independence properly refers to a *perceptual* style first identified in experimental studies of space orientation and perception of body position within different visual fields.

Witkin (1950) found that individual differences relating to how strongly one was affected by the surrounding visual field in such studies could be generalized to a perceptual disembedding task. The underlying stylistic dimension was
conceived as a narrowly perceptual one and was called field independence vs. field dependence:

In a field-dependent mode of perceiving, perception is strongly dominated by the overall organization of the surrounding field, and parts of the field are experienced as "fused." In a field-independent mode of perceiving, parts of the field are experienced as discrete from organized ground. (Witkin et al., 1971, p. 4)

Extensive subsequent research into the nature and correlates of field independent-dependent perceptual styles (Witkin, Dyk, Faterson, Goodenough, & Karp, 1962) revealed that the dimension extended further, into the cognitive domain. Field-dependent (FD) persons tended to do less well in solving problems which required isolation of an essential element from its original context, and its utilization in a new and different context. Hence the perceptual style of field independence-dependence was conceptually subsumed under the broader cognitive style of analytic vs. global (Witkin et al., 1971). "What is basically at issue in this cognitive style is extent of ability to overcome an embedding context" (Witkin et al., 1971, p. 7). When further study revealed a link between analytical and structuring ability (e.g., ability to impose structure upon inkblots with resultant percepts that are organized and definite as opposed to vague and indefinite), the presumed underlying cognitive style was broadened again in scope and renamed articulated vs. global (Witkin et al., 1962).
The articulated-global dimension of cognitive style was in turn subsumed theoretically under an even broader psychological dimension called level of psychological differentiation. This further generalization was made on the basis of studies showing the articulated-global cognitive style to relate to (1) body concept (degree of detail, realistic proportion, clarity of sex and role representation in human figure drawings); (2) sense of separate identity (awareness of one's own needs, feelings, and attitudes as opposed to reliance on external sources for self-definition); and (3) nature of psychological defenses (specialized, e.g., isolation, vs. nonspecialized, e.g., repression or denial) (Witkin et al., 1962). "Differentiation refers to the complexity of structure of a psychological system" (Witkin et al., 1971, p. 10). At any level of differentiation, Witkin notes, various modes and levels of integration are possible, and psychological adjustment is more a function of the effectiveness of an individual's integration than of differentiation per se.

Witkin and Goodenough (1976a, 1976b) recently modified the theory of psychological differentiation. Based upon the vast accumulated literature, they now divide differentiation into three main subsections: segregation of psychological functions (body concept, defense mechanisms, and control over impulse expression), segregation of neurophysical functions (to be discussed below in the section, "Laterality
and Cognitive Style"), and self-nonself segregation. Two subsections of self-nonself segregation are autonomy in interpersonal relationships and restructuring ability. While the influences of psychoanalytic theory, Werner's organismic theory of development, Lewin's field theory, and Gestalt principles can all be seen, the cognitive style dimension of Witkin and his associates presently fits clearly within their own developed theory of psychological differentiation.

From the foregoing discussion, it is evident that the correct designation of the cognitive style dimension of Witkin and his associates is either analytic-global or articulated-global. However, the field independence-dependence terminology has been retained in the present study in order to most clearly reflect (and emphasize) the perceptual nature of the criterion measure, the Group Embedded Figures Test. Also, the term "analytic" is ambiguous, since it has been used to describe an unrelated form of conceptualizing style (Kagan, Moss & Sigel, 1963). Similarly, "articulation" is a term easily confused with "conceptual articulation," which refers to cognitive complexity in the sense used by Kelly (1955).

Operationally, field independence (FI) and field dependence (FD) have been defined as performance on any of several accepted (and well-intercorrelated) tests: The Rod-and-Frame Test (RFT), the Body Adjustment Test (BAT), the Hidden Figures Test (HFT), the Embedded Figures Test (EFT),
and several alternative children's and group forms, including the Group Embedded Figures Test (GEFT). Of a variety of group EFT instruments, the GEFT used in the present study (achromatic, requiring memory) correlates most highly with the original, individually administered EFT ($r = .84$), which in turn has repeatedly demonstrated reliability in the low nineties (Jackson, Messick, & Myers, 1964). Witkin et al. (1971) report a split-half GEFT reliability of .82 for both males and females, and a concurrent validity with the parent EFT of -.82 for males and -.63 for females when the tests are scored in reverse fashion.

Witkin et al. (1971) vigorously maintain that field independence is independent of IQ, except for artifactual correlations with overall IQ produced by actual association with the relevant "analytic triad" of Picture Completion, Block Design and Object Assembly of the Wechsler scales. Nevertheless, significant positive correlations of FI with verbal ability measures (e.g., Wachtel, 1968; cf. Kogan, 1973) are not rare, and their absence cannot be assumed.

Field independent individuals appear to be less vulnerable to interference on the Stroop test (Bone & Eysenck, 1972; Messick & Fritzky, 1963) and less impulsive (Massari, 1975; Willoughby, 1967). Field independence appears unrelated to number of categories created in a sorting task (Gardner et al., 1959) and to dogmatism, rigidity and ambiguity tolerance (Goldstein & Blackman, 1978; Messick &
Cross-sectional developmental studies indicate that field independence increases from about age 8 to 15, levels off in young adulthood, and diminishes in older age, with the decline beginning in the late 30's (Witkin et al., 1971). Longitudinal data are also available for individuals between the ages of 8 and 24, which demonstrates the stability of subjects' standing on the variable relative to age peers ($r = .48$ to $.92$) (Kogan, 1973). Kogan (1973) noted that the studies which indicated more field dependence among the elderly, and more field dependence of retired elderly relative to employed elderly, were uncontrolled for educational level, whereas a study which did control for years of education showed no difference in field independence between institutionalized vs. noninstitutionalized elderly. He suggested that education rather than age constitutes the major determinant of observed differences between younger and older groups, and between retired and employed older persons.

Just as Witkin and his associates may overstate the case a bit in regard to developmental changes in field independence and its lack of association with verbal ability, his definite statements about sex differences (with males consistently regarded as more field independent) may require further qualification over time. The writer has noted several studies (Kuchler, Note 2) in which no sex differences in
field independence, or sex differences favoring females, have been found. In their validational study of a variety of forms of the EFT, Jackson, Messick and Myers (1964) reported:

In sharp contrast to a wealth of data indicating faster and more accurate EFT performance among males ... significant sex differences did not appear in the present sample for any of the EFT's, not even for the Witkin items administered individually. (p. 185)

Using the HFT as the criterion of field independence, Willoughby (1967) found no sex differences on the dimension. Kogan (1976) notes that "sex differences in cognitive functioning have been steadily declining" (p. 97) and that "the case for sex differences in cognitive styles and abilities may have been overstated" (pp. 118-119). While the actual current relationship of sex and field independence will only be determined as the evidence accumulates, the "striking" sex differences reported by Witkin et al. in the 1950's cannot be assumed to be evident in current samples of males and females.

Field independence as traditionally measured is clearly an ability dimension as opposed to a truly stylistic dimension, as these were distinguished by Kogan (1973). This distinction was anticipated by Wachtel (1968), who compared analytic conceptualizing style as measured by a free sorting task (Kagan, Moss & Sigel, 1963) with analytic "style" as measured by the EFT. Wachtel found no relationship between
the two. He noted that the EFT requires the subject to be analytical and thus analytic capacity is measured, whereas the sorting task may reflect a genuine stylistic preference.

The extremely field-independent individual has available to him a highly analytic mode of functioning . . . Whether an available mode of functioning is utilized almost exclusively or only in particular situations may itself represent an important stylistic variable. (p. 209)

Witkin et al. (1971) also express interest in the field-independent individual who always functions in field-independent fashion and the one who may or may not choose to do so. They appeal to Werner's (1957) concept of mobility vs. fixity to account for the difference.

A final issue of importance relevant to the field independence-dependence concept is the matter of differential valuing of the extremes of the "styles." As Kogan (1973) noted, the "purest" of style dimensions do not have value judgments associated with their poles. Witkin et al. (1971) assert that psychological maladjustment is a function of integration, not of differentiation, and that the adaptive value of differentiation depends on the setting (e.g., cultural or cultural subgroup expectations) and upon the occupation of the individual. Despite all these qualifiers, their bias in valuing field independence more highly than field dependence appears to emerge in statements such as the following:

A more field-independent mode of performing the EFT is conceived as reflecting more developed
cognitive functioning (p. 10). On the quite specific ground that it involves "fulfillment of the organism's potential," achievement of complex structure or greater differentiation is, within limits, to be valued over fixation at a more rudimentary level (p. 12). Maturity, as commonly conceived, connotes both developmental differentiation and effective integration. (p. 13)

Thus in Witkin's view, the notion of a mature field dependent individual is incongruous. Kogan (1971) noted that despite "lip service to a value-free study of cognition," field independence is clearly considered a more mature and adaptive mode of functioning. Explicit training efforts are typically in the direction of making people more field independent. "Not much is said about enhancing field dependence through training or of capitalizing upon the positive qualities of field-dependent individuals" (p. 252). The accumulated research shows field-dependent individuals to be superior to field-independent individuals in memory of social words and memory for faces, and they require less time to reach a group consensus.

There is now a good deal of evidence that these individuals are more sensitive to social stimuli than are field-independent persons . . . One may, in fact, legitimately claim that a cognitive style facilitating fine articulation and sensitivity to the social environment is for many purposes more highly adaptive than a style contributing to a better articulation of the physical setting. (Kogan, 1971, p. 253).

Ragan et al. (1979) also point out that:

Learning and performance of other jobs where interpersonal skills assume increased importance may be difficult for the field-independent person. Such jobs as teaching, law enforcement, and personnel
management may rely upon the abilities of the field-dependent cognitive style. (p. 12)

Regardless of its technical classification as an ability or style dimension and the issue of possible overvaluation of one of its poles, field independence-dependence is a variable of considerable interest in the present study. Because it is undoubtedly the most widely researched of cognitive styles, a wealth of literature is available for the present and continuing consideration of results. Also, it has been the subject of several studies directly issuing from a laterality model, to be discussed below.

Distractibility: Types A and B

Stephen Karp, a long-term associate of Witkin, published a factor analytic study in 1963 (Karp, 1963) which convincingly demonstrated that the ability to overcome the effects of distracting contexts can be distinguished from the ability to overcome effects of embedding contexts. Karp described the differences in the two types of tasks as follows:

With regard to the embedding context, each part of the simple figure has also been used as part of a different configuration. These configurations serve to "break up" the simple figure, by embedding its parts in other, more compelling, gestalts. In contrast, the distracting context . . . leaves the [figure] intact, although surrounded by considerable extraneous material. (Karp, 1962, p. 1)

Karp factor-analyzed six tests with distracting contexts along with three tests of field dependence (EFT, RFT, and BAT) and nine other measures, including several WAIS sub-
tests. He extracted eight factors, and found that while four of his distraction measures were highly loaded (.48 to .61) on Factor 2 ("Overcoming Distracting Contexts"), none of them loaded on the "Analytic Ability (overcoming embeddedness)" Factor 1, which was defined primarily by EFT, RFT, and BAT, all with Factor 1 loadings in the seventies. WAIS Vocabulary did not load on either of these factors. However, it is interesting to note that WAIS Block Design and Object Assembly had moderate loadings on the embeddedness factor, and WAIS Digit Symbol loaded on the distraction factor.

Karp's Arithmetic Operations (AO) test had the highest loading of all his distraction tests on the distraction factor, and this was the test utilized in the present study as a measure of Distractibility (Type A). Karp interpreted this factor as "involving ability to manipulate or locate items surrounded by a matrix of irrelevant items which serve to distract the subject from performance on the task" (1962, p. 6). The nature of the AO task is described in more detail in the Methods section to follow.

Traditionally, however, the most frequently used measure of distractibility is the Stroop Color-Word Test (Stroop, 1935; cf. Ragan et al., 1979). The Stroop was used as a measure of "constricted vs. flexible control" by Gardner and his associates (1959), who noted an apparent similarity of this dimension to Witkin's field dependence-independence dimension. In the Gardner et al. study, Stroop interference
scores did indeed correlate significantly ($r = .54, p < .01$) with field dependence for his female sample, although the correlation coefficient reported for males (.21) is not significant, considering his sample size ($n = 30$). Santo-stefano (1969) theoretically combined the constricted-flexible control principle and the field dependence-independence construct and called the superordinate construct "field articulation."

The question remained, however, of the empirical relationship between field independence and the two types of distraction measures (Karp's tests and the Stroop). Two subsequent factor analytic studies (Bone & Eysenck, 1972; Sack & Rice, 1974) replicated and extended Karp's (1962) findings, by showing the distractibility and field independence tests to load on different factors, and the Stroop interference measure to load primarily on a third factor in each case. Sack and Rice called the Stroop factor "shifting," defined as "a voluntary change in an established attentional focus" (p. 1005). In the present study, the cognitive style variable operationally defined by the Stroop test is called Distractibility (Type B). The nature of the Stroop test is described in the Methods section below.

**Reflection-Impulsivity**

Jerome Kagan is well-known to developmental psychologists for his important infant and infant-mother studies as
well as the famous 30-year longitudinal Fels study. He is also a major figure in the area of educational psychology due to his research focus upon problem-solving behavior of children. While his contributions are thus primarily within cognitive-developmental fields, his attention to personality variables as well gives his perspective an unusually broad quality. His work has been called "at once connectionist and cognitive, humanistic and behavioral" (Galloway, 1976, p. 182).

Kagan's identification of a reflective-impulsive cognitive style dimension was associated with his studies of children's problem-solving behavior. He describes the dimension as follows:

The reflection-impulsivity dimension describes the degree to which a subject reflects upon the differential validity of alternative solution hypotheses in situations where many response possibilities are available simultaneously. In these problem situations the subjects with fast tempo impulsively report the first hypothesis that occurs to them, and this response is typically incorrect. The reflective subject on the other hand, delays a long time before reporting a solution hypothesis and is usually correct. (Kagan, 1966, p. 119)

Massari (1975) simplifies the definition of reflection-impulsivity to "the degree to which a person evaluates the possible solution alternatives in situations of high response uncertainty" (p. 61).

Reflection-impulsivity is measured by Kagan's Matching Familiar Figures Test (MFFT), in which the subject must select the exact duplicate of a given standard stimulus from
an array of variants. The examinee is scored for both latency of initial responses and total number of errors made before the correct match is made. Reliability of the MFFT is low to moderate (Ragan et al., 1979), and yet the MFFT correlates .40 and upward with a variety of tasks involving response uncertainty (Kagan, Rosman, Day, Albert & Phillips, 1964; Kogan, 1971). Sex differences do not invariably appear, but when they do, the difference is in the direction of females being more reflective (Messer, 1976).

Reflectives are significantly more field independent than impulsives. In six studies reviewed by Messer (1976), the correlations of MFFT latency score with the EFT ranged from .18 to .38, while MFFT error score correlated with the EFT from -.35 to -.62. However, it is important to note that these studies (just as the reliability and validity studies reviewed) exclusively involved children as subjects. In the case of the studies of impulsivity-field dependence, the age of subjects ranged from 3 years, 9 months to 14 years. The relationship of MFFT and EFT scores in adults is unknown.

Reflection-impulsivity appears to be related to the cognitive control principle of "focusing-scanning" described by Gardner and his associates in 1959. Impulsives do not visually scan all of the alternative stimuli in the MFFT before responding, whereas reflectives do (Drake, 1970).

The reflective-impulsive dimension of cognitive style has direct, proven relevance for educational settings (Kogan,
1971) and has been most extensively studied in this context. The more recent adult form of the MFFT (purchaseable directly from Dr. Kagan) has yet to generate a research literature comparable to that extant for children.

In his review of the reflection-impulsivity literature, Messer (1976) emphasizes relatively recent criticisms of the usual double-median-split method of categorizing impulsives and reflectives. Traditionally, only those scoring below the median for latency and above the median in errors have been classified as impulsives; the converse group (high latency and low errors), reflectives. Fast-accurate and slow-inaccurate groups were ignored. This squandering of data results in loss of statistical power and results in analysis of variance designs whereas multiple regression techniques have been suggested as more appropriate.

Conceptual Differentiation and Category Width

In 1956, Jerome Bruner and his associates (Bruner, Goodnow, & Austin, 1956) demonstrated that individuals vary in a self-consistent manner in their estimation of extreme limits of a wide variety of categories. For example, in selecting the darkest and lightest brightness of an overcast sky, or the highest and lowest pitch of a female singing voice, subjects tended to be consistently broad, medium, or narrow in their limit-selection of categories, relative to the total group.
This interesting cognitive style dimension is defined by Messick (1976) as "consistent preferences for broad inclusiveness as opposed to narrow exclusiveness in establishing the acceptable range for specified categories" (p. 15). It has been variously called "category width," "breadth of categorization," "equivalence range," "(conceptual) band width" (Messick, 1976), and "coarseness-fineness" in categorizing (Fillenbaum, 1959).

Gardner and his associates (1959) used the term "equivalence range" to refer to a somewhat different type of task. In a free-sorting situation, individuals had been found to vary in terms of the number of sub-categories they spontaneously created. A broad equivalence range was inferred from the creation of relatively few categories; a narrow equivalence range was inferred from creation of relatively many categories. Later, performance on the free-sort type of task in terms of number of different categories generated by the subject came to be called "conceptual differentiation" (Messick, 1976), which Messick defined as "individual differences in the tendency to categorize perceived similarities and differences among stimuli in terms of many differentiated concepts or dimensions" (p. 15).

The similarity of the dimensions of category width and conceptual differentiation is apparent, and in fact these and the aforementioned terms are frequently confused or used interchangeably. However, Sloane, Gorlow, and Jackson (1963)
found a variety of sorting tests to load on a single factor, whereas various other measures of conceptual band width and "associative ease" (or lack of criticalness) loaded on clearly different factors. Messick (1976) has made the careful distinction that conceptual differentiation "refers to the relative multiplicity of distinctions between or among concepts, while category width or equivalence range refers to the extent of a single concept's range of reference" (pp. 15-16). In the present study, this conceptual distinction has been maintained, with separate measures included to represent the two dimensions of conceptual differentiation and category width.

Bruner and Tajfel (1961) report a positive correlation between narrow category width and tests of intelligence. However, Messick and Kogan (1965) found that when there is a large numerical spread in the response alternatives on quantitative multiple-choice tests, broad categorizers do better than narrow categorizers. This relationship disappears if actual computations are required, or if the response alternatives are narrowly spaced. In a rather complicated study of line-length judgments under Noise and No-Noise conditions, narrow categorizers were significantly less accurate in the discriminations under the noise-free condition. Under the noise condition, no main effect of category width was found, but its interaction with sex was significant: Narrow category width males were more accurate, while broad category width females were more accurate. In an all-male sample,
broad category width correlated significantly with the total number of adjectives checked as self-descriptive on the Adjective Check List, interpreted as "self-concept span" ($r = .30, p < .01$; Pettigrew, 1958). In an all-female sample (Pettigrew, 1958), category width was unrelated to the F (authoritarianism) scale and to the Rokeach Dogmatism scale. Wallach and Kogan (1965) found significant positive correlations of category breadth and divergent-thinking tests of creativity, the broader categorizers demonstrating greater divergence, at least among children. Narrow categorizers do better than broad categorizers on a memory-for-faces task (Messick & Damarin, 1964). Most studies report females to be narrower categorizers than males (Pettigrew, 1958; Bieri, 1969).

While conceptual differentiation as measured by sorting tasks has been found to correlate positively with category width in a number of studies (cf. Ragan et al., 1979), others have shown a lack of consistency between the two dimensions of cognitive style. Conceptual differentiation (number of groups created in a sorting task) correlates positively with vocabulary level and verbal knowledge (Messick & Kogan, 1963). The tendency to "compartmentalize," or form "groups" containing only single items, correlates negatively with measures of creativity (cf. Ragan et al., 1979). Lack of differentiation (creation of relatively few groups) is significantly related to a stylistic preference for extremely-worded, sweeping generalizations (Clayton & Jackson, 1961);
on the other hand, high differentiation (large number of groups) is significantly related with authoritarian item content when it is stated in probabilistic terms (Clayton & Jackson, 1961). The correlations reported by Gardner et al. (1959) of sorting task scores with EFT and Stroop performance of both males and females are nonsignificant, when their sample sizes are considered.

The most popular measure of category width appears to be the paper-and-pencil category width scale of Pettigrew (Pettigrew, 1958; cf. Kogan, 1971, and Ragan et al., 1979). An abbreviated form of this test, consisting of only those items which discriminated between the broad and narrow thirds of the sample at the .10 level or better (Pettigrew, 1958) was utilized in the present study. In regard to the conceptual differentiation dimension, no standard instrument of assessment has yet been developed (Ragan et al., 1979). Clayton and Jackson (1961) used lists of written objects for sorting, and scores on these sorting tasks loaded on the same factor as scores on sorting tasks using actual objects (Sloane et al., 1963). Unfortunately, Clayton and Jackson did not publish the lists of objects they used. Therefore, a written sorting task was created for the present study, which included the same number of items as previous sort tasks, based upon the same criteria for item inclusion (Clayton & Jackson, 1961; Gardner et al., 1959).

Cognitive Complexity

"Of the various cognitive styles and strategies ...
cognitive complexity–simplicity is most strongly beset by problems of adequacy of conceptualization and method" (Kogan, 1971, p. 271). In most general terms, cognitive complexity is defined as "individual differences in the tendency to construe the world in a multidimensional and complex way" (Ragan et al., 1979). However, some researchers stress only the number of different dimensions used by individuals in analyzing their environment, and others take into account the "hierarchic-integration" structure of the dimensions employed.

The first approach, the "differentiation" view of cognitive complexity, originated in the personal constructs theory of George Kelly (1955). Kelly devised a Role Constructs Repertory (REP) Test, to measure the complexity of an individual's personal construct repertoire utilized in judging similarities and differences in his or her social environment. The REP test was quite cumbersome in its original form, and a modified form of the REP (Tripodi & Bieri, 1963) simplified administration and scoring and also correlated substantially with the original REP test (Jaspars, 1964; Tripodi & Bieri, 1963).

Cognitive complexity in the sense proposed by Kelly is unrelated to vocabulary and verbal intelligence, at least among college students (Bieri, 1961; Bieri & Blacker, 1956). However, "total complexity" (a composite of the REP and other measures of complexity including the Barron-Welsh Art Scale) correlates significantly with "reputational Social IQ," a
measure based upon sociometric peer ratings ($r = .54 \ p < .01$; Sechrest & Jackson, 1961). Bieri (1955) found that high-complex subjects were more accurate than low-complex subjects in the accurate prediction of differences between the self and others, although they were not more accurate in the prediction of similarities. Consistently, low-complex judges appear to be better attuned to discriminating regularities in the social environment in a sequential judgment task, but high-complex judges show superior processing of incongruent information (Tripodi & Bieri, 1964). Also, high-complex judges are more confident in their judgments of incongruency, while low-complex judges express more certainty about their judgments of congruent information (Tripodi & Bieri, 1964). In impression-formation tasks, low-complex individuals respond more to superficial qualities of behavior, in contrast to high-complex individuals, who pay greater attention to inner psychological states (Leventhal & Singer, 1964). High-complex persons project more conflict into TAT stories (Tripodi & Bieri, 1966), and complexity correlates significantly with four different indices of determinant complexity as well as with two indices of content complexity on the Rorschach (Bieri & Blacker, 1956). A detailed review of this type of cognitive complexity, as well as an explicit description of the modified REP test (which was utilized in the present study), may be found in Bieri, Atkins, Briar, Leaman, Miller, & Tripodi (1966).
A second and quite different view of cognitive complexity is based upon the conceptual systems theory of Harvey, Hunt, and Schroder (1961). This is the "integrative complexity" model which purports to be concerned with cognition in general, as opposed to just persons and social environments. It takes into account a dimension of concreteness-abstractness as well as criteria such as absolutism, the presence and nature of qualifications, and relationships to authority, and thus complexity is determined more by the quality of constructs than by their multiplicity. The measure of integrative complexity is the "This I Believe" Test (TIB), which is a sentence-completion task. With intensive training, judges are reportedly able to achieve high interscorer reliabilities with the TIB (Greaves, 1971). Also, it does not appear to make any difference whether the TIB is administered in its original timed form or under the condition of no time limit (Greaves, 1971).

Unlike the type of complexity measured by the REP, integrative complexity is quite strongly correlated with verbal IQ ($r = .40$; Schroder, Driver & Streufert, 1967). Integrative complexity is unrelated, however, to mere verbal fluency (length of sentence completions) and Edwards Social Desirability (Schroder et al., 1967).

Harvey (1966) reports that integrative complexity is related to the REP, although he does not report the magnitude or significance level of the correlation. In a factor
analytic study of complexity, Vannoy (1965) found the two measures to load on different factors. Apparently, additional study is needed to clarify the relationship of complexity as measured by the REP, and integrative complexity.

The dimensions of cognitive style of relevance to the present study have been reviewed. In the sections to follow, evidence of functional asymmetries in the human brain will be presented, followed by a review of studies which investigate a possible relationship between differential brain hemispheric function and cognitive style.

**Functional Brain Asymmetries: Pathological Groups**

For over a century, it has been known that the left cerebral hemisphere in most humans is the dominant hemisphere for speech as well as motor control of the usually preferred (right) hand. "By a curious extrapolation, the left hemisphere also came to be regarded as dominant for all complex cognitive processes, with the right of lesser importance, except for elementary sensory and motor functions" (Milner, 1971, p. 272). Hence, the left hemisphere was called the "major" hemisphere, the right, "minor." This traditional view has now been largely rejected, with the breakthrough occurring on the basis of clinical studies of well-lateralized brain lesions in the 1940's, split-brain animal studies in the 1950's, and perhaps most dramatically, studies of human commissurotomy (split-brain) patients in the 1960's.
The human cerebral commissurotomies were performed in cases of intractible convulsive disorders, in efforts to confine the seizures to one side of the brain. The surgery resulted in an apparent lack of change in personality and ordinary behavior. However, special testing under the direction of R. W. Sperry indicated "functional disengagement of the right and left hemispheres with respect to nearly all cognitive and other psychic activities. Learning and memory (were) found to proceed quite independently in each separated hemisphere" (Sperry, Gazzaniga & Bogen, 1969, p. 275).

Objects seen in one visual hemifield were not perceived or remembered in the other. Pictures or objects presented to the right hemisphere were reported by patients to be "nothing," or at most, a "flash of light;" yet these stimuli could be recognized and identified nonverbally, such as by pointing.

If a pair of different objects was presented simultaneously to the right and left hemifields, the left hand (right hemisphere) selected only the object pictured in the left hemifield (right hemisphere); but if asked to name the object, the patient responded only with the name of the other, right-hemifield (left hemisphere) object and verbally denied seeing anything but the latter. In this sense, only the hemisphere capable of naming objects was "conscious."

Each of the separated hemispheres has its own visual sensations, percepts, associated concepts and short- and long-term memories . . . (I)t is as if two separate brains were viewing the left and right halves of the visual field, only one of which is able to communicate what it sees through speech or
Similarly, objects placed in the right hand were named, described, and handled normally; patients were unable to name or describe objects held out of sight in the left hand. If different objects were placed in both hands at once, the patient denied even the presence of a stimulus in the left hand.

Sperry and his co-workers found not only a functional disengagement of the two hemispheres of the commissurotomized patients, but also functional asymmetries which went beyond verbal expression. While the left hemisphere appeared dominant for numerical calculations as well as for speech and writing, the right hemisphere was superior to the left in spatial constructions. Milner and Taylor (1972) subsequently submitted compelling evidence of the isolated right hemisphere's superiority in the perception of spatial patterns. The isolated right hemisphere is more adept at classifying pictures of objects according to shape, while the left hemisphere excels at classification based upon function (Levy & Trevarthen, 1976). Right-hemispheric lesions in the temporal-parietal area are associated with a variety of spatial deficits including visual closure tasks and the perception of faces in high-contrast drawings (Benton, 1979).

The right hemisphere is not entirely lacking in verbal
ability. When testing conditions were arranged to permit an appropriate (nonverbal) response, the right hemisphere of split-brain patients could read many words and understand spoken sentences (Bogen, 1969a, 1979). Additional studies of hemispherectomy and unilateral lesion patients demonstrated that the right hemisphere comprehends nouns better than verbs (Bogen, 1969a) and can direct the verbalization of descriptive phrases, similes, and metaphorical expressions appropriately (Bogen, 1969b). Following complete left hemispherectomy, an individual may retain the capacity to sing, pray, and utter oaths (Smith, 1966). Bogen (1969b) concluded that it is not the mere possession of words which differentiates the hemispheres, but rather, the use of words in "propositional" vs. "appositional" thought. Propositional thinking, he suggested, is logical, convergent and analytic, whereas appositional thought is intuitive, divergent, and gestalt (cf. Corballis, 1980).

Certain aspects of musical ability, such as melody and rhythm perception, also appear to be represented in the right hemisphere (Bogen, 1969b). Alajouanine (1948) observed characteristics of creative artists who acquired aphasia (left hemisphere damage). The musician (Ravel) lost his ability to read musical notation, but he was unimpaired in melodic, rhythmic and stylistic sense and in playing or singing from memory. Conversely, right temporal lobectomy has been associated with impaired discrimination of tonal patterns,
tone quality and timbre (Milner, 1967). Motor amusia (avocalia), or inability to reproduce tones, has been related to unilateral right (or bilateral) lesions, while musical comprehension deficits have been clinically observed more frequently with left-sided lesions (Hécaen, 1969).

Lateral asymmetries have also been observed in clinical populations in the area of emotional expression. Flor-Henry (1969a, 1969b, 1972) reported a preponderance of left-sided and bilateral temporal lobe epilepsies among schizophrenic and schizo-affective psychotics, while right-sided epileptics were most frequently diagnosed manic-depressive. Lishman (1968) found more "intellectual" impairments among left-sided brain-injured individuals, and more affective disorders among the right. Comparing self-ratings with ratings by others of the interictal (between-seizure) behavior of temporal lobe epileptics, Bear and Fedio (1977) found the right-lesion group to underestimate their own sadness and aggression and overrate their own conscientious behavior ("image-polishing"). Conversely, the left-lesion group described themselves as angry, paranoid, and dependent and underrated their own conscientiousness ("image-tarnishing"). In response to intracarotid sodium amobarbital injection, which briefly anesthetizes one hemisphere of the brain, a "catastrophic" reaction more frequently follows anesthesia of the left hemisphere, while a "euphoric-maniacal" reaction more frequently follows right-hemisphere inactivation
(Gainotti, 1972; Rossi & Rosadini, 1967). Milner (1967) was unable to replicate these findings, however, with 104 Canadian patients undergoing the amobarbital test.

Flor-Henry (1976) studied groups of schizophrenics and affective psychotics without epilepsy, and reported both neuropsychological and EEG test data implicating left temporal lobe dysfunction in the former and bilateral (but predominantly right temporal) abnormality in the latter. Yozawitz and his co-workers (Yozawitz, Bruder, Sutton, Sharpe, Gurland, Fleiss, & Costa, 1979) found left-right ear preferences of affective psychotics on a dichotic listening task to resemble those found among patients with known right-hemispheric lesions. Bipolar illness followed right hemispherectomy in a recent case report (Forrest, 1982), which highlights the issue of whether differential emotional reactions may be associated with hemisphere-specific dysfunction or failure to inhibit processes of the other hemisphere (cf. D. Tucker, 1981).

Stern (1977) and Galin, Diamond, and Braff (1977) reported greater incidence of left-sided than right-sided dysfunction in cases of hysterical conversion reactions. They suggested that the right hemisphere may play a central role in the mediation of affectively or motivationally determined somatic symptoms. Bishop, Mobley, and Farr (1978), however, failed to confirm a predominance of left-sided occurrence of conversion symptoms. They noted that the left-
sided predominance was observed only among female subjects and thus the effect may be related to sex.

The foregoing review is more accurately an overview of the extensive clinical literature regarding functional brain asymmetries. More detailed reviews are available in the areas of commissurotomy (Bogen, 1979; Gazzaniga, 1970), unilateral lesion syndromes (Heilman & Valenstein, 1979), and psychopathology and hemispheric dysfunction (Marin & G. Tucker, 1981; D. Tucker, 1981). The purposes of the present overview are only to illustrate the range of functional brain asymmetries found among clinical populations, and to emphasize that in the surgically separated state, the two hemispheres are capable of functioning quite independently, although in qualitatively different modes.

**Functional Brain Asymmetries: Nonpathological Groups**

Surgical disconnection may provide an unusual and dramatic opportunity to directly investigate the differential capacities and functions of the brain hemispheres, but the question naturally arises as to generality of the findings to normal, intact human brains. Prior to disconnection of the hemispheres, commissurotomy patients manifested extremely abnormal brain function which, after all, necessitated the operation. Similarly, we cannot assume that the left and right hemispheres of the normally integrated brain are functionally lateralized in the same manner as those of unilateral lesion or psychiatric populations.
Investigation of functional brain asymmetries in non-pathological populations is hampered by the methodological problem of how to assess differential hemispheric involvement in the characteristic or performance under study. Basically, this assessment takes one of three forms: (1) EEG analysis, which is a direct measure of surface activity of the brain, (2) unilateral stimulus presentation, such as in tachistoscopic or dichotic listening studies, or (3) observational or other indirect methods, which are theoretically assumed to reflect differential hemispheric involvement.

Electroencephalographic (EEG) studies of differential hemispheric function among nonpatients have taken one of two forms: measurement of alpha-wave suppression (an indication of cortical arousal) in different areas of the brain, or asymmetries in evoked potentials from the right and left hemispheres. By such methods, the left cerebral hemisphere of normal subjects appears to be more active than the right hemisphere during arithmetic and verbal or linguistic task performance, while the right hemisphere appears to be more involved than the left during performance of visuospatial and musical tasks (Buchsbaum & Fedio, 1970; Galin & Ornstein, 1972; McAdam & Whitaker, 1971; McKee, Humphrey & McAdam, 1973; Morgan, McDonald & MacDonald, 1971; Morrell & Salamy, 1971; Wood, Goff & Day, 1971). In addition, differential hemispheric arousal has been associated with varying affective states (Harman & Ray, 1977; Tucker, Stenslie, Roth &
Shearer, 1981), although the findings in this area are more inconsistent, possibly due to ambiguities in definitions of "positive" and "negative" affect (cf. Tucker et al., 1981).

Tachistoscopic (T-scope) presentation allows investigation of differential reaction times to visual stimuli in the right hemifield (left hemisphere) vs. left hemifield (right hemisphere). This method also reveals left-hemispheric superiority in normals for verbal material (and easily verbally-labelled objects), and right-hemispheric superiority in face recognition, perception of the location and quantity of dots, line slope discrimination and depth perception (Arndt & Berger, 1978; Kimura, 1966; Kinsbourne, 1970; McKeever & Huling, 1970; Milner, 1971; Rizzolatti, Umilta & Berlucchi, 1971). Similarly, dichotic listening studies indicate greater left-hemispheric (right-ear) proficiency in the discrimination of digits, consonants, words, and semantic content, and greater right-hemispheric (left-ear) proficiency in recognition of simple pitch patterns, melodies, environmental sounds, nonverbal human sounds such as crying, shrieking and laughing, and emotional tone of voice (Carmon & Nachshon, 1973; Haggard & Parkinson, 1971; Kimura, 1963, 1964, 1967; Knox & Kimura, 1970; Mazzucchi & Parma, 1978; Milner, 1971; Safer & Leventhal, 1977). Right-ear (left-hemispheric) attentional bias has also been associated with decrements in visual imagery, trait anxiety, and an induced depressive mood (Tucker et al., 1981).
Interestingly, lateralization of some musical functions may depend in part upon the degree of musical training. Bever and Chiarello (1974) found a left-hemispheric superiority among trained musicians in melody recognition, while nonmusicians demonstrated the more typical right-hemispheric advantage on this task. Similarly, an EEG study showed greater left-hemispheric activity in musicians when whistling a song, but greater right-hemispheric activation in nonmusicians performing the same task (Davidson & Schwartz, 1977).

A variant of the unilateral stimulus presentation methodology is the "chimeric face paradigm," in which the subject is presented with one-half of a photographed face combined with its mirror-image. Studies utilizing this paradigm suggest that the left side of a viewed face (which is the right side of the face being viewed) is considered most similar to the original photographed face (Gilbert and Bakan, 1973), and that it is judged more emotionally expressive than the right side of the viewed face (Campbell, 1978), even though actual left-face composites are rated as expressing emotion more intensely than right-face composites (Sackeim, Gur & Saucy, 1978). Campbell (1978) has noted the "intriguing possibility . . . that the side of the face which dominates a viewer's impression when he is looking at another person is not the side which the expressor is using most strongly" (p. 338). In any case, these studies suggest greater right- than left-hemispheric involvement in
both the perception and expression of affect (cf. Hayne, Note 3).

The third general type of investigation of laterality effects in nonpathological groups includes those studies utilizing observational or inferential measures of hemispheric involvement. By far, the most common measure of this type is the observation and quantification of lateral eye movements (LEMs) in response to questions requiring some degree of reflective thought. Merle Day (1964) originally described the LEM phenomenon, which is a tendency for individuals to look briefly to the right or left after presentation of an oral question and prior to oral response. However, Bakan (1969) was the first to propose that LEMs may be an index of hemispheric asymmetry, a position elaborated in more explicit neuropsychological terms by Kinsbourne (1972, 1974). Theoretically, a lateral eye movement under the imposed reflective condition is indicative of activation of the contralateral hemisphere. While some investigators utilizing the LEM method focus upon contrasting characteristics of "right-lookers" (or right-movers) and "left-lookers" (left-movers)—i.e., groups of subjects displaying a disproportionate number of LEMs to the right or left—others focus on the situational factors which may affect direction of initial gaze shifts.

In support of his proposal of LEMs as an index of hemispheric asymmetry, Bakan (1969) provided evidence that
left-lookers (right-hemispheric "types") possessed clearer visual imagery, were more susceptible to hypnosis, and more frequently chose "soft majors" as opposed to "hard" scientific majors than right-lookers. Morgan, McDonald and MacDonald (1971) also reported an association between left lateral eye movements and hypnotizability. Harnad (1972) found left-lookers to score higher than right-lookers on the Remote Associates Test, a presumed measure of creativity. Left-lookers are more "inner attentive" than right-lookers, as determined by a combined score on the Repression-Sensitization scale and an imagery test (Meskin & Singer, 1974). Gur and Gur (1975) found a positive association between left-looking and incidence of psychosomatic symptoms as well as greater utilization of the defense mechanisms of repression and denial. More left lateral eye movements were observed among college students classified as "hysteric" in style on the basis of a modified Rorschach procedure, as opposed to those classified as "obsessive-compulsive" (Smokler & Shevrin, 1979).

While the earliest LEM research focused upon personality differences of left and right hemispheric "types" of individuals, a somewhat later development was an emphasis upon the effect of task and situation variables upon lateral eye movements. This direction of LEM research, based upon the Kinsbourne (1972, 1974) theoretical model, is exemplified by studies showing relationships between right LEMs and
verbal, numerical, and nonemotional item content, and between left LEMs and musical, spatial, and emotional item content (Gur, Gur & Harris, 1975; Schwartz, Davidson & Maer, 1975; Weitan & Etaugh, 1976). Situational variables which have been related to LEM behavior include experimenter location (Gur, Gur & Harris, 1975) and experimentally-induced stress, or performance anxiety (D. Tucker, Roth, Arneson & Buckingham, 1977), the latter being associated with increased frequency of left lateral eye movements.

The early LEM studies generated considerable excitement, not only because of positive and theoretically meaningful findings, but also because of the relative ease of LEM assessments. However, the LEM-hemispheric asymmetry model has been criticized due to mixed experimental outcomes, methodological inconsistencies, and theoretical ambiguities. Of 19 experiments comparing LEM response to "left-hemispheric" vs. "right-hemispheric" questions, for example, only nine yielded results in the expected direction (Ehrlichman & Weinberger, 1978).

In addition to the LEM observational procedure, laterality among nonpathological groups has been assessed indirectly by means of self-report questionnaires. Questionnaires of this type include the Zenhausern Preference Test (Zenhausern, 1978) and the Verbalizer-Visualizer Questionnaire (Richardson, 1977). Both of these questionnaires purport to assess visual
vs. nonvisual thinking style. Theoretically, the two styles are a direct consequence of cerebral dominance, the visual mode being associated with right hemispheric dominance, the nonvisual or verbal, with left hemispheric dominance.

Using an early form of the Zenhäusern test (ZEN) in conjunction with a similar questionnaire, Zenhäusern and Gebhardt (1979) investigated the relationship of hemispheric dominance to the recall of words both high and low in imagery value, with auditory and visual presentation. Their findings included significant three- and four-way interactions which nearly defy comprehension, and even the authors dismiss these in their discussion except to remark that "their mere existence . . . supports the use of hemispheric dominance as a meaningful classifying variable" (p. 73). However, their main finding was of a consistent relationship between auditory input and a left-hemispheric style on the one hand, and between visual input and a right-hemispheric style on the other. This pattern of relationships was interpreted as consistent with the theory of left-hemispheric specialization for sequential auditory input, and right-hemispheric specialization for visual-spatial information processing.

In a similarly complex research design, Coleman and Zenhäusern (1979) compared male and female left- and right-dominant groups, on a discriminative reaction-time task in which both target and probe stimuli were varied (words or pictures). Somewhat confusingly, "right dominants," as
identified by agreement between the ZEN and a similar questionnaire, were faster in reaction time on the discrimination task than "left dominants," but at the same time, reaction time was significantly faster for probes presented to the left-hemisphere than for probes presented to the right-hemisphere. The faster left-hemisphere processing was observed for both words and pictures, and the effect was four times stronger in "left dominants" than "right dominants." Again, the reader will not be subjected to the interpretive throes of a significant three-way interaction of target type, probe type, and hemispheric dominance. Generally, the authors interpreted the findings as indicative of "two distinct groups: one which is more efficient in tasks that demand a parallel processing mode, and another which is more efficient at tasks that demand a sequential processing mode" (p. 360).

Zenhausern and Gebhardt (1979) report a 70% agreement between the early ZEN questionnaire and the "Your Style of Learning and Thinking" questionnaire (Torrance, Reynolds, Riegel & Ball, 1971), another purported measure of subjective preference for right-hemispheric vs. left-hemispheric functions. Reliability of the ZEN measure is unknown.

The Verbalizer-Visualizer Questionnaire (VVQ) of Richardson (1977) is similar in item content to the ZEN. The VVQ was empirically derived from Paivio's (1971) 36-item Ways of Thinking questionnaire on the basis of item correlation with left lateral eye movements. Richardson reports
a seven-day test-retest reliability of .91 and freedom from social desirability response bias (correlations with the Marlowe-Crowne Social Desirability Scale ranged from .00 to -.07 in the original series of studies). Reliability was substantially lower with a different, younger sample and longer (three week) test-retest interval (Warren & Good, 1979). However, the validity of the VVQ was supported in the Warren and Good study by discriminating subjects who responded favorably and those who responded less favorably to a particular (verbal) therapy mode. Additional data summaries provided by the author with a copy of his test (Richardson, Note 4) revealed that, while a 1979 sample of females continued to demonstrate nonsignificant correlations of VVQ and social desirability, VVQ scores of a 1979 male sample were significantly correlated with social desirability (r = -.38, p < .01, n = 49). Since the VVQ is scored in the direction of visualizing tendency, results indicated that the higher the visualizing tendency of these male subjects, the lower the social desirability scores. Richardson (1977) relies primarily upon the studies of Kinsbourne (1972) and Kocel, Galin, Ornstein & Merrin (1972) as theoretical bases for the presumed relationship between self-reported visualizing tendency and hemispheric specialization.

In summary, an impressive number of EEG and bilateral stimulus presentation studies, as well as a substantial proportion of the LEM studies, point to hemispheric specialization
in nonpathological groups that is similar to that demonstrated with clinical populations. Specifically, the left hemisphere appears to be specialized for the processing of verbal and linguistic information, while the right hemisphere appears to be more involved in visuospatial and some musical functions (at least among nonmusicians). Also, studies have been reviewed which suggest a special but not yet well-defined role in the processing of emotional stimuli, and possibly in personality characteristics such as suggestibility and features consistent with an hysteric personality style.

Based upon the evidence of functional brain asymmetries in both clinical and nonpathological groups, several leading investigators (e.g., Bogen, 1969a; Levy, 1969; Nebes, 1974) have suggested a neuropsychological model of cognitive style. According to this model, the two hemispheres of the brain are not merely specialized to deal with differing task content (i.e., verbal vs. nonverbal). Rather, they are specialized for different processing modes. The mode of the left hemisphere is analytic, sequential, and logical. Its facility with linguistic material and propositional speech is compatible with this mode, although the cause-effect relationship between language development and left-hemispheric cognitive style is the subject of current speculation (cf. Joseph, 1982). The mode of the right hemisphere is global or holistic, nonsequential, and intuitive in nature—hence its demonstrated superiority in a variety of tasks requiring
pattern perception and construction, its facility for simile and metaphor even when propositional speech is absent, and its sensitivity to emotional and other nonverbal environmental cues. Galin (1974) eloquently compared current notions of left-right hemispheric style with Freud's early structural theory, noting the irony that perhaps the neuropsychological view will eventually reaffirm a structural basis for unconscious process. He noted several congruencies of right-hemispheric functioning with the primary process, a form of thought originally assigned to the Unconscious: nonverbal mode of representation, nonlinear mode of association, less involvement with perception of time and sequence, and nonpropositional speech (e.g., metaphors, puns, double-entendre—"word pictures"). Conversely, left-hemispheric style is congruent with conscious, goal-directed, sequential, verbal, logical secondary-process thinking.

However, our goal is not to simply translate the terms of one theoretical model into those of another. Rather, we shall first review those studies directly involved in determining relationships between laterality measures and traditional tests of cognitive style, followed by delineation of objectives of the present study.

Laterality and Cognitive Style

Studies designed to specifically investigate relationships between differential hemispheric function and traditional
measures of cognitive style are relatively few in number. Of 644 bibliographic citations in a quite recent review of the cognitive style literature (Back et al., 1979), only 14 involved the concept of lateralized brain function in any way (if we include, for example, studies of hand, ear or eye dominance in relation to cognitive style). Of the traditional cognitive style dimensions, these studies were nearly exclusively concerned with field dependence-independence.

A study of unilateral lesion patients (Russo & Vignolo, 1967) led to tentative conceptualization of field independence as a manifestation of analytic, left-hemispheric capacity. However, the relationship of laterality and field independence appears to be more complex. Several studies have shown more field independent subjects to evidence greater left-hemispheric lateralization for verbal functions (Pizzamiglio, 1974; Pizzamiglio & Carli, 1974; Pizzamiglio & Cecchini, 1971; Waber, 1976), but Oltman, Ehrlichman & Cox (1976) found that more field independent subjects also demonstrated greater right-hemispheric specialization in a face perception task. Oltman et al. suggest that field independence tasks may require both perceptual analysis and synthesis, and thus field independence may be a function of greater lateralization of both left- and right-hemispheric functions. Zoccolotti & Oltman (1978) compared field independent and dependent subjects on both left- and right-hemispheric tasks. They found, as expected, that the field independent group not only showed
a greater right-hemifield (left-hemispheric) superiority in letter recognition but also a greater left-hemifield (right-hemispheric) superiority in face discrimination. They reported an overall correlation of .35 ($p < .10$) between extent of right-hemifield superiority for letter discrimination and left-hemifield superiority for face discrimination. Field dependent subjects did not demonstrate significant hemifield differences on either type of task. "Apparently, the field-dependent-independent dimension is related to the degree of segregation of functioning between the two hemispheres, rather than to some generalized tendency to use one or the other" (Zoccolotti & Oltman, 1978, p. 161). In support of this view, Silverman, Adevai and McGough (1966) had found non-right-handed individuals to be more field dependent than clearly right-handed individuals, suggesting that greater specialization of lateral function may be associated with field independence. D. Tucker (1976), utilizing a more sophisticated measure of lateral brain involvement than handedness, found both hemispheres to show EEG desynchronization during EFT performance.

If field independence is a function of greater bilateral specialization of function, one would expect a stronger association between right LEMs and verbal questions, and between left Lems and spatial questions, in more field independent individuals. However, Ehrlichman, Weiner and Baker (1974) found the opposite. Content-specific LEMs were less evident
among field independent subjects than among their field
dependent counterparts. Tucker (Note 5) found no association
between right and left LEMs and field independence among either
college students or young children, but in both groups, he
found a positive relationship between field independence and
frequency of nonlateral eye movements. In his discussion of
these apparently inconsistent findings, Tucker noted that the
unilateral stimulus presentation methods of Zoccolotti and
Oltman and others tend to maximize lateralized processing,
whereas the LEM procedure constitutes a free-choice situation
in terms of task approach. Thus more field independent indi-
viduals may manifest greater functional differentiation of
the hemispheres upon "demand," but on the LEM, their per-
formance may reflect relatively bilateral usage associated
with greater integration. We are reminded of the distinc-
tion of Wachtel (1968) between capacity and style in analytic
functioning, and of the fixity-mobility factor in field inde-
pendence (Witkin et al., 1971). Possibly, field independent
functioning requires a capacity for specialized hemispheric
task performance, but not an exclusively or even predominant
reliance upon this mode in a naturalistic setting. On the
contrary, field independent subjects may manifest greater
bilateral, "integrated," or "mobile" usage in such a situation.

Integration of specialized hemispheric functions was
viewed by Bogen and Bogen (1969) as the basis of creativity.

The hemispheres are not as much "major" and "minor"
as . . . they are complementary, and each hemisphere
is capable of thinking on its own, in its own way . . . Specialization of the hemispheres for different modes of thought greatly increases the flexibility and creativity of the ensemble. (p. 194)

While creativity is a general term which has been variously defined in terms of product, person, context and process variables (cf. Taylor, 1975), it is of relevance to the field of cognitive style because of the previously discussed associations between creative personality and cognitive style dimensions including reflection-impulsivity, rigidity, and figural complexity preference. A neuropsychological model of cognitive processes may generate additional hypotheses regarding the relationship between differential hemispheric function and cognitive style dimensions relevant to some aspects of the creative process. The Bogen and Bogen (1969) model of creativity recognizes both left-hemispheric and right-hemispheric contributions, i.e., a differentiated and integrated state. Regarding the role of the right hemisphere in the creative process, they observe that "there are many persons possessing technical proficiency in music, drawing, or writing whose production is devoid of those innovative and informative values which distinguish an artist from a performer" (pp. 200-201). On the other hand, they quote Bruner to emphasize the role of the left hemisphere:

As surely as the recital of a daydream differs from the well-wrought tale, there is a barrier between undisciplined fantasy and Art. To climb the barrier
requires a right hand [left hemisphere] adept at technique and artifice. (Bogen & Bogen, 1969, p. 200).

Ornstein and Galin (1976) and Dumas and Morgan (1975) found no overall EEG differences between lawyers and engineers on the one hand and artists, sculptors and ceramicists on the other during performance of left and right hemispheric tasks. Arndt and Berger (1978) found no differences in lateralization (as measured by discriminative reaction time to left-right hemisphere stimuli presentation) among graduate students in sculpture, law, or psychology. These negative findings have been interpreted to contraindicate a relationship between hemispheric specialization and creativity (e.g., Corballis, 1980), while in fact they merely confirm that creativity cannot be explained in terms of simple hemispheric dominance.

Some evidence suggests that, even presuming a bilateral contribution to the creative process, the pattern of hemispheric contributions may differ among artists and nonartists in relevant task variables. Recall the studies of Bever and Chiarello (1974) and Davidson and Schwartz (1977), which indicated greater left-hemispheric involvement in musical tasks among musicians but greater right-hemispheric involvement in the same tasks among nonmusicians.

Figural complexity preference was associated with verbal fluency in the studies of Barron (1953a). A number of neuropsychological studies of unilateral lesion patients have established an association between left but not right frontal
lobe damage and defects in verbal fluency. "'Dominant' frontal lesions but not 'minor' frontal ones, interfere with verbal processes, particularly in respect to spontaneity and the ability to maintain a flow of verbal evocation, without actually producing one of the typical aphasias" (Damasio, 1979, p. 383). Zangwill (1976) found left frontal lesion patients to perform particularly poorly on tests of divergent thinking, a presumed measure of creativity which heavily relies upon verbal fluency. Possibly, the same neuropsychological basis of the verbal fluency aspect of creativity underlies figural complexity preference.

Martindale (1975) has proposed a cortical arousal model of creativity. He compared groups of "high- vs. low-creatives" (based upon performance on the Remote Associates and Alternate Uses Tests, two heavily verbal measures of creativity) in terms of EEG alpha activity while resting and while working on an "imaginative problem." He found that in the resting state, high creatives were more aroused in both hemispheres; this generally aroused state (in comparison to medium- and low-creative subject) was also suggested by higher levels of skin conductance.

Highly creative people amplify sights, sounds, and textures, the stimuli around them. They feel shock and noise more intensely; they exaggerate sizes and sensations. This oversensitivity is the subjective counterpart of the physiological overactivity that shows up in greater [bilateral] blocking on EEG records. (p. 48)
Curiously, when engaged in imaginative task performance, the opposite results were obtained. High creatives then operated at the lowest level of arousal (most alpha), although Martindale did not specify whether this effect was unilateral or bilateral. Martindale concludes from his series of studies that "creative people view the world and react to it unlike most of their peers do, not because they are eccentric and strange, but because they process information differently" (p. 50).

The preceding sections have provided an overview of the cognitive style, functional brain asymmetry and laterality-cognitive style literatures. The following and concluding section of this chapter will present the purposes and objectives of the present study.

Purposes of the Present Study

Goldstein and Blackman (1978) concluded from their extensive review of the cognitive style literature that "studies designed to relate the variables used by one investigator to those used by other investigators are needed" (p. 4). This constitutes one major purpose of the present study: to investigate the nature and degree of intercorrelation of various dimensions of cognitive style. Prior research establishes expectancy of certain relationships among some subsets of cognitive style dimensions, as reviewed above. For example, it is expected that the theoretically and
methodologically similar dimensions of dogmatism, rigidity and ambiguity intolerance will be significantly intercorrelated. It is also expected that field independence will be negatively correlated with impulsivity, but independent of distractibility measures. For many other combinations of cognitive style dimensions, however, the lack of prior studies does not permit empirically-based expected relationships.

Simple intercorrelation of the cognitive style variables, as indicated by Goldstein and Blackman, is of interest in its own right. However, the second and larger purpose of the present study is to explore the relationship between cognitive style and hemispheric function. Since none of the cognitive style tests utilized in the present study were developed within a neuropsychological theoretical context, there is little reason to predict an association between an index of laterality and any particular, individual cognitive style test, with the possible exception of field independence. However, it is proposed that the assorted cognitive style tests, when factor analyzed, will yield a fewer number of broad cognitive style factors, which in turn may relate meaningfully to a laterality index. The notion of reducing larger numbers of cognitive style test scores to a fewer number of factor scores for purposes of theoretical clarification has precedent in the study of Mos, Wardell and Royce (1974). In this study, 26 variables for psychological differentiation and cognitive abilities yielded eight factors. While
the design of the Mos et al. study is similar in part to that of the present study, its scope was restricted primarily to investigation of relationships between perceptual differentiation \textit{a la} Witkin and conceptual differentiation as defined by Kagan. The present study applies to a larger variety of cognitive style test dimensions, and is an attempt to theoretically relate hemispheric mode to some basic and general cognitive style factors. Since the study is exploratory in nature, the precise nature of the cognitive style factors cannot be anticipated. Speculatively, however, such factors may include general dimensions including complexity/differentiation, verbal distractibility, and flexibility. Theoretically, since the laterality index is scored in the direction of right hemispheric preference, the first factor would be expected to relate negatively, the second positively, and the third either positively or negatively with extreme scores on the laterality index.

The laterality index used in the present study is a composite score, based upon three different measures of laterality (LEM, ZEN, and VVQ). While each of these measures has its shortcomings, as described previously, it is proposed that the composite index may be a more reliable measure than any of its individual components.

In addition to the cognitive style and laterality tests, the present study also involves measures of left- and right-hemispheric ability. These are included in order to evaluate
the cognitive dimensions in terms of the "ability vs. style" distinction of Kogan (1976). Additional measures of trait anxiety, repression-sensitization, and social desirability response bias are included in view of their potential relevance to interpretation of cognitive style factors and/or the laterality index.

A description of the various tests used, the procedure and the statistical analyses performed will be presented in the following chapter.
CHAPTER THREE: METHODOLOGY

Subjects

The subjects were 52 female and 45 male right-handed undergraduate volunteers who received partial course credit for their participation in the study. Mean age of female and male subjects was 20.25 (S.D. = 3.45) and 21.42 (S.D. = 3.0), respectively. The predominantly white subject group included one Native American female, one Native American male, one black female and one black male. While equal numbers of males and females (n = 50) were sought according to the original design of the study, an insufficient number of male subjects was acquired despite vigorous recruitment efforts. Further contributing to the subsample size differential was the fact that two additional male subjects only partially completed the study and thus all of their data were omitted from subsequent analyses. All female subjects provided complete and usable data.

Tests Administered

Subjects were administered a variety of laterality, cognitive style and selected other tests. The laterality measures included the following:

Zenhausern Preference Test (ZEN). The revised ZEN consists of 26 items which purport to assess visual vs. nonvisual thinking style. The forthright items require self-ratings by
subjects on ten-point scales, with the rating poles varying according to item content. E.g., the poles associated with the item, "How vivid are your daydreams," are "Not at all," and "Extremely," whereas self-rating for the item "Are you fluent in using words," may vary from "Never" to "Always." The raw ZEN score consists of the sum of right hemispheric item ratings (15 items) less the sum of left hemispheric item ratings (11 items).

Verbalizer-Visualizer Questionnaire (VVQ). The VVQ (Richardson, 1977) consists of 15 True-False items distributed among 15 "buffer" items. Designed to identify habitual verbalizers and visualizers, it is scored in the direction of visualizing tendency. The critical items are highly similar in content to ZEN items (e.g., "My dreams are extremely vivid"). Six of the keyed items are scored if marked "True," nine are scored if marked "False." Scores may range from 0 (extreme verbalizer) to 15 (extreme visualizer).

Lateral Eye Movements (LEM). Four research assistants were trained in the administration of the LEM questionnaire and in the observation and recording of responses. The questionnaire (see Appendix A) consisted of a balanced subset of 20 items from those items originally used by Schwartz, Davidson and Maer (1975). Subjects were tested individually, seated across a table (approximately 2½ feet) from one of the four examiners. Experimental rooms were devoid of visual distractions. After presentation of each item, examiners covertly recorded direction of subject eye movements on a
form resembling the face of a clock. Summary statistics were computed by examiners and rechecked by the investigator after the session. Interscorer reliability of the assistants in the scoring of nonlateral, right lateral and left lateral eye movements of a sample subject in videotaped interview was determined to be .96.

Assistants recorded the total number of nonlateral, right and left LEMs for each subject. The subsequent raw score computed for the LEM measure consisted of the proportion of left minus right lateral eye movements of all initial lateral eye movements, in order to be consistent in interpretation with the other laterality test scores. That is, a higher LEM score thus reflected more left-looking (presumably greater right hemispheric activation); the ZEN and VVQ are similarly scored in the direction of right hemispheric preference.

To obtain a combined laterality score (LAT) for each subject, scores on the component tests—ZEN, VVQ, and LEM—were standardized by sex and then averaged.

Cognitive style tests utilized in the final data analysis included eight group-administered and three individually administered tests. The group cognitive style tests included the following:

Group Embedded Figures Test (GEFT). The GEFT (Witkin et al., 1971) is a measure of field independence, or the ability to perceive simple geometric figures set within an
embedding context. The examinee must retain the specified one of eight simple figures (printed on the back of the test booklet) in memory while examining the figure in which it is embedded, although no constraints are imposed regarding the number of times the simple figure may be re-examined. The examinee traces the outline of the specified simple figure in its embedded context. Two minutes are allowed for a practice series of seven items. Five minutes are allowed for each of two subsequent nine-item test series. The GEFT raw score consists of the total number of 18 test items solved correctly within the allotted time limit. Thus a high score reflects greater field independence or analytic ability.

Modified Role Construct Repertory Test (REP). Bieri et al. (1966) developed this modification of the Kelly REP test (Kelly, 1955) to measure cognitive complexity. The subject rates each of 10 personally familiar people on 10 personality dimensions, resulting in a grid of 100 numerical judgments ranging from +3 to -3. The rather complicated scoring procedure, described in detail by Bieri et al. (1966), considers the degree of redundancy of ratings within individuals rated by the subject. Higher scores indicate relatively differentiated intra-individual ratings (complexity), lower scores, relatively undifferentiated ratings (simplicity).

Category Width Scale (CWS). Developed by Pettigrew (1958), the breadth of categorization test measures consistent individual preferences for broad inclusiveness vs.
narrow exclusiveness in establishing an acceptable range for specified categories. On the CWS, the subject is given a fictitious series of "average" values of various stimuli and must select from multiple choices the presumed upper and lower limits of the category. For example, the examinee may be given "the average width of windows" and be asked to estimate the width of "the widest window" and "the narrowest window." The multiple choices are keyed so that the broadest limits (numerically farthest from the fictitious mean) receive highest scores, the narrowest limits (closest to the given mean), the lowest. The keyed sum of all estimates is total CWS score; thus, higher total scores indicate broader, more inclusive categorization.

Object Sort (SORT). The factor analytic study of Sloane et al. (1963) revealed that all types of object sorting tasks, including those using both actual objects and written names of objects, loaded on a single factor. Clayton and Jackson (1961) developed two written object sort tasks, both of which loaded as highly on the sorting factor of Sloane et al. as did the actual object sort of Gardner et al. (1959). Unfortunately, Clayton and Jackson did not publish their own written lists of 50 objects to free-sort. Therefore, for the present study, a list of 50 objects was created which met their specified criteria (see Appendix B). The score is the number of categories created by the examinee which included at least two elements.
Dogmatism (DOG), Ambiguity Tolerance (AMBIG) and Rigidity (RIG). The DOG scale requires subject ratings of degree of agreement (-3 to +3) with 15 statements, e.g., "Most people just don't know what's good for them." For scoring, ratings are transposed by addition of the constant +4, to values of +1 to +7 (to avoid possible negative sums) and totalled. The AMBIG and RIG scales require True-False responses to similar items. The 20 AMBIG items are exemplified by, "It bothers me when I don't know how other people react to me" (scored if "false"). Fifteen of the AMBIG items are scored in the False direction, five in the True direction. The 22 RIG items are all scored in the True direction and are of the type, "There is usually only one best way to solve most problems."

Welsh Figure Preference Test (WFPT). The WFPT (Welsh, 1980) consists of 400 black and white drawings varying in complexity and abstractness. The subject indicates whether (s)he "likes" or "does not like" each figure. While scores may be determined for over 30 scales of this test, only two empirical scales were utilized in the present study. The 93-item Origence (WOR) scale, which is a refinement of the earlier Barron-Welsh Art Scale (Barron, 1953a), is a measure of figural complexity preference, while the 69-item Intellectance (WIN) scale measures degree of preference for abstract geometric figures vs. concrete figures. WIN has been interpreted as a nonverbal measure of abstract attitude. Theoretically, the high WOR-low WIN pattern is consistent with a right
hemispheric cognitive style and the low WOR-high WIN pattern, with a left. Thus the score selected to represent the WFPT measure was the WOR-WIN difference score (WW). High positive or high negative WW scores would thus reflect the "purer" types (imaginative vs. intellectual), whereas intermediate scores would represent mixed, relatively nonlateralized styles.

Matching Familiar Figures Test (MFFT). The MFFT is a measure of reflection vs. impulsivity. The adult form of the MFFT requires the examinee to match a stimulus picture (which remains in view) to its identical counterpart set among seven other highly similar pictures. If an incorrect choice is made, the examinee is asked to continue guessing until the correct alternative is identified. Two scores are derived from the MFFT: the average initial response latency (MF-T) for 12 items, and total number of errors (MF-E).

Arithmetic Operations (AO). The AO test is a measure of one type of distractibility. The examinee must solve as quickly as possible 24 simple arithmetic problems (e.g., "1 + 3 - 2 = ") surrounded by extraneous written material. The test is scored for both time required (AO-T) and the number of errors (AO-E).

Stroop Color-Word Interference Test (STROOP). As a measure of a second type of distractibility, the STROOP requires inhibition of conflicting verbal cues. First, the examinee reads aloud a list of 100 words as quickly as possible (which consists of the recurring words "red," "blue," and
Next, the examinee names aloud the "colors of the ink" of 100 sets of "X" marks, which are typed in red, blue and green ink in irregular order. The actual interference test is Part 3, in which the examinee must again name the "colors of the ink," but must "ignore the words that are spelled" (see Appendix C). Interference is posed by the fact that the words are names of colors incongruent with the ink-color with which they are typed, e.g., the word "red" is typed in blue ink. Interference scores are obtained for both time required to name the colors on Part 3 (ST-T) and total number of errors on Part 3 (ST-E).

In addition to the laterality and cognitive style tests, two tests of ability were included in the battery. A group-administered written form of the Wechsler Adult Intelligence Scale Vocabulary subtest (VOC) (see Appendix D) (Wechsler, 1955) was constructed and used as an estimator of verbal (left hemispheric) ability. The Mooney Faces Test (MOON) (Mooney, 1957), also adapted for group testing (see Appendix E), served as an estimator of right-hemispheric ability, as the Mooney Test is regarded as a relatively pure measure of the ability to synthesize visual information (cf. Benton, 1979).

Additional measures included in the battery because of their possible relevance to laterality and cognitive style test performance were the Spielberger Trait Anxiety Inventory (ANX) (Spielberger, Gorsuch & Lushene, 1970), the MMPI
controlled Repression-Sensitization scale (CRS) (Handal, 1973), and the Marlowe-Crowne Social Desirability Scale (SD) (Crowne & Marlowe, 1960).

A summary of all tests included in the battery and the variables they purport to measure is given in Table 1.
Table 1
The Test Battery

<table>
<thead>
<tr>
<th>Laterality Tests</th>
<th>Measured Variable</th>
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<tbody>
<tr>
<td>Zenhausern (ZEN)</td>
<td>visual (R) vs. nonvisual (L) thinking</td>
</tr>
<tr>
<td>Verbalizer-Visualizer Questionnaire (VVQ)</td>
<td>visualizer (R) vs. verbalizer (L)</td>
</tr>
<tr>
<td>Lateral Eye Movements (LEM)</td>
<td>left-looking (R) vs. right-looking (L)</td>
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<tr>
<th>Cognitive Style Tests</th>
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<tbody>
<tr>
<td>Group Embedded Figures Test (GEFT)</td>
<td>field dependence (global) vs. independence (analytic)</td>
</tr>
<tr>
<td>Modified Role Construct Repertory (REP)</td>
<td>cognitive simplicity vs. complexity</td>
</tr>
<tr>
<td>Category Width Scale (CWS)</td>
<td>broad vs. narrow categorization</td>
</tr>
<tr>
<td>Object Sort (SORT)</td>
<td>conceptual differentiation</td>
</tr>
<tr>
<td>Dogmatism (DOG)</td>
<td>open- vs. closed-mindedness</td>
</tr>
<tr>
<td>Ambiguity Tolerance (AMBIG)</td>
<td>ambiguity tolerance vs. intolerance</td>
</tr>
<tr>
<td>Rigidity (RIG)</td>
<td>cognitive flexibility vs. rigidity</td>
</tr>
<tr>
<td>Welsh Figure Preference Test Orgence-Intellectance (WW)</td>
<td>imaginative vs. intellectual type</td>
</tr>
<tr>
<td>Matching Familiar Figures Test (MPFT)</td>
<td>impulsivity vs. reflection</td>
</tr>
<tr>
<td>Arithmetic Operations (AO)</td>
<td>distractibility (Type A)</td>
</tr>
<tr>
<td>Stroop Color-Word Interference Test (STROOP)</td>
<td>distractibility (Type B)</td>
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<th>Ability Tests</th>
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<tr>
<td>WAIS Vocabulary (VOC)</td>
<td>verbal (L) ability</td>
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<tr>
<td>Mooney Faces (MOON)</td>
<td>visual synthesizing (R) ability</td>
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</table>

<table>
<thead>
<tr>
<th>Additional Tests</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Spielberger Trait Anxiety (ANX)</td>
<td>trait anxiety</td>
</tr>
<tr>
<td>Controlled Repression-Sensitization (CRS)</td>
<td>repressor vs. sensitizer</td>
</tr>
<tr>
<td>Marlowe-Crowne Social Desirability (SD)</td>
<td>social desirability response bias</td>
</tr>
</tbody>
</table>

1"R" refers to presumed right-hemispheric function, "L" to left-hemispheric function
Procedure

Data collection proceeded in three phases. The first was a large-scale group screening battery administered to right-handed undergraduate volunteers for partial course credit as part of an independent study. The screening battery consisted of the ANX, ZEN, SD and CRS scales, in that order, and required approximately one-half hour of subject time. All students taking the screening battery were invited at that time to volunteer for participation in the present study for additional research credit. In this way, one male and 20 female subjects were recruited. All other subjects were recruited in conventional sign-up fashion, and these students were administered the screening battery at the time of the second data-gathering phase.

For the second phase, each participant was seen individually by appointment for approximately one hour. Individual sessions were conducted by one of four trained, advanced undergraduate research assistants. Initially, efforts were made to counterbalance (1) number of subjects seen by each assistant, (2) approximate time of day of testing by each assistant, and (3) subject sex vs. assistant sex. However, these efforts were thwarted at an early stage due to gross imbalances in assistant availability. Assistant 1 (female) tested 16 females and 18 males; Assistant 2 (female) tested 14 females and 14 males; Assistant 3 (male) tested 14 females and 10 males; and Assistant 4 (male) tested 9 females and 3
males. During the individual sessions, subjects were administered the screening battery (ANX, ZEN, SD and CRS) if necessary, LEM interview, AO, STROOP and MFPT, in that order. All test introductions and directions were provided to assistants in written form to be read verbatim. At the conclusion of individual testing sessions, subjects were given reminder slips specifying the location, date and time of their final group testing session, which was scheduled at the same time as individual sessions.

All but two (male) subjects who completed the individual testing also completed the final group testing. Altogether, eight group sessions were held in order to accommodate students' schedules, the groups ranging in size from two to 25. One female subject who failed to appear for one group session and also a subsequently scheduled session did complete the study when rescheduled a second time. All group sessions were conducted by the writer and each lasted approximately three to three and one-half hours. The order of group test presentation was invariably as follows: GEFT, MOON, VVQ, VOC, REP, CWS, DOG, AMBIG, RIG, SORT and WFPT. The first two tests (GEFT and MOON) were timed tests; the remaining tests were untimed and completed at the subjects' own pace. Coffee and doughnuts were available to subjects during the untimed portion of group sessions, and the taking of breaks was encouraged as necessary. The relaxed testing atmosphere was intended to encourage optimal cooperation and to minimize
fatigue. In fact, very few subjects chose to take breaks of more than a minute or two, or expressed feelings of fatigue at the end of the extensive test battery.

Statistical Analyses

First, t-tests of the mean scores obtained by males and females on all variables were computed in order to determine whether subsequent analyses should be conducted separately by sex. Since sex differences on the laterality and cognitive style measures were minor (to be discussed below), subsequent analyses utilized pooled data (N = 97).

Next, first-order correlations were obtained for all variables.

The third step of data analysis consisted of a series of multiple regression analyses, utilizing cognitive style test scores to predict the composite (LAT) and individual (ZEN, VVQ, and LEM) laterality measures. While prediction of the composite LAT score was of primary interest according to the design of the study, separate analyses of the LAT component tests were deemed desirable due to low intercorrelations of these measures. These separate analyses were thus conducted in order to determine whether the cognitive style tests related in different ways to the various component measures of the LAT index. Also, it may be recalled that three of the cognitive style tests (STROOP, AO, and MFFT) each yielded two different scores, an error score and a time score. The present
series of analyses and all subsequent analyses were conducted twice—first utilizing error-type cognitive style test scores for those measures yielding dual scores, and secondly utilizing time-type cognitive style test scores. In summary, the third step of data analysis consisted of a series of eight multiple regression analyses: prediction of LAT, ZEN, VVQ, and LEM from cognitive style tests including error-type scores, and the same predictions from cognitive style tests including time-type scores.

The cognitive style test scores were then factor-analyzed (principal axis method with oblique rotation). The initial factor analysis utilized squared multiple correlations of the measures as prior communality estimates. Subsequently, for purposes of deriving factor scores, values of 1.0 were used as prior communality estimates, thus taking into account the total cognitive style test score variance. Cognitive style factor scores, of both error (CSF-E) and time (CSF-T) type, were generated for each subject. These cognitive style factor scores, along with the ability and additional test scores (VOC, MOON, ANX, CRS, and SD) were entered as independent variables into a series of multiple regression equations, with the laterality measures as the dependent variables. These stepwise regression analyses revealed the degree of laterality variance predicted by each variable as well as by all variables combined. Again, the analyses were conducted separately for the composite (LAT) and individual (ZEN, VVQ,
and LEM) laterality measures, and separately for the CSF-E and CSF-T sets of scores, yielding a total of eight multiple regression analyses.
CHAPTER FOUR: RESULTS

Sex Differences

The t-test procedure revealed no sex differences on any of the laterality measures (ZEN, VVQ and LEM), nor on the combined LAT scores.

Of the 14 cognitive style tests, the mean scores of the sexes did not significantly differ on 12 (GEFT, REP, DOG, AMBIG, RIG, SORT, WW, AO-E, AO-T, MF-E, MF-T, or ST-E). Significant mean sex differences were observed only on ST-T ($t = 2.63, p < .01$), showing females to require less time than males on the Stroop color-word interference task, and on CWS ($t = 2.53, p < .01$), indicating females to be narrower categorizers than males on the Pettigrew limit-specification task.

Males and females did not differ significantly in mean scores on either of the ability measures (VOC or MOON). Of the additional measures (ANX, CRS, and SD), the sexes differed significantly only on mean ANX scores ($t = 1.97, p < .05$), showing females to score higher than males on Spielberger Trait Anxiety.

Intercorrelation of the Measures

The correlation matrix of all variables of the study is shown in Table 2.
Table 2  
Correlation Matrix: All Variables\(^1\)

|     | ZEN  | VVQ  | LEM  | GEFT | REP  | CWS  | DOG  | AMBIG | RIG  | SORT | AO-T | AO-E | MF-T | MF-E | ST-T | ST-E | WW   | VOC  | MOON | ANX  | CRS  | SD  |
|-----|------|------|------|------|------|------|------|-------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|
| LAT | 64\(^d\) | 74\(^d\) | 50\(^d\) | 26\(^b\) | 02 | -07 | 04 | 16 | 00 | 14 | 18 | 04 | 03 | -24\(^a\) | 15 | 07 | 09 | -22\(^a\) | 05 | 05 | 12 | 00 |
| ZEN | -- | 35\(^c\) | -13 | 19 | -01 | 03 | -05 | 28\(^b\) | -11 | -05 | 14 | -10 | -13 | -04 | 06 | -04 | 01 | -17 | 11 | 00 | -04 | 18 |
| VVQ | -- | 08 | 09 | 10 | 03 | 14 | 05 | 20\(^a\) | 19\(^a\) | 06 | 10 | 07 | -26\(^b\) | 02 | 10 | 02 | -34\(^c\) | -08 | -02 | 21\(^a\) | 11 |
| LEM | -- | 23\(^a\) | -03 | -17 | 02 | -01 | -08 | 10 | 21\(^a\) | 11 | 13 | -16 | 22\(^a\) | 07 | 13 | 07 | 05 | 12 | 04 | -25\(^b\) |
| GEFT | -- | 02 | 12 | -18 | 07 | -10 | 00 | 00 | -26\(^b\) | -03 | -18 | 06 | -04 | -10 | 22\(^a\) | 10 | -14 | -02 | -15 |
| REP | -- | 15 | 08 | 09 | -09 | 01 | 07 | 11 | 16 | -16 | -04 | 12 | 21\(^a\) | 03 | -02 | 17 | 00 | -12 |
| CWS | -- | -01 | -04 | 04 | -17 | -21\(^a\) | 03 | -02 | 09 | 09 | 13 | -07 | 14 | 18 | -02 | 03 | -08 |
| DOG | -- | -36\(^c\) | 28\(^b\) | 17 | 10 | 07 | -02 | 17 | 03 | 01 | 04 | -30\(^b\) | -23\(^a\) | 08 | 27\(^b\) | -11 |
| AMBIG | -- | -41\(^d\) | -06 | 14 | 14 | -05 | 03 | -09 | 09 | -04 | 09 | -11 | 17 | 00 | -14 | 26\(^b\) |
| RIG | -- | 07 | -15 | -06 | -22\(^a\) | 07 | -06 | 05 | 02 | -09 | -16 | -15 | 30\(^b\) | 07 |
| SORT | -- | -19 | -02 | 13 | -14 | 03 | -01 | 01 | -16 | -12 | 05 | 10 | 04 |
| AO-T | -- | 08 | 15 | 04 | 46\(^d\) | 21\(^a\) | 06 | -35\(^c\) | -22\(^a\) | 03 | -01 | 21\(^a\) |
| AO-E | -- | -07 | 12 | 00 | -08 | 03 | -15 | 08 | 09 | 24\(^b\) | 13 |
| MF-T | -- | -54\(^d\) | 09 | -05 | -07 | -03 | 05 | 07 | -07 | -03 |
| MF-E | \(a < .05\) | | | | | | | | | | | | | | | | | |
| ST-T | \(b < .01\) | | | | | | | | | | | | | | | | | |
| ST-E | \(c < .001\) | | | | | | | | | | | | | | | | | |
| WW | \(d < .0001\) | | | | | | | | | | | | | | | | | |
| VOC | | | | | | | | | | | | | | | | | | |
| MOON | | | | | | | | | | | | | | | | | | |
| ANX | | | | | | | | | | | | | | | | | | |
| CRS | | | | | | | | | | | | | | | | | | |

\(^1\)Decimal points are assumed but not shown in the correlation coefficients.
The high correlations of LAT with ZEN ($r = .64$), WQ ($r = .74$) and LEM ($r = .50$), all significant at the .0001 level, were to be expected since LAT was derived from scores on these measures. LAT correlations with individual cognitive style test scores were nonsignificant, with the exceptions of GEFT ($r = .26$, $p < .01$) and MF-E ($r = -.24$, $p < .05$). Thus a right-hemispheric style, operationally defined in terms of LAT score, is associated with a more field independent perceptual style (ability to perceptually overcome an embedding context) and with fewer errors on the MFFT (ability to identify identical pictorial stimuli under time pressure). LAT correlates negatively with verbal ability as measured by VOC ($r = -.22$, $p < .05$) but is apparently unrelated to visual synthesizing ability (MOON). LAT correlations with the additional measures (ANX, CRS and SD) were all nonsignificant.

The individual laterality tests correlated with cognitive style measures in unique and inconsistent patterns (see Table 2). None of the individual laterality measures, nor the composite LAT score, correlated significantly with seven (REP, CWS, DOG, AO-E, MF-T, ST-E, WW) of the 14 cognitive style variables, with the MOON ability measure, or with trait anxiety.

The strongest intercorrelations among the individual cognitive style measures were between time and error scores on the MFFT ($r = -.54$, $p < .0001$), time and error scores on the STROOP ($r = .38$, $p < .0001$), AO time and STROOP time ($r =$
.46, p < .001), Ambiguity Tolerance and Rigidity (r = -.41, p < .0001), and Ambiguity Tolerance and Dogmatism (r = -.36, p < .001).

Multiple Regression Analysis: LAT x Individual Cognitive Style Measures

Using first that set of cognitive style test scores which included error scores of the STROOP, AO and MFFT, stepwise regression analysis revealed that GEFT alone accounted for about 7% of total LAT variance, that GEFT and MF-E jointly accounted for 10.5% of LAT variance, and that the best 11-variable model found accounted for about 23% of total LAT variance. Using the cognitive style test scores which included ST-T, AO-T, and MF-T instead of ST-E, AO-E, and MF-E as independent variables, the order of entry of the variables after GEFT varied, and the best 11-variable model accounted for only about 18% of total LAT variance.

Multiple Regression Analyses: Individual Laterality Measures x Individual Cognitive Style Measures

The order of entry of individual cognitive style variables in multiple regression equations to predict individual laterality measures was highly inconsistent, and total proportions of variances explained were limited. Eleven-variable predictions of ZEN accounted for only 12% and 14% of ZEN variance, respectively, utilizing cognitive style tests yielding error
and time scores. For LEM, the corresponding proportions of explained variance were 21% and 20%; for VVQ, 25% and 15%.
The patterns of relative contributions of the independent variables in the regression equations for individual laterality measures were dissimilar to those for the composite laterality index, with the exception that GEFT was weighted most heavily in the prediction of LEM, just as for LAT.

Factor Analyses: Cognitive Style Test Scores

An initial factor analysis (principal axis method), using squared multiple correlations as prior communality estimates, yielded only one cognitive style factor with an eigenvalue greater than 1.0. This factor was defined primarily by the Dogmatism, Rigidity, and Ambiguity Tolerance measures, all with factor loadings in the 50's and accounting for about 10% of the variance. The appearance of only one factor by this method was attributed to the low intercorrelations of individual cognitive style tests. Thus for subsequent factor analyses and derivation of factor scores, values of 1.0 were taken as initial communality estimates, thereby taking into account total cognitive style test score variance as opposed to the more limited shared variance (squared multiple correlations) of these measures.

Using unity, then, as initial communality estimates, the factor analysis of cognitive style tests including error scores yielded five factors with eigenvalues greater than
1.0. The factor analysis of cognitive style tests including time scores also yielded five factors. The matrices of factor loadings after oblique rotation (the factor structure matrices) for both sets of cognitive style tests are given in Table 3.
### Table 3
Cognitive Style Factor Loadings

<table>
<thead>
<tr>
<th>Variables</th>
<th>I(E)</th>
<th>I(T)</th>
<th>II(E)</th>
<th>II(T)</th>
<th>III(E)</th>
<th>III(T)</th>
<th>IV(E)</th>
<th>IV(T)</th>
<th>V(E)</th>
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<td>.09</td>
<td>--</td>
<td>.10</td>
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1(E) = Set of cognitive style test scores including error (not time) scores on three measures.

2(T) = Set of cognitive style test scores including time (not error) scores on three measures.
Factor I of both sets of cognitive style test scores was defined by the DOG, AMBIG, and RIG measures, all with loadings in the .70's, and thus appeared to be an "Open vs. Closed-Mindedness" factor. It accounted for approximately 16% of total variance of both types of cognitive style test scores.

Factor II differed for the cognitive style tests including error (E) scores versus those including time (T) scores. For the first group, Factor II was defined primarily by REP (factor loading .85), but a moderate negative loading of MF-E (-.48) also appeared on this factor. Based upon its most substantial contributor, however, this factor was called "Verbal Complexity vs. Simplicity." Factor II of the second (T) set of cognitive style tests was clearly defined by time scores on both of the distractibility tests (AO-T, loading .87; ST-T, loading .80) and was thus easily interpretable as a "Distractibility vs. Nondistractibility" factor.

Factor III of the first (E) type of cognitive style tests appeared to be an "Inclusive vs. Exclusive Categorizing" factor. For this factor, positive loading of CWS (.76), indicative of broader, more inclusive limit-setting on the Category Width Scale, was associated with negative loading of SORT (-.66), which reflects fewer categories created (and thus more inclusive groupings) in the free-sort task. Conversely, more conservative, exclusive, or narrower CWS categorizing was associated with more numerous (and hence
exclusive) categories created on the SORT task. Factor III of the second (T) group of cognitive style tests was less easily interpretable, being defined primarily by positive loadings on both MF-T (.78) and SORT (.60). Longer response latencies on the figure-matching task were thus associated with more exclusive SORT groupings (larger numbers of categories created). This factor thus combined elements of reflectiveness in task approach, and a discriminating approach to conceptual groupings. It was unrelated, however, to response latency on the other two timed tasks, AO and STROOP, and so the type of reflectiveness involved did not appear to be due to distractibility. Therefore, to avoid any connotations of distractibility, this factor was called "Reflective Discrimination vs. Impulsive Nondiscrimination." This interpretation was supported by a moderately positive loading of REP on this factor. Greater complexity in ratings of people (less redundancy of ratings, or more differentiated perceptions of others) was thus associated with the "reflective discrimination" pole of this factor. Conversely, more global and relatively undifferentiated perceptions of other people were associated with the "impulsive nondiscrimination" pole.

GEFT and AO-E defined Factor IV of the first cognitive style test group, with loadings of -.70 and .78, respectively. This factor thus associated low GEFT accuracy with more AO errors, and high GEFT accuracy with fewer AO errors. Ability to overcome embedding contexts has been theoretically and
empirically distinguished from ability to overcome distracting contexts in the past, and GEFT accuracy was unrelated to either AO-T or ST-T on Factor II(T). Thus the relationship apparent in the present factor did not appear to be attributable to distractibility. Possibly, Factor IV(E) tapped instead a common underlying non-perceptual ability dimension, which may indeed be the very ability factor that tends to occasionally contaminate the "purely perceptual" GEFT performance. This ability factor may also partially confound the AO test, even though the AO items were deliberately constructed to be quite simple and designedly thus unaffected by numerical ability. An appropriate name for this hypothesized common underlying ability factor was elusive, but it was tentatively designated "Numerical-Analytic Ability" in order to most closely reflect its constituent tests. For this factor, only one pole was named, because as an ability measure, it is presumed to be a "more-or-less" variable as opposed to a qualitative continuum.

Factor IV of the second (T) group of cognitive style tests was unique and interpretively complex. CWS had the highest loading (.84) on this factor, followed by REP (.53), with modest contributions by GEFT (.36) and SORT (-.34). It was partially reminiscent of Factor III(E), which also had positive CWS and negative SORT loadings. However, REP and GEFT were noncontributory to that factor (which had been called "Inclusive vs. Exclusive Categorizing"). Therefore,
in addition to the inclusive-exclusive dimension, the present factor also contained elements of cognitive complexity and perceptual field independence, both of which were associated, curiously, with the inclusive direction of this factor. The interpretive dilemma was not resolved by limiting consideration to only those tests, CWS and REP, with the highest factor loadings. Simultaneous positive loadings on these measures is both contraintuitive and contratheoretical. Why should a broader, more inclusive limit-setter on the Category Width Test also manifest more complex and discriminating interpersonal judgments? This curious factor was finally named after the single variable of highest loading (CWS), viz., "Broad vs. Narrow Bandwidth." The "bandwidth" term was chosen vs. "categorization" in order to avoid confusion with Factor III(E), and to emphasize that it applies primarily to the CWS variety of category formation, without generality to the REP task (except paradoxically).

Factor V(E) was primarily defined by the Stroop error score (.75), with moderate additional loadings of MF-E (.59) and WW (.58). This pattern was descriptive of a type of impulsivity or distractibility associated with preference for figural complexity and dislike of simple geometrical forms when a more "interesting" alternative visual stimulus was available. The contribution of WW, probably the purest stylistic preference (vs. ability) measure in the battery, suggested that the Stroop and MFPT errors made by individuals
scoring high on this factor were of a qualitatively different type than those scoring low on the "Numerical-Analytical Ability" Factor, or high on the "Distractibility" Factor. Arithmetic Operations Test error scores were in fact slightly negatively loaded on this factor. The type of errors associated with high Factor V(E) scores, then, were evident on tasks requiring oral or pointing (but not written) responses. Considered in conjunction with the contribution of WW, this factor was therefore interpreted to reflect a type of spontaneity, noncritical in certain task situations, with its polar opposite being a critical reflectiveness also associated with preference for figural order, simplicity, and symmetry. Factor V(E) was named "Noncritical Spontaneity vs. Critical Reserve."

Finally, the highest loadings on Factor V(T) were those of WW (.81) and REP (.63). This factor appeared to combine two different types of cognitive complexity: preference for figural or nonverbal complexity, and complexity in interpersonal perception. High Factor V(T) scorers would thus both prefer and impose more differentiated cognitive-perceptual stimulus arrays; low scorers would prefer and impose more simplified and generalized cognitive-perceptions. In order to emphasize the application of this factor to both verbal and nonverbal domains, it was named "Cognitive-Perceptual Complexity vs. Simplicity," to distinguish it from Factor II(E), which applied only to the verbal cognitive domain.
A summary of the ten factors extracted in this series of analyses is presented in Table 4.

<table>
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<th>Factor</th>
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<td>GEFT -.70</td>
<td>(REP .53)</td>
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<td>Noncritical Spontaneity vs. Critical Reserve</td>
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Multiple Regression Analyses: LAT x Cognitive Style Factors and Additional Measures

Using the error-type cognitive style test factor scores (CSF-E), as well as the ability and selected additional test scores (VOC, MOON, ANX, SD, and CRS), the best three-variable model found to predict the composite LAT score included VOC, CSF-E Factor 4 (Numerical-Analytical Ability), and CSF-E Factor 2 (Verbal Complexity vs. Simplicity), in that order. In combination, these variables accounted for approximately 13% of LAT variance, and the inclusion of all ten variables increased this explained variance to only about 18%.

The corresponding regression analysis using CSF-T factors and additional measures as independent variables resulted in a ten-variable model which accounted for only 12% of LAT variance. The variables included in the best three-variable model were VOC, CSF-T Factor 2 (Distractibility vs. Nondistractibility), and MOON, which jointly accounted for about 8% of LAT variance.

Multiple Regression Analyses: Individual Laterality Measures x Cognitive Style Factors and Additional Measures

Multiple prediction of the individual laterality measures from cognitive style factors and additional test scores accounted for 11% to 25% of respective laterality variances. Prediction from both error and time types of cognitive style factors was poorest for the ZEN measure, with total
explained ZEN variance being 11% and 12%, respectively. The best prediction was of VVQ (25%), from CSF-E factor scores and additional measures, with the best three-variable solution including VOC, CSF-E Factor 2 (Verbal Complexity vs. Simplicity), and CSF-E Factor 5 (Noncritical Spontaneity vs. Critical Reserve). In the multiple regression equation for VVQ, VOC was negatively weighted, and the factors are weighted in the directions of verbal complexity and critical reserve.
In the following discussion, obtained intercorrelations of the individual measures will first be considered, and compared with results of previous studies where applicable. Next, sex differences will be addressed. Finally, the cognitive style factors and their relation to the laterality index will be discussed, with consideration of some general procedural and theoretical issues and implications for future research.

Dogmatism, rigidity, and ambiguity tolerance all correlated significantly with each other, at the .01 level or better, as expected on the basis of previous studies. In fact, the obtained correlation coefficient of -.41 ($p < .0001$) between rigidity and ambiguity tolerance is of precisely the same magnitude as that reported by MacDonald (1970). While these three tests were clearly related to each other, none of them correlated significantly with any other cognitive style variable, with the exception of rigidity, which was related to MFPT time score ($r = -.22, p < .05$). Higher rigidity scores were thus associated with greater impulsivity, at least in terms of response latency (but not in terms of errors). With regard to the ability measures, only dogmatism showed any significant relationship, and this relationship was negative with both verbal and nonverbal ability. DOG, RIG, and AMBIG were all unrelated to trait anxiety, but
both DOG and RIG were significantly related to sensitizing on the CRS scale. Dogmatism has previously been related to sensitizing (Vacchiano et al., 1969), so this finding is consistent with the literature. Also consistent, even though somewhat surprising, is an apparent lack of relationship between dogmatism and social desirability. High-dogmatics have been clearly shown to be a conventional, conservative, conforming type, unusually dependent upon authority figures and perceived environmental expectations, in a variety of tasks and settings. Of all the cognitive style variables in the battery, in fact, dogmatism might be expected to relate most clearly to a social desirability response bias on rational, if not empirical, grounds. Yet, not only was this relationship not evident, but ambiguity tolerance correlated positively with social desirability ($r = .26, p < .01$) in the present sample, contrary to the findings of MacDonald (1970). Apparently, high-dogmatics "believe what they believe" regardless of the social desirability of doing so, whereas those who profess tolerance of uncertainties, alternative views, challenging problems without clearcut answers, and so forth, may in fact be doing so partly because of an expectation that this is socially desirable behavior. Alternatively, genuinely ambiguity tolerant individuals may be "right-brained," visual thinkers (AMBIG was the only cognitive style variable to significantly correlate, positively, with the ZEN), whose higher social desirability scores may
be interpreted as "image-polishing," in the terms of Bear and Fedio (1977).

The Origence-Intellectance (WW) cognitive style variable related to some other variables in the battery in expected or plausible ways. The so-called "imaginative type" of individual, defined by figural complexity preference and avoidance of regular, geometric designs, also demonstrates a complex (differentiated) personal constructs system, as measured by the REP. In fact, WW was the only cognitive style variable to significantly correlate with REP. Although it may not be surprising to observe a relationship between cognitive complexity and complexity preference, it is interesting that this "complexity" dimension applies to a certain extent to both verbal and nonverbal modes. WW was also significantly negatively correlated with the verbal IQ estimator (VOC), which is consistent with Welsh's (1980) claim that the high WOR-low WIN type does worst on traditional IQ measures, whereas the opposite type does best. Higher WW scores were also associated with higher trait anxiety, which is consistent with the literature involving the Barron-Welsh Art Scale (BWAS). Welsh (1980) had reported "breakdown of repression" and sensitizing tendencies associated with this scale, and the writer (Note 1) had found a significant positive relationship between the BWAS and Spielberger trait anxiety. Similarly, the EEG studies of Martindale (1975) had indicated relatively high bilateral arousal among "high creatives"
in the resting state, and various other manifestations congruent with sensitization and/or trait anxiety. Thus the significant correlations of WW with other variables in the study were sensible; the more perplexing findings in regard to WW were the absence of certain expected relationships. From the foregoing discussion, one such expected relationship was obviously with sensitizing tendency on the CRS scale. This was nonexistent ($r = .00$). Other expected relationships were with impulsivity (positive) and dogmatism (negative), based upon Welsh's review of the BWAS, and with rigidity (negative), based upon the writer's preliminary study noted above. Possibly, these effects were attenuated due to the contribution of WIN subscale performance, instead of heightened, as proposed by Welsh.

Due to the substantial accumulated literature regarding field independence, a number of relationships could be anticipated. Generally, however, only the expected "non-relationships," as opposed to positive or negative ones, were borne out in the present study. Specifically, field independence was expected to be independent of the SORT measure (as per Gardner et al., 1959), and of dogmatism, rigidity, and ambiguity tolerance (Goldstein & Blackman, 1978; Messick & Fritzky, 1963). These variables were indeed unrelated to GEFT in the present study. However, field independence could be expected to correlate negatively with impulsivity, STROOP interference score, and possibly the Mooney Faces test (cf.
Kogan, 1971), and positively with cognitive complexity (per Witkin's "psychological differentiation" theory). None of these relationships were apparent. The only variables with which GEFT correlated significantly in the present study were the Verbal IQ estimator ($r = .22, p < .05$) and Arithmetic Operations errors ($r = - .26, p < .01$). This finding was obtained even though VOC and AO-E were unrelated to each other. While Witkin maintains that field independence is independent of verbal intelligence, this assertion has not always been supported in the past (cf. Kogan, 1973; Wachtel, 1968) and it is not supported in the present study. That field independence is associated with fewer errors on the distractibility task also calls into question Karp's (1963) claim that ability to extract relevant information from an embedding context is independent of the same skill in a distracting context. Furthermore, Karp had reported factorial independence of the Arithmetic Operations test and WAIS Vocabulary, but in the present study, the AO time score was correlated (negatively) with both ability measures. Thus, lower verbal and visual synthesizing ability scores were associated with longer time required to perform the AO distraction test, and more errors on the embedded figures test; and more GEFT errors were also associated with more AO errors. The rather low (but significant) pattern of obtained intercorrelations would support the notion that GEFT field independence and AO freedom from distractibility
are related but not identical abilities, that neither of them are completely independent of verbal intellectual ability, and that AO distractibility is also related in part to lower visual synthesizing ability.

What of the other type of distractibility, the type measured by the Stroop test? Previous factorial studies had suggested that the STROOP and AO tests tap different cognitive domains. But in the present study, both STROOP time and error scores were significantly related to AO time (but not AO error) scores. In fact, the correlation between STROOP time and AO time ($r = .46, p < .0001$) was the strongest observed interrelationship between any pair of different cognitive style tests. Individuals who require more time on the color-word interference test (and who make more errors in the process) also tend to require more time to solve simple arithmetic problems in a highly distracting context. The independence of these two types of distractibility is thus questionable. Also, Stroop time and errors appear to be negatively related to both verbal and visual synthesizing ability (three of the four correlations involved were significant). Perhaps the most surprising finding with the STROOP, however, was its apparent lack of relationship to field independence. Gardner et al. (1959) had found more field dependent subjects to be more susceptible to Stroop interference, at least among females (the obtained correlation of .21 for males in that study was nonsignificant with consideration of
sample size). The failure to replicate this finding with the present sample is all the more puzzling due to observed associations between the STROOP and AO, AO and GEFT, and between all three of these measures with the ability measures. Given these, we would also expect a STROOP relationship with GEFT. But this relationship was very nearly zero. Apparently, the facility to inhibit a verbal cue (as required by the STROOP) bears some relationship to speed and accuracy in extracting and working with numerical information (the AO), inhibiting extraneous material, but it is unrelated to perceptual analysis, requiring the disembedding of a geometric figure. The difference may thus possibly be explained in terms of task content (verbal/numerical vs. visuospatial) or in terms of the primary task demand (inhibition vs. active analysis).

Expected relationships involving the reflection-impulsivity (MFFT) test were highly tentative, since the relevant prior studies had all been done with children. Reflective children had been found to be more field independent, with MFFT time scores relating positively to EFT accuracy and MFFT error scores relating negatively to EFT accuracy. With the present sample of college students, these relationships were not apparent. Correlations of MF-T and MF-E with the GEFT were nonsignificant. We are reminded of Wachtel's (1968) distinction between style and capacity, especially as this relates to child-adult differences in analytic functioning. While Wachtel had confined his discussion to analytic ability
field independence) vs. analytic style (as measured by a sorting task), finding these to be related in children but not necessarily in adults, his reasoning may be applicable to the current topic. That is, a reflective task approach may well be an ability or capacity dimension in children, thus related positively to EFT accuracy. But in adults, reflection-impulsivity (or "cognitive tempo") may represent more of a stylistic dimension, not necessarily related to GEFT ability. This interpretation is supported by the observation that while the GEFT positively correlates with the verbal ability measure even in adults, the MFFT bears no relation to either ability measure.

Not surprisingly, longer initial response latencies on the MFFT were clearly and negatively related to MFFT errors ($r = -.54, p < .0001$). MFFT errors were also positively associated with STROOP errors ($r = .26, p < .01$). Of somewhat greater interest, longer MFFT response latencies also correlated with lower Rigidity scores ($r = -.22, p < .05$). A reflective task approach thus appears associated to some degree with greater cognitive flexibility. The previous speculation, that reflectiveness may represent more of a stylistic than an ability dimension in adults, is indirectly supported by its association with rigidity, which also was unrelated to either ability measure in the present study.

The conceptual differentiation (SORT), category width (CWS), and cognitive complexity (REP) measures yielded the
most disappointing results of the study, with the exception of the REP relationship to figural complexity preference discussed earlier. These three dimensions did not show any relationship to each other or to any other variable in the study, except for weak relations between SORT and the VWQ ($r = .19, p < .05$) and between CWS and AO-T ($r = -.21, p < .05$). These isolated relationships make little theoretical sense and may easily be chance findings. The large number (39) of potential significant intercorrelations of these measures with each other and with other cognitive style variables could have provided an excellent basis for emergence of an anticipated "complexity-differentiation" cognitive style factor. Therefore, while the apparent independence of these dimensions in 37 of 39 of these comparisons is impressive in its own right, this very independence substantially doomed hope of extracting a cognitive style factor of this type.

Of the cognitive style variables, findings of some prior studies led to expectation of sex differences on the GEFT (males more field independent), and the MPFT (females more reflective). In the present sample, the mean scores of males and females did not significantly differ on either of these measures. Also, the occasionally reported superior vocabulary scores of females were not evident in the present study. Despite prior findings of higher quantitative facility among males than females, the sexes in the present study did not differ in performance on the distraction task involving
numerical content. The sexes did differ on the CWS, as reported in prior studies, with females manifesting narrower categorization. Females also obtained significantly higher trait anxiety scores. Despite these isolated observed differences, the more prominent findings of the present study in regard to sex differences were (1) absence of several expected differences, and (2) the large number of no observed sex differences. These findings support the observation of Kogan (1976), and more recently, of Hyde (1981), that sex-related cognitive differences may typically be overstated in the literature and may even be declining over time. The implication of such findings and observations, is not that investigators should fail to seek sex differences, or to report or control for them when observed, but rather that they not be inappropriately exaggerated, assumed, or otherwise utilized in ways which serve to foster sexual discrimination in real-life settings such as school guidance or career counseling (cf. Hyde, 1981). Such implications and applications go "far beyond the data."

The cognitive style factors extracted in the current study accounted for very little more of the total cognitive style test variance than did any single cognitive style test score. This is not surprising, in view of the low intercorrelations of individual cognitive style tests. The first and largest factor (and the only one with an eigenvalue greater than 1.0 in the factor analysis using squared multiple
correlations as initial communality estimates), was an "open vs. closed-mindedness" factor defined by Dogmatism, Rigidity, and Ambiguity Tolerance, which demonstrated the most consistent individual intercorrelations. Additional factors, generated by the factor analytic procedure in which total cognitive style test variance instead of shared variance was considered, were different depending upon whether time or error scores were used for those tests which yielded both types of scores. Other than the tests which loaded on Factor 1 (DOG, RIG, and AMBIG), even those tests which did not yield dual scores did not load on comparable factors in the second series of factor analyses. Thus, it would appear that only Open vs. Closed-Mindedness is a factor which emerges reliably, regardless of the method used. However, it should be recalled that even this reliable first factor only accounted for up to 7% more total variance (depending upon the type of factor analytic method used) than any of its individual component tests, so that its theoretical as well as practical significance is very limited.

Similarly, the multiple regression analyses revealed that a relatively small amount of laterality test variance was predictable from cognitive style tests, cognitive style factors, and additional measures. Unexplained composite LAT variance ranged from 77% to 88% with maximum $R^2$ prediction; unexplained individual laterality test variance ranged from 75% to 89%. Furthermore, the patterns of relative
contributions of independent variables in these analyses were inconsistent, among individual laterality tests and between individual and composite laterality measures.

Generally, we might draw conclusions from the present study similar to those of Gardner et al. (1959), from theirs:

Perhaps the most salient new finding of the present study is that these control principles are independent of each other . . . This is an important finding. It implies that it is necessary to sample the various controls in a person's cognitive behavior if we are to understand his "cognitive style." This is particularly true since even the simplest-appearing adaptive behaviors may involve more than one cognitive factor. (pp. 137-138)

While the inclination to simplify and to generalize, and to infer some cognitive characteristics of people on the basis of others, is both natural in everyday interaction and a goal of scientific psychological theory, studies such as the current one should loudly caution against such inclinations. We might, as suggested by Gardner, confine our inquiries to a "variable by variable" assessment of an individual's multidimensional cognitive style, predicting with confidence only from a mosaic cognitive style profile, which in a way represents an abandonment of the search for higher-order, unifying theoretical principles.

Or, we might conclude, like Corballis (1980), that the search for unifying principles of cognitive style is not unreasonable or unrealistic; but that the neuropsychological model itself is inadequate to the task:

My quarrel is not with the classification of cognitive styles that has been grafted onto the left-right axis.
It is perfectly acceptable to contrast intuition with reason, the holistic with the analytic, the appositional with the propositional . . . What I am objecting to is the simplistic notion that these contrasting cognitive styles are identified with the two cerebral hemispheres. (p. 288)

The major problem with Corballis' argument, however, is that until only about twenty years ago, differential hemispheric capabilities other than localization of speech and language function were unknown. Before that, the idea that the right hemisphere can perceive and copy geometric figures while the left, in isolation, cannot, that objects presented to the right hemisphere could be correctly identified nonverbally while the left hemisphere concurrently verbally denies their very existence, would also have seemed incredible and perhaps simplistic. Yet this is well-documented fact, and the implications of these and other differential functions have only begun to be explored. To reject the relevance of these structural and functional differences to cognitive style—information processing in the normal brain—seems premature at best. The two brain hemispheres do appear to process different information, in different ways, and that is what the construct of "cognitive style" is all about.

We would agree with Corballis that over-hasty, sweeping inferences about left-right hemispheric differences in everyday behavior are also premature and inappropriate. As Ley (1979) has noted, "The behavioral manifestations of functional cerebral asymmetries in man embody a current psychological Zeitgeist" (p. 41). "Split-brain psychology"
has indeed been dubbed the "fad of the year" (Goleman, 1977). Articles abound in the popular press (e.g., Loch, 1981; Raudsepp, 1981) which grossly exaggerate known behavioral correlates of left vs. right hemispheric function. Such exaggerations and distortions are naturally an affront to serious investigators and do little but provide "bad press" for neuropsychological models of behavior. They are reminiscent of the explosion of speculative material and applications which followed introduction of psychoanalytic concepts early in the present century. However, just as "popular analysis" is irrelevant to the validity or invalidity of psychoanalytic theory, popular notions of "hemisphericity" in all areas of life and civilization need not and should not detract from or discourage scientific investigation of the laterality model.

The present study does offer implications for future research in this area. For one, the observed intercorrelations among the three "laterality" measures were very low, suggesting the need for improvement of the measurement of laterality in nonclinical settings. The LEM measure did not correlate significantly with either the ZEN or the VVQ, so that it is doubtful that the LAT index was much more than self-reported visual modality preference. While this preference may eventually prove to be related to a degree to a right-hemispheric processing style, it is probably not identical with it. Thus one major implication of the study is that more sophisticated
measures of laterality in normal subjects need to be developed. Secondly, the "cognitive style variables" of the present study were a potpourri of tests, many apparently measures of ability as opposed to style, developed within various theoretical frameworks. It would seem that, to assess cognitive style from a neuropsychological viewpoint, measures of dimensions of cognitive style must be developed which are based soundly upon neuropsychological research. Validation of these measures against real-life problem-solving strategies would follow.

The present study has offered evidence that several existing "laterality" measures are largely unrelated to a number of traditional cognitive style measures. The cognitive style dimensions in turn were found to be largely independent of each other, indicating that individuals manifest considerable diversity in their cognitive styles as they are presently measured, and that in fact the term "cognitive style" may be misleading in its implications of unity and consistency. Future efforts to investigate the relationship between laterality and cognitive style might best begin with refinement of assessment techniques in both domains.
APPENDICES
Appendix A. The LEM Questionnaire

LEM Introduction

"I'm going to ask you some questions, and I want you to consider your answers carefully."

LEM Questions

1. Envision the keyboard of a typewriter. In which corner of the keyboard is the letter "p"?

2. Tell me how you feel when you are anxious.

3. What is meant by the proverb, "One today is worth two tomorrows?"

4. Visualize and describe the most upsetting photograph of the Vietnam war that you have seen.

5. What is the primary difference between the meanings of the words "mischief" and "malice"?

6. Make up a sentence using the words "code" and "mathematics."

7. If you were crossing a street from west to east, and a car coming from the south smashed into you, which leg would be shattered first?

8. Imagine a rectangle. Draw a line from the upper left hand corner to the lower right hand corner. What two figures do you now have?

9. Imagine that you are relaxing in hot sulfur baths looking westward over the Pacific Ocean in California on a clear, sunny day. Your friend is peacefully resting with his back toward your right side. Approximately what direction is your friend looking out over?

10. Visualize the Prudential Tower in Boston and the United Nations building in New York and tell me which one is taller.

11. Make up a sentence using the words "shock" and sadness.

12. What is the primary difference between the meanings of the words "recognize" and "remember"?
13. For you, is anger or hate a stronger emotion?

14. Envision walking through your house or apartment and tell me how many doors there are.

15. Picture the last automobile accident that you have seen. In which direction were the cars going?

16. Do you use the word "logical" or "rational" more often?

17. What is meant by the proverb, "The more cost, the more honor?"

18. When you visualize your father's face, what emotion first strikes you?

19. On the face of a quarter, does the face of George Washington look to the left or right?

20. Tell me how you feel when you are frustrated.
Appendix B. The Object Sort Test

Below you will find a list of the names of 50 common objects. Your task is to put together into groups the objects which seem to you to belong together. In the space below (and continued on the back of this page if necessary), write down the list of objects in each group, labeling each group with a name or phrase which describes the way in which they belong together. Use each object only once; that is, do not place any single object in more than one group.

You may create as many or as few groups as you like, and you may have as many or as few objects in a group as you like, as long as the objects in each group belong together for a particular reason. If, after you have thought about all the objects, a few do not seem to belong with any of the others, you may put those objects into groups by themselves. PLEASE SORT ALL THE OBJECTS.

Sandpaper  Cigarette  Suntan oil
Bicycle bell  Doll  Deck of cards
Thimble  Padlock/Key  Wrench
Pebble  Medicine dropper  Cigar
Sugar cube  Picture postcard  Paperback book
Spoon  Paper clip  Penny
Comb  Cologne  Sunglasses
Toy hammer  Ping pong ball  Butter knife
Bow tie  White chalk  Hairbrush
Sponge  Fishing fly  Golf ball
Crayon  Hairpin  Spool of thread
Bar of soap  Nail  Pocket knife
Light bulb  Postage stamp  Vitamin pill
Lipstick  Candle  Typewriter ribbon
Dime  Lollipop  Watercolor set
Fork  Earring  Pencil
Button  Screwdriver
Appendix C. Stroop Test Directions

(Words, Page 1) "This is a test of how fast you can read the words on this page. After I say begin, you are to read down the columns, starting with the first column, reading the words OUT LOUD as quickly as you can. After you finish the first column, go on to the next and so on until you reach the end. If you make a mistake, correct it and go on. Any questions? Then begin."

(Colors, Page 2) (Same as above, except say "colors of the ink" instead of "words").

(Colors-Words, Page 3) "This is a test of how fast you can read the colors of the ink on this page, ignoring the words that are spelled. Remember to read the colors OUT LOUD, and read the columns as quickly as you can. Again, if you make a mistake, correct it and go on. Ready? Begin."

Appendix D. The Vocabulary Test

"Please write a brief but complete definition of the following words. If you do not know a word, you may skip the item, although you are encouraged to attempt all the items (there is no penalty for guessing). Please do not write in the column marked 'X'."

[Words presented are Items 4-40 of the WAIS Vocabulary subtest. In scoring, full credit is assumed for Items 1-3.]
Appendix E. Mooney Test Directions and Answer Format

The figures you are about to see are all human faces, and they are all right side up. The numbered items below refer to the numbers of the figures in the accompanying booklet.

Your task is to describe the face by placing an (x) next to the most correct word in each of the following categories: SEX (Male, Female), AGE (Child, Adult, Aged), and DIRECTION FACING (e.g., left, right, up, down, etc.). Rate the direction facing according to your own perspective—your right or left, etc.—and not according to the perspective of the face in the picture.

If you are unable to see a figure within a few seconds, skip it and return to it later.

[The answer sheet is of the following form, for the series of 24 test stimuli presented separately in a booklet:]

<table>
<thead>
<tr>
<th>SEX</th>
<th>AGE</th>
<th>DIRECTION FACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>_M</td>
<td>_Child</td>
</tr>
<tr>
<td></td>
<td>_F</td>
<td>_Adult</td>
</tr>
<tr>
<td></td>
<td></td>
<td>_Aged</td>
</tr>
<tr>
<td>2.</td>
<td>_M</td>
<td>_Child</td>
</tr>
<tr>
<td></td>
<td>_F</td>
<td>_Adult</td>
</tr>
<tr>
<td></td>
<td></td>
<td>_Aged</td>
</tr>
</tbody>
</table>

[Items are counted correct only if the sex, age, and direction facing choices are correct.]
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