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ALTERNATE MODELS OF WISC-R PSYCHODIAGNOSTICS

by

Edward D. Rossini

A Dissertation Submitted to the Faculty of the Graduate School
of Loyola University of Chicago in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Philosophy

October

1985

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VITA

The author, Edward D. Rossini, is the son of August J. Rossini and the late Tina (Herman) Rossini. He was born in Chicago on March 29, 1954.

He was educated in the Roman Catholic parochial school system (St. Sylvester School) of Chicago. Secondary education was at Lane Technical High School, with graduation in June, 1972.

In September, 1972, Mr. Rossini entered Loyola University of Chicago as a State of Illinois Scholar, majoring in psychology with an academic minor in theology. He graduated with a Bachelor of Science, magna cum laude in February, 1976.

He was admitted to the Graduate School of Loyola University of Chicago to read clinical psychology in September, 1976. The Master of Arts degree (psychology) was awarded in 1981. He has completed two internships in clinical psychology: the Loyola Guidance Center (1978-1981) and at the Hines Veterans Administration Medical Center (1982-1983). He is currently employed at the Edgewater Uptown Community Mental Health Center and as an adjunct faculty member of DeLourdes College.

Mr. Rossini has co-authored several research studies of child neuropsychology and in the intellectual assessment of children appearing in the Journal of Consulting and Clinical Psychology and the International Journal of Clinical Neuropsychology.

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CHAPTER I

INTRODUCTION

Psychological assessment has long been accepted as a valuable procedure for understanding "troubled and troubling" children (Hobbs, 1982). The use of objective psychological tests in the assessment of childhood psychopathology spans the history of the psychodiagnostic movement, providing reliable data to infer clinically meaningful individual or group differences. Beginning with Binet, individual intelligence tests have been the most popular psychological tests in evaluating children. Regardless of the nature of the child's symptomology or "problem area," intelligence tests remain the benchmark of a comprehensive assessment battery (Galvin & Elliott, 1985). Within this genre of psychological tests, the primacy of the Wechsler Intelligence Scale for Children-Revised (WISC-R) (Wechsler, 1974) is well established (Zimmerman & Woo-Sam, 1984). The prominence of the WISC-R derives from several converging sources of evidence. The Wechsler Intelligence Scale for Children-Revised is the most frequently administered psychological test among school-aged children (Lubin, Larsen, & Matarazzo, 1984). The enduring popularity of the WISC-R can be

attributed to two distinct uses of the test, psychoeducational measurement and clinical assessment. In psychoeducational measurement, the WISC-R is the most frequently used test of intelligence (Kaufman & Reynolds, 1984), and the most referenced citation in educational research (Oakland, 1984). Similarly, the WISC-R is an established part of psychodiagnostic testing batteries (Elbert, 1984; Piotrowski, Sherry, & Keller, 1985). The WISC-R has been used in neuropsychological assessment (e.g., Kuncze & McMahon, 1979) and extensively in the assessment of behavioral disorders and psychopathology (Kaufman, 1979; Sattler, 1982).

The increasing use of the WISC-R among atypical groups of children, not included in the nationally representative standardization sample, has greatly expanded the scope and purpose of intelligence testing from a specific psychometric purpose, "measuring a subject's mental abilities or current intellectual capacities" (Wechsler, 1974) to a "clinical-diagnostic" purpose (Achenbach, 1982). Methods of inferring clinical hypotheses from WISC-R data have become a common practice with textbooks of WISC-R interpretation abounding (Cooper, 1982; Ogden, 1982; Kaufman, 1979; Sattler, 1982). Each author generalizes the application of the WISC-R to groups of children not represented in the standardization. Precedent for this extrapolation was established in the clinical use of the adult versions of the Wechsler intelligence scales (Matarazzo,

1972) and with the original Wechsler Intelligence Scale for Children (Glasser & Zimmerman, 1967).

The method of deducing clinical hypotheses from intellectual test data is valid to the extent that specific hypotheses are generated and tested in quasi-experimental studies. Test validation is a logical process; the validity of a test is independent of its name or avowed purpose. The validation of test scores for novel purposes has become a common area of psychometric research. Blau (1979) suggested that this method of "situation-specific revalidation" would be the most valuable contribution of clinical research to clinical practice; it would determine how current tests can be used more effectively.

This study was partially designed in response to Blau's call for situation-specific revalidation of the most popular tests among children. The WISC-R has a tradition of being a fertile "clinical-diagnostic" test generally unsubstantiated by research. The purpose of this study was to review the literature on the psychodiagnostic utility of the WISC-R and to propose potentially more effective models of interpretation based on the psychometric "strengths" of the test, while obviating the methodological problems characteristic of previous research. Specifically, this study proposes a "successive sieve" analysis of two recently proposed WISC-R interpretative models, the factor structure model (Kaufman, 1979) and the reclassification

of subtests proposed by Bannatyne (1971, 1974). The conceptual scores of the WISC-R will be evaluated in a "classical validity" design with the goal of determining significant differences between groups of control children and emotionally-disturbed children. Inter-group variation will be evaluated for the "clinical utility" of such differences with the goal of determining the efficacy of each model to individual psychodiagnostics. Finally, the construct validity of selected WISC-R conceptual variables hypothesized to be useful in differentiating control from disturbed children will be examined from a neuropsychological perspective. A combined cognitive-neuropsychological model of differentiating control from emotionally-disturbed children will be evaluated.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

The Psychodiagnostic Utility of the WISC-R Full Scale Intelligence

Relatively little is known about the frequency distribution of WISC-R full-scale intelligence (FSIQ) scores in psychiatric populations of preadolescent children. The test's standardization sample was limited to "normal" children. Children with undefined "severe emotional problems" were not included in the nationally representative standardization. However, the intellectual characteristics of emotionally-disturbed/behavior-disordered children can be inferred from extrapolating the results of a series of descriptive and quasi-experimental studies. This information is essential because of the application of the WISC-R into increasingly deviant groups of children; an interpretative reference group of similar children is the defining characteristic of the Wechsler deviation quotient.

There is an implicit hypothesis that psychopathology effects children's cognitive functioning on standardized intelligence tests in a deleterious manner. As Kaufman (1979) noted in his textbook on WISC-R

interpretation "emotionally-disturbed children sometimes perform very poorly on mental tasks because their disorder interferes with and disrupts their cognitive processing" (p. 16). This clinical hypothesis appears to be widely accepted among WISC-R clinicians (Cooper, 1980; Sattler, 1982), though the exact nature of the deleterious effects and their extent remains anecdotal. An initial attempt to identify "psychopathological" performance on the WISC-R among samples of psychiatrically-disordered children posed the question: Has any clinical group demonstrated subnormal intelligence?

Evidence indicates that neither specific diagnostic groups nor undifferentiated groups of emotionally-disturbed children have been found to be of subnormal intelligence as measured by the WISC-R full scale intelligence quotient. This conclusion was affirmed by a review of several types of studies: descriptive reports of single-group psychopathological samples, quasi-experimental comparisons between clinical and control groups, and finally, inter-clinical quasi-experimental comparisons.

Descriptive Studies

A series of descriptive studies have examined the intellectual performance of inpatient and outpatient children attempting to discern subtle differences within the normal range of WISC-R performance. Average intellectual performance was reported for hospitalized schizophrenic

children (Green, 1984). Average levels of intellectual performances were reported for heterogeneous groups of children on short-term inpatient units (Kazdin, French, Dawson, & Sherick, 1983), extended care psychiatric units (Kazdin, 1984), and among children on long-term psychiatric units (Forness, Bennett, & Tose, 1983). Among these studies two findings emerged: first, the inpatient groups of children consistently demonstrated average levels of intellectual performance in Wechsler's nominal classification format (IQ = 90-109); however, the distribution of FSIQ appeared to be slightly skewed negatively in the inpatient groups with a higher incidence of Low Average (IQ = 80-89) scores than expected based on the normal distribution.

Descriptive studies of the intellectual characteristics of children in outpatient treatment revealed a similar pattern of intellectual performance; average intellectual performance with a slightly negative skew to the distributions (Coble, 1984; Hodges, Horowitz, Kline, & Brandt, 1982; Munford, 1978).

Behavior-disordered children enrolled in special education classrooms have consistently been found to score within the average range of intelligence on the WISC-R (Gettinger, 1983; Piaget, 1982; Vance, Fuller, & Ellis, 1982). Children with severe behavioral disorders (Attention Deficit Disorder with Hyperactivity) manifest average

intelligence (Abikoff & Gittelman, 1985; Brown, Wynne, & Medenis, 1985). Colvin (1977) reported that children without psychiatric disorders, but experiencing acute psychosocial stress, demonstrated average levels of intellectual performance during their stressful situations.

Quasi-Experimental Studies: Control Groups Versus Psychopathological

Descriptive studies on discrete clinical groups provide information generally limited to that group alone. The larger question of whether psychopathology adversely affects FSIQ can only be answered in a quasi-experimental concurrent validity series of studies. These studies begin with a well-defined clinical sample and compare their WISC-R performance with a group of similar, though non-problematic, peers. Such group comparisons are frequent in psychological research and are termed "classical validity" studies.

The quasi-experimental literature on the psychodiagnostic use of the FSIQ is limited to a handful of relevant studies. When compared with control groups, psychiatric samples of children consistently demonstrate equivalent, and average, levels of intelligence. Decina, Kestenbaum, Farber, Kron, Gargen, Sackeim, and Sieve (1983) found no significant intellectual differences among children identified as being "at risk" for affective disorders, "at risk" children with documented psychiatric disorders,

and control children matched for age, sex, and socioeconomic status. In an unusual finding, the mean FSIQ for each group was in the High Average (IQ = 110-119) range. Finegan, Zucher, Bradley, and Doering (1982) investigated the intellectual characteristics of a clinical group hypothesized to be above average in intelligence, boys with a DSM-III Gender Identity Disorder. These boys were compared with their non-problem brothers and with a psychiatric control group. The three groups all demonstrated average levels of intelligence and could not be differentiated on the basis of FSIQ. Milich and Dodge (1984) found no significant intellectual differences between control children and a heterogeneous group of clinic-referred children.

In an attempt to document intellectual deficits among emotionally-disturbed children, which appeared evident at the idiographic level (Brumback, Staton, & Wilson, 1980), several studies used the WISC-R standardization sample mean ($\underline{M} = 100$) as a control reference score. Morris, Evans, and Pearson (1978) compared the intellectual performance of "severely emotionally-disturbed" children with the expected mean scores of the standardization sample ($\underline{M} = 100$). They reported that the disturbed sample was below average in FSIQ and significantly lower than the average "expected" performance. Several studies have found significantly lower FSIQ scores among conduct-disordered

children when compared with the "expected" score from the WISC-R standardization sample, though these studies reported that the disturbed groups' performance was within the average range (Beitchman, Patterson, Gelfand, & Minty, 1982; Thompson, 1980).

Quasi-experimental studies indicate that no meaningful intellectual differences appear evident between disturbed and control children; slight differences within the average range of performance appear evident with the disturbed children typically scoring below the expected score of control children.

Inter-clinical Group Intellectual Differences

Inter-clinical group comparisons have found consistently average intellectual levels between diagnostic categories of childhood psychopathology. Rubin, Lippman, and Goldberg-Hier (1984) found no significant intellectual differences between groups thought to differ on degree of psychopathology, neurotic and borderline children. Hodges, Horowitz, Kline, and Brandt (1982) reported no intellectual differences among consecutive referrals for outpatient services among the modal diagnostic categories of childhood psychopathology: conduct disorder, adjustment disorder, affective disorder, and hyperactivity. No FSIQ differences were reported between aggressive and non-aggressive conduct-disordered children (Petti & Law, 1982; Stewart, DeBlois, Meardon, & Cummings, 1981).

Several recent reviews of the clinical applications of the WISC-R have concluded that the global intelligence quotient (FSIQ) is not a discriminating variable between emotionally-disturbed and control children (Hogan & Quay, 1984; Sattler, 1982). A compelling argument can be made that the concept of "average" intelligence is itself too inclusive to offer effective discrimination between any groups other than between retardation, non-retardation, and intellectually gifted. On the WISC-R, "average" performance has two meanings. In conventional psychometric assessment, an "average" performance is one within one standard deviation of the normative mean; for the WISC-R any score between 85 and 115 is an "average" score (68%). Wechsler (1974) proposed a more conservative discrimination; an "average" score was between 90 and 109 (50%). Even with the more restrictive range of average performance, FSIQ does not appear to have merit as a psychodiagnostic discriminator between psychopathology and normal behavior in children.

Other authors have located the hypothesized intellectual differences between psychopathological groups and controls within the structure of the WISC-R. Two levels of clinical inference have been proposed: subtest analysis (Cooper, 1982; Ogden, 1981) and the diagnostic interpretation of various intermediate scores (Bannatyne, 1974; Kaufman, 1979). The psychodiagnostic literature on these

interpretative models will be reviewed.

Subtest Analysis

The construction of the WISC-R lends itself well to the analysis of individual subtests, and to the interpretation of patterns among the subtests. Statistical approaches to evaluating differences between subtests can readily be applied because the twelve subtests are standardized on a common scaled score with the same mean ($\underline{M} = 10$) and standard deviation ($\underline{SD} = 3$).

The second major approach to using the WISC-R as a psychodiagnostic test uses the individual subtest scores as the principle sources of clinical information. This approach has been termed either subtest analysis or pattern analysis. The search for diagnostic patterns on the Wechsler intelligence tests has been a recurrent research interest, though most of the relevant research has been done on the adult versions of the Wechsler tests which possess the identical structure and nominal characteristics of the WISC-R subtests. In a comprehensive review of the "Wechsler Enterprise," Frank (1983) traced the origins and enduring appeal of subtest analysis. In the early days of the psychometric movement it was considered axiomatic that specific intellectual functions, as measured by various Wechsler subtests, were differentially impaired among psychiatric conditions. These hypothesized cognitive differences were assumed to manifest distinct patterns on

the Wechsler tests (Rappaport, Gill, & Schafer, 1945; Schafer, 1944). The essential thesis of pattern analysis was succinctly stated in the revision of the standard clinical text Diagnostic Psychological Testing (Rappaport, Schafer, & Gill, 1945): "In our view, the scatter on the . . . (subtests) . . . is not random, but follows definite rules and is diagnostically differential between kinds of clinical and normal groups" (p. 78).

A considerable literature exists on subtest pattern analysis among adult psychiatric patients, reviewed by Matarazzo (1972) and Frank (1983). The conclusions of each review were uniformly disappointing: "The use of the Wechsler subscales to assess the differential cognitive/intellective performance of various types of psychiatric patients revealed no great success. . ." (Frank, 1983, p. 118).

The original Wechsler Intelligence Scale for Children (Wechsler, 1949) was developed within a strong clinical tradition. Wechsler, to his credit, remained quite conservative in his extrapolations of intellectual data to clinical situations. In the Manual for the revised Wechsler Intelligence Scale for Children (Wechsler, 1974) a noticeable ambivalence regarding the clinical utility of the WISC-R is evident. Wechsler appears to advocate making clinical inferences from subtests and patterns between subtests, yet he does not hypothesize any specific patterns.

The WISC-R was considered "a useful clinical and diagnostic tool. . . in the areas of educational assessment and the appraisal of learning and other disabilities. . . with broader applications than just providing a reliable intelligence quotient" (p. iii). While "broader applications" were alluded to, a clear reference to the tradition of psychodiagnostic interpretation of subtest scores, no pathognomonic patterns were identified. Similarly, no guidelines were discussed for the valid application of subtest scores to groups of children excluded from the standardization sample. Wechsler's ambivalence was again evident in his apparent narrowing of the diagnostic range of the WISC-R to "organic brain disease, of failure on certain tests pointing to specific learning (e.g., reading) disabilities" (p. 6). Yet in the next paragraph he alluded to a specific subtest pattern (low Digit Span, high Vocabulary/Information) characteristic of an "anxiety situation."

What is clear from a close reading of the WISC-R Manual is that the author advocates an intuitive psychodiagnostic strategy based on a pair-wise or triadic comparison among subtests. This clinical interpretation of subtest covariation was advocated without empirical support or documentation: "Fortunately, most of the statistically possible patterns do not turn up, and of those that do, only a few are diagnostically relevant. These few, however, add much to an examiner's diagnostic armamentarium" (p. 7).

Wechsler declined to identify these few pathognomonic patterns in the manual.

There is no evidence that any subtest or pattern of subtests can differentiate between control and emotionally-disturbed children, or among groups of emotionally-disturbed children (Sattler, 1982; Woo-Sam, 1984). Hale and Landino (1981) attempted to use WISC-R subtest scores to differentiate among control children and three common clinical samples of children, characterized by a description of their presenting symptoms: anxious, withdrawn, and acting-out. While the groups manifested some subtest differences, all within the average range, these differences were not large enough, or distinctive enough to correctly classify children into their a priori diagnostic group. Clarizio and Veres (1983) attempted to validate one specific WISC-R pattern as a pathognomonic pattern among children. They reported that this pattern resulted in no meaningful discrimination. Morris, Evans, and Pearson (1978) reported significantly lower subtest scores and a variable subtest pattern among severely emotionally-disturbed children as compared with the "expected" average performance of the standardization sample. However, no effective discrimination was attempted between these disturbed children and a valid control group. This finding is consistent with Dean's (1977; 1978) conclusions that adolescent emotionally-disturbed subjects demonstrate

significantly more inter-test variability than expected in their WISC-R profiles. Dean's conclusions are similarly limited because of a lack of a valid comparative control group.

The two most popular textbooks on WISC-R interpretation, Intelligent Testing with the WISC-R (Kaufman, 1979) and Sattler's (1982) Assessment of Children's Intelligence and Special Abilities, encourage the evaluation of individual subtests to determine subtest "strengths and weaknesses" relative to their Verbal or Performance subtests' mean score. Each author suggested that the univariate interpretation of individual subtests is a valid source of clinical inference only if the subtest is significantly deviant from its respective mean. Silverstein (1982) provided useful statistical tables for determining a significant difference between a subtest and its respective mean. Once a reliable difference is determined, Silverstein (1984) argued that another discrimination must be made; a determination of the "abnormality" of such a difference by comparison with the frequency of such a difference within the WISC-R standardization sample.

There have been no WISC-R studies evaluating the pathognomonic significance of subtest "strengths or weaknesses" using the statistical model of inferring deviance proposed by Silverstein (1982; 1984).

Critique of Subtest Analysis

Attempts to identify diagnostic patterns on the WISC-R have proven uniformly disappointing (Zimmerman & Woo-Sam, 1984). Retrospectively, it can be argued that such a strategy was predestined to fail because the psychometric characteristics of the subtests were never adequately examined. The premise of all methods of subtest analysis is that the twelve subtests are each reliable and unique measures. This psychometric condition was tacitly assumed, but never adequately documented. The format of the WISC-R partially accounts for this confusion. The WISC-R resembles a test battery; that is, a group of relatively independent measures. It was this misleading appearance, the illusion of a test battery, rather than highly correlated subtests comprising one test, which has perpetuated the search for clinically useful patterns in spite of uniformly disappointing empirical evidence.

The use of individual WISC-R subtests to determine psychodiagnostic patterns has traditionally been an invalid model of assessment due to the psychometric limitations of the subtests. Two lines of reasoning support this assertion: issues of reliability and of subtest specificity.

First, the reliability coefficients of the WISC-R subtests are neither consistent across age levels nor sufficiently high to advocate individual interpretation at

a meaningful clinical level (Groff & Hubble, 1984; Hirschoren, & Kavale, 1976). Two sets of reliability data were presented in the WISC-R Manual, coefficients of internal consistency and coefficients of temporal stability.

While the internal consistencies of the WISC-R full scale (FSIQ), Verbal (VIQ), and Performance (PIQ) deviation quotients are impressive (.90+), the internal consistencies of the individual subtests are less reliable, and typically vary within the range of marginal (inadequate) reliability for individual diagnostic purposes. Extrapolated from the Manual are the mean internal consistency coefficients across subtests for school-aged children: 7½ ($\underline{r} = .75$), 8½ ($\underline{r} = .76$), 9½ ($\underline{r} = .78$), 10½ ($\underline{r} = .75$), 11½ ($\underline{r} = .80$), and 12½ ($\underline{r} = .80$). The range of actual subtest internal consistency coefficients was from .63 (clearly unreliable) to .89 (quite reliable).

The second, and perhaps more important aspect of reliability, is the temporal stability of subtest scores (test-retest reliability). The WISC-R Manual provided limited information about the temporal stability of subtest scores. Data from three age levels were provided. The temporal stability of the WISC-R summary scores is quite impressive (.89+). However, the temporal stability of individual subtest scores appears significantly lower and often within the unreliable range. The mean temporal stability coefficient for the youngest age level reported

(7½ - 8½) was .70. Among school-aged children (10½ - 11½) the mean temporal stability coefficient was only .78. The range of individual subtest reliability scores was again quite variable, ranging from .62 (unreliable) to .81 (marginally reliable) in the youngest age group. Among the school-aged children, the range was from .70 (unreliable) to .85 (reliable). Determining acceptable levels of reliability is an individual decision. On the WISC-R, Anastasi (1982) accepted .80 as an adequate level of subtest reliability, while Gutkin (1978) concluded that a .90 level of reliability was essential if subtest scores were to be individually interpreted. In the only available study of WISC-R temporal stability among atypical children, Vance, Blixt, Ellis, and DeBell (1981) reported that three subtests were markedly unreliable and that four other subtests were marginally reliable at best in a sample of emotionally-disturbed and learning-disabled children.

The subtests of the WISC-R do not appear to be highly reliable measures for individual interpretation. The issue of subtest reliability has been addressed in a series of methodological articles providing stringent guidelines for inferring reliable differences between subtest scores (Piotrowski, 1978) and between difference scores between subtests (Feingold, 1984).

Subtest Specificity

The second psychometric limitation of the WISC-R

subtests in traditional methods of subtest analysis is the issue of subtest uniqueness or specificity. Specificity refers to the proportion of a test score's variance that is both reliable and distinctive to that subtest. If a subtest's specificity is relatively low, it cannot be said to be measuring a specific trait or cognitive capacity. Subtest specificity is one aspect of a test's construct validity; a necessary but not sufficient attribute of a valid psychological construct. WISC-R subtests of adequate specificity can be considered analogous to specialized tests within a testing battery and may be interpreted singly. Subtests of inadequate specificity cannot be interpreted as unitary constructs.

Kaufman (1975) explored the specificity of each WISC-R subtest using the standardization data. Three subtests were found to possess ample specificity (Digit Span, Coding, and Picture Arrangement). Four subtests were found to have less specific, though adequate, specificity (Arithmetic, Picture Completion, Information, and Block Design). These seven subtests demonstrated sufficient uniqueness within the WISC-R to allow individual interpretation of the constructs they measure. Four subtests were found to be inadequately specific at most age levels (Vocabulary, Comprehension, Object Assembly, and Similarities). More recent analyses (Kaufman, 1979, 1980) examined the specificity of the WISC-R subtests from

alternate statistical models. Kaufman's findings were ostensibly contradictory. All WISC-R subtests except Object Assembly and Similarities ($8\frac{1}{2}$ - $16\frac{1}{2}$) were found to possess adequate specificity. However, most WISC-R subtests manifested a common variance exceeding their respective specific variance. Only Coding and the two optional subtests, Digit Span and Mazes, consistently displayed more unique variance than shared (common) variance across the age range. Kaufman concluded that while the WISC-R subtests possess adequate or ample specificity, their interpretative significance appears to reflect fewer "areas" of cognitive functioning. Several of the subtests are highly intercorrelated, measuring a common cognitive area rather than discrete and highly specific cognitive areas. The use of composite scores rather than discrete subtests scores was advocated as an interpretative system. These composite scores would be more reliable than individual subtest scores (Tellengen & Briggs, 1967) and logically interpretable within the verbal, visual, and perhaps memory parameters of the test's historical and structural composition (Cohen, 1959).

Advocates of WISC-R Subtest Analysis

In spite of Wechsler's ambivalence, and the lack of empirical evidence as to the psychodiagnostic validity of subtest analysis in the identification of psychopathology, the major secondary sources in WISC-R interpretation

continue to encourage the use of subtest analysis as a clinical data source (Cooper, 1982; Kaufman, 1979; Sattler, 1982). Cooper's (1982) textbook The Clinical Interpretation of the Wechsler Intelligence Scale for Children-Revised presented a simplistic subtest-by-subtest "analysis" of psychopathological signs and manifestations of anxiety or behavior-disordered performance reminiscent of the discredited "clinical cookbooks" of Gilbert (1978) and Ogden (1981). Such texts offer psychopathological "signs" for virtually any aspect of subtest variation. Frank's (1983) critical overview of the "Wechsler Enterprise" offered cogent criticism of the "sign" approach in inferring psychopathology from intelligence test data.

Sattler's (1982) text Assessment of Children's Intelligence and Special Abilities appears to be the principle secondary source in educational psychology for WISC-R interpretation. Sattler advocated a more statistically sophisticated interpretative model, emphasizing a "successive level" model of inference. While documenting the limitations of the WISC-R in differential diagnosis, fourteen psychodiagnostic hypotheses were suggested based on pairwise comparisons of WISC-R subtests. In fairness to Sattler, he stated that "The hypotheses should be treated as tentative, formulated in relation to the child's absolute scaled scores, and not referred to as 'verifiable insights'" (Sattler, 1982, p. 201). If, however, as is

presently the case, the use of WISC-R subtests is advocated as a hypothesis-generating procedure, those hypotheses need to be specified and tested. Otherwise, continued use of the WISC-R subtests appears unjustifiable in the assessment of childhood psychopathology.

Kaufman (1979) proposed an integration of the rich clinical tradition of the Wechsler tests with the psychometric strengths of the WISC-R. He argued that the strategy of using various WISC-R scores as potentially discriminating variables between control and emotionally-disturbed children was valid; however, the historical use of global intelligence scores or specific subtest scores was unjustified. Kaufman advocated the clinical interpretation of a set of intermediate WISC-R scores:

The most valuable information about a child's mental abilities lies somewhere in-between the global full scale IQ and the highly specific subtest scores. Whereas the overall IQ is too broad to provide insight into the child's strong and weak abilities, the separate scaled scores are far too narrow in their scope to be of much value for practical usage" (p. 132).

The use of intermediate scores obviated the psychometric limitations of subtest reliability or specificity; composite scores are both more reliable than individual scores, and more logically interpretable (Tellengen & Briggs, 1967).

There are currently two models of intermediate WISC-R scores widely used in childhood assessment. From

a clinical tradition, Kaufman's 1975) factor analytic model proposed three distinct WISC-R constructs: Verbal Comprehension, Perceptual Organization, and Freedom from Distractibility. From the psychoeducational perspective, Bannatyne's (1974) four category model of the WISC-R (Verbal, Spatial, Sequencing, Acquired Knowledge) is the most widely used intermediate interpretative model.

WISC-R Factor Analytic Research

One general approach to reducing a large amount of data into a smaller number of variables can be accomplished by factor analysis. Factor analysis is a generic multi-variate procedure that summarizes a matrix of correlations among variables in terms of a limited number of "factors." Factor analysis is a particularly appealing technique applicable to the WISC-R because of the high inter-correlation among some subtests. Wechsler proposed an intuitive dichotomy of the intelligence tests into Verbal and Non-verbal (Performance) sections. This tradition of grouping all subtests under the heading of Verbal or Performance scales has been uniformly maintained through all revisions of his intelligence tests.

Kaufman (1975) explored the factor structure of the WISC-R for the eleven age levels representing the standardization sample. His purposes were (a) to provide a normative factor analysis at each age level, (b) to compare the factor composition of the WISC-R with the widely accepted

structure of its predecessor (Cohen, 1959), (c) to examine possible developmental trends in factor composition, and (d) to identify interpretable constructs of clinical significance. Three consistent and pervasive factors emerged for each of the eleven age levels (6½ - 16½) in the standardization sample. Each of the twelve subtests was found to have a primary loading on one and only one of these factors:

<u>Verbal Comprehension</u>	<u>Perceptual Organization</u>	<u>Freedom From Distractibility</u>
Information Similarities Vocabulary Comprehension	Picture Arrangement Picture Completion Block Design Object Assembly (Mazes)	Arithmetic Coding (Digit Span)

The similarity of the Verbal Comprehension factor with the WISC-R Verbal Scale, and of the Perceptual Organization factor with the Performance Scale gave strong support to Wechsler's Verbal-Performance dichotomy. Both the Verbal Comprehension and Perceptual Organization factors were found to be robust and consistent in composition throughout the age range. The construct validity of these factors is well known and well understood (Kaufman, 1979).

The third factor, Freedom from Distractibility, was also consistent throughout the age range of the WISC-R, though its interpretation posed a conceptual problem. While Cohen (1959) reported a similar factor in the original WISC, both its name and inferred construct validity

have differed across authors. Cohen (1952, 1959) vacillated between Freedom from Distractibility, an attentional or concentrational construct, and an interpretation of the factor as a short-term memory construct (Cohen, 1957). Lutey (1977) labeled this factor as "freedom from disruptive anxiety," an essentially psychiatric construct, based on the clinical tradition of referring to its component subtests (Arithmetic, Digit Span, Coding) as the "anxiety triad." Neuropsychological interpretations were suggested by Bannatyne (1974) and Stewart and Moely (1983). Bannatyne considered the essential underlying ability one of processing sequential information; he labeled the factor Sequencing Ability. Stewart and Moely (1983) found that simple behavioral measures of distractibility from external sources did not explain the Distractibility factor. They hypothesized, yet unsubstantiated, neuropsychological processing explanations for individual differences in this factor score. Kaufman (1980) proposed that "As a distractibility dimension, the third factor fits more into the behavioral than cognitive domain, making it qualitatively different from the two major factors" (p. 204). Kaufman (1975) also suggested that the third factor could simply be a measure of numerical ability.

The construct validity of the Distractibility factor has yet to be inferred, though most authors agree that it represents a "nonintellective factor." This

conceptualization of the third factor as some type of behavioral, or neuropsychological ability opened fertile research areas. As Achenbach (1982) noted, except in simple cases of determining mental retardation, "cognitive variables are typically of less concern to clinicians. . . than noncognitive variables" (p. 581). The identification of a noncognitive variable on the WISC-R has great significance in psychopathological and developmental research.

The tripartite factor structure identified in the standardization sample has been cross-validated among various racial and ethnic groups with remarkable consistency. Gutkin and Reynolds (1981) compared the factor structures between black and white children within the standardization sample. Identical factors, in essentially the same magnitude, emerged in each racial group. Reynolds and Jensen (1983) explored the factor structure between black and white children matched for age, sex, and intelligence. No significant differences were found. Similarly, no factorial differences were found among black and white groups of "normal" latency-aged children (Shiek & Miller, 1978) or among children referred for psycho-educational assessment (Johnson & Bolen, 1984).

Several studies have affirmed the factorial validity of the three factors among bi-lingual children of Mexican heritage (Reschly, 1978; Stedman, Lawlis, Cortner, & Achterberg, 1978).

The tripartite factor structure of the WISC-R among children with atypical levels of intelligence or impaired neuropsychological functioning was reported to be comparable to the normative sample. Two studies on mentally-retarded children reported the familiar factor structure. Van Hagen and Kaufman (1975) identified three factors among profoundly retarded children. Groff and Hubble (1982) found the tripartite structure among mildly retarded children. McMahon and Kuncze (1981) reported that children with various neuropsychological disorders demonstrated three distinct factors.

At the opposite intellectual pole, Karnes and Brown (1980) identified the tripartite factor structure among intellectually-gifted children.

The factor structure of the WISC-R identified by Kaufman (1975) and cross-validated by Harlow, Tanaka, and Comrey (1982) appears to be a consistent and valid interpretative strategy for all children within the 6½ to 16½ age range of the WISC-R.

A series of studies examined the WISC-R factor structure among psychopathological samples of children. All such studies have identified the Verbal Comprehension and Perceptual Organization factors among children referred for assessment of behavioral disorder/emotional disturbance (Finch, Kendall, Spirito, Entin, Montgomery, & Schweitzer, 1979; Hodges, 1982; Lombard & Riedel, 1978; Stedman,

Lawlis, Cortner, & Achterberg, 1978; Swerdik & Schweitzer, 1978).

Cross-validation of the Distractibility factor among psychopathological samples of children is compelling, though among a specific diagnostic group (conduct disordered boys), the research does not support a tripartite factor structure. DeHorn and Klinge (1978) and Hodges (1982) found the Distractibility factor among hospitalized children and adolescents. The familiar three factors emerged among heterogeneous samples of children referred for psychological assessment for behavioral disorders (Lombard & Riedel, 1978; Stedman, Lawlis, Cortner, & Achterberg, 1978; Swerdik & Schweitzer, 1978).

Two studies (Finch et al., 1979; Peterson & Hart, 1979) found no Distractibility factor among conduct disordered boys. In their review of cognitive processes of behavior disordered children and adolescents, Hogan and Quay (1984) concluded that the structure of the WISC-R as indexed by Kaufman's factors is equivalent for normal and emotionally-disturbed children.

The application of the factor scores to psychodiagnostic assessment is a recent, though increasing, phenomena. Two descriptive studies have reported that the Distractibility factor score was significantly lower than either Verbal Comprehension or Perceptual Organization among behaviorally disordered boys of average intelligence

(Paget, 1982; Thompson, 1981). Using the more stringent analysis, there has been only one quasi-experimental study evaluating the Kaufman factors in discriminating among a control group and children at different levels of "risk for psychopathology." Worland, Weeks, Janes, and Strock (1984) reported that control children performed significantly better on all factor scores than children of either "high risk" or "moderate risk" for psychopathology. All children performed within the average range on all factors, although a non-significant pattern was evident in all three groups (VC = PO > FD). However, "risk" was determined by parental levels of psychopathology, and not by children's level of psychopathology.

Performance on the Distractibility factor was reported to be the lowest among the factors within three clinical groups of children matched for age, intelligence, and parental socioeconomic level (Finegan, Zucher, Bradley, & Doeing, 1982). In the most comprehensive clinical study to-date, Hodges, Horowitz, Kline, and Brandt (1982) compared the traditional WISC-R summary scores (VIQ, PIQ, FSIQ) with the Kaufman factor scores to detect differences among four clinical groups of children. Equivalent performance was found among the groups on the traditional summary scores, while significant group differences were found on the Distractibility factor score. Three clinical groups (adjustment disorder, overanxious, and hyperactive)

manifested a subtle deficit on the Distractibility factor score. Conduct disordered children performed equivalently on all three factor scores. They concluded that "These findings suggest that the scores based on the Kaufman factors provided important clinical summary information that was not available from the traditional scores" (p. 830).

Synopsis and Conclusion: Factor Analytic Research

Kaufman's (1975) factor structure has provided both clinicians and cognitive researchers an alternative model of WISC-R interpretation. Conceptually, the three identified factors provide a coherent, psychometrically sound, structure underlying the various subtests of the WISC-R. These intermediate constructs allow for a renaissance of "classical validity" studies attempting to find significant WISC-R differences between meaningful groups of children. More stringent inter-group comparisons can be made because the WISC-R factors provide more homogeneous constructs; Verbal Comprehension and Perceptual Organization represent better constructs than the traditional Verbal and Performance Intelligence quotients. The identification of a robust Distractibility factor, tentatively inferred to be in the neuropsychological domain, provides a "nonintellective" factor assumed to represent personality traits which "operate at all levels of intelligence, and may be expected to affect the capabilities of the superior as well as the

poorly endowed individual" (Wechsler, 1974, p. 6).

The use of the factor scores in clinical assessment suggests that the Distractibility factor score may be a significant discriminating variable between control and emotionally-disturbed children, even within the average range of functioning. Subtle differences appear evident in the factor performance of disturbed children; the Distractibility factor score tends to be lower, often significantly lower than scores on Verbal Comprehension and Perceptual Organization. It appears that the Distractibility factor, whatever its construct validity, presents emotionally-disturbed children with a relatively difficult task. The efficacy of the Distractibility factor as a discriminating variable needs to be evaluated. Similarly, the psychological processes inherent in the Freedom from Distractibility factor, whether memory capacity, attentional ability, or numerical skill need to be examined as sources of difference between control and disturbed children.

Bannatyne (1974) Classification Research

Bannatyne (1974) suggested an alternate model of intermediate WISC-R scores, adapted from the factor analytic research, but cast into four-category interpretative system more appropriate to psychoeducational assessment. Wechsler (1974) encouraged the regrouping of WISC-R subtests into situation specific constructs, noting that in

addition to the standard Verbal and Performance scales "the abilities represented in the tests may also be meaningfully classified in other ways" (p. 9). Kaufman (1979) similarly proposed a series of novel subtest categories based on various aspects of subtest similarity or response characteristics.

From a psychoeducational perspective, Bannatyne (1971, 1974) reorganized the WISC-R into these four categories:

<u>Verbal</u> <u>Conceptualization</u>	<u>Spatial Ability</u>	<u>Sequencing</u>	<u>Acquired</u> <u>Knowledge</u>
Vocabulary Comprehension Similarities	Picture Completion Block Design Object Assembly	Arithmetic Coding (Digit Span)	Information Arithmetic Vocabulary

The Bannatyne classification system appears to be the most frequently used WISC-R interpretative model, though its application has been generally limited to the diagnosis of educational deficits or learning disabilities (Henry & Wittman, 1981; Quattrocchi, 1980). The importance of the Bannatyne system in psychopathological research is twofold. First, Bannatyne proposes a different interpretation of the triad of subtests composing the Freedom from Distractibility/Sequencing Ability score. He suggested that Sequencing Ability represents a cognitive process within the neuropsychological domain and an area typically deficient among children with neurologically-based learning disabilities.

The second area of importance in the Bannatyne system is the differentiation of basic verbal skills (Verbal Comprehension) from verbal information acquired in school (Acquired Knowledge). An analogous differentiation was part of the factor analysis of the original WISC (Cohen, 1959). A common clinical pattern among emotionally-disturbed children is average verbal skills concurrent with significant gaps in their academic achievement (Hobbs, 1982). The Acquired Knowledge construct is an attempt to operationalize global achievement deficits on the WISC-R on tasks sensitive to academic interest.

The psychometric qualities of the Bannatyne classification system have not been thoroughly investigated in spite of its widespread use. The validity of the Verbal Conceptualization and Spatial Ability constructs can be inferred from their similarity to the empirical factors. Sequencing is identical in composition to the Freedom from Distractibility factor. The reliability of these category scores is similarly inferred from the factor research and can be directly measured by the formula provided by Tellen-gen and Briggs (1967). Moreover, Groff and Hubble (1984) reported that the Bannatyne Spatial score appeared to represent an estimate of a child's visual ability than the Perceptual Organization factor score due to its consistency across clinical groups. As a practical consideration, White (1979) provided statistical tables for determining

significant differences between pairs of Bannatyne scores to aid in interpretation.

The application of Bannatyne's WISC-R model to psychopathological groups has been remarkably limited. Among the few available studies two consistent results emerged: emotionally-disturbed children perform in the average range on all Bannatyne category scores, though within this average range Sequencing and Acquired Knowledge scores tend to be significantly lower than Verbal and Spatial scores (Paget, 1982; Thompson, 1981). Clarizio and Bernard (1981) similarly observed a relative deficit among emotionally-disturbed children on the Sequential score.

The Bannatyne classification system is the most widely used interpretative system of the WISC-R intermediate scores, though its application is generally limited to psychoeducational assessment. From a psychodiagnostic perspective, Bannatyne's model offers an alternative diagnostic system in the attempt to validate effective discriminating variables between control and emotionally-disturbed children. Sequencing (Freedom from Distractibility) has been cross-validated as a problematic area among disturbed children and a plausible rival hypothesis to "distractibility" has been posited as its defining characteristic. Secondly, the hypothesis that emotionally-disturbed children manifest a subtle deficit in Acquired Knowledge has been proposed in the scant research on

Bannatyne's system among psychopathological samples. This hypothesis has considerable anecdotal support (Forness, Bennett, & Tose, 1983). Hobbs (1982) concluded that "underachievement in school is the single most common characteristic of emotionally-disturbed children" (p. 251). Such underachievement appeared to have affective, rather than neuropsychological etiology. Bannatyne proposed that the Acquired Knowledge construct could detect such affective or environmental deficits in children with normal intellectual capacity.

Synopsis and Conclusion: Bannatyne Classification System

Bannatyne's intuitive adaptation of the WISC-R factor analytic research for a "situation-specific" purpose has become widely accepted in psychoeducational assessment. Its application to psychodiagnostic assessment is in the initial stages, requiring stringent psychometric evaluation of its "classical validity," the ability to differentiate among groups, and its "clinical utility," the application of nomothetic construct differences to individual cases. The literature suggests that emotionally-disturbed children demonstrate subtle deficits within the average range of performance on the Sequencing Ability and Acquired Knowledge construct scores.

Synthesis and Proposal

Attempts to discern pathognomonic patterns on the WISC-R have not been successful using full-scale

intelligence or specific subtest scores. Yet, the WISC-R remains the most frequently chosen psychological test in the assessment of emotionally-disturbed children. The enduring popularity of the WISC-R as a "clinical-diagnostic" instrument has perpetuated the search for valid pathognomonic patterns. Previous research has demonstrated that full-scale intelligence is too broad a construct to have discriminating power between normal and psychopathological groups. The use of WISC-R subtests, or subtest patterns, as discriminating variables has a long tradition in adult assessment; however, the available research is consistently adversarial to their continued use. Psychometric limitations of the subtests have been discussed to partially explain the unfavorable conclusions.

Two recently proposed models of "intermediate" WISC-R scores appear to obviate the psychometric limitations of previous psychodiagnostic research. The strategy of comparing clinical groups with control groups, termed "classical validity" studies, to detect reliable group differences is a valid research paradigm. The "intermediate" constructs proposed by Kaufman (1975) and Bannatyne (1974) provide reliable and valid variables for such a strategy. This study proposes the first quasi-experimental test of discriminative validity and clinical utility of the Kaufman and Bannatyne models in the psychodiagnostic assessment of preadolescent children.

Two specific areas of relative deficit were inferred through an inductive review of the WISC-R psychodiagnostic literature. These conceptual areas are Distractibility/Sequencing and Acquired Knowledge. It appears that these areas of relative deficit exist among disturbed children within generally average levels of overall intellectual performance and would not be detected with traditional WISC-R interpretation. The exact nature of their construct validity has yet to be inferred, though Distractibility is increasingly interpreted as a neuropsychological construct related to auditory attention and concentration, and perhaps auditory short-term memory. This hypothesis will be evaluated with reference to the subscales of the Luria-Nebraska Neuropsychological Battery-Children's Revision (Plaisted, Gustavson, Wilkening, & Golden, 1983) (LNNB-CR) relating to attentional capacity, sustained auditory concentration, conceptual arithmetic skill and short-term memory capacity. The second area of potential deficit among disturbed children was inferred to be in the area of academic interest and incidental knowledge (Acquired Knowledge). The differentiation of WISC-R verbal skills into basic language (Verbal Comprehension) skill and a more esoteric language content component (Acquired Knowledge) revealed a subtle deficit among disturbed children on the latter construct. This hypothesis will be evaluated with the LNNB-CR subtests related to basic academic skill

(Writing, Reading, and Arithmetic), areas untapped by the WISC-R.

This study proposes a "successive sieve" analysis attempting to identify WISC-R constructs with valid discriminating efficacy and to examine the neuropsychologically inferred processes which may account for the subtle deficits observed in emotionally-disturbed children.

Hypotheses

(1) It is hypothesized that the Psychiatric sample will demonstrate significantly lower (worse) performance than the Control group on the WISC-R Distractibility/Sequencing factor score.

(2) It is hypothesized that no significant differences between the Psychiatric group and the Control group will be found on either the WISC-R Verbal (Verbal Conceptualization/Verbal Comprehension) or Performance (Perceptual Organization/Spatial) scores.

(3) It is hypothesized that the Psychiatric group will demonstrate significantly lower (worse) performance than the Control group on the WISC-R Acquired Knowledge score.

(4) It is hypothesized that the Kaufman (1975) factor model will identify a significant discriminant function and will correctly classify subjects into their actual diagnostic group significantly better than chance assignment.

(5) It is hypothesized that the Bannatyne (1974) classification model will identify a significant discriminant function and will correctly classify subjects into their actual diagnostic group significantly better than chance assignment.

(6) It is hypothesized that no significant differences between the Psychiatric group and the Control group will be evident on the overall level of neuropsychological integrity (Pathognomonic Scale).

(7) It is hypothesized that the Psychiatric group will score significantly higher (worse) than the Control group on the LNNB-CR content scales: Acoustical-Motor (Rhythm), Arithmetic, Reading, Writing, and Memory.

CHAPTER III

METHOD

Subjects

This study assessed the intellectual and selected neuropsychological functioning of sixty-four children representing two distinct groups of latency-aged youth: current psychiatric clients in outpatient psychotherapy ($N = 32$) and Control children ($N = 32$). These groups of children are considered most relevant to outpatient clinical practice. Preadolescent children represent the modal age group referred for psychological and psychiatric assessment, and for outpatient psychotherapy (Carek, 1982). In a large-scale epidemiological study of childhood psychopathology, Goldberg, Roghman, McInerney, and Burke (1984) reported increasing psychiatric risk among preadolescent children, and considerable psychopathology among children seen in traditional medical practice. Valid assessment techniques are especially needed to detect subtle emotional disturbance among children without florid psychopathology and within the average range of intellectual functioning.

All subjects in this study participated with the consent of a parent and with the child's informed consent.

This study complied with the ethical principles established by the Institutional Review Board of Loyola University of Chicago.

Psychiatric Group

The Psychiatric sample ($N = 32$) included sixteen male and sixteen female psychotherapy clients primarily recruited from the psychiatric clinic affiliated with Illinois Masonic Medical Center, Chicago, Illinois. In order to obtain a potential psychiatric sample for this study, all clinic-child cases between June, 1981 and November, 1982 were reviewed as part of a larger study (Carr, Sweet, Rossini, & Angara, 1983). The Illinois Masonic Medical Center provided 28 (87%) of the Psychiatric subjects. Four subjects were recruited from a Chicago psychoeducational school.

Psychiatric diagnoses (DSM-III) (American Psychiatric Association, 1980) had been established independent of this study by a child psychiatrist. A description of the distribution of diagnoses is presented in Table 1. Children with DSM-III diagnoses of: (a) Mental Retardation, (b) Pervasive Developmental Disorder, (c) Specific Developmental Disorder (Learning Disability), (d) Stereotyped Movement Disorder, or (e) Attention Deficit Disorder were not recruited for this study. The clinical records of all Psychiatric subjects were evaluated for the presence of "soft" neurological signs, evidence of "minimal brain

Table 1

Psychiatric Subjects: Frequency of Diagnoses

Diagnosis	Males	Females
Dysthymic disorder	5	5
Post-traumatic stress disorder	0	1
Unsocialized aggressive conduct disorder	2	0
Socialized aggressive conduct disorder	2	0
Socialized non-aggressive conduct disorder	1	1
Overanxious disorder	1	0
Adjustment disorder with withdrawal	1	0
Adjustment disorder with mixed disturbance of emotion and conduct	4	4
Adjustment disorder with psychosomatic symptoms	0	1
Adjustment disorder with anxiety	0	2
Adjustment disorder with conduct disturbance	2	1
Passive-aggressive personality	2	1
Obsessive compulsive personality	0	1
Schizoid personality	0	2

Note: Several subjects received and were counted under two (DSM-III, Axis I and/or Axis II) diagnoses.

dysfunction," or primary referrals for learning or academic difficulty. No child whose record indicated primarily psychoeducational problems was included in the Psychiatric sample.

Control Group

The Control group included sixteen male and sixteen female subjects recruited from four educational facilities: St. Sebastian School ($N = 17$), a Catholic parochial school adjacent to Illinois Masonic Medical Center; Walker School, Evanston Illinois ($N = 8$); and two Chicago public schools, Kilmer or Hayt ($N = 7$). Control children were assumed to be non-problematic. Screening of Control subjects indicated that no child had obvious sensory or motor handicaps. None of the Control children had recent serious medical illness or was currently taking prescription medication. All children were enrolled in normal classrooms and had uninterrupted school attendance records.

Demographic Characteristics

Socioeconomic status and racial characteristics. An appropriately urban range of ethnicity and socioeconomic status was anticipated. The demographic characteristics of the sample are presented in Table 2. There were no significant racial differences between groups, $\chi^2(3) = 5.09$, $p = .10$. The socioeconomic variable represented a global rating of the source of parental income. Subjects were classified into nominal categories based on the highest

Table 2

Demographic Distribution of the Sample

Group	Race/Ethnicity				
	<u>N</u>	White	Black	Latino	Other
Psychiatric	(32)	20	3	7	2
Control	(32)	20	8	4	0

$$\chi^2(3) = 5.09, p = .10$$

Group	Occupational Source of Parental Income				
	<u>N</u>	Public Aid	Blue Collar	White Collar	Professional
Psychiatric	(32)	14	7	9	2
Control	(32)	4	13	12	3

$$\chi^2(3) = 7.97, p = .05$$

level of parental income: (1) Public Aid, (2) Blue Collar/Manual employment, (3) White Collar/clerical employment, (4) Professional employment. Chi-square analysis indicated that the Control group was significantly (though slightly) more representative of better employed, more affluent families than the Psychiatric group, $\chi^2(3) = 7.97$, $p = .05$.

Age and Sex Characteristics

Although males have a higher incidence of psychopathology than females in all major categories of childhood psychiatric disorder, an equal number of males and females was included in each group ($N = 16$) (Eme, 1979). Latency-aged children were selected for this study due to their availability and increasing incidence of emotional disturbance (Goldberg et al., 1984). The age range of children in this study was 8-0 years/months to 13-0 years/months. Children were recruited from two age levels: younger children (8-0 to 10-6 years/months) and older children (10-7 to 13-0 years/months). There was no significant difference in age between the Control group ($M = 123.9$) and the Psychiatric group ($M = 125.5$), $F(1,62) = .17$, $p = .15$.

Intellectual Level

There was a significant difference between the groups on full-scale intelligence. The Control group scored significantly higher ($M = 113.1$) than the Psychiatric group

($\underline{M} = 102.6$), $\underline{F}(1,62) = 20.25$, $\underline{p} = .001$. While control groups typically score "higher" than atypical groups in intelligence in clinical records, the difference is rarely significant, and inevitably, both groups are within the average intellectual range. To compare the intellectual characteristics of this sample in greater detail, the distribution of full-scale intelligence quotients for each sample was grouped into the nominal categories proposed by Wechsler (1974). Table 3 presents this frequency distribution and associated chi-square analysis. Chi-square analysis indicated that there was no significant relationship between diagnostic group and level of intellectual functioning, $\chi^2(4) = 8.29$, $\underline{p} = .10$. The significant group difference appeared to be the function of several "outliers" in the Control group. Several children (including two brothers) scored in the highest range of Very Superior intelligence. The group difference can be considered a sampling artifact.

Measures

The Wechsler Intelligence Scale for Children-Revised (WISC-R) (Wechsler, 1974) is the most frequently administered test of childrens' intelligence (Lubin, Larsen, & Matarazzo, 1984). This study employed six WISC-R scores, the three factor scores identified by Kaufman (1975) and the three category scores proposed by Bannatyne (1974). Full-scale intelligence was used as an ancillary variable

Table 3

Intellectual Characteristics of the SampleWechsler's Nominal Classifications of Intelligence

	<u>Low</u> <u>Average</u> <u>(80-89)</u>	<u>Average</u> <u>(90-109)</u>	<u>High</u> <u>Average</u> <u>(110-119)</u>	<u>Superior</u> <u>(120-129)</u>	<u>Very</u> <u>Superior</u> <u>(130+)</u>
Control Group	1	14	4	9	4
Psychiatric Group	5	19	3	4	1

$$\chi^2(4) = 7.89, p = .10$$

in the analyses of covariance.

Normative Data

The standardization sample of the WISC-R included 100 boys and 100 girls at each of eleven age levels from 6½ to 16½ years ($N = 2200$). The sample was stratified on six variables based on the 1970 United States Census: sex, race, geographical region, urban-rural residence, parental occupational level, and age level. The sample was limited to normal children. Children with "severe emotional disorders" were excluded from the nationally representative standardization sample. Raw scores on each subtest were first transformed into normalized standard scores within the child's own age level. Individual subtest scores are expressed with the same mean ($M = 10$) and standard deviation ($SD = 3$). The WISC-R yields three summary scores, a full-scale deviation quotient, a verbal deviation quotient and a performance deviation quotient, each with a mean of 100 and standard deviation of 15.

Reliability

The reliability (temporal stability) of the WISC-R varies with the level of the score. The full-scale intelligence quotient and the Verbal and Performance deviation quotients have excellent reliability, .90 or better over the entire age range. The WISC-R construct scores used in this study have excellent reliability as estimated from the Tellengen and Briggs (1967) formula:

Verbal Comprehension ($\underline{r} = .93$), Perceptual Organization ($\underline{r} = .88$), Freedom from Distractibility/Sequencing ($\underline{r} = .85$), Verbal ($\underline{r} = .90$), Spatial ($\underline{r} = .96$), and Acquired Knowledge ($\underline{r} = .91$).

The temporal stability of the individual subtests is quite variable, and generally less than adequate for individual interpretation.

Validity

There was no discussion of validity in the WISC-R manual. However, the validity of the WISC-R as an intelligence quotient yielding instrument is considered axiomatic. Numerous studies addressing the construct, criterion, and predictive validity of the WISC-R are reviewed by Sattler (1982) and Zimmerman and Woo-Sam (1984).

The Luria-Nebraska Neuropsychological Battery-Children's Revision (LNNB-CR) (Plaisted, Gustavson, Wilkening, & Golden, 1983) represents a developmental modification of the adult version of the test (Golden, Purisch, & Hammeke, 1980) applicable to children between eight and thirteen years of age. The test consists of 149 individually scored items grouped into eleven neuropsychological scales: Motor, Acoustical-Motor (Rhythm), Visual, Expressive Language, Receptive Language, Reading, Writing, Arithmetic, Memory, Tactile, and Intellectual Processes. This study included five scales of the LNNB-CR hypothesized to be areas of relative deficit among psychiatric children:

Rhythm, Arithmetic, Reading, Writing, and Memory. A brief description of each of these scales follows:

The Rhythm (Acoustical-Motor) Scale (8 items) is considered to be the most sensitive scale to disorders of attention and concentration. It evaluates a child's ability to attend to auditory stimuli, to perceive tonal and pitch qualities, and to be able to reproduce tonal patterns vocally and motorically.

The Arithmetic Scale (9 items) is considered to be the most sensitive LNNB-CR scale to educational deficits in children. Items include: writing numbers, copying numbers from print and dictation, number comparisons, and doing simple mathematical operations including multiplication.

The Reading Scale (7 items) measures skills in letter recognition, sound synthesis, nonsense syllable reading, and vocal word, sentence and paragraph reading.

The Writing Scale (7 items) closely parallels the Reading Scale. Items include: copying and dictation tasks of increasing difficulty, items which test the child's ability to analyze letter sequence and timed automatic writing.

The Memory Scale (8 items) is a measure of immediate and short-term memory operations. No attempt is made to evaluate long-term memory. Visual and verbal memory is assessed under standard and interference conditions.

One additional LNNB-CR scale was included in this study, the recently developed Pathognomonic Scale (13 items). This scale was empirically developed to provide a brief measure of cortical impairment manifested on the LNNB-CR. This scale is composed of items drawn from the other scales which maximally differentiate between normal and neurologically-impaired children (Sawicki, Leark, Golden, & Karras, 1984).

Normative Data

The Manual of the LNNB-CR has not been published; however, there are a number of papers addressing the construction and initial validation of the battery available from the authorship team (Golden, 1981; Gustavson, Golden, Leark, Wilkening, Hermann, & Plaisted, 1982; Wilkening, Golden, MacInnes, Plaisted, & Hermann, 1981). There are currently several general theoretical discussions of the LNNB-CR and its relationship to the neurological theories of its eponymous author A.L. Luria (Plaisted, Gustavson, Wilkening, & Golden, 1983; Wilkening & Golden, 1982).

The LNNB-CR went through four experimental versions prior to the format which is currently in use. The fourth revision of the test was then administered to 125 normal children, 25 at each age level between 8 and 12 years. Performance norms were derived for each age level by year and then this data was analyzed in order to establish a 3-point scale for each of the 149 items. In each instance,

performance within one standard deviation above or below the mean performance was given a score of "0" (normal). A raw score of "1" was given to performance between one and two standard deviations below the mean performance (borderline). A score of "2" indicated performance more than two standard deviations below the mean performance (impaired). Separate scoring criteria were developed for all items exhibiting a significant difference in performance due to age. Scores can be reported in terms of raw scores or in T-scores.

Validity

The concurrent validity of the LNNB-CR as a neuropsychological battery has been inferred through a series of validation studies, and more recently by independent cross-validation studies. The initial validation study (Wilkening, Golden, MacInnes, Plaisted, & Hermann, 1981) used a subject population of 76 neurologically-impaired and 125 control children (standardization sample). All subjects in the neurologically-impaired group had medical evidence of cerebral pathology, though the majority of these subjects were considered "mildly impaired" through standard neurological criteria. Within this sample of "mildly impaired" children, an overall hit-rate of 86.2 percent was achieved. Each individual scale was found to be valid in the differentiation between groups. A second validation study with a more geographically representative

sample affirmed the results. An overall 85 percent hit-rate was found with each scale independently differentiating between control and "mildly impaired" neurological subjects. Carr, Sweet, Rossini, and Angara (1983) reported similar results in an independent cross-validation which included a psychiatric control group. Recently, research efforts have been directed towards assessing the validity of the LNNB-CR in the identification of specific neurological diseases and disorders.

The Luria-Nebraska Neuropsychological Battery-Children's Revision was administered and scored according to detailed instructions provided by the author (Golden, 1980).

Scorer Reliability

In the absence of comprehensive reliability data on the LNNB-CR, reliability in administration and scoring was evaluated. All of the subjects in this study were tested by one of two examiners trained in LNNB-CR use. This author tested 15 of the 32 Psychiatric subjects (46%) and 29 of the 32 Control subjects (90%). To establish scorer reliability, the performance of ten subjects was simultaneously scored by each examiner, with the second examiner sitting outside of a child's line of vision. The Psychiatric sample was selected for the reliability study. Their performance was considered more potentially variable and difficult.

To assess scorer reliability, univariate analyses of variance were performed on each of the LNNB-CR scales with the examiner as the criterion. There was no significant scorer difference on ten of the eleven LNNB-CR scales. Appropos of this study, there were no significant scorer differences on the Reading, Writing, Memory, Arithmetic scales. There was, however, a significant difference found on the scoring of the Rhythm scale, $F(1,19) = 2.69$, $p = .05$. This scorer difference was more closely examined in Table 4 in an item-by-item analysis. The reported significant difference on the Rhythm scale was attributable to a single item which required the detection of a subtle pitch discrimination. This item yielded a 50% agreement rate. All other Rhythm items exhibited reliable administration and scoring. It was demonstrated that the LNNB-CR has adequate scorer reliability.

Table 4

Percent Inter-rater Agreement on the LNNB-CR

Subtest	Items	Number of Items Showing Scorer Agreement at Level					
		100%	90%	80%	70%	60%	50%
Rhythm	(8)	7	0	0	0	0	1
Writing	(7)	5	1	1	0	0	0
Reading	(7)	3	3	0	1	0	0
Arithmetic	(9)	7	1	1	0	0	0
Memory	(8)	5	3	0	0	0	0

CHAPTER IV

RESULTS

Kaufman Factor Scores (WISC-R)

To assess differences between the Psychiatric group and the Control group on the three factor scores proposed by Kaufman (1976), univariate analyses of variance were performed. The results of these analyses are presented in Table 5. The Psychiatric group performed significantly lower (poorer) on the Verbal Comprehension factor score ($\underline{M} = 10.54$) than the Control group ($\underline{M} = 12.00$), $\underline{F}(1,62) = 5.13$, $p = .03$. On the Perceptual Organization factor score, the Psychiatric group ($\underline{M} = 11.03$) scored significantly lower than the Control group ($\underline{M} = 12.09$), $\underline{F}(1,62) = 4.84$, $p = .03$. Similarly, on the Freedom from Distractibility factor score the Psychiatric group scored significantly lower ($\underline{M} = 9.09$) than the Control Group ($\underline{M} = 11.10$), $\underline{F}(1,62) = 14.83$, $p = .001$. However, the performance of both groups was within the average range on all three factor scores.

An analysis of covariance was performed on each factor score with full-scale WISC-R intelligence entered as a metric independent variable (covariate) due to the

Table 5

Analysis of Variance on the Kaufman Factor Scores

	Control	Psychiatric	<u>F</u>	<u>p</u>
Verbal Comprehension	<u>M</u> = 12.00	10.54	5.13	.05
	<u>SD</u> = 2.60	2.52		
Perceptual Organization	<u>M</u> = 12.09	11.03	4.84	.05
	<u>SD</u> = 1.82	2.00		
Distractibility	<u>M</u> = 11.10	9.09	14.83	.001
	<u>SD</u> = 2.25			

unexpected, significant difference in intelligence quotients between the groups. The Control group manifested a significantly higher level of intelligence ($\bar{M} = 113$) than the Psychiatric group ($\bar{M} = 103$), $F(1,62) = 20.25$, $p = .001$.

In the analyses of covariance, no significant differences were found between the Control group and the Psychiatric group on Verbal Comprehension or Perceptual Organization. On the Freedom from Distractibility score, however, the Psychiatric group remained significantly lower than the Control group, $F(1,61) = 4.13$, $p = .05$.

It was hypothesized that there would be no difference between the groups on the Verbal Comprehension factor score. This hypothesis was not confirmed until the effect of full-scale intelligence was removed. It was hypothesized that there would be no difference between the groups on Perceptual Organization. This was also confirmed in the analysis of covariance. Among the Kaufman factor scores, it was hypothesized that the Psychiatric group would demonstrate a significantly lower (worse) Freedom from Distractibility score. This hypothesis was confirmed in both the analyses of variance and covariance. While the Psychiatric group demonstrated a relative deficit on the Distractibility score, the performance of each group was within the average range on all three Kaufman factor scores.

Bannatyne Classification Scores (WISC-R)

To assess differences between the Psychiatric and Control groups on the classification scores proposed by Bannatyne (1974) a similar analysis of variance/covariance series was performed. The results of these analyses are presented in Table 6. In the univariate analyses, the Psychiatric group scored significantly lower (worse) than the Control group on all four measures: Verbal Conceptualization, Spatial, Acquired Knowledge, and Sequencing.

In the analyses of covariance, with the effect of the full-scale intelligence removed, no significant differences were found between the groups in the Verbal or Spatial scores. On the Verbal factor, our Psychiatric group ($\underline{M} = 10.96$) scored lower, but not significantly lower than the Control group ($\underline{M} = 12.35$), $\underline{F}(1,62) = .71$, $p = .40$. On the Spatial factor, the Psychiatric group ($\underline{M} = 10.90$) scored slightly lower than the Control group ($\underline{M} = 11.98$), $\underline{F}(1,62) = 0.55$, $p = .81$. It was hypothesized that there would be no group differences on the Verbal or Spatial factors. These hypotheses were confirmed in the analyses of covariance.

An analysis of covariance demonstrated a significant group difference on the Acquired Knowledge classification score, with the Psychiatric group ($\underline{M} = 9.23$) significantly lower than the Control group ($\underline{M} = 11.39$), $\underline{F}(1,62) = 3.90$, $p = .05$. Bannatyne's construct Sequencing is identical

Table 6

Analysis of Variance on the Bannatyne Category Scores

	Control	Psychiatric	<u>F</u>	<u>p</u>
Verbal Conceptualization	<u>M</u> = 12.35	10.96	4.41	.05
	<u>SD</u> = 2.65	2.62		
Spatial Ability	<u>M</u> = 11.98	10.90	4.31	.05
	<u>SD</u> = 1.91	2.24		
Acquired Knowledge	<u>M</u> = 11.39	9.23	14.37	.001
	<u>SD</u> = 2.34	2.20		
Sequencing	<u>M</u> = 11.10	9.09	14.83	.001
	<u>SD</u> = 2.25	1.91		

to Kaufman's Freedom from Distractibility. As previously reported, the Psychiatric group ($\underline{M} = 9.09$) scored significantly lower than the Control group ($\underline{M} = 11.10$), $\underline{F}(1,62) = 4.13$, $p = .04$. It was hypothesized that the Psychiatric group would score significantly lower than the Control group. This hypothesis was again confirmed. While Acquired Knowledge and Sequencing were significantly lower in the Psychiatric group, both sets of scores were within the average range of intellectual functioning.

Discriminant Analyses

To assess how well the Kaufman variables were able to discriminate control children from emotionally-disturbed children (clinical utility), a stepwise linear discriminant function analysis was employed. The multivariate Wilk's lambda from the linear discriminant function analysis assesses the extent to which the profile of variable scores is different for the two groups. Stepwise techniques (Wilk's method) select the most powerful variables to be used in the classification.

Analysis of the three Kaufman factor scores indicated that a significant discriminant function was identified, with the Freedom from Distractibility score the sole variable selected needed to achieve maximum classification accuracy between the groups, lambda = .806, $\chi^2(1) = 13.18$, $p = .001$. When this function was used to reclassify subjects into the Psychiatric and Control

groups, 41 of 64 subjects (64%) were correctly classified. This hit-rate was significantly above chance assignment (50%) and equivalent to the direct discriminant analysis, using all three Kaufman scores, which resulted in a 66% hit-rate. However, the use of the Freedom from Distractibility factor score to differentiate between groups resulted in considerable error. Twenty-three subjects (36%) were misclassified; 11 subjects in the Psychiatric group were misclassified and 12 (37%) Control subjects were misclassified. Table 7 presents the results of the discriminant analyses on the Kaufman scores.

An analogous stepwise discriminant analysis was performed on the four Bannatyne scores. The analysis indicated that a significant discriminant function could be identified using only two of the scores, Acquired Knowledge and Verbal, $\lambda = .762$, $\chi^2(2) = 16.55$, $p < .001$. When this function was used to reclassify subjects into Psychiatric and Control groups, 48 of 64 subjects (75%) were correctly classified. This hit-rate was significantly above chance assignment (50%) and slightly better than the direct discriminant analysis using all four Bannatyne variables (72%). Eight subjects in each group were misclassified (25%) using the two selected Bannatyne scores. The results of the discriminant analyses using the Bannatyne scores are presented in Table 8.

Huberty (1984) recently introduced an "improvement

Table 7

Discriminant Analyses of the Kaufman Factor Scores

Stepwise Discriminant Analysis

Actual Group	Cases	Predicted Group	
		Psychiatric	Control
Psychiatric	(32)	21 (65.5%)	11 (34.4%)
Control	(32)	12 (37.5%)	20 (62.5%)

Percent of cases correctly classified: 64.06%

Direct Discriminant Analysis

Actual Group	Cases	Predicted Group	
		Psychiatric	Control
Psychiatric	(32)	21 (65.5%)	11 (34.4%)
Control	(32)	11 (34.4%)	21 (65.5%)

Percent of cases correctly classified: 65.63%

Table 8

Discriminant Analyses of the Bannatyne Category Scores

Stepwise Discriminant Analysis

Actual Group	Cases	Predicted Group	
		Psychiatric	Control
Psychiatric	(32)	24 (75.0%)	08 (25.0%)
Control	(32)	08 (25.0%)	24 (75.0%)

Percent of cases correctly classified: 75.0%

Direct Discriminant Analysis

Actual Group	Cases	Predicted Group	
		Psychiatric	Control
Psychiatric	(32)	23 (71.9%)	09 (28.1%)
Control	(32)	09 (28.1%)	23 (71.9%)

Percent of cases correctly classified: 71.88%

over chance" statistic, the "I index," to evaluate the efficacy of a hit-rate resulting from a discriminant analysis. Similar to the kappa statistic, "The 'I' is a proportional-reduction-in-error statistic in that 100 X 1% fewer classification errors result using a classification rule than would be expected by chance classification" (p. 168). It was hypothesized that both systems, Kaufman and Bannatyne, would produce a discrimination between groups significantly better than chance assignment. Both hypotheses were supported; however, the Bannatyne classification system demonstrated some improvement over the Kaufman system in the identification of group membership. Using the Bannatyne scores (Acquired Knowledge and Verbal), the "I index" indicated that a 50% reduction in classification error would be effected. Using the Kaufman system (Freedom from Distractibility) the "I index" indicated that only a 28% reduction in errors would be made as compared with random assignment.

Correlational/Regression Analyses

To assess the relationship between the Kaufman factor scores and the Bannatyne classification scores, a Pearson product-moment correlation matrix was generated. This matrix is presented in Table 9. Highly significant correlations were found among all possible pairs of variables indicating a high degree of interrelationship

Table 9

Pearson Correlations: Kaufman and Bannatyne Scores

Kaufman	Bannatyne			
	Verbal	Spatial	Acquired Knowledge	Sequencing
Verbal Comprehension	.98	.36	.89	.59
Perceptual Organization	.36	.96	.55	.56
Freedom from Distractibility	.57	.52	.77	1.00

Note: All correlational coefficients are significant,
 $p = .001$.

between systems. Among analogous constructs nearly perfect correlation coefficients were found: Verbal Comprehension and Verbal, $\underline{r} = .98$; Perceptual Organization and Spatial, $\underline{r} = .96$. Among the unique scores, Acquired Knowledge was significantly correlated with Verbal Comprehension, $\underline{r} = .89$ and with Verbal, $\underline{r} = .85$. Its correlation with the Performance constructs was significant but lower than with the Verbal constructs: Acquired Knowledge with Perceptual Organization, $\underline{r} = .55$ and with Spatial, $\underline{r} = .52$. Sequencing/Freedom from Distractibility correlated equivalently with all four constructs: Verbal Comprehension ($\underline{r} = .59$), Verbal ($\underline{r} = .57$), Perceptual Organization ($\underline{r} = .56$), and Spatial ($\underline{r} = .52$). Acquired Knowledge correlated significantly with Distractibility/Sequencing ($\underline{r} = .77$).

The Freedom from Distractibility/Sequencing construct and the Acquired Knowledge construct have emerged as noteworthy in the ANCOVA analyses. The WISC-R subtest, Arithmetic, is common to each measure. Stepwise multiple regression analyses were computed on Acquired Knowledge and Freedom from Distractibility/Sequencing to assess the relative contribution of Arithmetic's variation on each construct.

In the analysis of Freedom from Distractibility/Sequencing as a criterion variable, Arithmetic, Digit Span, and Coding were the independent predictor variables.

Analysis of the Distractibility/Sequencing score revealed that Arithmetic accounted for 14% of the variance, the least amount of variation among the three components of the Distractibility score.

With Acquired Knowledge as the criterion variable and Arithmetic, Information, and Vocabulary as independent predictors, the Arithmetic subscore accounted for 13% of the variation.

Results of the multiple regression analyses indicated that the Arithmetic subtest manifested equivalent amounts of accountable variation in each of the two conceptual scores of which it is a component. It appeared to contribute relatively little in the overall discriminative efficacy of each WISC-R construct.

As a theoretical note, in a partial correlational analysis with full-scale intelligence partialled out, Freedom from Distractibility and Acquired Knowledge are not significantly related constructs ($r = .19$, $p = .10$).

Luria-Nebraska Neuropsychological Battery-Children's Revision

To assess differences between the Psychiatric and Control groups on the content subscales of the LNNB-CR, an analysis of variance was performed on each scale: Rhythm, Memory, Arithmetic, Reading, and Writing. Results of these analyses are presented in Table 10. The Psychiatric group scored significantly higher (worse) on each

Table 10

Analyses of Variance and Covariance on the LNNB-CR

	Psychiatric Control		ANOVA p	ANCOVA p
Reading	<u>M</u> = 3.78	0.62	.001	.001
	<u>SD</u> = 3.71	1.09		
Writing	<u>M</u> = 3.68	0.93	.001	.001
	<u>SD</u> = 2.65	1.31		
Arithmetic	<u>M</u> = 5.03	1.87	.001	.01
	<u>SD</u> = 4.14	2.05		
Memory	<u>M</u> = 4.03	2.03	.001	.05
	<u>SD</u> = 2.74	1.73		
Rhythm	<u>M</u> = 2.12	0.62	.001	.01
	<u>SD</u> = 2.26	0.87		
Pathognomonic	<u>M</u> = 7.84	3.09	.001	.001
	<u>SD</u> = 4.08	2.87		

content scale. The Psychiatric group scored higher on the Rhythm scale ($\underline{M} = 2.21$) than the Control group ($\underline{M} = .62$), $\underline{F}(1,62) = 6.76$, $p = .01$. The Psychiatric group was higher on the Memory scale ($\underline{M} = 4.03$) than the Control group ($\underline{M} = 2.03$), $\underline{F}(1,62) = 4.22$, $p = .04$. The Psychiatric group scored higher ($\underline{M} = 5.03$) than the Control group ($\underline{M} = 1.87$) on the Arithmetic scale, $\underline{F}(1,62) = 5.86$, $p = .01$. On the Reading scale, the Psychiatric group scored higher ($\underline{M} = 3.78$) than the Control group ($\underline{M} = .62$), $\underline{F}(1,62) = 12.73$, $p = .001$. On the Writing scale, the Psychiatric group ($\underline{M} = 3.68$) scored higher than the Control group ($\underline{M} = .93$), $\underline{F}(1,62) = 16.63$, $p = .001$.

It was hypothesized that the Psychiatric group would score higher (worse) than the Control group on the LNNB-CR content scales: Rhythm, Memory, Reading, Writing, and Arithmetic. These hypotheses were confirmed.

Pathognomonic Scale

The Pathognomonic scale was not constructed as a standard scale of the LNNB-CR. It was empirically validated as a global measure of overall neuropsychological impairment manifested on the LNNB-CR. Its construction was based on an analysis of all 149 LNNB-CR items for the best items to differentiate neurologically-impaired children from Control children. Thirteen items were selected from the following scales: Motor (3 items), Rhythm (1 item), Visual (2 items), Reading (1 item),

Arithmetic (1 item), Memory (3 items), and Intellectual Processes (2 items). The Pathognomonic scale is the sum of these items.

It was hypothesized that there would be no significant difference between the Psychiatric and Control groups on the Pathognomonic scale. The Psychiatric group ($\underline{M} = 7.84$) scored significantly higher (worse) than the Control group ($\underline{M} = 3.09$), $\underline{F}(1,62) = 16.33$, $\underline{p} = .001$. This hypothesis was not confirmed and was contradictory to the test author's hypothesis that "Individuals with personality disorders or mild neurosis will perform exactly as the normal group if they are without brain damage and are properly motivated to cooperate with the testing procedures" (Golden, Hammeke, & Purisch, 1980).

Given the heterogeneous nature of the Pathognomonic scale items, a stepwise discriminant analysis was performed on the thirteen component items to determine if they could be used to reclassify subjects into their diagnostic group. A significant discriminant function was identified and a hit-rate of 89% was achieved using ten items from the Pathognomonic scale. This unexpected finding will be discussed in Chapter V.

WISC-R/LNNB-CR Interrelationships

To assess the relationship among WISC-R construct scores and the LNNB-CR content scores a Pearson product-moment correlation matrix was generated. This matrix is

presented in Table 11. All of the WISC-R-LNNB-CR dyads were significantly and inversely correlated ($p = .01$). This pattern of correlation was expected since cognitive performance is considered an aspect of cortical integrity. The highest correlations were between the WISC-R scores and the Pathognomonic scale.

Specific WISC-R-LNNB-CR relationships were hypothesized. It was hypothesized that the Freedom from Distractibility/Sequencing factor would be significantly related to the Luria Rhythm, Memory, and Arithmetic scales. Stepwise multiple regression was performed with the Freedom from Distractibility/Sequencing score as the criterion variable and the LNNB-CR Rhythm, Memory, and Arithmetic scales as independent predictor variables. This regression analysis revealed that Memory accounted for 27% of the variance, $F(1,62) = 7.29$, $p = .05$. Neither Rhythm nor Arithmetic significantly contributed to Distractibility's accountable variation. The hypothesized relationship was not confirmed.

It was hypothesized that the Acquired Knowledge factor would be related to the Writing, Reading, and Arithmetic LNNB-CR scales given the construct definition of Acquired Knowledge as a global academic index. Regression analysis of the Acquired Knowledge factor score indicated that the Arithmetic scale accounted for 45% of the explained variance, $F(1,62) = 21.23$, $p = .01$. Neither

Table 11

Pearson Correlational Matrix: WISC-R and LNNB-CR (N = 64)

	Reading	Writing	Arithmetic	Memory	Rhythm	Pathognomonic
Verbal Comprehension	-.36	-.43	-.55	-.53	-.45	-.62
Perceptual Organization	-.30	-.26	-.36	-.35	-.26	-.58
Distractibility/ Sequencing	-.38	-.48	-.47	-.51	-.30	-.60
Verbal	-.34	-.40	-.52	-.51	-.45	-.58
Spatial	-.29	-.27	-.33	-.32	-.29	-.54
Acquired Knowledge	-.48	-.53	-.67	-.58	-.50	-.75

Note: All correlations significant, $p < .01$.

Reading or Writing scores made a significant contribution to the Acquired Knowledge variance. The Reading and Writing scales were not significantly related to Acquired Knowledge. The hypothesis was not confirmed.

Discriminant Analysis

An additive model of interpretation was proposed combining the WISC-R and LNNB-CR scores in an attempt to identify a comprehensive set of variables useful in the identification of emotionally-disturbed children. A stepwise discriminant analysis was generated by entering the three Kaufman scores along with the five LNNB-CR scores. The analysis indicated that a significant function was identified using four of these variables: (1) Writing, (2) Freedom from Distractibility, (3) Rhythm, and (4) Verbal Comprehension, $\lambda = .608$ $\chi^2(4) = 29.81$, $p < .001$. When this subset of scores was used to reclassify subjects into their a priori groups 48 of 64 (75%) of the subjects were correctly classified--results are presented in Table 12. This model was significantly more effective in classification than the use of the three Kaufman scores (64%) or the use of the best Kaufman predictor, Freedom from Distractibility (64%).

A similar stepwise discriminant analysis was generated by entering the four Bannatyne scores with the five LNNB-CR scores. This analysis indicated that a significant function could be identified using four

Table 12

Discriminant Analysis for Kaufman/Luria Scores

Actual Group	Predicted		
	Cases	Psychiatric	Control
Psychiatric	(32)	22 (68.8%)	10 (31.3%)
Control	(32)	6 (18.8%)	26 (81.3%)

Note: Percent of cases correctly classified: 75.0%.

variables: (1) Writing, (2) Sequencing, (3) Rhythm, and (4) Verbal, $\lambda = .607$ $\chi^2(4) = 29.87$, $p < .001$. Using this subset, 49 of 64 subjects were correctly classified (76%)--results are presented in Table 13.

This additive model was equivalent to the efficacy of the stepwise analysis of the Bannatyne scores (75%) using Verbal and Acquired Knowledge, and somewhat better than the direct analysis of the Bannatyne scores (72%). The addition of the Luria-Nebraska scores did not appreciably improve the discriminative efficacy of the Bannatyne model.

In each analysis the same constructs emerged as independent discriminators between Psychiatric and Control children. Among the LNNB-CR variables, Writing was the single best discriminator overall. Since there are no written items on the WISC-R, this appears to be an area untapped by the WISC-R. The second LNNB-CR variable found in each analysis was Rhythm, or Acoustical-Motor Organization, considered the best measure of auditory attention and concentration.

Attention and concentration are considered primary characteristics of the Freedom from Distractibility/Sequencing construct, the second most effective discriminating variable in each analysis. In both analyses, the verbal construct was the last variable entered in the discriminant function.

Table 13

Discriminant Analysis for Bannatyne/Luria Scores

Actual Group	Predicted		
	Cases	Psychiatric	Control
Psychiatric	(32)	23 (71.9%)	9 (28.1%)
Control	(32)	6 (18.8%)	26 (81.3%)

Note: Percent of cases correctly classified: 76.56%.

CHAPTER V

DISCUSSION

This study was proposed in response to Blau's (1979) call for better controlled applied clinical studies in the psychological assessment of troubled and troubling children. A "situation specific re-validation" of the most popular psychological test among children, the Wechsler Intelligence Scale for Children-Revised, was evaluated for its psychodiagnostic merit. The validity and clinical utility of the interpretative models of Kaufman (1975) and Bannatyne (1974) were compared. Specific psychodiagnostic hypotheses were deduced from the literature and postulated to be within the neuropsychological domain. These hypotheses were subjected to cross-validation with inferred correlates from the Luria-Nebraska Neuropsychological Battery-Children's Revision. The results of this study are discussed and integrated within the psychometric domain in which they were proposed.

Concurrent Validity: Kaufman (1975) Factor Scores

No significant group differences were found between the Psychiatric and Control groups on the Verbal Comprehension or Perceptual Organization factors once the effect

of full-scale intelligence was controlled. It was hypothesized that there would be no differences between groups on these WISC-R constructs. Hogan and Quay (1984) noted that the search for simple Verbal versus Performance patterns among psychiatric samples of children has been largely abandoned. In this study, as hypothesized, neither Verbal Comprehension nor Perceptual Organization was shown to possess psychodiagnostic validity in the differentiation of psychiatric children from normal peers. Both groups performed within the average range of performance on the verbal and visual skills measured by the first two factors.

Freedom From Distractibility

As hypothesized, the Psychiatric group scored significantly lower ($\underline{M} = 9.09$) than the Control group ($\underline{M} = 11.10$) on the Freedom from Distractibility factor. The actual group difference was sizable (2.01 scaled score points) and robust; this difference remained even with intelligence controlled. However, the performance of both groups was within the average range of functioning. Their representative \underline{z} -scores (Psychiatric group, $-.30$; Control group, $+.36$) provide a standard reference point to interpret the actual differences from the normative mean score ($\underline{M} = 10.0$). The performance of the Psychiatric group on Distractibility in this study is compatible with the results of the descriptive literature suggesting a relative deficit in the Freedom from Distractibility factor among

psychiatric subjects. This provides the first quasi-experimental evidence for a relative deficit in Distractibility in a heterogeneous psychiatric sample.

Concurrent Validity: Bannatyne Classification Scores

No significant group differences were found between the Psychiatric group and the Control group on either Verbal Conceptualization or Spatial Ability. It was hypothesized that there would be no significant differences on these classification scores analogous to the first two WISC-R factors. Given their correlational similarity to Verbal Comprehension ($r = .98$) and Perceptual Organization ($r = .96$), these redefined classification scores contribute little to additional understanding of the WISC-R.

Acquired Knowledge

As hypothesized, the Acquired Knowledge classification score was significantly lower in the Psychiatric group ($M = 9.23$) than in the Control group ($M = 11.39$). The actual group difference was considerable (2.16 scaled score points) though the difference was marginally significant in the more stringent analysis of covariance ($p = .054$). The performance of both groups on Acquired Knowledge was within the average range of functioning. Their representative mean z -scores (Psychiatric group, $-.25$; Control group, $+.46$) provide a standard reference point to interpret the actual group differences from the normative mean ($M = 10.0$). The Acquired Knowledge is therefore

inferred to be of limited validity as a psychodiagnostic construct in the differential diagnosis of Control and Psychiatric children.

Construct Validity: Freedom from Distractibility and Acquired Knowledge LNNB-CR Correlates

The inclusion of several LNNB-CR variables to this study was an initial attempt to infer the construct validity of the two WISC-R constructs hypothesized and subsequently confirmed to be areas of relative deficit in emotionally-disturbed children, Freedom from Distractibility and Acquired Knowledge. The LNNB-CR variables selected were those subscales whose neuropsychological domain appeared most relevant to either Distractibility or Acquired Knowledge. Specific patterns of relationship were hypothesized. The relationship between WISC-R subscales and LNNB-CR performance has been limited to several studies. Tranmontana, Klee, and Boyd (1984) examined the interrelationships between WISC-R subtests and LNNB-CR subscales in a study with considerable methodological limitations. Sweet, Carr, Rossini, and Kaspar (1985) have explored the relationship between WISC-R factors and LNNB-CR performance in a multigroup correlational design. Both tests appear to be sensitive to "cortical integrity" in general as well as possessing unique contributions to neuropsychological assessment.

In an ancillary analysis of the LNNB-CR variables

selected for this study, the Psychiatric group performed significantly higher (worse) than the Control group on all subscales (Rhythm, Memory, Arithmetic, Reading, and Writing) though the performance of the Psychiatric group was within the average range of neuropsychological functioning. Similarly, the Psychiatric group performed significantly higher (worse) on the Pathognomonic scale, though again within the range of average functioning. In fact, relative deficits were observed in the Psychiatric group on all neuropsychological variables employed in this study. It was hypothesized that relative deficits would be found in the performance of the Psychiatric group on the five LNNB-CR content scales: Rhythm, Writing, Reading, Memory, and Arithmetic. These hypotheses were supported but the magnitude of these relative deficits was limited to the below average, yet normal, range of neuropsychological functioning.

It was hypothesized that there would be no significant difference between groups on the Pathognomonic scale, the overall measure of cortical integrity on the LNNB-CR. Results indicated that the Psychiatric group performed significantly poorer (worse) on the Pathognomonic scale than the Control group. The hypothesis was not confirmed. This counter-intuitive finding was perhaps the most important, if serendipitous, finding of this study. The scale is composed of thirteen individual items from the LNNB-CR

selected as the most sensitive to cortical dysfunction. Six of these items were included on scales selected for this study as hypothesized correlates of either Distractibility or Acquired Knowledge: Rhythm (1 item), Reading (1 item), Memory (3 items), and Arithmetic (1 item). A stepwise discriminant analysis of the Pathognomonic scale items indicated that the Psychiatric group could be differentiated from the Control group with a hit-rate of 89%, rendering the Pathognomonic scale a valid measure of clinical utility in psychodiagnostics. The performance of the Psychiatric group was not within the neurologically-impaired range, nor was any member of the Psychiatric group identified as neurologically impaired, yet the measure effectively differentiated between groups with remarkable accuracy. No single variable, or combination of variables in this study approached the accuracy of the Pathognomonic scale in differentiating between groups.

Construct Validity: Freedom from Distractibility

The Freedom from Distractibility factor has been demonstrated to possess validity as a psychodiagnostic measure in the differentiation between Control and Psychiatric groups of children. Interpretation of the significance of the relative deficit found among the Psychiatric group requires an exploration of the components of Distractibility and its correlates. The identification of a factor structure is an empirical procedure; naming

identified factors is an intuitive procedure. The relationship between the WISC-R Freedom from Distractibility factor and the neuropsychological construct of "distractibility" is far from apodictic.

Lezak (1983) stated

A common concomitant of brain damage is distractibility; the patient has difficulty shutting out or ignoring extraneous stimulation. . . This difficulty may exacerbate problems in attention and concentration, interfere with learning, and increase likelihood of fatigue and frustration (p. 125).

In reference to childhood neuropsychological problems, Gardner (1979) used the term "distractibility" "to refer to the readiness with which competing stimuli can redirect attention from the primary task at hand" (p. 75). Both definitions refer to a filtering-out process which appears to have attentional and concentrational aspects. Each author implied that memory problems and anxiety can mimic distractibility problems in children.

The WISC-R Freedom from Distractibility factor is composed of three subtests: Arithmetic, Digit Span, and Coding (Digit Symbol). In a stepwise multiple regression analysis of the Distractibility factor score in this sample ($N = 64$), Digit Span accounted for the great majority of explained variation (68%) with Arithmetic (18%) and Coding (12%) contributing considerably less variation. In this sample it appears that the neuropsychological processes which underlie Distractibility are primarily those which

underlie Digit Span.

Lezak (1983) discussed the neuropsychological processes inferred necessary for Digit Span. She suggested two distinct abilities were required. Digits Forward has "most aptly been described as a test of the 'passive span of apprehension'" (p. 268), thereby more of an attentional process than a traditional memory task. Digits Backward involved "storing a few bits briefly while juggling them around mentally in an effortful activity that calls upon working memory" (p. 269). Attentional ability and short-term auditory memory (with interference) appear to be the essential abilities required in Digit Span.

Several recent studies have attempted to infer the construct validation of the Freedom from Distractibility factor as a neuropsychological construct. Stewart and Moely (1983) attempted to isolate the cognitive processes involved in the task requirements of the Distractibility factor. They concluded that "distractibility" in its traditional definition did not appear to be the essential factor which inhibited performance on the third factor. They tentatively suggested memory span and some type of rehearsal strategy or "complex cognitive processes" (p. 941) were the defining neuropsychological abilities. Ownby and Matthews (1985) similarly considered Freedom from Distractibility to be a misnomer. They suggested that auditory attention and memory as well as the cognitive

"efficient task strategies" are the essence of the Distractibility factor. Dollinger, Goh, and Cody (1984) correlated Distractibility scores with the clinical subscales of the Children's Personality Inventory, testing the "anxiety" hypothesis of Distractibility performance. Distractibility performance was not significantly correlated with: Anxiety ($\underline{r} = -.13$), or Hyperactivity ($\underline{r} = -.13$), but was significantly correlated with maturational attention/concentration (Development, $\underline{r} = -.55$) and interestingly, with Somatic Concern ($\underline{r} = -.67$). These authors suggested that if "distractibility" were operative, it would be due to internal sources of inattention (physical discomfort or somatic anxiety) rather than to environmental stimuli.

The construct validity of the Freedom from Distractibility factor was explored with selected subscales of the LNNB-CR. It was hypothesized that WISC-R Distractibility would be highly related to the Luria Acoustical-Motor (Rhythm), Memory, and Arithmetic subscales. Significant Pearson correlations were found between Distractibility and Rhythm ($\underline{r} = -.30$), Memory ($\underline{r} = -.51$), and Arithmetic ($\underline{r} = -.47$). These neuropsychological scores were entered into a stepwise multiple regression analysis; results indicated that only Memory accounted for a significant amount of variance (27%). Neither Arithmetic nor Rhythm added significant explanatory variance. The

hypothesis was partially confirmed in that short-term memory as measured by the LNNB-CR Memory scale was inferred to be a significant aspect of the WISC-R Distractibility factor. The relationship between Freedom from Distractibility and cortical integrity as measured by the Pathognomonic scale was significant ($r = -.60$) again suggesting a neuropsychological interpretation of the relative deficit found in the Psychiatric sample.

The Freedom from Distractibility factor was inferred to be a valid construct in psychodiagnostic assessment. Its interpretation appears to represent a cognitive ability within the domain of memory operations in which information can be briefly retained and used concurrently without interference from either environmental interference (classical "distractibility") or proprioceptive interference. The traditional interpretation of the Distractibility factor as a significant correlate of state anxiety (Rappaport, Gill, Schafer, 1968) does not appear to account for the relative deficit observed in this Psychiatric sample. These results generally support the recent trend in hypothesizing a neuropsychological interpretation of the Distractibility factor performance among atypical samples of children.

Construct Validity: Acquired Knowledge

Bannatyne's (1974) attempt to differentiate WISC-R verbal ability into basic verbal skills (Verbal

Conceptualization) and a more sophisticated, academically influenced verbal facility (Acquired Knowledge) is the unique contribution of his interpretative model. As with factors, the nominal aspect of this classification system is an intuitive, rather than objective, process. The naming of a construct represents an attempt at establishing its causality, and potentially the source of its remediation. Acquired Knowledge was considered more of an environmental ability than the traditional verbal and spatial scores. It was assumed to represent more of a motivational (conative) intellectual skill. Bannatyne (1974) assumed that long-term memory processes were involved, but that exposure to, and active interest in, an enriched home and school environment accounted for good performance on this construct.

Acquired Knowledge is composed of the Vocabulary, Arithmetic, and Information subtests. In the stepwise multiple regression of the Acquired Knowledge construct in this sample ($N = 64$), Vocabulary accounted for 80% of the explained variance with Arithmetic (14%) and Information (6%) accounting for relatively little explained variance. Acquired Knowledge is essentially an expressive language skill highly correlated with Verbal Conceptualization ($r = .85$) and Kaufman's Verbal Comprehension ($r = .89$). Given this correlation with the basic verbal ability, it can be considered an independent construct.

Specific relationships with the LNNB-CR were hypothesized. It was hypothesized that Acquired Knowledge would be significantly correlated with the Arithmetic, Reading, and Reading subscales, the so-called "academic triad" of the LNNB-CR. Significant Pearson correlations were found between Acquired Knowledge and Arithmetic ($r = -.67$), Writing ($r = -.53$), and Reading ($r = -.48$). These LNNB-CR variables were entered into a stepwise multiple regression analysis. Results did not confirm the hypothesis. The Arithmetic subscale accounted for 45% of the explained variance, but neither Reading nor Writing added significant explanatory variance. This series of analyses indicate that Acquired Knowledge is not a particularly valid measure of academic facility or academic environment in the sense hypothesized by Bannatyne.

The utility of the Acquired Knowledge construct is tempered by two considerations: its marginal significance in the analysis of covariance ($p = .054$) and its high correlation with the Verbal Conceptualization construct.

Clinical Utility: Kaufman's Factor Scores

The clinical utility of the Kaufman factor structure was evaluated through both direct and stepwise discriminant analyses. Both analyses revealed a similar pattern of classification. The direct analysis employed all three factors, Verbal Comprehension, Perceptual Organization, and Freedom from Distractibility, and resulted in a hit-

rate of 66%. The stepwise discriminant analysis selected one variable, Freedom from Distractibility, as the most parsimonious discriminator between groups with a hit-rate of 64%. While both classifications were significantly better than chance assignment, the clinical utility of the Kaufman model is only marginally effective in psychodiagnostic assessment.

All psychodiagnostic techniques involve classification error. The classification table of a discriminant analysis provides two indices from which to infer clinical utility: the overall hit-rate readily computed into a proportional improvement over chance statistic (Huberty, 1984) and the classification table itself, the "confusion matrix" allowing for a detailed examination of the patterning of errors. Over one-third of the children in this study were misclassified using the Kaufman scores: direct analysis (34%) and stepwise analysis (35%). In the stepwise analysis both types of classification errors were évident. "False negative" errors involve not detecting actual psychopathology. This occurred in 11 of the 32 cases (34.4%). "False positive" errors involve detecting psychopathology in Control children. This occurred in 12 of 32 cases (37.5%). The overall error rate in the stepwise discriminant analysis was 36%.

While both false negative and false positive errors limit the usefulness of a psychological test, it is

important to ask which type of error is more detrimental to the assessment process. Determining acceptable levels of classification error and identifying a preferential type of error is the difficult task of the clinician. That is, is it worse to miss actual deviance (false negative) or to identify deviance when none exists (false positive)? In neuropsychological practice, false negative error is considered more problematic because neuropsychological problems can be effectively ruled out with additional assessment generally without psychological stigma attached to the original findings (false positive), while a false negative diagnosis effectively ends an evaluation process especially as a screening procedure. In psychodiagnostic assessment, however, the opposite position appears more compelling; false positive errors appear more problematic and with more detrimental consequences. There are adverse consequences of psychiatric labels both to the misdiagnosed person and in the response of other people interacting with the person (parents, teachers). False negative error, not detecting psychopathology, certainly runs contrary to the purpose of testing, but casts the burden of "proof" back to the person's behavior which has ample opportunity for observation in the natural environment. The "ruling-in" of psychopathology has many avenues, psychological testing being but one. In the research underlying the use of psychological tests, especially in

tentative extensions of tests to new problems as in this study, some leeway is granted to false positive errors.

Clinical Utility: Bannatyne Classification Scores

The clinical utility of the WISC-R classification model proposed by Bannatyne (1974) was evaluated through direct and stepwise discriminant analyses. Both analyses revealed a similar pattern of classification. The direct discriminant analysis employed all four classification scores (Verbal Conceptualization, Spatial Ability, Acquired Knowledge, and Sequencing) and yielded a hit-rate of 72%. The stepwise analysis selected two variables, Verbal Conceptualization and Acquired Knowledge, as the best subtest for discriminating between groups and results in a hit-rate of 75%. A hit-rate of 75% is traditionally considered marginally valid as a criterion of clinical utility.

Closer examination of the stepwise analysis results somewhat temper the interpretation. The original variable selected was Sequencing (Freedom from Distractibility). The next variable selected was Verbal Conceptualization followed by Acquired Knowledge. The final step in the analysis was the removal of Sequencing from the discriminant function. As has been alluded to previously, the correlation between Verbal Conceptualization and Acquired Knowledge is significant ($r = .85$). The final discriminant function using the Bannatyne model results in a marginally

significant model of clinical utility; however, it employed essentially the same constructs. It appears that the single common WISC-R subtest (Vocabulary) accounted for the discrimination efficacy of this stepwise solution. The use of the two originally selected variables (Sequencing and Verbal Conceptualization) resulted in a hit-rate of 66%, comparable to the efficacy of Sequencing (Freedom from Distractibility) alone (64%).

The analysis of errors in the stepwise analysis classification table revealed an equal number of false positive errors [8 of 32 cases (25%)] and false negative errors [8 of 32 cases (25%)]. The Bannatyne model, as with the Kaufman model, was unable to minimize false negative errors in classification.

Clinical Utility: WISC-R and LNNB-CR

The two tests employed in this study were combined to test their joint clinical utility in the differentiation of Control from Psychiatric children. The rationale for this joint analysis was developed from the selection of LNNB-CR variables hypothesized to be areas of relative deficit among Psychiatric subjects. The Luria-Nebraska Neuropsychological Battery-Children's Revision offered brief, and highly specific scales of specific neuropsychological functioning. The exploration of the two WISC-R models attempted to validate specific areas of cognitive functioning. The joint discriminant analysis was an

attempt to apply the "best" variables on these tests to the task of differential diagnosis. A stepwise discriminant analysis was performed on the three Kaufman factors and the five LNNB-CR content scales. The analysis resulted in a hit-rate of 75% with four variables selected as the best discriminators: (1) Writing (LNNB-CR), (2) Freedom from Distractibility, (3) Rhythm (LNNB-CR), and Verbal Comprehension. The final two variables added little improvement to the model and this model maximized false negative error (31.3%) rendering it of limited clinical utility.

A comparable analysis was performed on the four Bannatyne scores and the five content scales of the LNNB-CR. This analysis resulted in a 76% hit-rate with four variables selected as the best discriminators: (1) Writing (LNNB-CR), (2) Sequencing (Distractibility), (3) Rhythm (LNNB-CR), and Verbal Conceptualization. As with the Kaufman-LNNB-CR analysis the latter two variables added little to the effectiveness of this model.

The interesting result of the series of joint discriminant analyses was the preeminence of the Writing scale score as the single best discriminator between groups. There are no written items on the WISC-R and the LNNB-CR Writing scale can be considered among the most "academic" tasks in this joint model. The next best discriminator, Freedom from Distractibility/Sequencing again

affirms the validity of this factor as a psychodiagnostic measure; it alone resulted in a 64% hit-rate.

The cornerstone of this study was the hypothesis that emotionally-disturbed children possessed a relative deficit on Freedom from Distractibility. This hypothesis was confirmed. This single result, confirmed for the first time in quasi-experimental research between control and psychiatric groups of children, allows for consideration of the underlying conceptual issue; does the relative deficit on Freedom from Distractibility among psychiatric subjects represent a subtle neuropsychological deficit, or does it represent an affective epiphenomenon of the psychiatric disorder?

The traditional clinical interpretation of Freedom from Distractibility deficits, both in adults and children, emphasized an affective etiology, with state anxiety as the inferred causal agent (e.g., Rappaport, Gill, & Schafer, 1968). However, research with the WISC-R has inferred the construct validity of the Freedom from Distractibility factor to be within the neuropsychological domain, though its specific interpretation has yet to be identified. The results of this study are compatible with the theme of recent Distractibility research, highlighting auditory short-term memory as a principle component. Bannatyne's hypothesis that sequential auditory memory was the essential aspect, rather than simple short-term memory capacity,

has merit in that it posits a more specific ability within a complex neuropsychological process. The interpretation of Freedom from Distractibility as a neuropsychological construct recasts the original question into neuropsychological terms: do emotionally-disturbed children possess an enduring memory deficit, or a functional memory impairment more transient in nature?

It was not within the scope or design of this study to address the etiological question, but rather to document the validity of a significant behavioral difference between control and emotionally-disturbed children, assessable through the WISC-R. It was interesting to note that the best discriminators between groups, Freedom from Distractibility and the LNNB-CR Pathognomonic scale, are measures of cortical integrity most sensitive to the presence of central nervous system dysfunction. There is a trend in the child assessment literature to apply neuropsychological tests to psychiatric populations, particularly in the conduct disorders, in an attempt to detect temperamental, potentially predisposing, neuropsychological characteristics underlying childhood psychopathology. This study can be classified within the genre of differential diagnostic studies at the interface of psychopathology and neuropsychology.

Several avenues of research were suggested by the results of this study. First, the cross-validation of the

Freedom from Distractibility factor as a neuropsychological construct needs to be established in heterogeneous categories of childhood psychopathology. Its principle components need to be inferred through traditional construct validation studies. Secondly, the conceptual issues raised by these results can effectively be examined through cross-lagged panel studies (Cook & Campbell, 1979). Through multiple correlational designs, the causal relationship, if any, between Freedom from Distractibility and anxiety can be evaluated directly with children whose psychiatric symptoms are expected to remit with time (adjustment disorders). Similarly, the inferred causal relationship between cortical integrity and Freedom from Distractibility can be tested through cross-lagged panel studies with various measures of overall cortical functioning, the Pathognomonic scale being one. The introduction of the LNNB-CR as an inexpensive, yet comprehensive neuropsychological battery offers a fruitful method of directly addressing the issue debated since the introduction of the original Wechsler-Bellevue intelligence test.

The WISC-R was developed as a test of intelligence, of which it remains the premier instrument. Extrapolations to clinical assessment were inevitable given the popularity of the test. The two interpretative models reviewed offer alternate models of using conceptual scores psychodiagnostically. This study has demonstrated the

validity and clinical utility of these models in childhood psychopathological assessment. Freedom from Distractibility merits consideration in all cases where psychological tests are being considered. The brief Pathognomonic scale of the Luria-Nebraska Neuropsychological Battery-Children's Revision has also demonstrated validity as a routine measure in psychological testing batteries. It is the task of future research to infer the "situation specific revalidation" of these measures to specific psychodiagnostic situations.

CHAPTER VI

SUMMARY

This study proposed the first quasi-experimental comparison of the two most widely employed models of interpretation of the Wechsler Intelligence Scale for Children-Revised (WISC-R) in the differentiation of outpatient emotionally-disturbed children ($N = 32$) and control children ($N = 32$), groups of children considered equivalent in overall intellectual functioning. Kaufman's (1975) factor analytic model (Verbal Comprehension, Perceptual Organization, and Freedom from Distractibility) and Bannatyne's (1974) psychoeducational model (Verbal Conceptualization, Spatial Ability, Sequencing, and Acquired Knowledge) were compared in a concurrent validity design, followed by a test of their respective "clinical utility" through linear discriminant function analyses. Two intermediate constructs were hypothesized to be areas of relative deficit among emotionally-disturbed children: Freedom from Distractibility and Acquired Knowledge. Their construct validity was examined with reference to selected scales of the Luria-Nebraska Neuropsychological Battery-Children's Revision (LNNB-CR).

Results indicated that the emotionally-disturbed

group did possess a relative deficit on Distractibility and Acquired Knowledge relative to their control peers, though the deficit was not within the abnormal range on either construct. With full scale intelligence controlled for, no other WISC-R intermediate scores manifested a significant difference between groups. Each interpretative model demonstrated generally equivalent clinical utility in the differentiation between groups; stepwise analyses selected Freedom from Distractibility as the best discriminating variable between the groups. However, neither model demonstrated an efficacy level adequate for individual psychodiagnostics. The emotionally-disturbed group performed significantly worse than the control group on all neuropsychological variables, though well within the normal range of functioning. Freedom from Distractibility was inferred to be a short-term memory construct, rather than as a measure of attention/concentration. The construct validity of Acquired Knowledge was not specifically inferred, though it appeared to represent more of a numerical facility than as a global educational index. The best discrimination between groups occurred on an item analysis of the LNNB-CR Pathognomonic scale. This unexpected result, if replicated, extends the efficacy of the Pathognomonic scale to the domain of psychodiagnostic assessment.

The purpose of this study was to examine the

psychodiagnostic utility of the WISC-R intermediate scores. The results were interpreted within a traditional psychometric context; suggestions to clinicians and research recommendations were offered.

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The final copies have been examined by the Director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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