CLINICAL UTILITY OF THE WECHSLER SCALES IN PSYCHOLOGICAL EVALUATIONS TO ESTIMATE VOCATIONAL APTITUDE AMONG LEARNING DISABLED YOUNG ADULTS

by

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(ABSTRACT)

A growing body of opinion, research, and legislation [PL 98-524] implies that school psychological evaluations with adolescents and young adults should routinely include estimates of vocational interests and aptitude. Certainly all secondary level special education evaluations should include this important vocational component. Evidence suggests that the experience of career development among learning disabled young adults is particularly frustrating and difficult without early planning and exploration of options. This study examines the utility of traditionally available psychometric data in assisting the clinician make initial, <u>exploratory</u> estimates of vocational aptitude without referring the client for specialized testing.

Wechsler Adult Intelligence Scale - Revised [WAIS-R], and General Aptitude Test Battery [GATB] scores were subjected to a multivariate, canonical correlation analysis to examine the overlap among constructs estimated by these sets of variables. The sample was composed of 148 learning disabled young adults enrolled in a state supported vocational rehabilitation program. Three significant canonical correlations were interpreted. The redundancy index showed that 34% of the variance in GATB aptitudes is explained by three linear combinations of WAIS-R subtest scaled scores, and that 31% of the WAIS-R subtest variance is predictable from three composites of GATB aptitude scores. Analysis of the structure correlations suggests that the first pair of canonical variates [$\underline{Rc}$ = .87] share a general intelligence, or verbal comprehension factor. A second pair [$\underline{Rc}$ = .73] share a perceptual and motor coordination construct. The third pair of canonical variates [$\underline{Rc}$ = .61] define a perceptual speed, or psychomotor construct that overlaps both the GATB and the WAIS-R set of test scores. There is evidence that GATB and WAIS-R estimate similar, but essentially independent dimensions of the same three psychoeducational constructs. WAIS-R may provide better estimates of fluid ability than GATB; and GATB may provide better estimates of crystallized ability than WAIS-R.

Clinical implications for psychologists making exploratory estimates of vocational ability and aptitude from clinical profiles of WAIS-R scaled scores are discussed. Assessment issues with respect to the learning disabled young adult are also presented. [175 references]

ACKNOWLEDGMENTS

In the Afterword to his epic tale on the French Revolution, Ninety Three, Victor Hugo describes his writing method. He wrote standing at upright desk with pen and India ink on oversize sheets of vellum. When he completed his manuscript, he sent it to the printer. No editors, no layout artists, no critics, no advisory committee; he apparently needed no one to help make his ideas clear, or assure that his efforts proved worthwhile. But then, he was Victor Hugo. Bill Heinlein needed help.

My most important helper has been Tom Hohenshil. The enthusiasm he has for our profession, and the particular ability to focus my attention that he has consistently demonstrated over the years have kept the whole project moving. He translated my original manuscript into English from whatever language it was in before, and acted as the technical advisor throughout. I can't think of any one who would have made the time available to do the two jobs better.

I would wish to acknowledge the support I received from personnel of the Woodrow Wilson Rehabilitation Center. In particular, Robin Hawks and Barbara Pondell of the Adult LD Project, whose efforts in the collection of data were invaluable. A special thanks to Tena Simmons and her very helpful staff in the WWRC Central Records Library is extended. Appreciation is also due Dr. Jim Hoffmann, Director of Research, and all members of the Research Review Committee whose early recommendations were keys to the final product.

I would also like to thank all the members of the Committee for their confidence and productive comments over the period since this study began as a five page proposal. Dr. Susan Asselin is due special thanks for her interest, sincerity, and keen insight for the implications of this investigation. Dennis Hinkle's confidence in my mathematical ability still mystifies, but it is greatly appreciated and so were his suggestions to improve the analysis. Also, my thanks to colleague, business partner, and friend Dr. David Lovern for his consistent and unique support in both my research and for our various joint ventures over the years. Judith R. Scott, though she may not know how important, deserves a large debt of gratitude for providing the initial motivation to get this project underway. I could not have done it without them all.

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CHAPTER I

Introduction

The development, use, and interpretation of valid, reliable, and non-discriminatory psychometric estimates of human aptitudes, abilities, and interests have been the concern of professional psychologists for decades. This has been particularly true of school psychologists who are most interested in the prediction of learning capacity and uncovering potential learning difficulties in children and young adults within an educational setting.

Professional school psychology has traditionally been concerned with elementary school aged students (Hohenshil, Ryan, & Warden, 1978). School psychology has witnessed an enormous leap in growth in the last decade due especially to PL 94-142 special education legislation that has re-characterized the professional school psychologist's unique services by a number of activities aimed at a broader range of students (Ziv, 1980; Hohenshil, 1981). Within the broad domain of professional school psychology, the vocational school psychology specialty (Hohenshil, 1974) has been charged with the advocacy of vocational and career development in the schools. The specialist is most concerned with the development and use of psychometric tests for estimation of ability, interest, or aptitude among handicapped, secondary school aged students for the purpose of a planned transition from school to work.

The organization of the American secondary school has traditionally had as its educational emphasis the preparation of youth for entry level employment, preparation for advanced education, or preparation for advanced vocational training. Aptitude and ability estimates of secondary students, especially those with special needs, and the prediction of the likelihood that these students will experience successful transition from school to work is a major, newly charged task for the generalist or specialist school psychologist (Fagan, 1981).

A vocational component in every junior and senior high school psychological evaluation conducted by professional school psychologists across the broad spectrum of their referral base is clearly being recognized as essential (Hohenshil, Levinson, & Heer, 1985). This was publically acknowledged in March 1979 when the National Association of School Psychologists (NASP) unanimously adopted the Study Report of the National Commission to Study the School Psychologists' Role in Career and Vocational Education. This Report called for increased involvement of school psychology in career planning for all students, as well as the formal recognition of the Vocational School Psychology specialty. This mandate to address vocational needs was subsequently formalized for the profession in the Standards for the Provision of School Psychological Services (NASP, 1984).

These Standards recommend that all professional psychologists provide vocationally oriented assessment services as a component of their routine school psychological practice. In the area of general assessment, these Standards state the following:

> "Psychological and psycho-educational assessments include consideration as appropriate in the areas of personal-social adjustment, intelligence-scholastic aptitude, adaptive behavior, language and communication skills, academic achievement, sensory and perceptual-motor functioning, environmental-cultural influences, and vocational development, aptitude, and interests." (p. 19)

These recently adopted Standards suggest that the inclusion of vocationally oriented assessments are to be considered expected services from all practicing school psychologists (Hohenshil, 1984). With more a force of authority, it has also been a clear interpretation of the recent Carl Perkins Act (PL 98-524) that all evaluations for secondary level students include assessment of vocational interests and aptitudes (Hohenshil, in press). Thus, a basic goal of school psychological evaluation at the secondary level is to assist students, their placement committees, and parents select appropriate educational and vocational options. The latter would involve matching student abilities with aptitudes that may be required for success in a variety of occupational areas (Heinlein, Nelson, & Hohenshil, 1984).

The goal of this study is to provide the generalist school psychologist a valid, easily implemented strategy by which the mandated vocationally oriented assessment can be interpreted, or inferred, from the analysis of traditionally available school psychometric test data.

Rationale for the Study

In attempting to predict the likelihood that a young adult in secondary school will begin to experience successful vocational development, specialists have characteristically focused on the results of highly specific, vocationally oriented test protocols. Counselors then focus on identification of particular profiles in the score results that are known to be correlated with aptitude in one or another broad occupational field. This has proven troublesome for the generalist psychologist in the typical public school. The general practitioner usually lacks the required highly specialized training with psychometric instruments related to vocational assessment. The general practitioner also lacks the luxury of significantly increased amounts of clinical time required for reliable assessment of the vocational aspect; especially given the typically immediate academic demands of special education placement requests that tend to predominate referrals.

The professional school psychologist need not turn entirely to highly specialized, vocationally oriented test instruments in collecting and reporting information pertinent to student's vocational aptitude or interests (Levinson & Shepard, 1982; Shepard & Levinson, 1985). The school psychologist who wishes to fulfill the 1984 NASP Standards, and who is sensitive to the vocational needs of clients, need not significantly alter the traditional school psychological approach, or the resulting report. The idea is to incorporate vocationally relevant findings based upon sources of information typically available to the school psychologist (e.g., Wechsler Adult Intelligence Scale-Revised [WAIS-R]) resulting from the overall psycho-educational assessment. Armed with traditionally available Wechsler intellectual profiles on clients, the practicing school psychologist could incorporate in reports of examinations valid, vocationally oriented aptitude estimates, or recommendations. These would be based upon psychometric estimates derived from WAIS-R scores correlated to known vocational aptitudes. Vocational recommendations as a result of routine intellectual assessment with the WAIS-R would thus be available to the general practitioner (Shepard & Hohenshil, 1983).

Information on the vocational structure of WAIS-R would enable the school psychologist to be in position to meet the spirit of the mandates of the NASP Standards and the Carl Perkins Act: PL 98-524. Additionally, such information when made available to university trainers of school psychologists, will provide one efficient, cost effective way to incorporate the vocational mandates of the NASP Standards into existing instructional programs.

Purpose of the Study

The purpose of this study is to: (a) investigate from an exploratory standpoint the amount of statistical overlap among the constructs measured by General Aptitude Test Battery (GATB) and the constructs measured by WAIS-R, and (b) provide an exploratory schema by which WAIS-R can be interpreted from a vocational aptitude perspective.

Research Questions

The following two broad research questions will be addressed in the study:

1. Is there statistical overlap among constructs measured by WAIS-R and constructs measured by GATB?

2. Can linear combinations of WAIS-R subtest scores be used to estimate specific vocational aptitudes?

Operational Definitions

1. Learning Disabled. LD for the purpose of this study will be defined as persons diagnosed as experiencing such by the WWRC Adult LD Project. The WWRC adopts the definition of LD included under the Rehabilitation Act of 1973, as amended. Multi-dimensional sources of information were the basis of their final diagnosis.
2. WAIS-R. Complete definitions including technical statistics for the *Wechsler Adult Intelligence Scale - Revised* and its subtests are in Appendix B.
3. GATB. Complete definitions and statistics for the *General Aptitude Test Battery* aptitudes and its subtests are presented in Appendix C.

Limitations of the Study

1. Ex-Post-Facto research. Ex-post-facto research is systematic empirical inquiry in which the researcher does not have direct control because manifestations among variables have already occurred (Kerlinger, 1973). This study uses such an approach. Inferences about relations among variables are made, without direct intervention, from concomitant variation of sets of variables (Kerlinger, 1973).

2. Sample. The sample is limited to a self-selected group of students aged 16 to 42 participating in a vocational rehabilitation project for specific learning disabilities. External generalization to other

young adults, or other special needs categories will introduce error variance of unknown magnitude.

3. Restriction of range. Restriction of range as applied to test scores is a general term which means that the test scores for a particular group are concentrated in a small portion of the possible range of scores. This study uses WAIS-R and GATB test scores from a sample of self-selected LD students. This implies that the sampled aptitude scores (GATB) and intelligence scores (WAIS-R) may not be representative of the broader GATB/WAIS-R standardization groups. Groups restricted in range have smaller standard deviations than those not so restricted. It must be recognized that correlations between the tests, subtests, or factors in this study *may* be lower for this LD group than for groups whose scores are not restricted.

Summary of Chapter I

The problem proposed is to investigate from an *exploratory* standpoint the development of an interpretative schema by which scores from the WAIS-R (Wechsler, 1981) can be validly interpreted from a vocational perspective by examining the tests' statistical overlap with the General Aptitude Test Battery (United State Employment Service [USES], 1970, 1980). More specifically, does the WAIS-R offer a useful set of scores for estimation of vocational aptitude that are meaningfully correlated with the GATB in a sample of learning disabled young adults in a rehabilitation setting?

The availability of such a schema to the practicing psychologist will permit them to interpret traditionally available scores (e.g., WAIS-R) from a vocational perspective. This would allow psychologists to at least provide their secondary special education clients with _initial_, _exploratory_, vocationally oriented _options_ for a planned transition from school to the world of work.

Organization of the Study

The problem was introduced; the purpose, rationale, and limitations of the study were presented in Chapter 1. Chapter 2 contains a review of pertinent and related literature regarding concepts relative to learning disability in adults, studies of vocational issues for LD adults, and studies on the WAIS-R and GATB. Chapter 3 provides a comprehensive description of the investigative techniques including details regarding the sample, setting, variables, procedures, design, data collection, and analysis. A presentation of the results of the study comprises Chapter 4. Chapter 5 provides a discussion of findings, implications of the results for the school psychology and counseling professions, recommendations for further research, and summary remarks based on the entire program of research.

CHAPTER II

Review of Related Literature

A review of the relevant literature is presented in this chapter. Included are major sections which address the content of this study.

Research on Vocational Assessment of the Learning Disabled Adult

According to career development theory, each person must achieve an individual adaptation to the world of work. The relationships between individuals, psychology, work, and career is very well documented in the literature (e.g., Ginzberg, Ginsberg, Axelrod, & Herma, 1951; Super, 1957; Holland, 1959; Tiedeman & O'Hara, 1963; Erikson, 1968; Gottfredson, 1981).

Although there has been this considerable vocational research directed to non-handicapped populations, much less attention has been focused on persons with handicaps (e.g., Dawis & Lofquist, 1968; Brolin, 1973; Brolin, 1976; Brolin & Kolstoe, 1978; Brolin & Kokaska, 1979; Herr & Cramer, 1979; Flynn & Nitsch, 1980; Hohenshil, 1982; Hohenshil & Warden, 1978).

Considering the lack of vocational research with the general population of handicapped, even more rare are vocational studies of individuals with specific learning disabilities (LDs). Longitudinal studies of LDs were not found for this review. LDs have just within the last few years become eligible for vocational rehabilitation services, and only since 1976 have they been eligible for special education services. Most of these individuals presently aged 15-years or older received little, if any, intensive vocational education during school years and may be ill-prepared for the world of work. Little is known about the vocationally oriented instructional techniques, or vocational assessment techniques that are most appropriate for this group of young adult LDs.

Learning disabled students (LDs) cover the widest spectrum of individual conditions and needs among all the known categories of students with special needs (Wender, 1971). IQ generally ranges from low average (80-90) to superior (120+). Specific abilities may range from mentally deficient to gifted across subtests. Behaviors may range from learned helplessness to unsocialized conduct disorders or fully appropriate social behavior. Vocational goals and expectations may range from floundering (Super, 1957) to the professional level. There is no single test or battery that will provide satisfactory answers in the vocational assessment of this group (Brown, 1982; Brown, 1981). Persons with LDs present a perplexing situation for individuals concerned about vocational counseling.

According to Super and Hall (1978), the longitudinal Career Pattern Study and the National Assessment of

Educational Progress have shown that normal high school students have not explored the world of work adequately, lack needed information, and typically do not know what information to seek or how to seek it. For the handicapped, the process may be less adequate (Hooper, 1980).

For example, Bingham (1978, 1980, 1981) has found a significant deficit in vocational maturity with pre-adolescents and adolescents who are LD. He speculates that unsuccessful school experiences may have led to the negative attitude of these students toward work and career choices. LD students have significant trouble planning and organizing their own career development (Kendall, 1980, 1981). A study of LD young adults indicated that they have lower level jobs and were significantly less satisfied with their employment than were non-LD peers (White, Schumaker, Warner, Alley, & Deshler, 1980).

Most workers are fired because of their inability to acquire socially acceptable work habits in the specific work environment (Hooper, 1980). Cook (1979) noted in regard to LD students, deficits in social perception skills: inability to emphasize or identify appropriate models, to interpret context and social cues, and to interpret non-verbal communication or even their own capacity for change. The same kinds of behavior that cause LD students problems in school likely cause problems on the job (Brown, 1982).

It can be seen that assessment of this population is an area of active research interest for school psychologists.

Research on Adult Learning Disability

A fundamental goal of professionals concerned with the education of learning disabled children is to facilitate the development of well-adjusted, successful adults. Concern for the adolescent and young adult with learning disabilities has closely paralleled the evolution observed within the field of special education (Dunn, 1973). During the 1950s, the primary focus was on the diagnosis and remediation of young children with perceptual and motor handicaps (e.g., Osgood & Sebeok, 1954; Strauss & Lehtinen, 1947). As this population matured, the focus shifted from a concern with perceptual handicaps and primary language deficits to developing diagnostic and remedial strategies for improving cognitive and academic function (e.g., Frostig & Maslow, 1973). Since the mid-1970s there has been tremendous pressure from parent groups, teacher organizations, and legislation to provide services for the LD adolescent (e.g., Lerner, 1981). Now, as these students progress in life, the focus seems to be on study of the learning disabled adult (Kroll, 1984; Johnston, 1984; Polloway, Smith, & Patton, 1984; McCue, Shelly, & Goldstein, 1986; Buchanan & Wolf, 1986).

A review of the LD literature will find three broad domains of interest addressed to three specific sub-population samples. Studies are generally concerned with the following domains: (a) studies of attention and hyperactivity, (b) studies of educational issues and skills, and (c) studies of emotional or personality effects. These broad domains of interest are addressed, usually quite specifically, to three specific sub-populations: (a) secondary level LD adolescents, (b) college LD students, and (c) LD adults. We will briefly survey the studies relevant in each of these three broad areas.

Studies of Attention and Hyperactivity

Hechtman, Weiss, Perlman, and Tuck (1981) reviewed follow-up studies on the status of hyperactive children in adolescence and adulthood and found 40% to 50% with continuing problems including an unstable work history and lack of long-standing intimate relationships most likely due to lowered self-esteem and lack of confidence. Weiss, Hechtman, Milroy, and Perlman (1985) found 23% of their follow-ups with mild to severely disabling psychiatric status including personality and anxiety disorders and substance abuse conditions. Huessy and Howell (1985) in a retrospective study showed that responses of adult alcoholics closely resembled those of people with childhood history of attention deficit disorder and learning disability.

Mannuzza and Gittelman (1984) found no consistently significant psychiatric behavioral differences in hyperactive adult females and males treated earlier with medication. Hechtman, Weiss, Perlman, and Amsel (1984) again followed-up on hyperactives as adults and college students to determine which initial childhood factors were predictive of adult outcome. None were found, but additive interactions of SES, family mental health, IQ, emotional stability, and frustration tolerance were found to contribute to positive or negative outcomes.

Hechtman et al. (1984) also found that those treated with medication as children tended to have more positive adult outcomes. Mattes, Boswell, and Oliver (1984) did not find medication helpful in treatment of adult manifestations of learning disability but Wender, Reimherr, Wood, and Ward (1985) did find very significant treatment effects. Secondary students and college students, however, do not seem to show the same contradictory findings and may be strongly helped by use of psychostimulant medications (Dulcan, 1985; Gauthier, 1984).

Educational Characteristics of LD Adults

The educational characteristics of LD adults and older adolescents have been studied comprehensively. The studies focus mainly on reading ability and post-secondary academic achievement as well as programs and techniques of academic intervention at the secondary or post-secondary level. Simpson (1979), and Cohen (1983) contend that the majority of young adults with learning disabilities have failed in post-secondary education because of weaknesses in reading comprehension, reading rate, written language, mathematics, and/or interpersonal relationships. This continuing difficulty with reading has consistently been demonstrated with LDs (Cook, 1979; Scarborough, 1984; Vellutino, 1987). Ineffectual study habits and a lack of organizational and time management skills compound these overall academic skill related problems (Simpson, 1979).

McCue et al. (1984) concluded that adult LD individuals show a neuro-psychological and psycho-educational pattern very similar to those seen in LD children. This similarity of psycho-educational pattern was also found by Whyte (1984). Byring and Pulliainen (1984) found persisting neurological deficiencies in older adolescents and adults with dyslexia that include problems of fine motor control, auditory sequential processing, phoneme manipulation, manual sequencing, and generalized dysfunction of the left hemisphere. These findings of neuropsychological and psycho-educational dysfunction have generally been found in all social classes of LD individuals and across cultural and national boundaries (Michelsson, Byring, & Bjorkgren, 1985; Scarborough, 1984).

With respect to vocational training issues, Kroll (1984) indicates that fewer LD students complete high school, go on to post-secondary vocational training or college than is typical for the general population; and, if they do go on they carry the learning disability with them, especially noted in reading and spelling skills. Markel, Bizer, and Wilhelm (1985) describes the special pressures and circumstances typically faced by LD students in preparing for and taking the Scholastic Achievement Test (SAT). They note that it is still unclear if mean SAT scores for LD students is less than the mean SAT scores for the general population.

LD adolescents and young adults are additionally at greater disadvantage if they find themselves in a post-secondary educational environment where they can not avail themselves of specialized education services or individualized instruction (Vogel & Adelman, 1981). Strichart and Mangrum (1985), and Cowen (1985) provide procedures for selecting a college or post-secondary placement for the LD student. Decker, Polloway, and Decker (1985) proposes that counseling programs, relaxation training, and modifying inappropriate expectations should be the focus for intervention programs for the college student with learning disabilities. The University of Virginia Learning Needs and Evaluation Center (Lefebvre, 1984) describes details of the provided services to LD college students including assessment with the WAIS-R; similar programs of special service to the LD young adult abound (Barbaro, 1985; Mick, 1985).

Personality and Emotional Features

With respect to the personality and emotional characteristics of the adult LD individual the studies are less conclusive than studies of educational characteristics, but they are certainly not less numerous. During the 1970s two serious misconceptions about learning disabilities were exposed in a multitude of studies. First was the idea that the learning disability represented only a temporary, sometimes typical, maturational delay in the development of that portion of the central nervous system that was responsible for the function(s), and that the disability would correct itself normally during puberty (e.g., Wender, 1971). Most studies now show that learning disabled children may outgrow some of the most obvious signs of the disorder, whereas the information-processing, and behavioral problems remain unchanged into adulthood. Second, a learning disability had previously been thought to significantly affect only school related skills (e.g., Lerner, 1981). It is now increasingly clear that in many ways a learning disability has greater impact on the social and emotional experiences of a developing child than on the school based skills (Osman, 1982). Learning disabled children rarely grow up in a sufficiently understanding and supportive environment to avoid significant emotional scarring as a by-product of their disorder (Schulman, 1984).

In this regard, Stevenson and Romney (1984) investigated the frequency of depression among LD children and adolescents and found a prevalence of low self-esteem, oversensitivity and neuroticism. Weiss (1984) found that LD children and adolescents tend to project their own characteristics onto others and generally make social misperceptions. Omizo, Cubberly, and Longano (1984) found LD adolescents and children to have higher anxiety, external locus-of-control, and lower aspirations. These studies are clearly suggestive of significant, and lasting socially learned psychological dysfunctions in the adult learning disabled population.

Levin, Zigmond, and Birch (1985) conducted a follow-up study of LD adolescents in adulthood and found a majority had been encouraged to leave school before graduation because of persistent academic, behavior, and attendance problems. Buchanan and Wolf (1986) analyzed personal and educational histories of LD adults and administered the WAIS and other tests to find that LDs were continuing to manifest in adulthood such characteristics as cognitive and achievement deficits as well as low motivation, distractibility, self-concept problems, emotional lability, and lack of motivation and organization. Cohen (1985) also found in his study of LD college students similar problems of work and learning, an increased frequency of depression, and, in general, "a series of ongoing psychological processes that become interrelated with various aspects of ego functioning and development." (p. 178)

Wood (1985) administered a questionnaire on human sexuality to 340 adult LDs in 16 states and results showed that the LDs reported difficulty interpreting gestures, facial expressions, tone of voice, and in making friends of the opposite sex. This implies that LDs need more focus on social cues in their education to avoid implications of mild difficulties in adult sexual adjustment. Similarly, a questionnaire to 1700 LD university students revealed that they viewed themselves and their parents more negatively, and they recalled more family stress during childhood and adolescence, and reported more delinquency, suicidal thoughts, and substance abuse than did a non-LD group. Huessy and Howell (1985) also found a link between adult alcoholism and childhood behavior disorders including hyperactivity and specific learning disability.

Johnston (1984) provides a fine summary description of the psychological characteristics of the LD adolescent and young adult, the specific assessment practices that have been implemented to evaluate this target population, and the current educational programs that are available to service this age category. Johnston concludes that one of the major problems in understanding this target population is the vague manner by which adolescents and adults with LD are classified. There is a critical need to design new diagnostic measures for LD adolescents and adults that more accurately differentiate between primary neurological indicators and secondary emotional symptomatology.

It seems clear that many learning disabled adults must seek psychological counseling for a variety of reasons including the following: anxiety, depression, low self-esteem, poor interpersonal skills, vocational difficulties, problems with intimacy, impulsivity, socially inappropriate behavior, tangential thinking, concrete thinking, rigidity, perceptual/social distorting, etc. (Cato & Rice, 1982; Lombana, 1982; Fafard & Haubrick, 1981; Schulman, 1984). Often too, however, they generally report poor therapy results and experiences, feeling that their therapists do not understand the concept of learning disabilities --- or rather, do not understand "them" since neither client nor therapist is necessarily aware of the impact of the learning disability from a social development perspective (Humes, 1974; Schulman, 1984; Humes & Brammer, 1985; Weatherley, 1985). It should be noted that no longitudinal research has been done regarding the psychodynamic implications of learning disability on personology variables such as temperament, social skills acquisition, character trait development, emotional expressivity, or, for that matter, vocational development.

Research Relative to WAIS-R: Wechsler Adult Intelligence Scale-Revised

In this section studies relative to the statistical properties, score analysis, and the vocational and adult LD applications of the WAIS-R will be reviewed. The WAIS-R Manual (Wechsler, 1981) should be consulted for details regarding administration, scoring, and specific statistical properties. Appendix B of this study presents detailed definitions of WAIS-R subtests, the six global factors, specific reliabilities, and standard errors of estimate for each subtest.

An exhaustive and critical review of over 1000 important studies during the last 40 years relating to all areas of inquiry with Wechsler scales is provided by Frank (1983). House and Lewis (1985) add to this collection with their excellent introductory review of Wechsler tests.

Clear, integrative texts illustrating clinical and psycho-educational use of both the WAIS-R and WISC-R are now available (Sprandel, 1985; Cooper, 1982).

WAIS-R Standardization, Reliability, and Validity

The norms of the WAIS-R are based on a group of 1,880 adults, 16 to 74-years inclusive. This sample was stratified on the basis of nine age groups, sex, two levels of race, four levels of region, six levels of occupation, five levels of education, and both urban and rural residence, following

1970 census reports. The standardization has been found more than adequate relative to other editions and other instruments (Matarazzo, 1985; Matarazzo & Hermann, 1984; Hermann, 1982). The norms do not specifically include LDs.

Consistent with the prior history of the Wechsler scale, the reliabilities reported in the standardization sample for the WAIS-R are quite adequate, generally superior for psychometric instruments, and consistent with the reliabilities and standard errors reported for the WAIS (House & Lewis, 1985). Ryan, Prifitera, and Larsen (1982) have reported investigation of the split-half reliabilities and standard error of measurement with a large heterogeneous sample of Veterans Administration patients. The estimates of internal consistency and standard errors of measurement were generally similar to those reported in the standardization group except for a difference with Arithmetic. Internal consistency seems to be quite adequate.

Ryan, Georgemiller, Geisser, and Randall (1985) studied the test-retest stability of the WAIS-R against the standardization group in a similar sample of Veterans Administration patients. They found highly stable Verbal, Performance, and Full Scale IQ global scores, yet simultaneously demonstrated considerable variability from test to retest for individual patients (range from -13 to +18). These findings underscore the distinction between psychometric retest reliability and clinical retest reliability; that is, psychometric reliability was satisfactory, but clinical reliability was unimpressive. Thus assessing improvement or deterioration of intellectual functions from test to retest is not warranted. This identical finding of strong psychometric reliability but poor clinical reliability of WAIS-R was reported by Matarazzo and Hermann (1984), with WAIS by Matarazzo, Carmody, and Jacobs (1980), and Silverstein (1982b).

No independent validity data are reported in the manual for WAIS-R, but references are made to the data supporting the validity of the Wechsler-Bellevue, and WAIS. Given the basic identity and significant overlap in item content between these forms, this appears to be a defensible position (House & Lewis, 1985). There is no reason to suspect that the WAIS-R is not as valid an instrument as earlier editions. Matarazzo (1972) gives a comprehensive review of the validity data on the previous scales and the WAIS-R manual makes reference to his conclusion that the overall correlation between tests of global intelligence, including the WAIS, Stanford-Binet, is .85, and with school performance in the order of .50.

Kavale and Forness (1984) have undertaken a massive, 94-study meta-analysis of the validity of the Wechsler scale profiles and recategorizations and found robust validity for inferences based on the global Verbal, Performance, and Full Scale IQs and the individual subtest scores, but not necessarily for pattern or scatter analysis (especially between groups of normals [e.g., white/non-white] and those with special needs [e.g., LDs]).

In summary, the WAIS-R seems to demonstrate more than adequate reliability for both test-retest and split-half. The global IQs are very reliable as are the subtest scaled scores for both males and females. Patterns and profiles may be much less reliable especially with non-white groups. The WAIS-R demonstrates adequate content validity as will also be seen in the review of factor studies to follow. Concurrent validity has been established with the original WAIS, the Woodcock-Johnson Tests of Cognitive Ability (WJTCA) and the Stanford-Binet. Construct validity will remain open to hot debate in the literature of intelligence assessment (e.g., Sternberg, 1979; Gardner, 1983). There is no convincing evidence to suggest that WAIS-R is not a reliable, or valid instrument for the assessment of LDs.

Factor Studies of WAIS-R

The research literature is replete with factor analytic studies of the structure of the WAIS and WAIS-R. Most of these have been consistent with and interpreted from the viewpoint of either the paradigm suggested by Vernon (1950), which includes a general (g) factor and two major group factors, verbal-educational (v:ed), and spatial-perceptual (k:m), or the paradigm suggested by Cohen (1957), which elicited three factors (Verbal Comprehension, Perceptual Organization, and Factor III: Memory, or Freedom from Distractibility). These have been reviewed in detail by Matarazzo (1972). Many of these studies have been replicated with the WAIS-R. These examinations of the interrelationships between the eleven Wechsler tests range from simple and affirmatory to the complex and cautious. To some degree these contradictions reflect the diversity of opinion on the proper use of empirical classification approaches in the behavioral sciences, especially with reference to human traits (Guilford, 1975). Lee and Comrey (1979) have discussed some of these difficulties. Perhaps most disturbing is the common failure to distinguish between exploratory (descriptive) and confirmatory (theory testing) factor analysis. Researchers are advised by Lawley and Maxwell (1971) that "It should always be kept firmly in mind that, except in artificial sampling experiments, the basic factor model is useful only as an approximation to reality, and should not be taken too seriously." (p. 38)

A number of factor analytic studies have now been carried out with the WAIS-R, most using the data from the standardization sample. Silverstein (1982a) used principal-factor analysis for the nine age groups. A two-factor solution was adopted for all age groups, and an additional three-factor solution was computed for the three youngest age groups. The first factor loaded highest the subtests of Vocabulary, Information, Comprehension, and Similarities. The second factor loaded Block Design and Object Assembly. Silverstein concludes that these were essentially the Verbal Comprehension and Perceptual Organization factors previously identified for the Wechsler-Bellevue and WAIS, and believed his findings justified interpretation of the WAIS-R Verbal and Performance global IQs. The third factor, that could be justified for the three youngest age groups, showed inconsistency across the age groups. For the 16 to 17, and 20 to 24-year old age groups it seemed to be the previously described Factor III: Freedom from Distractibility (high loading on Digit Span, Arithmetic, and Digit Symbol); for the 18 to 19 age group, however, the highest loadings were on Picture Completion, Picture Arrangement, and Object Assembly. Silverstein also examined the specific and common variance components for the WAIS-R and concluded that Digit Span, Arithmetic, Picture Completion, Picture Arrangement, Block Design, and Digit Symbol possessed sufficient specific variance to justify specific interpretation.

Silverstein (1982c) subsequently discusses the statistical problems in making multiple comparisons of subtest scores and presents a solution based on the standard error for comparing a subject's score on each of the Verbal or Performance subtests with an average Verbal or Performance subtest score, or the overall average. The differences required for significance at the .05 and .01 levels in comparing WAIS-R subtest scores are presented. (These differences range from 1.8 for Vocabulary at .05, and 4.4 for Picture Arrangement at .01.) These factor analytic studies were replicated with essentially identical findings (Silverstein, 1985).

Parker (1983) also performed a principal-factor analysis of the standardization data followed by a varimax (orthogonal) rotation. For each age group he extracted two, three, and four factors. Parker believes the two-factor solutions reflect the Verbal and Performance divisions. He believes that the three-factor solution produces, with the exception of the 18 to 19 and the 45 to 54-year old groups, the Verbal Comprehension, Perceptual Organization, and Freedom from Distractibility factors found by Cohen (1957) for W-B and WAIS, and by Kaufman (1975, 1979) for WISC-R. Parker reports that the confusion of pattern in the two age groups noted were resolved by the four-factor solution. He found Picture Completion and Picture Arrangement to have high test specificity and probably measure constructs outside the domain of the other subtests (as well as the _g_ factor). This may be a sequencing factor (Bannatyne, 1974).

Blaha and Wallbrown (1982) report another analysis of the standardization data using a hierarchical factor solution. Three factors were identified: a general _g_ factor, with the highest loading on Vocabulary, Information, Similarities, and Comprehension; a major group factor labeled "verbal-educational" which loads highest on Vocabulary, Information, Comprehension, and Similarities; and a minor group factor labeled "spatial-perceptual" which loads highest on Block Design and Object Assembly. Blaha and Wallbrown (1982) believe their results support the construct validity of the WAIS-R as a test of general intelligence. They report that the general intelligence factor accounts for approximately 47% of the total subtest variance for the nine age groups. Blaha and Wallbrown (1982) also support Wechsler's maintenance of separation of the Verbal and Performance IQs. They believe their results also support the cautious use of significant discrepancies between the Verbal and Performance IQs to generate clinical hypotheses; and the cautious use of specific subtest results for clinical hypotheses if the examiner remains cognizant of the limitations involved and treats the hypotheses as tentative. An important observation made by Blaha and Wallbrown (1982) is that the factor structure of clinical groups referred for assessment may be more complex than that of the normals in the standardization sample. They cite WISC and WISC-R studies with LD populations consistent with this possibility.

In a rather ambitious study, Naglieri and Kaufman (1983) subjected the WAIS-R standardization data to three factor analytic procedures: principal-components analysis, factor analysis with iteration of communality estimates, and factor analysis without iteration. In each case, a varimax rotation was used to produce the final factor solution. Their conclusions are that the two- and three-factor solutions are the most defensible for the WAIS-R with the factors being a Verbal Comprehension factor, a Perceptual Organization factor, and, frequently, a Freedom from Distractibility factor. They believe that Factor III should be interpreted when one of the three subtests most often defining Freedom from Distractibility (Arithmetic, Digit Span, and Digit Symbol) deviates significantly (i.e., +4, or -4) from its respective scaled score mean.

A final available factor study of the WAIS-R standardization sample is different in an important way from the one reviewed above. O'Grady (1983) carried out a confirmatory, maximum likelihood factor analysis of the data. He tested four models: orthogonal two-factor, oblique two-factor, orthogonal three-factor, and oblique three-factor. O'Grady concluded from his analysis that none of the models provide a good fit to the data and none of the models are superior to the one-factor _g_ solution.

This is a complex topic beyond the scope of this chapter, but his conclusions obviously depend on acceptance of the appropriateness of using this confirmatory factor analysis model which is not at all straightforward.

A factor analytic study is reported that uses data independent of the standardization group. Insua (1983) studied a large group of white Americans and a large group of Spanish speaking foreign nationals. He used a principal factor analysis and found good support for the three-factor solution in both samples.

Atkinson and Cyr (1984) also conducted a factor analysis of the WAIS-R with a sample of 114 psychiatric inpatients and found a three-factor solution similar to those from studies of the standardization sample. Ryan, Rosenberg, and DeWolfe (1984) identified two factors, Verbal Comprehension and Perceptual Organization, in their research with a very small group of 85 veterans under vocational rehabilitation.

Gutkin, Reynolds, and Galvin (1984) specified the criteria for inclusion of subtests in factors, indicating that for at least five of the nine age levels of the WAIS-R standardization sample there should be a loading of at least .45 on the factor, and the factor should account for at least 20% more variance than any other rotated factor. On the basis of these criteria, they decided to retain two factors: Verbal Comprehension Deviation Quotient (VCDQ) and a Perceptual Organization Deviation Quotient (PODQ). VCDQ is calculated by formula: VCDQ = 1.4 (INFO + VOCAB + COMP + SIM) + 44. The PODQ is calculated by formula: PODQ = 2.8 (BD + OA) + 44. Both of these obtained values can be interpreted like an IQ in that they have a mean of 100 and a standard deviation of 15.

Simple algebraic manipulation of equations would suggest that a Factor III: Freedom from Distractibility Deviation Quotient (FDDQ) could be calculated by the formula: FDDQ approximately = 1.867 (DSYMBOL + ARITH + DSPAN) + 44 to maintain some equivalance for a FACTOR III.

In summary, what should be concluded on the factor structure of WAIS-R? House and Lewis (1985) state that, "The world is a confusing place and answers do sometimes depend on who is asking the question and how they ask it" (p. 345). In general, there seems reasonable, even if not compelling, evidence of the usefulness of recognizing at least a verbal and spatial factor, and perhaps a concentration factor. Also, there is sufficient specific variance among the subtests consistently observed that clinical hypotheses (not conclusions) can be meaningfully formulated for subtest patterns (Silverstein, 1984; Hill, Reddon, & Jackson, 1985; House & Lewis, 1985; Willson & Reynolds, 1985).

Vocational Applications of the WAIS-R

The literature in the field of vocational evaluation and counseling makes regular reference to the individual intelligence test, usually endorsing its use as an instrument to predict the client's potential for reaching a certain educational or occupational level (Maloney & Ward, 1979). Furthermore, the relationship between IQ test scores and occupational level has been documented in many studies. A review of this literature may be found in Matarazzo (1972). Hermann (1982) points out that the standardization data of the WAIS-R shows a moderately strong relationship between mean IQ and occupational level, with a mean spread of 22 points between subjects in occupational groups 1 and 5 (the lowest/highest categories of employed persons that were included in the norms).

The literature of vocational psychology usually makes a gesture toward individual intelligence tests as they relate to educational and occupational guidance, and to a lesser degree to the direction or type of intellectual competency necessary for occupational success (House & Lewis, 1985). Then, however, they generally refer the reader to multiple aptitude (e.g., GATB) or special aptitude tests. Despite this, Lindemann and Matarazzo (1984) observe that the use of the Wechsler Adult Intelligence Scale "is almost universal" (p. 86) in their own extensive familiarity with psychologists and agencies which conduct vocational psychological evaluations. They also state, "It is our opinion that the individual adult intelligence test contributes more to effective career counseling than appears to be recognized in the literature, and that its contribution could be potentially greater, given recognition of this fact and increased systematic investigation of vocational applications" (p. 86).

House and Lewis (1985) also address the contribution that the WAIS-R makes to vocational assessment and planning while at the same time urging caution since little is known about the vocational characteristics of the WAIS-R. In the comprehensive vocational assessment, global ability measures add to the psychological picture obtained by occupational interest tests, personality inventories, and tests of specific skills and aptitudes. They state, "In addition to the global IQ scores obtained from the WAIS-R, the richness of hypotheses that can be obtained from the scaled scores and individual items of the WAIS-R can be invaluable in suggesting potentially profitable lines of inquiry for vocational counseling or for further specific follow-up testing" (p. 363).

The first reference to the use of the Wechsler Adult Intelligence Scale (WAIS) in a specifically vocational context with a handicapped sample is the Drasgow and Dreher (1965) study where the test was an element of a battery used to predict psychiatric client readiness for training and placement in vocational rehabilitation. They found that global IQ scores were predictive of vocational training success and they urged further work in the area.

Lowe (1967) describes a study to determine if the ability of psychiatric hospital patients to become gainfully employed following release could be predicted from the WAIS, MMPI and Rorschach. Only the Block Design subtest of the WAIS even approached significance and Lowe was quite negative in his evaluation of the utility of the WAIS and other tests for prediction of vocational success. Pierce (1968) responds to Lowe and states the study was statistically flawed and in stark contrast to other evidence supporting use of WAIS in vocational appraisal.

Webster (1974) presents the first validation study of the WAIS aimed at prediction of potential achievement on both a clinical and vocational level. He evaluated the relationship between the WAIS Block Design and Object Assembly subtests to six different types of practical work tasks. It was hypothesized that subjects with different types of disabilities would exhibit different predictability patterns on the WAIS relative to their level of proficiency on the actual work tasks. No significant differences were found, but Webster suggested the further use and investigation of WAIS in vocational prediction studies. His design was weak; he had a sample of 160 persons with emotional, physical, psychiatric, and neurological impairments (alone and in combination); and he performed 29 _t_ tests as his only analysis.

Webster (1979) improved his approach in another study by examining the utility of WAIS Object Assembly, Block Design, and global IQs in combination with age, in a group of 180 psychiatric outpatients. Although no significant statistical differences were obtained in a cross-validation procedure indicating that psychiatric disability may have affected the efficacy of the derived regression equations, substantial differences in predictable variance accounted for were found to be related to Full Scale IQ and Performance IQ. The major result of his study is the support it lends for the use of statistical methods to predict vocational success using WAIS.

The Webster (1979) study seems to be the last to specifically address the utility of the Wechsler scales in vocational research. With the advent of the WAIS-R most research with the new instrument tended to examine it in terms of factor structure. Ryan et al. (1984) presented a study to determine WAIS-R factor structure in a clinical sample receiving vocational counseling and job preparation training and compared this structure to that reported by Silverstein for the normative group. He found the robust, previously discussed, two-factor solution for this group

(Verbal Comprehension and Perceptual Organization).

At no time has any researcher attempted to examine the specific vocational characteristics of the WAIS or WAIS-R. Additionally, Ryan et al. (1984) strongly urged in their study that additional investigations into the factor structure of the WAIS-R be undertaken --- especially with psychotic and neurologically dysfunctioning (e.g., LD adult) patient groups in vocational rehabilitation settings.

Research on WAIS-R with LD Adults

Many of the studies which have addressed the utility of the Wechsler tests as diagnostic tools have done so either by examining the individual subtest patterns or by investigating the grouping of subtests. In general, there is also a great deal of research interest in the utility of the Wechsler tests with learning disabled persons. Much of this research has been done with the children's form of the Wechsler (WISC). There has been less dealing with LD adults, the WAIS, or WAIS-R.

One of the most researched areas with the group of adult LDs is in regard to discrepancies between Verbal IQ and Performance IQ. Grossman (1983), and Knight (1983) both studied the standardization sample of the WAIS-R with respect to verbal-performance discrepancies. In general, they provide tables that are consistent with the well known

Wechsler guideline that a difference of 15 or more IQ points should be the point at which further investigation is merited. Frauenheim and Heckerle (1983) have reported the longitudinal study of Verbal-Performance IQ differences in a group of severely dyslexic, LD adults. Average differences of 21 IQ points had been found on the WISC and differences of 19 points on the WAIS-R, with Performance higher than Verbal in both administrations. The Verbal, Performance, and Full Scale IQs were virtually the same after the time lapse of almost 17 years, with Performance IQs within the average to superior classifications. Verbal IQs were in the borderline to average classifications, and Full Scale IQs ranging from low average to average.

The WAIS-R has also been used in the identification of LD adults. Rogers (1982) suggests the use of the WAIS or WAIS-R as part of a comprehensive assessment, including a verbal history, evaluation of graphic skills and of writing skills, and other tests. She believes that the WAIS-R gives "valuable clinical information concerning basic abilities attributable to the status of neurological functioning, independent of prior learning opportunities" (p. 35), including indicators as to right and left brain aptitudes (i.e., visual and auditory sequential memory). The 15 point Verbal-Performance IQ difference, suggested by many others as significant, is also mentioned by Rogers as a possible indicator of LD.

Cordoni, O'Donnell, Ramaniah, Kurtz, and Rosenshein (1981) used the WAIS-R and the WRAT to compare the results from LD and control young adults, particularly in relation to the similarity of results to those commonly found with the WISC and WISC-R. They found that Bannatyne's (1974) Sequential factor, based on Digit Span, Arithmetic, and Coding, discriminated between the groups. The mean for the LD group was 7.1 points below that for the normal group ($p < .001$). These researchers also examined differences on the cluster of tests often referred to as the ACID cluster (Arithmetic, Coding/Digit Symbol, Information, and Digit Span) and found that Digit Span and Coding/Digit Symbol were the most important subtests in this cluster.

In summary, these studies clearly provide documentation of the usefulness of the WAIS-R Verbal-Performance IQ discrepancy, and some profile/pattern indices in the adult LD population; as well as showing some evidence of the comparability of the structure of children's WISC/WISC-R and the adult WAIS-R. Other of these research results reviewed seem to certainly corroborate the continuation of the concept of learning disabilities into adulthood. These studies also corroborate the possibility of identification of learning disability through the use of the Wechsler Adult Intelligence Scale-Revised as part of a complete diagnostic process with young adults.

Research Related to GATB

For half a century, the United States Employment Service (USES) has focused on studying the GATB (USES, 1970, 1980) and various specific occupations to establish GATB predictive norms (Occupational Aptitude Patterns: OAPs) designed to predict differential occupational success (USES, 1979a, 1979b). Over 460 occupations have been job-analyzed, and criterion-referenced with the GATB and OAPs (USES, 1980). Today the General Aptitude Test Battery is the most widely and frequently used multi-aptitude test, and "is without peer in its amount of systematically collected occupational information" (Borgen, 1982, p. 43). Appendix C in the present study contains a complete discussion of the GATB tests, and GATB aptitudes for those unfamiliar with them.

GATB Standardization, Reliability, and Validity

The GATB has been under continuous development since its introduction after World War II (Dvorak, 1947). Forms C and D were introduced in 1981. A Form A of the battery of 12 subtests was initially normed on a broadly representative occupational sample of 4,000. Form B is a parallel form of Form A. The counseling versatility of the GATB is enhanced with separate OAP cutoff scores for adults, ninth and tenth graders. The extensive GATB test-retest reliability data provided by USES (1970, 1979b, 1980, 1983a, 1983b) based on samples of 23,428 show satisfactory levels, ranging up to .90 over three years for Aptitude G (Intelligence) and down to mid .70s over three years for some of the manual performance subtests.

Kujoth (1973) conducted a validity study of the GATB for the educationally deficient and his recommendations were for a less restrictive policy of pre-test coaching and retesting, combined with action research on the effects of remedial education on aptitudes scores. USES undertook such studies and can accommodate special populations such as this with their pre-testing orientation program (USES, 1980).

Hanners and Bishop (1975) conducted a validity study with high school aged vocational students and they found that Aptitude G was the best predictor of success. Also, they found that the best combination of variables for predicting success in vocational classes was the G, N, P, F, and M aptitudes.

Modahal (1981) in his dissertation, studied the GATB aptitude profile in relation to the WAIS for mentally low average and mildly deficient (Aptitude G below 85) and Aptitude S (Spatial) was average or above (S above 100). This was a population of 65 vocational rehabilitation clients in Wisconsin. It was concluded that the results indicated that both Aptitude G and Aptitude S is a fair predictor of WAIS Full Scale IQ and that together they account for 99.6% of the common variance of the WAIS FSIQ.

Briscoe, Muelder, and Michael (1981) conducted a concurrent validity study of the GATB with self-estimates of high school students. No correlation was found in either a large group of males or females who were CETA job training program eligible. Their final recommendations were (a) all secondary level students should have the opportunity to determine their aptitudes with the GATB, and (b) aptitude testing should be made available to male and female special needs students beginning in the ninth grade.

Hakstian and Bennet (1978) is a good example of several studies that examine the concurrent validity other multi-aptitude tests with the GATB as criterion, including in this case, their own Comprehensive Ability Battery (CAB) and the well known Differential Aptitude Test (DAT). This and other similar studies lend strong support for their own aptitude tests when compared to the GATB.

In summary, the GATB test battery itself has satisfactory validity and reliability with many different samples of the working population. There have been no known studies dealing with the GATB in a specifically LD adult or LD adolescent sample, although a dissertation study (discussed below) suggests that it may be appropriate for this type of population since specific profiles may be noted. The research and development arm of the U. S. Employment Service has produced over 500 studies documenting the extent to which GATB predicts future job performance, "making GATB the best validated test battery in existence for use in occupational selection" (USES, 1983a, p. 2). GATB is considered without any serious contention the multi-aptitude battery to which all others are compared. It enjoys in its realm a similar pre-eminence that the WAIS-R enjoys in adult intelligence assessment.

GATB Factor Structure

USES (1983a, 1983b) has undertaken a long term and ongoing study of the underlying dimensionality of the GATB in efforts to find stronger support of its validity claims. They claim "GATB validity generalization research....shows that the GATB is in fact a valid predictor of successful performance for 12,000 jobs" (USES, 1983a, p. 2).

Before the validity generalization solution, a complex, relatively new approach to estimate multiple independent sources of error variance, could be applied, it was necessary to satisfy two assumptions: (a) that the nine individual GATB aptitudes represent some orderly, underlying factor structure; and (b) that the validity evidence reported in other studies could be attributed to these general underlying factors (USES, 1983a). Multivariate procedures were used to confirm these assumptions with samples of over 23,000 demonstrated that the nine GATB aptitudes break into three general clusters:

1. A cognitive factor containing the Aptitude G, V, and N components (Intelligence, Verbal, Numerical) referred to as GVN or the Cognitive Factor.
2. A perceptual factor defined by the Aptitude S, P, and Q components (Spatial, Form Perception, Clerical Perception) known as SPQ or the Perceptual Factor.
3. A psychomotor factor made up of the Aptitude K, F, and M components (Motor Coordination, Finger Dexterity, Manual Dexterity) called KFM or the Psychomotor Factor.

The confirmatory factor analysis studies reported by USES (1982, 1983a, 1983b) present intercorrelation matrices of Aptitudes and Factors. Generally, the cognitive and psychomotor clusters are relatively independent, but both are highly related to the perceptual factor. A multiple regression analysis confirms that performance on the perceptual factor is almost perfectly predicted by the cognitive and psychomotor components. "This pattern of results justified combining the individual aptitudes into these three composites with no appreciable loss of predictive power" (USES, 1983a, p. 4). Correlations for n = 23,428 between the factors are .88 for Cognitive and Perceptual, .75 for Perceptual and Psychomotor, and .46 for Cognitive and Psychomotor.

Evidence confirms that most of the GATB variance is attributable to the general factors. It follows that generalized composites are good predictors of job performance, as they account for most of the variance (USES, 1983a). The GVN cognitive composite explains 80%, the SPQ perceptual composite 79%, and the KFM psychomotor composite 75% of the total GATB variance for nine specific aptitudes (USES, 1983a).

The evidence is strong that the GATB shows three factors spanning two dimensions. The cognitive factor is slightly different from the classic concept of intelligence in that it is distinguished from the perceptual factor. The correlations between the factors and additionally presented data on age and race show the perceptual factor to be perfectly predictable from the other factors and causally dependent on them (USES, 1983b).

"There are two theories relating ability to job performance. Specific aptitude theory asserts that job performance is best predicted by aptitudes that are most similar to the task in the content of the test. Specific aptitude theory asserts that intelligence is only indirectly correlated with job performance because it is correlated with the relevant specific aptitude. General ability theory asserts that job performance is learned as a new aptitude in its own right. Specific aptitudes will be valid only indirectly because they are correlated with general intelligence. The findings of the validation studies carried out by the USES clearly disconfirm the specific aptitude theory and show almost perfect fit for the general ability theory. The only known departure is for artistic and scientific jobs where spatial aptitude is more valid than general perceptual ability" (USES, 1983b, p. 39).

The factor analytic work on which the GATB was originally based has been described in an extensive paper published by the staff of the Division of Occupational Analysis (Staff, 1945). Eight factor analyses were carried out, using a total of 59 tests. Other independent factor studies of the GATB have been conducted. Most notably in this group are Watts and Everitt (1980), and Hammond (1984). Watts and Everitt re-examined the correlational structure of the GATB to determine whether it permits the measurement of nine separate aptitudes, as claimed. They concluded that a three-factor solution was necessary and sufficient to account for the correlation data they observed. Watts and Everitt called the GVN cluster the Symbolic Factor; identical to the USES Cognitive Factor. They called SPQ the Perceptual Factor and the KFM a Psychomotor Factor.

Hammond (1984) looked at the factorial structure of the GATB based on a sample of 1084 working Irish males and females aged 15 to 67 (mean = 26.6). Hammond and his associates re-standardized the GATB for use with Irish peoples at this time. A four-factor structure was found most adequate in this study. The GVN, Cognitive/Symbolic Factor was clear. The SPQ, Perceptual Factor was also clear. But Hammond found good evidence to split the common psychomotor cluster into Finger Dexterity and Manual Dexterity Factors (KF and FM respectively). The differences are considered trivial and lend additional support for the GATB three-factor solution.

One additional study is of considerable interest before we conclude this review of GATB literature. Miller (1977/1978) undertook a dissertation at Auburn University to study the Wechsler Intelligence Scale for Children (WISC) subtest scores as predictors of GATB Occupational Aptitude Patterns (OAPs) for 72 educable mentally retarded (EMR) high school students in an occupational orientation program. Correlational techniques, ANOVA, and linear regression was used in his analysis. It was concluded that (a) the WISC subtest scores for this group were distributed in the same fashion as the subtest scores for the normative sample although the means of the subtest scores for the group were significantly different from the means for the norm group, (b) at least one significant correlation ($p < .05$) was available for each GATB/WISC pair except for GATB Aptitude M, Manual Dexterity, and (c) linear regression based on significant correlations between WISC subtest and GATB aptitude scores did provide information regarding vocational aptitude for individuals in this EMR group. Thus "a unique set of WISC subtest scores existed from which information [i.e., vocational information] other than IQ might be extrapolated" (Miller, 1977/1978, p. 66).

Significant correlations were found by Miller at the .05 level as follows:

1. GATB *G* - Intelligence correlated with WISC Information, Comprehension, and Digit Span.
2. GATB *V* - Verbal correlated with WISC Information, Comprehension, and Digit Span.
3. GATB *N* - Numerical correlated with WISC Information, Arithmetic, Digit Span, and Coding.
4. GATB *S* - Spatial correlated with WISC Comprehension, Picture Arrangement, Block Design, and Object Assembly.
5. GATB *P* - Form Perception correlated with WISC Digit Span and Coding.
6. GATB *Q* - Clerical Perception correlated with WISC Arithmetic, Digit Span, and Coding.
7. GATB *K* - Motor Coordination correlated with WISC Coding.
8. GATB *F* - Finger Dexterity correlated with WISC Coding.
9. GATB *M* - Manual Dexterity had no significant WISC correlations.

Since the primary purpose of the Miller study was to determine if vocational aptitude information might be available from WISC data, his final product was a table by which WISC subtest scores could be converted into GATB adjusted aptitude scores. The table was constructed as a result of a series of bivariate regressions. This table is reproduced here as Table 2.1, but should not be used clinically.

Summary of Chapter II

Chapter II presents a summary of relevant literature related to issues in this study including the concept of adult learning disability, the Wechsler Adult Intelligence Scale-Revised, and the General Aptitude Test Battery.

The present study will investigate the utility of the WAIS-R, relative to the GATB, in predicting vocational aptitude among learning disabled young adults. The issue is relevant and important for the profession of school psychology. The WAIS-R is fully appropriate as a component of adult vocational, and adult learning disability assessment. There is no convincing evidence to not suggest extending the concept of learning disability to the adult population. The GATB is an established, multi-aptitude test well suited for use as the criterion in this study.

Table 2.1

Table for Converting WISC Subtests into GATB Adjusted Scores ($p < .01$)

WISC SUBTEST SCORE	GATB / WISC	G / C	V / I	N / A	S / BD	P / CO	Q / CO	K / CO	F / CO	M / –
10		78	87	84	89	99	101	95	87	–
9		76	86	81	87	96	99	91	85	–
8		73	84	78	85	93	97	88	84	–
7		71	83	75	82	90	95	84	82	–
6		68	81	72	80	87	93	80	80	–
5		65	80	69	78	84	91	76	79	–
4		63	78	66	76	81	89	72	77	–
3		60	77	63	74	78	87	68	75	–
2		58	75	60	72	75	84	64	73	–
1		55	74	57	70	72	82	60	72	–
0		52	72	54	68	69	80	56	70	–
b_{yx}		2.6	1.5	3.0	2.1	2.9	2.1	3.9	1.7	
a_{yx}		52.3	72.0	53.7	67.5	69.2	80.3	56.5	70.0	
SE_m		8.7	5.2	10.4	7.6	15.3	8.8	13.7	13.9	

Note. From "A Study of WISC Subtest Scores as Predictors of GATB Occupational Aptitude Patterns for EMH Students in a High School Occupational Orientation Course" by J. T. Miller, unpublished doctoral dissertation, 1977/1978 p. 95.

Example. With VIQ of 86, PIQ of 75, FSIQ of 79, and selected WISC subtest scores of C(omprehension) = 8, I = 9, A = 7, BD = 7, and CO(ding) = 8. The predicted GATB adjusted aptitude scores were G = 73, V = 86, N = 75, S = 82, P = 90, Q = 95, K = 84, and F = 82. With this data and GATB *Manual* OAPs can be constructed for the subject based on extrapolations of WISC scores.

CHAPTER III

Methodology

This chapter includes a detailed description of the methods that were utilized to investigate the research questions in this study. The chapter is divided into sections that will describe the research conditions, variables, and analytic procedures such that the study may be replicated. A final section will provide a concise summary of the methodology.

Sample

Paired Wechsler Adult Intelligence Scale-Revised (WAIS-R) and General Aptitude Test Battery (GATB) test scores were obtained ex-post-facto from 148 male and female subjects aged 16-years and older. Both tests were given within two week assessment periods between August 1984 and November 1986 at a state supported rehabilitation center.

Program participants were diagnosed as learning disabled (LD) by a multidisciplinary team following the assessment phase. These LD subjects were initially self-referred to this comprehensive rehabilitation center through regional Virginia Department of Rehabilitative Services (DRS) counselors. The participants all had difficulty in getting or keeping employment, and all expected to gain from DRS rehabilitation prior to their referral for assessment in the adult LD program. All subjects selected for this study were voluntary participants in the assessment phase of this adult LD Project (NIH R & D

Project #VA 831008-00226200760) supported in part by the sponsor, Woodrow Wilson Rehabilitation Center (WWRC), and a grant from the National Institute of Handicapped Research (NIH), United States Department of Education.

All subjects participating in the WWRC LD Project assessment phase were administered a model multi-disciplinary battery of tests. This battery included a complete WAIS-R and a complete GATB. The battery also included, over an assessment period of two weeks during which the subjects were residents on the campus of the WWRC, 29 additional tests measuring psychological adjustment, cognitive processes, language, academic, and occupational variables that are being investigated by the WWRC LD Project itself for ultimate utility in adult LD assessment.

Setting

All subjects were participants in the adult LD Project assessment phase sponsored by the Woodrow Wilson Rehabilitation Center (WWRC), Fishersville, Virginia. WWRC, a division of the Virginia Department of Rehabilitative Services, provides services on its campus to over 500 individuals with physical, mental, developmental, and/or emotional disabilities.

The WWRC adult LD Project is a four-year demonstration and research project for improving vocational rehabilitative services to adults with learning disabilities. It involves the combined efforts of the DRS, WWRC, the WWRC Foundation, and the Special Education Department of James Madison University. Any person who is aged at least 16-years, has had difficulty in getting or keeping a job, has a reasonable expectation of benefiting from vocational rehabilitation, has a history of diagnosed learning disability, and who are residents of the USA are eligible for project assessment and/or admission to training.

The goals of the WWRC LD Project are: (a) to identify adult LD needs, (b) to identify barriers experienced by LD adults, (c) to identify contributing factors for successful LD job placement and employment, (d) to develop and evaluate a model diagnostic battery for adult LD, and (e) to develop and evaluate a model vocational rehabilitation treatment plan appropriate for the adult with specific learning disabilities.

Variables

The GATB is a battery of 12 aptitude tests that will provide nine (9) standardized aptitude scores for each of the subjects included in the study. The nine standardized (uncorrected) aptitude scores of the GATB (mean = 100; SD = 20) is one set of variables for this study.

The WAIS-R is a test of intelligence that will provide a total of seventeen (17) standardized scores for each of the subjects included in the study. The eleven (11) standardized WAIS-R subtest scores, plus three (3) WAIS-R IQs, and three (3) WAIS-R factor scores were collected for this study from each subject. The second set of variables for the study are only the 11 standardized subtest scores (mean = 10; SD = 3) of the WAIS-R. The six additional global scores (FSIQ, VIQ, PIQ, VCDQ, PODQ, and FFDQ) collected for each subject will not be used in the primary statistical analyses of the study since they are linear combinations of the original 11 subtest scaled scores.

WAIS-R and GATB variables are all attribute variables since they are measured and not manipulated. Both sets of variables are considered continuous since they are all capable of taking on an ordered set of values within an established range in the respectively defined domains of intelligence and aptitude. Complete descriptions of these variable sets can be found in Appendix B and Appendix C.

Data Collection Procedures

Seventeen (17) WAIS-R subtest scores, and nine (9) GATB aptitude scores were collected for the 148 subjects included in the study. Subtest scores were obtained from the original GATB/WAIS-R test forms in WWRC Central Records Library. Scores were cross-checked for accuracy with WWRC LD Project files, and by computation, but reliability of administration may be a source of error variance of unknown magnitude. Also, WWRC ID#, DOB, DOT, sex, grade completed, state of residence, and disability codes were collected. No individual client names were recorded.

Formal permission was obtained from the WWRC Research Review Committee (RRC) to undertake data collection for this study. A copy of the WWRC-RRC letter of permission for this research is provided in Appendix A.

Analysis of the Data

In order to meet the first major goal of this study, to determine the degree of overlap among constructs estimated by the two sets of variables included in the WAIS-R and GATB, a technique of multivariate, multiple linear regression analysis was employed. This technique is referred to as canonical correlation (e.g., Tatsuoka, 1971; Pedhazur, 1982; Marascuilo & Levin, 1983; Dunteman, 1984).

Conceptually this analysis starts with an equation where the 11 variables for WAIS-R will be on the right side, and the 9 variables for GATB will be on the left side of an equation. The procedure determines the number of significant canonical roots, or variate pairs, which are the maximum possible correlations between weighted linear combinations of the left and right sets. The canonical correlation coefficients between variates will give an index of relationship between underlying constructs in the left (GATB) set of variables and similar underlying constructs in the right (WAIS-R) set of variables. This procedure provides an index of similarity of constructs measured by both WAIS-R and GATB. This analysis was performed by VPI IBM-MVS 3084, and the Statistical Analysis System, Release 5.16 (SAS Institute, 1982).

To answer the second research question of the study, a multiple regression approach was used. To explore a schema by which vocational inferences can be made about WAIS-R scores alone, nine (Backward) multiple regression equations were constructed on WAIS-R based on significant correlations among the 11 subtest scores and the 9 GATB aptitude scores. This analysis was performed with the VPI IBM-MVS 3084 and the Statistical Package for Social Science, Release X:2.1 (SPSS Inc., 1983). Standard descriptive statistics and correlational data are also presented for each of the variables included in the study. Principal component factor analyses are also presented for the GATB set of scores and the WAIS-R set of scores to explore the nature of the tests within a sample of adult LDs.

Summary of Chapter III

Chapter III presents a complete description of the sample, setting, variables, data collection procedures, and analysis of the data for this study.

A sample of 148 adult LD clients involved in the assessment phase of a state supported rehabilitation program was selected. Sets of variables were collected for each of these subjects including 9 GATB aptitude scores and 11 WAIS-R subtest scores for the analysis.

The following two broad research questions were addressed by the study:

1. Is there statistical overlap among constructs measured by WAIS-R and constructs measured by GATB?

   Analysis of data to answer this question involved a canonical correlation analysis of the two sets of variables defined in GATB and WAIS-R.

2. Can linear combinations of WAIS-R subtest scores be used to estimate specific vocational aptitudes?

   Analysis of data to answer this question involved a multiple regression procedure to construct equations to estimate nine dependent variables (GATB) from a linear combination of the independent variables (WAIS-R).

Overall research implications may permit an interested clinician to make valid, vocationally oriented aptitude predictions from WAIS-R test data alone. In general, it may reveal for the first time, and for purposes of theoretical discussion or further investigation, a vocational structure inherent in the Wechsler Adult Intelligence Scale-Revised.

CHAPTER IV

Results of the Study

The results of the analysis of the data for the study are presented in this chapter. Sections are included that present summary information regarding the characteristics of the sample, the characteristics of the GATB and WAIS-R data sets, the nature of the statistical overlap among constructs and, finally, how the eleven WAIS-R subtests relate to the nine aptitudes estimated by GATB. A concluding section will provide a concise summary of the chapter.

Characteristics of the Sample

All subjects were participants in the assessment phase of the WWRC LD Project. There were 145 subjects who participated in the assessment phase of the project and were subsequent participants in the training/treatment phase of the project. There were at least 29 subjects who participated in the assessment phase of the project but were not subsequent participants in the training/treatment phase of the project. From this pool of 174, a total of 148 subjects were selected for the study with the only criterion being that pairs of complete WAIS-R and GATB test scores were available for each subject.

Age Distribution

A mean _test age_ of 20-years with standard deviation 4.0 was manifest in the sample. Subjects ranged from a maximum 42-years to a minimum 16-years. In this sample, 21% were aged 16-17 years, 40% aged 18-19 years, 28% aged 20-24 years, and 10% aged 25-34 years. 89% of sample is contained by the first three age intervals of the WAIS-R standardization.

Gender Distribution

Male subjects accounted for 113 or 76% of the total sample. Female subjects accounted for 35 or 24% of the sample. This distribution represents a 3:1 ratio of men to women. This ratio is typically understood to be the ratio observed in the total population relative to the incidence of specific learning disability (e.g., Vellutino, 1987).

Educational Level

High school graduates accounted for 47% of the total sample (*n* = 69). 40% failed to graduate from high school (*n* = 59), and *n* = 23 attended only elementary school. Only *n* = 4 had any formal post-secondary education. The mean educational level in years was 10.6 with a standard deviation of 1.7-years. Levels ranged from a maximum of 14-years to a minimum of 5-years.

Clinical Disability

All 148 subjects were clients at a state supported rehabilitation facility, and as such their cases were given approved diagnostic codes appropriate to their primary, secondary, and/or tertiary disability. 66% carried "learning disability" as a primary disability (n = 97). Of 51 Ss not having a primary diagnosis of LD, 24 had LD at the second or third level. Thus, 121 subjects (82%) were diagnosed LD. The remaining 18% were distributed among categories as further detailed in Table 4.1.

Preliminary Analysis of The WAIS-R and GATB Data Sets

Preliminary Inspection of Sample WAIS-R Data

The mean Full Scale IQ (FSIQ) for the sample was 85 (SD = 9.1) ranging from a maximum 114 to minimum 66. Mean Verbal IQ (VIQ) was 84 (SD = 9.3) ranging from a maximum 122 to minimum 63. Mean Performance IQ (PIQ) was 89.5 (SD = 12.4) with a maximum 124 and minimum 61. Mean scaled score on the Verbal IQ Scale was 6.78 ($\overline{SD}$ = 2.2). Mean scaled score on the Performance IQ Scale was 8.33 ($\overline{SD}$ = 2.5).

The standardization group for WAIS-R has mean scores for FSIQ, VIQ, and PIQ of 100 (SD = 15) while WAIS-R scaled scores have a mean of 10 (SD = 3). There is some evidence that the sample for the study may be slightly biased particularly with respect to verbal test scores. The sample is broadly within the norm group parameters, but the sample may be over-representative of the low average to borderline level on the WAIS-R intellectual ability continuum.

Table 4.1

Distribution of Clinical Disability Among Sample for First, Second, and/or Third Diagnosis

Diagnostic Category	n %Primary	n %Secondary	n %Tertiary
Learning Disabled	97 66%	22 15%	2 1%
Mild Mental Retardation	17 11%	3 2%	1 1%
Emotional Disorder	15 10%	7 5%	1 1%
Personality Disorder	0 0%	5 3%	0 0%
Brain Injury	5 3%	3 2%	0 0%
Medical Disease	14 10%	40 10%	4 2%
n Total %	148 100%	80 37%	8 5%

Table 4.2 provides WAIS-R means, standard deviations, and standard errors for the eleven variables of interest in the study along with the statistics for the six additional factor scores. Standard deviations and standard errors for all subtests and global scores are characteristic of the trends described by Wechsler (1981) for the WAIS-R norm group, but also tend to be consistently lower in value.

Tables 4.3, 4.4, and 4.5 provide Pearson product-moment correlations among the WAIS-R sample variables and give an index of the magnitude of relationship among these measures. The highest correlation is between Block Design and Object Assembly (.64) and all the sample WAIS-R subtest inter-correlations are low to moderate. This is generally consistent with intercorrelation trends in the WAIS-R standardization groups, but lower (Wechsler, 1981, p. 46).

As discussed in Chapter II, WAIS-R has a well documented structure that typically presents two or three factors depending upon the rotation and sample studied. The standardization group has two factors for all ages (VCDQ and PODQ), and a generally recognized third factor (Factor III or FDDQ) especially for the three youngest age groups (Silverstein, 1982a; Cohen, 1957; Vernon, 1950).

In an effort to examine the factorial characteristics of the sample used in this study, a principal components factor analysis was performed on the 148 sets of WAIS-R subtest scores. Oblique OBLIMIN rotations converged in

Table 4.2

Means, Standard Deviations, and Standard Errors for the Sample WAIS-R Test Scores ($\underline{n}$ = 148)

WAIS-R	MEAN	SD	STD ERROR
INFO: Information	5.96	2.03	0.17
DSPAN: Digit Span	7.12	2.40	0.20
VOCAB: Vocabulary	6.59	2.10	0.17
ARITH: Arithmetic	6.24	1.83	0.15
COMP: Comprehension	7.45	2.57	0.21
SIM: Similarities	7.32	2.37	0.20
PC: Picture Completion	8.57	2.40	0.20
PA: Picture Arrangement	8.82	2.42	0.20
BD: Block Design	8.28	2.53	0.21
OA: Object Assembly	8.82	2.92	0.24
DSYMBOL: Digit Symbol	7.16	2.38	0.19
VIQ: Verbal IQ	83.99	9.34	0.77
PIQ: Performance IQ	89.47	12.36	1.02
FSIQ: Full Scale IQ	85.10	9.12	0.75
VCDQ: Verbal Comprehension Deviation Quotient	82.12	10.32	0.85
PODQ: Perceptual Organization Deviation Quotient	91.69	13.74	1.13
FDDQ/FACTOR III: Freedom From Distractibility Deviation Quotient	82.40	8.61	0.71

Table 4.3

Correlations Among the Sample WAIS-R Subtest Scores (n = 148)

	INFO	DSPAN	VOCAB	ARITH	COMP	SIM	PC	PA	BD	OA	DSYMBOL
INFO	1.00										
DSPAN	.29**	1.00									
VOCAB	.51**	.24**	1.00								
ARITH	.33**	.40**	.34**	1.00							
COMP	.47**	.19*	.60**	.31**	1.00						
SIM	.48**	.24**	.59**	.31**	.52**	1.00					
PC	.18*	.01	.18*	.21**	.31**	.27**	1.00				
PA	.04	.27**	.19**	.22**	.17*	.16*	.38**	1.00			
BD	.02	.11	.25**	.26**	.19*	.22**	.41**	.44**	1.00		
OA	-.03	-.06	.11	.05	.21**	.10	.38**	.26**	.64**	1.00	
DSYMBOL	.16*	.16*	.09	.18*	.08	.20**	.35**	.22**	.21**	.20**	1.00

** $p < .01$

* $p < .05$

Table 4.4

Correlations Among the Sample WAIS-R Global IQ and Factor Scores (n = 148)

	VIQ	PIQ	FSIQ	VCDQ	PODQ	FACTOR III
VIQ	1.00					
PIQ	.34**	1.00				
FSIQ	.82**	.81**	1.00			
VCDQ	.84**	.30**	.70**	1.00		
PODQ	.15*	.78**	.55**	.17*	1.00	
FACTOR III	.61**	.46**	.63**	.35**	.16*	1.00

** $p < .01$

* $p < .05$

Table 4.5

Correlations Among the Sample WAIS-R Global Scores and WAIS-R Subtest Scores ($\underline{n}$ = 148)

	VIQ	PIQ	FSIQ	VCDQ	PODQ	FACTOR III
INFO	.64**	.09	.44**	.75**	.00	.36**
DSPAN	.56**	.13	.42**	.27**	.00	.75**
VOCAB	.71**	.29**	.62**	.83**	.20**	.30**
ARITH	.60**	.28**	.53**	.37**	.15*	.69**
COMP	.70**	.31**	.62**	.82**	.23**	.25**
SIM	.73**	.32**	.64**	.80**	.15*	.34**
PC	.25**	.69**	.55**	.31**	.44**	.26**
PA	.20**	.64**	.51**	.17*	.39**	.34**
BD	.21**	.74**	.58**	.19*	.88**	.26**
OA	.08	.70**	.47**	.12	.89**	.09
DSYMBOL	.18*	.55**	.41**	.15*	.21**	.66**

** $\underline{p} < .01$

* $\underline{p} < .05$

7 iterations and principal components extracted three factors. VARIMAX provided almost identical structure matrices as did OBLIMIN. Table 4.6 presents the OBLIMIN statistics for the sample data set. For purposes of naming and interpretation of each significant factor, only the highest loadings were utilized. Table 4.7 contains the pattern matrix with a list of subtest variables grouped by factor and their loadings on each of the three significant factors. Loadings of a magnitude less than .30 are not printed to assist clarity since they are not meaningful in any substantive sense (e.g., Pedhazur, 1982). Table 4.8 presents the factor correlation matrix for the three significant factors. The three factors account for 60.7% of the total subtest variance extracted by the analysis.

Inspection of these analyses will suggest that the sample of WAIS-R scores used in this study presents the well recognized three factor structure for the WAIS-R standardization group. Factor I extracted seems to fit the _g_, and/or verbal comprehension/verbal educational characteristics. Factor I contained WAIS-R variables Vocabulary, Comprehension, Similarities, and Information. This Factor I (called VCDQ) is identical to that previously described (Blaha & Wallbrown, 1982; Silverstein, 1982a).

Inspection of Factor II in this sample data will

Table 4.6

Eigenvalues and Percent of Common WAIS-R Sample Variance Accounted by Each Principal Component

FACTOR	EIGENVALUE	PERCENT OF VARIANCE
1	3.60297	32.8
2	1.89809	17.3
3	1.17062	10.6
4	.93734	8.5
5	.69360	6.3
6	.63934	5.8
7	.53587	4.9
8	.46291	4.2
9	.45311	4.1
10	.34366	3.1
11	.26249	2.4

Table 4.7

OBLIMIN Pattern Matrix for Sample WAIS-R Subtest Scores

WAIS-R SUBTEST	FACTOR I	FACTOR II	FACTOR III
VOCAB	.82251		
COMP	.81792		
SIM	.76872		
INFO	.74429		
OA		.84833	
BD		.81050	
PC		.66606	
PA		.52224	.46133
DSPAN			.83844
ARITH			.59605
DSYMBOL		.35327	.39283

Table 4.8

OBLIMIN Factor Correlation Matrix for WAIS-R

	FACTOR I	FACTOR II	FACTOR III
FACTOR I	1.00000		
FACTOR II	.16727	1.00000	
FACTOR III	.26515	.19061	1.00000

suggest the generally recognized WAIS-R second factor with the usual perceptual organization/spatial/sequential characteristics. Factor II contained variables of Object Assembly and Block Design, with some element of Picture Completion, Picture Arrangement, and Digit Symbol. Loadings were highest for Block Design and Object Assembly consistent with previous findings for this factor (PIQ/PODQ).

Inspection of Factor III in this sample of subtest data clearly defines the frequently observed third factor for the Wechsler scale. Since Silverstein (1982a) found this factor was justified only in the first three age groups for the standardization, it seems logical that it would be manifested in this sample. Of the 148 cases in this study, fully 89% are contained by the first three age groups (aged 16-17, 18-19, and 20-24 years). The Factor III in this study can be labeled Freedom From Distractibility (called FDDQ) since it contains variables requiring concentration, attention, and sequencing (Digit Span, Arithmetic, Digit Symbol, and Picture Arrangement). Silverstein (1982a) found Digit Span, Arithmetic, and Digit Symbol to load on Factor III for the 16-17 and 20-24 year old groups; he also found these three subtests were joined on Factor III by Picture Arrangement for only the 18-19 year group. In the sample of WAIS-R scores used in this study, 40% of all 148 Ss were aged 18-19 years.

In summary of this preliminary examination of the WAIS-R data sets, it can be said with confidence that the scores closely parallel the factor structure of the standardization group. The subtest intercorrelations and distribution of scores within set are characteristic of the norm groups yet the values are slightly lower in magnitude than expected --- likely due to bias toward the low average verbal IQ levels within this homogeneous adult LD sample.

Preliminary Inspection of Sample GATB Data

A total of 148 sets of GATB aptitude scores were obtained. Mean aptitude scores, standard deviations, standard errors, and minimum and maximum values for the sample are presented in Table 4.9. The standardization group has aptitude means of 100 (standard deviation = 20). It can be seen from inspection of Table 4.9 that the group sampled may be restricted in range. Many of the nine, mean aptitude scores for the sample fall slightly below the first deviation relative to the norm group mean.

This lowered overall mean performance on the GATB tests is most particularly noted in the verbal/cognitive aptitudes (Aptitude G, Aptitude V, and Aptitude N) and to a lesser degree with the psychomotor aptitudes (Aptitude K, Aptitude F, and Aptitude M). Performance on the perceptual/spatial aptitudes (Aptitudes S, P, and Q) seem within expected limits. This observation may suggest

Table 4.9

Means, Standard Deviations, Standard Errors, and Minimum/Maximum Scores for Sample GATB Data Sets (n = 148)

GATB APTITUDE	MEAN	SD	MIN	MAX	STD ERROR
G: General Intelligence	73.14	11.42	50	123	.94
V: Verbal Aptitude	79.22	9.22	51	108	.76
N: Numerical Aptitude	71.57	12.99	42	128	1.07
S: Spatial Aptitude	88.66	17.38	39	130	1.43
P: Form Perception	87.76	18.55	31	125	1.53
Q: Clerical Aptitude	91.45	10.72	65	135	.88
K: Motor Coordination	76.36	18.56	29	120	1.53
F: Finger Dexterity	75.09	24.72	10	125	2.03
M: Manual Dexterity	81.31	27.73	25	143	2.28

that the sample is slightly biased towards the low average or borderline deficient end of the continuum defined by the GATB. This observation may also be consistent with the previously noted mean WAIS-R Full Scale IQ of 85, mean Performance IQ of 98, and mean Verbal IQ of 83.

Tables 4.10, 4.11, and 4.12 contain Pearson product-moment intercorrelations among the nine GATB aptitude scores used in the subsequent data analysis. Table 4.10 contains correlations of the aptitudes among themselves, and Tables 4.11 and 4.12 contain the correlations of GATB aptitude scores with the WAIS-R set of scores. The highest inter-aptitude correlation is between Aptitude G and Aptitude N (.74) and the remainder of the indices describe a high-moderate to low-moderate within set correlation consistent with trends in the GATB norm group (USES, 1970, pp. 34, 269), but generally lower in magnitude. GATB and WAIS-R correlations are all low to moderate; the highest being .62 between Aptitude G and Block Design as to be expected.

As discussed in Chapter II, previous research provides good evidence to reduce the nine GATB aptitudes to three general factors (USES, 1982, 1983a, 1983b; Watts & Everitt, 1980). These factors are the GVN or Cognitive factor, the SPQ or Perceptual factor, and the KFM or PsychoMotor factor. In an effort to examine the factorial characteristics of the study sample, a principal components factor analysis was performed on the 148 sets of GATB scores. Orthogonal VARIMAX rotations converged in 6 iterations and principal components extracted three factors. OBLIMIN rotations converged in 17 interations and did not provide the best three factor fit to the theoretical model. Table 4.13 presents VARIMAX rotation statistics for each of the 9 possible factors. For purposes of naming and interpretation of each significant factor, only the highest loadings were utilized. Table 4.14 contains the VARIMAX rotated matrix with a list of aptitude variables grouped by factor and their loadings on each of the three significant factors. Loadings of a magnitude less than .30 are not printed to assist clarity since they are not meaningful in any substantive sense (e.g., Pedhazur, 1982). Table 4.15 presents the OBLIMIN factor pattern matrix for the three significant GATB factors contained in the sample data set for purposes of comparison only.

Inspection of the VARIMAX rotation suggests that the sample of GATB scores used in this study fairly well presents the known three factor structure for the GATB standardization group. Factor I extracted in this analysis seems to fit the general g factor that has been labeled the Cognitive or GVN factor. Factor I contained the variables of Aptitude G, Aptitude V, and Aptitude N, as expected; but, in this particular GATB sample, it also contained Aptitude Q, Clerical. Factor I accounted for 39% of the common factor variance extracted.

Table 4.10

Pearson Correlations Among Aptitudes of

Sample GATB Data Sets (n = 148)

APTITUDE	G	V	N	S	P	Q	K	F	M
G: GENERAL	1.00								
V: VERBAL	.65**	1.00							
N: NUMERICAL	.74**	.49**	1.00						
S: SPATIAL	.61**	.18*	.32**	1.00					
P: PERCEPTION	.40**	.07	.35**	.43**	1.00				
Q: CLERICAL	.38**	.35**	.48**	.29**	.49**	1.00			
K: MOTOR	.22**	.24**	.28**	.06	.34**	.31**	1.00		
F: FINGER	.16*	-.09	.07	.28**	.42**	.14*	.27**	1.00	
M: MANUAL	.11	-.09	.08	.17*	.37**	.20**	.41**	.63**	1.00

** $p < .01$

* $p < .05$

Table 4.11

Pearson Correlations Among the GATB Aptitude Variables and the WAIS-R Subtest Variables in the Study ($\underline{n}$ = 148)

Variable	APT G	APT V	APT N	APT S	APT P	APT Q	APT K	APT F	APT M
INFO	.48**	.48**	.43**	.29**	.02	.19*	.12	-.13	-.18*
DSPAN	.36**	.35**	.28**	.01	-.01	.07	.21**	.06	.00
VOCAB	.50**	.43**	.36**	.25**	.05	.09	.06	-.11	-.15*
ARITH	.50**	.37**	.55**	.18*	.09	.19*	.16*	-.08	-.09
COMP	.57**	.43**	.33**	.32**	.16*	.12	.11	-.04	-.06
SIM	.46**	.42**	.37**	.27**	.10	.32**	.13	-.12	-.05
PC	.41**	.17*	.26**	.42**	.28**	.24**	.13	.24**	.23**
PA	.38**	.22**	.25**	.52**	.35**	.29**	.08	.25**	.22**
BD	.62**	.28**	.35**	.61**	.44**	.22**	.02	.31**	.21**
OA	.36**	-.14*	.14*	.49**	.49**	.05	-.06	.32**	.21**
DYSMBOL	.28**	.12	.34**	.18*	.44**	.34**	.49**	.24**	.31**

** $\underline{p} < .01$

* $\underline{p} < .05$

Table 4.12

Pearson Correlations Among the GATB Aptitude Variables and the WAIS-R Global IQ and Factor Scores (n = 148)

Variable	VIQ	PIQ	FSIQ	VCDQ	PODQ	FACTOR III
APT G	.64**	.59**	.75**	.60**	.52**	.53**
APT V	.54**	.20**	.47**	.52**	.08	.38**
APT N	.53**	.40**	.56**	.44**	.25**	.53**
APT S	.29**	.63**	.56**	.34**	.60**	.18*
APT P	.05	.55**	.36**	.10	.50**	.25**
APT Q	.20**	.29**	.29**	.22**	.13	.28**
APT K	.22**	.17*	.22**	.12	-.03	.42**
APT F	-.12	.36**	.15*	-.13	.34**	.11
APT M	-.14*	.31**	.09	-.14*	.23**	.13

** $p < .01$

* $p < .05$

Table 4.13

Eigenvalues and Percent of Common GATB Variance Accounted by Each Principal Component

FACTOR	EIGENVALUE	PERCENT OF VARIANCE
1	3.49622	38.8
2	1.86866	20.8
3	1.04219	11.6
4	.76966	8.6
5	.52529	5.8
6	.47590	5.3
7	.39636	4.4
8	.31695	3.5
9	.10878	1.2

Table 4.14

VARIMAX Rotated Factor Matrix for the GATB Sample

GATB VARIABLE	FACTOR I	FACTOR II	FACTOR III
APT G: GENERAL	.76950		.51431
APT V: VERBAL	.82383		
APT N: NUMERICAL	.80712		
APT S: SPATIAL			.83037
APT P: PERCEPTUAL	.31448	.61448	.36628
APT Q: CLERICAL	.62515	.31662	
APT K: MOTOR	.47930	.58979	-.42148
APT F: FINGER		.80551	
APT M: MANUAL		.85835	

Table 4.15

OBLIMIN Factor Pattern Matrix for the GATB Sample

GATB VARIABLE	FACTOR I	FACTOR II	FACTOR III
APT G: GENERAL	.81972		-.35496
APT V: VERBAL	.85945	-.30150	
APT N: NUMERICAL	.83434		
APT S: SPATIAL	.31305		-.72471
APT P: PERCEPTUAL		.62522	
APT Q: CLERICAL	.61257		
APT K: MOTOR	.39652	.46699	.59643
APT F: FINGER		.85931	
APT M: MANUAL		.86443	

OBLIMIN Factor Correlation Matrix

FACTOR I	1.00000		
FACTOR II	.22311	1.00000	
FACTOR III	-.08288	-.03454	1.00000

Factor II extracted in varimax analysis seems to fit the general characteristics of the PsychoMotor or KFM factor described by previous researchers. Factor II contained the variables of Aptitude K, Aptitude F, and Aptitude M as expected; but, Factor II also contained Aptitude P, Perception, and Aptitude Q, Clerical.

Factor III extracted in the analysis is difficult to characterize. Theoretically, it should fit the well recognized Perceptual or SPQ factor described by previous research. However, Factor III in this GATB data set seems to contain only the strong spatial element. Aptitude S loads on this factor and shares variance with no other factor. Aptitude Q does not load significantly on this factor at all, and Aptitude P loads only to a moderate degree.

USES (1982, 1983a, 1983b) note that in the norm groups GVN and KFM are completely independent from each other, yet are highly correlated to the SPQ factor. This may assist in understanding the imperfect third factor in this particular sample.

The three factor solution obtained for the 148 GATB data sets included in this study, however, account for a total of 71.2% of the explained variance.

In summary of the preliminary data analysis regarding the GATB set of variables, a three factor solution is apparent that closely approximates the theoretical structure of the GATB standardization group. This is particularly noted with respect to the GVN or Cognitive factor, and the KFM or PsychoMotor factor. There is less communality among the SPQ Perceptual factor although there is close approximation along a spatial dimension.

The means, standard deviations, and Pearson inter-correlations suggest that the sample GATB data set is broadly representative of the GATB standardization group. There is some suggestion that the GATB sample scores in the study are slightly biased by being restricted in range towards the low average to borderline deficient levels.

Canonical Correlation Analysis of GATB and WAIS-R

There were 148 pairs of GATB and WAIS-R data sets in the analysis. There were nine variables in the left set (GATB). There were eleven variables in the right set (WAIS-R). This yields a variable-to-subject ratio of 7.4. Marascuilo and Levin (1983) and others suggest a ratio 10.0 be the minimum acceptable for the stability of the multivariate correlation coefficients. The ratio 7.4 is considered an appropriate and acceptable approximation to the ideal in that this study constitutes an "exploratory" investigation of the relationship among constructs measured by the GATB and the WAIS-R. Additionally, although the ratio of 10:1 is ideal in a mathematical sense, in the practical sense 7.4:1 is quite high given previous research reported in applied education and psychology literature that use multivariate analysis.

The multivariate, multiple linear regression of data with _k_ independent variables (the right set) and _m_ dependent variables (the left set) is called canonical correlation analysis. The focus of this procedure is on the _Rc_, the canonical correlation coefficient, as it describes the relationship between two independent linear composites (one for the left set and one for the right set) representing "constructs" underlying each set of original variables. It differs fundamentally from factor analysis in that canonical analysis constructs _variates_ that maximize the average of the standardized cross products, the correlation; whereas, factor analysis constructs _factors_ to maximize explained sums of squares, the variance. The "factors" and "variates" from each analysis, however, can be interpreted analogously in substantive meaning.

Table 4.16 provides the canonical correlations between the GATB and the WAIS-R variates with associated statistics for the maximum number of roots (pairs of variates) possible in the data set for this study.

Table 4.16

Canonical Correlations Between the GATB and the WAIS-R

ROOT #	CANONICAL CORRELATION	EIGEN VALUE	PROPORTION OF EIGEN	WILKS' LAMBDA	RAO F	df	CANONICAL SQUARED
1	.874278	3.2434	.5509	.0314	5.85**	99/914	.7644
2	.729039	1.1345	.1927	.1333	3.87**	80/827	.5315
3	.611983	0.5988	.1017	.2845	2.93**	63/738	.3745
4	.574878	0.4936	.0838	.4548	2.35**	48/649	.3305
5	.437979	0.2374	.0403	.6793	1.54*	35/558	.1918
6	.283969	0.0877	.0149	.8405	0.99	24/465	.0806
7	.255759	0.0700	.0119	.9142	0.82	15/370	.0654
8	.131368	0.0176	.0030	.9782	0.37	8/270	.0173
9	.068070	0.0047	.0008	.9954	0.21	3/136	.0046

** $p < .001$ * $p < .05$

Note: The sum of all eigenvalues = 5.8881. Canonical roots 1, 2, and 3 account for a cumulative proportion of 84.53% of the total eigenvalues [e.g., (.5509 + .1927 + .1017) = .8453; and .5509 = (3.2434/5.8881), etc.]. Root 4 accounts 8.4%, and Roots 5 through 9 account for 7% additional.

The minimum criterion for substantive interpretation of the canonical correlations between variates is typically only those with an associated eigenvalue of 1.0 or more. Inspections of this data set and the overall result of the canonical analysis suggest that an additional criteria would be to also include canonical correlations between variates that account for 10% of the sum of eigenvalues [Table 4.16: Note]. This was considered reasonable since the overall result of this analysis (after redundancy analysis) suggest that only 42% of the total variance in the left set (GATB) can be explained by all composites of the right set (WAIS-R) --- when all 9 pairs of possible linear combinations are included (Table 4.22). Only 36% of the variance in the right set (WAIS-R) can be explained by all composites of the left set (GATB) --- with all 9 possible canonical correlations included (Table 4.21).

Inspection of Table 4.16 reveals only the first two pairs of canonical variates have associated eigenvalues of 1.0 or greater. The first pair of canonical variates correlate with each other .87 (Wilks' Lambda = .03, Rao F [99, 914] = 5.85, $p < .0001$). The second pair correlate with each other .73 (Wilks' Lambda = .13, Rao F [80, 827] = 3.87, $p < .0001$). This suggests that there are at least two relatively independent, similar, underlying constructs whose dimensions are estimated by both GATB and WAIS-R.

The first canonical squared correlation between variates suggests that the first root (variate pair) accounts for 76% of variance between the linear composites of GATB and WAIS-R. This is 55% of the sum of all possible eigenvalues (i.e., 3.2438/5.8881). The second canonical squared correlation suggests that the second root accounts 53% of the residual variance among the composites. This explains another unique 19% of sums of eigenvalues. Together these two canonical roots account for a cumulative proportion of 74% of the eigenvalues provided by all 9 possible composites of GATB/WAIS-R variables. [see Table 4.16: Note].

The third canonical correlation is .61 with an associated eigenvalue of 0.5988 (Wilks' Lambda = .29, Rao F [63, 738] = 2.9, $p < .0001$). This vector has a squared canonical correlation that would explain 38% of the remaining variance among composites and could be attributed to a third, underlying construct measured by the original GATB/WAIS-R variables. This explains another 10.2% of the sums of eigenvalues. The first three canonical correlations account for a cumulative proportion of 84.5% of the variance explained (before redundancy analysis) by all possible composites between GATB and WAIS-R.

The fourth canonical correlation is moderately high at .57 (Wilks' Lambda = .455, Rao F [48, 649] = 2.4, $p < .0001$) yet it only explains an additional 8% of all possible eigenvectors. Its eigenvalue is only .4936.

Only the first three canonical correlations will be subjected to structure and redundancy analysis. The first pair of significant canonical variates (composites) will be called GATB1 and WAISR1. The second set are called GATB2 and WAISR2. The third set are GATB3 and WAISR3.

Table 4.17 contains the standardized weights for these three pairs of canonical variates based on correlations among the original WAIS-R and GATB variables. These standardized canonical coefficients can be used to compute "canonical variable scores" from the original GATB and WAIS-R variables. These coefficients are analogous to traditional regression weights and are components of multivariate prediction equations.

Table 4.18 contains the structure (correlation) coefficients between the weights in Table 4.17 for the first three significant canonical variates and their own original standardized GATB or WAIS-R variables.

Table 4.19 contains the structure (correlation) coefficients between the weights in Table 4.17 for the three GATB and WAIS-R canonical variates and each of the GATB and WAIS-R original variables in the opposite set.

Table 4.20 contains the squared multiple correlations between the original WAIS-R and GATB scores and the first, second, and third variates of the opposite set (from Table 4.19; and see Table 4.20: Note).

Table 4.17

Standardized Weights for the Canonical Variates Based on Correlations Among the WAIS-R and GATB Variables

VARIABLE	SET ONE		SET TWO		SET THREE	
	GATB1	WAISR1	GATB2	WAISR2	GATB3	WAISR3
APT G	.5403		-.1391		1.4561	
APT V	.2364		-.3591		-.8133	
APT N	.0204		-.2730		-.2750	
APT S	.3903		.3772		-.9778	
APT P	.1148		.5728		.2716	
APT Q	-.0739		-.0862		-.3090	
APT K	-.0830		-.3158		.4455	
APT F	.0157		.1081		.1318	
APT M	-.0055		.2109		-.1674	
INFO		.3898		-.1258		-.5081
DSPAN		-.0113		-.2566		.5604
VOCAB		-.0642		-.1542		.2287
ARITH		.0693		-.2957		.1979
COMP		.3178		-.0750		.3389
SIM		-.0139		-.1087		-.3571
PC		-.0009		-.0163		.0360
PA		.2014		.3451		-.6293
BD		.6495		-.0721		-.2660
OA		-.0402		.7088		.5334
DSYMBOL		.0210		.0302		.4652
Canonical Correlation	.8743*		.7290*		.6120*	
Canonical *R*-Squared	.7644		.5315		.3745	

* $p < .001$

Table 4.18

Structure/Correlation Coefficients Between the First Three Significant Canonical Variates and Their Original Variables

VARIABLE	SET ONE		SET TWO		SET THREE	
	GATB1	WAISR1	GATB2	WAISR2	GATB3	WAISR3
APT G	.9470		-.1756		.2275	
APT V	.6280		-.6087		-.1664	
APT N	.6440		-.3394		.1628	
APT S	.7934		.4076		-.2656	
APT P	.4627		.5327		.2853	
APT Q	.3646		-.0469		-.2009	
APT K	.1406		-.2006		.4021	
APT F	.2048		.4855		.2278	
APT M	.1066		.4056		.1809	
INFO		.5418		-.4680		-.1409
DSPAN		.3018		-.4383		.3752
VOCAB		.5387		-.3664		.0853
ARITH		.4849		-.4533		.2344
COMP		.6227		-.2378		.2222
SIM		.4975		-.3400		-.1035
PC		.4987		.1938		.0614
PA		.5462		.2995		-.2703
BD		.7790		.3436		.0561
OA		.4800		.7136		.3558
DSYMBOL		.2807		.0707		.4145
Sum of Squares	2.7556	3.0083	1.4091	1.6826	0.5446	0.6613
Proportion Explained	.3062	.2735	.1566	.1529	.0605	.0601

Note: The first three GATB variates account for .5233 cumulative proportion of variance in the original GATB; and the first three WAIS-R variates account for .4865 cumulative proportion of variance in the original WAIS-R. The proportion of variance that each separate variate accounts in its own set is the mean of squared component loadings [e.g., 2.7556/9 = .3062; and 3.0083/11 = .2735].

Table 4.19

Structure/Correlation Coefficients Between the Three GATB and WAIS-R Canonical Variates and Each Original Variable in the Opposite Set

VARIABLE	SET ONE		SET TWO		SET THREE	
	GATB1	WAISR1	GATB2	WAISR2	GATB3	WAISR3
APT G		.8279		-.1281		.1392
APT V		.5490		-.4438		-.1019
APT N		.5631		-.2475		.0996
APT S		.6937		.2971		-.1626
APT P		.4045		.3884		.1746
APT Q		.3188		-.0342		-.1229
APT K		.1229		-.1463		.2461
APT F		.1790		.3540		.1394
APT M		.0932		.2957		.1107
INFO	.4737		-.3412		-.0862	
DSPAN	.2639		-.3196		.2296	
VOCAB	.4709		-.2671		.0522	
ARITH	.4240		-.3304		.1435	
COMP	.5445		-.1734		.1360	
SIM	.4349		-.2478		-.0633	
PC	.4360		.1413		.0376	
PA	.4775		.2183		-.1654	
BD	.6811		.2505		.0343	
OA	.4196		.5202		.2178	
DSYMBOL	.2454		.0516		.2536	
Sum of Squares	2.2995	2.1062	0.8942	0.7491	0.2477	0.2040
Proportion Explained	.2090	.2340	.0813	.0832	.0225	.0227

Note: The first three GATB variates account for .3128 cumulative proportion of variance in the original WAIS-R. The first three WAIS-R variates account for .3399 cumulative proportion of variance in the original GATB. The proportion of variance that each separate composite accounts for in the opposite set is the mean of the squared component loadings.

Table 4.20

Squared Multiple Correlations Between the Original WAIS-R and GATB Scores and the First, Second, and Third Canonical Variables of the Opposite Set

VARIABLE	SET ONE		SET TWO		SET THREE	
	G-1	W-1	G-2	W-2	G-3	W-3
APT G		.6855		.7019		.7212
APT V		.3014		.4984		.5087
APT N		.3171		.3783		.3882
APT S		.4812		.5695		.5959
APT P		.1636		.3145		.3449
APT Q		.1016		.1028		.1179
APT K		.0151		.0365		.0971
APT F		.0321		.1574		.1768
APT M		.0087		.0961		.1084
INFO	.2244		.3408		.3482	
DSPAN	.0696		.1718		.2245	
VOCAB	.2218		.2931		.2958	
ARITH	.1798		.2889		.3095	
COMP	.2964		.3265		.3450	
SIM	.1891		.2506		.2546	
PC	.1901		.2101		.2115	
PA	.2280		.2757		.3031	
BD	.4639		.5266		.5278	
OA	.1761		.4467		.4941	
DSYMBOL	.0602		.0629		.1272	

Note: These data are computed from information contained in Table 4.19 [e.g., .2244 is the square of .4737; and .3408 is -.3412 squared + .2244, etc.].

Figures 4.1, 4.2, and 4.3 are scatterplots with values on the first three pairs of canonical variates for each subject as entries (GATB1*WAISR1; GATB2*WAISR2; GATB3*WAISR3). Inspection suggests strong linear relations.

Table 4.21 contains the results of the canonical redundancy analysis. The redundancy analysis examines how well the original variables can be predicted from the variates. The redundancy measure is important because a very large canonical correlation coefficient could be the result of a very large zero-order correlation of just one variable of one set with just one other variable of the other set. Table 4.21 displays the standardized variance of the WAIS-R subtest scaled scores explained by their own canonical variates, and the opposite canonical variates. Similarly, Table 4.22 displays the standardized variance of the GATB aptitude scores explained by their own, and their opposite canonical variates.

The index of redundancy yields the proportion of variance of the variables of one set that is accounted for by the linear combination of the other set. It is equivalent to the average of the squared multiple correlations of each variable of one set with the linear combination of the other set. The index is an estimate of the amount of overlap each variable had with the linear composite of the other set.

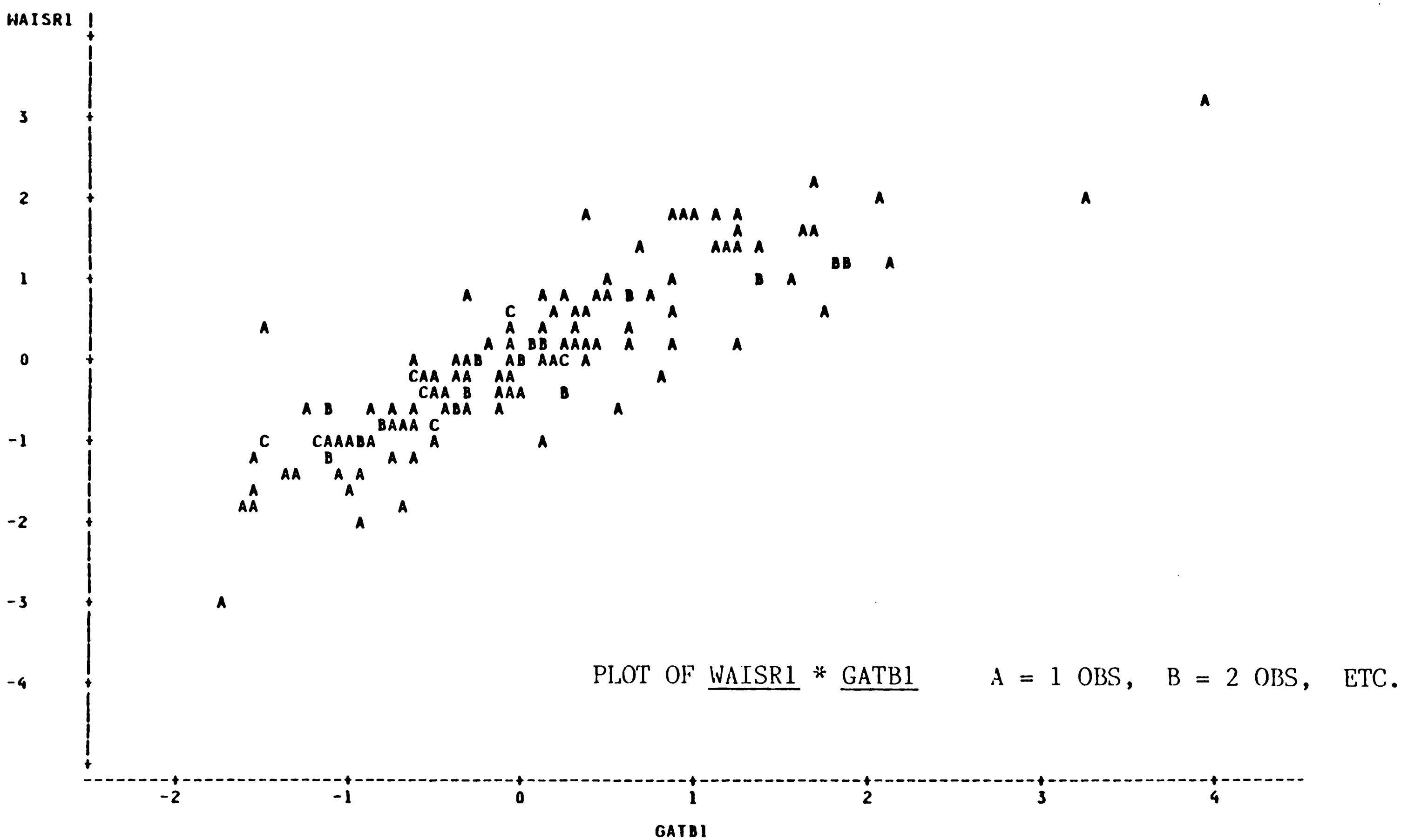

Figure 4.1

Plot of the First Pair of Canonical Variates for the WAIS-R and GATB

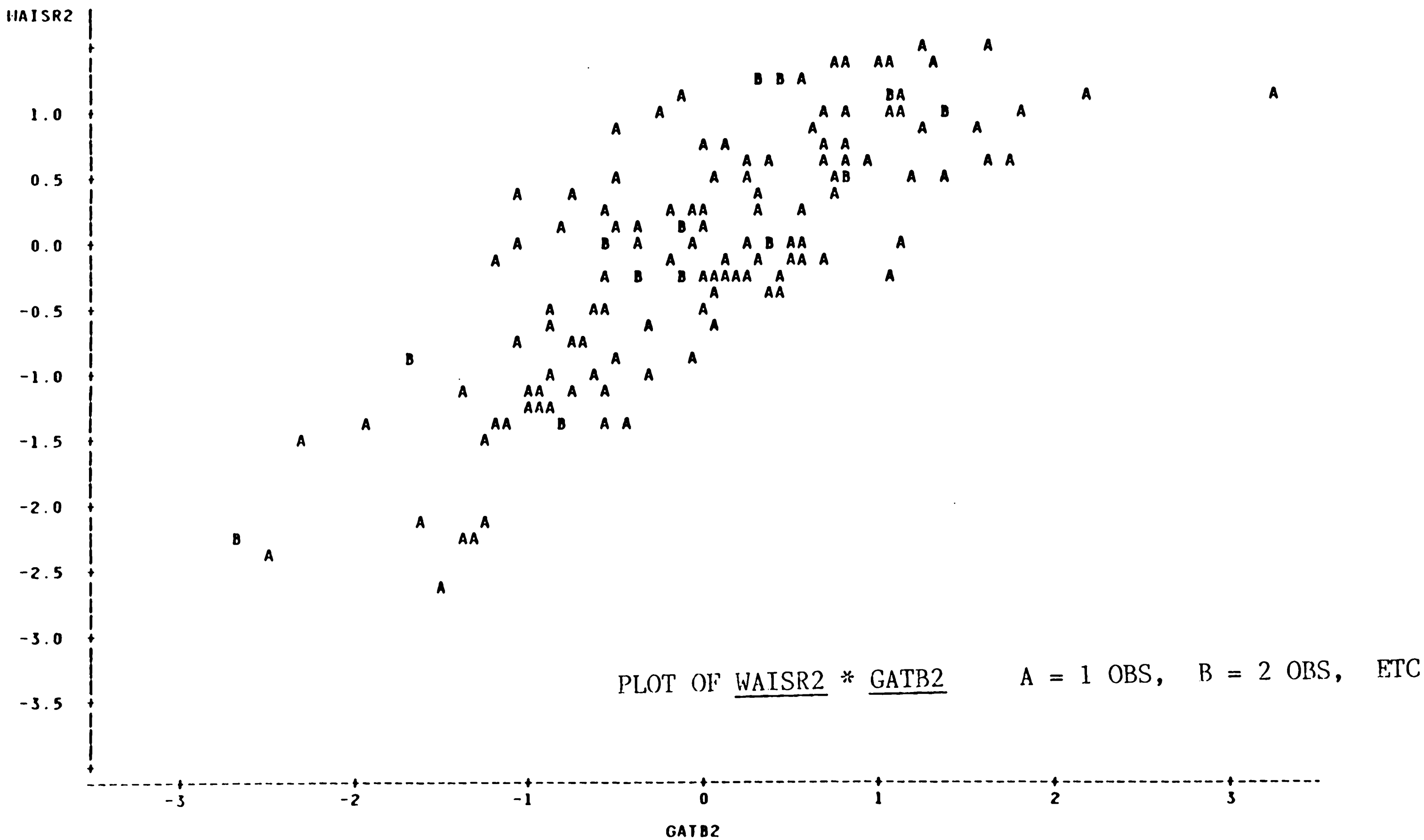

Figure 4.2

Plot of the Second Pair of Canonical Variates for the WAIS-R and GATB

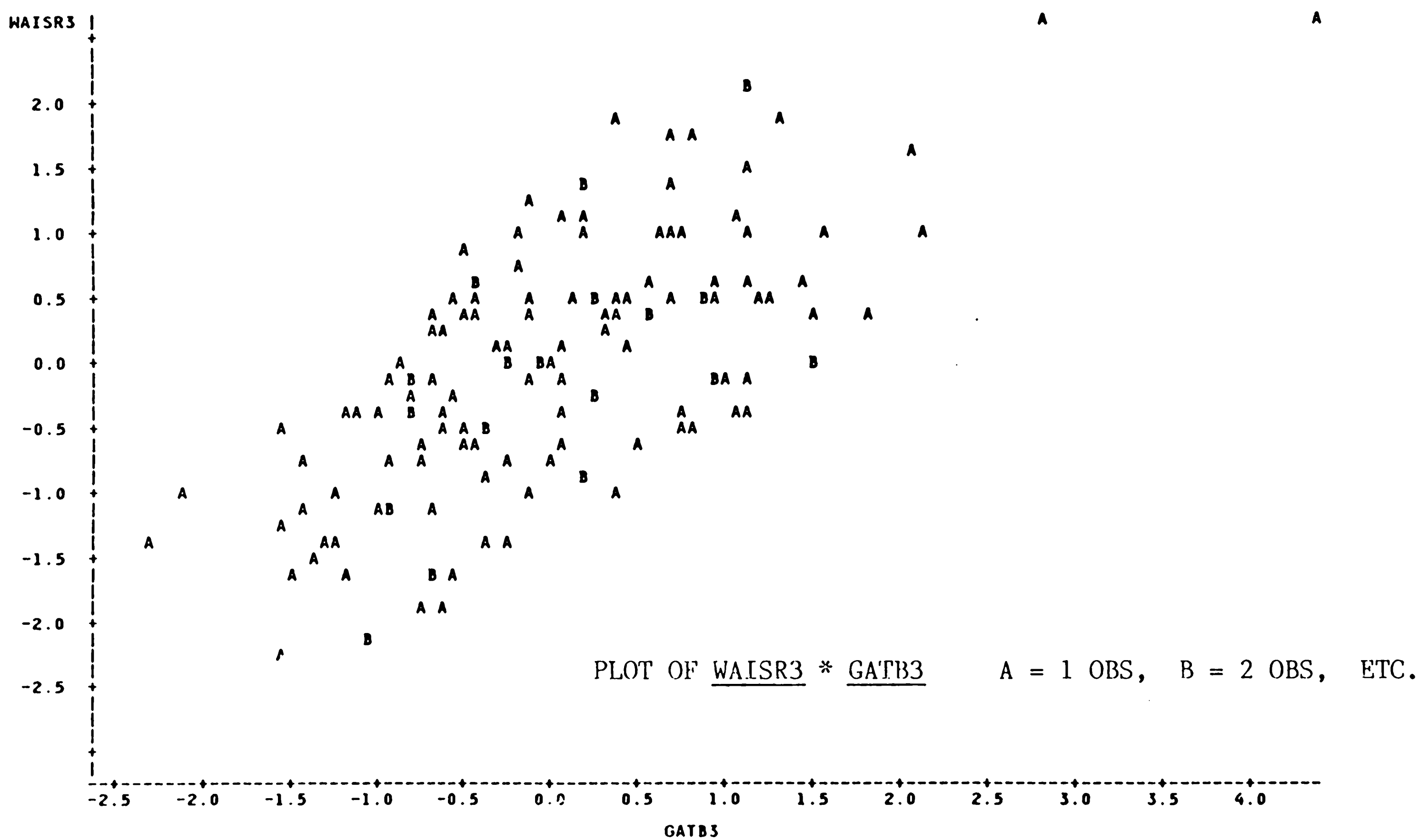

Figure 4.3

Plot of the Third Pair of Canonical Variates for the WAIS-R and GATB

Table 4.21

Standardized Variance of the WAIS-R Subtest Scaled Scores

Explained by

	Their OWN Canonical Variables			The OPPOSITE Canonical Variables	
ROOT	PROPORTION EXPLAINED	CUMULATIVE PROPORTION	CANONICAL R-SQUARED	PROPORTION EXPLAINED	CUMULATIVE PROPORTION
1	0.2735	0.2735	0.7644	0.2090	0.2090
2	0.1529	0.4264	0.5315	0.0813	0.2903
3	0.0601	0.4865	0.3745	0.0225	0.3128*
4	0.0819	0.5685	0.3305	0.0271	0.3399
5	0.0472	0.6156	0.1918	0.0090	0.3490
6	0.0550	0.6707	0.0806	0.0044	0.3534
7	0.0840	0.7547	0.0654	0.0055	0.3589
8	0.0671	0.8219	0.0173	0.0012	0.3601
9	0.0572	0.8791	0.0046	0.0003	0.3603*

* 36.03% is the maximum amount of WAIS-R variance that can be explained by all possible linear composites of GATB; the first three variates explain 31.28%.

Table 4.22

Standardized Variance of the GATB Aptitude Scores

Explained by

	Their OWN Canonical Variables			The OPPOSITE Canonical Variables	
ROOT	PROPORTION EXPLAINED	CUMULATIVE PROPORTION	CANONICAL R-SQUARED	PROPORTION EXPLAINED	CUMULATIVE PROPORTION
1	0.3062	0.3062	0.7644	0.2340	0.2340
2	0.1566	0.4628	0.5315	0.0832	0.3172
3	0.0605	0.5233	0.3745	0.0227	0.3399*
4	0.1736	0.6969	0.3305	0.0574	0.3973
5	0.0848	0.7817	0.1918	0.0163	0.4136
6	0.0392	0.8208	0.0806	0.0032	0.4167
7	0.0713	0.8922	0.0654	0.0047	0.4214
8	0.0514	0.9435	0.0173	0.0009	0.4223
9	0.0565	1.0000	0.0046	0.0003	0.4225*

* 42.25% is the maximum possible variance of GATB scores that can be explained by all possible linear composites of WAIS-R scaled scores. The first three variates account for a total of 34%.

Analysis of redundancies of the first three pairs of canonical composites showed that the variance of the WAIS-R subtest scaled scores explained by their own canonical variates is 48.65%. The amount of variance in WAIS-R subtest scaled scores explained by the first three GATB variates is 31.28%. 36.03% is the maximum amount of WAIS-R variance that can be explained by all possible linear composites of GATB. Generally, it can be said that the constructs estimated by GATB aptitude scores overlap (explain) only to a fair degree constructs estimated by the WAIS-R subtest scores.

Analysis of the redundancies of the first three pairs of canonical composites showed that the variance of the GATB aptitude scores explained by their own canonical variates is 52.33%. The amount of variance in GATB aptitudes explained by the first three WAIS-R variates is 33.99%. 42.25% is the maximum possible variance of GATB scores that can be explained by all possible linear composites of WAIS-R scaled scores. Generally, it can be said that constructs estimated by WAIS-R scaled scores overlap (explain) only to a fair degree constructs measured by the GATB aptitudes.

Analysis of the structure coefficients for the first three pairs of canonical variates will reveal the contributions of the original individual variables to each variate. Analysis of the contributions of the individual variables to the first pair of canonical variates shows that the highest loadings were obtained on general cognitive tests that tap *g* and/or verbal comprehension. This is highly similar to the first factor of both the GATB and the WAIS-R (GVN and VCDQ) extracted by Principal Components (PC). On GATB1 the highest loadings were Aptitude G (.9470), and Aptitude V (.6280) and Aptitude N (.6440). Aptitude S (.7934) also loads onto this variate. On the WAISR1 variate the highest loadings were for Information (.5418), Vocabulary (.5387), Comprehension (.6227), and the best non-verbal estimate of *g*, Block Design (.7790). The first pair of canonical variates therefore seems to define a strong verbal comprehension or *g* dimension that underlies both the GATB aptitude scores and WAIS-R scaled scores moderately well.

On the second pair of canonical variates, variables of WAIS-R and GATB that involve spatial elements and/or have strong visual/motor demands obtained the highest loadings. On GATB2 Aptitude F (.4855) and Aptitude M (.4056) loaded moderately well. Also Aptitude P (.5327). On WAISR2 Block Design (.3436) and Object Assembly (.7136) loaded. WAISR2 is clearly the same as PODQ extracted in the PC factor analysis. The second pair of canonical variates seems to define a moderately strong perceptual organization and/or motor coordination dimension that underlies both the GATB and WAIS-R.

On the third pair of canonical variates, variables of WAIS-R and GATB that involve visual analysis, speed and/or attention/concentration loaded highest. On GATB3 Aptitude S (.2656), Aptitude P (.2853), and Aptitude Q (-.2009) loaded best. Aptitude K (.4021) also loaded moderately well. On WAISR3 Digit Span (.3752), Arithmetic (.2344), and Digit Symbol (.4145) loaded highest. This third set of canonical variates seems to moderately to poorly define a visual analysis/speed/attention-concentration dimension that underlies both the WAIS-R and the GATB.

WAISR1 correlates highest with GATB Aptitude G (.8279), Aptitude V (.5490), Aptitude N (.5631), and Aptitude S (.6937). WAISR2 correlates highest with GATB Aptitude P (.3884), Aptitude F (.3540), Aptitude S (.2971), and Aptitude M (.2957). WAISR3 correlates highest with GATB Aptitude K (.2461), Aptitude F (.1394), and Aptitude M (.1107).

From these structure coefficients/correlations it can be generally said that the WAIS-R set of scores is an overall moderate to poor predictor of GATB aptitudes. Although the GATB and WAIS-R seem to have similar underlying dimensions (three significant roots/factors), these dimensions are composed of somewhat independent sources of variation that overlap to a much lesser degree than was anticipated. As stated earlier, 33.99% of the variance in GATB aptitude scores can be explained by the first three composites of WAIS-R subtest scores; and 42.24% of GATB can be explained by all possible configurations of WAIS-R subtest scores.

Results of the Multiple Regression to Predict GATB Aptitudes from WAIS-R Subtest Scores

In an effort to examine further how WAIS-R subtests relate to GATB aptitudes, a series of multiple regression equations were generated to predict each of the nine GATB aptitudes from some set of WAIS-R subtest scaled scores. This will serve as a way to compare the regression equation loadings to the canonical structure of the variates. At the same time, it will provide a much more straightforward way to estimate GATB aptitudes from a linear combination of WAIS-R subtest scaled scores.

A backward selection strategy for the regression was selected since it is most economical. That is, it starts with all WAIS-R variables in the equation and sequentially removes one variable at a time until a parsimonious linear combination that maximizes explained variance (R Squared) is achieved. The results of this regression are presented in Table 4.23 and Table 4.24.

Table 4.23

Backward Regression Analysis Predicting GATB Aptitudes from WAIS-R Subtest Scaled Scores

GATB APTITUDE	MULTIPLE *R*	*R*-SQUARE	STD ERR	*df*	*F*
G: General	.846	.716	6.20	5/142	71.4*
V: Verbal	.728	.530	6.43	5/142	32.1*
N: Numerical	.681	.464	9.64	4/143	31.0*
S: Spatial	.767	.588	11.35	5/142	40.6*
P: Perception	.625	.390	14.64	3/144	30.7*
Q: Clerical	.488	.238	9.48	4/143	11.2*
K: Motor	.530	.281	15.90	3/144	13.8*
F: Finger	.445	.198	22.45	4/143	8.8*
M: Manual	.445	.198	25.27	5/142	7.0*

* $p < .0001$

Table 4.24

Backward Regression Beta Weights for WAIS-R Subtests to Predict GATB Aptitudes

	APT G	APT V	APT N	APT S	APT P	APT Q	APT K	APT F	APT M
INFO	.254**	.295**	.277**	.338**	--	--	--	--	--
DSPAN	.118*	.119	--	-.215**	--	--	.120	--	--
VOCAB	--	--	--	--	--	-.174	--	--	-.194*
ARITH	.150**	--	.373**	--	--	--	--	-.158	-.152
COMP	.289**	.278**	--	--	--	--	--	--	--
SIM	--	--	--	--	--	.345**	--	-.189*	--
PC	--	--	--	--	--	--	--	--	--
PA	--	--	--	.360**	.177*	.215**	--	--	.148
BD	.505**	.548**	.214**	.370**	--	--	--	.341**	.174*
OA	--	-.527**	--	.161*	.377**	--	-.148*	--	--
DSYMBOL	--	--	.183**	--	.327**	.240**	.503**	.238**	.285**
R-SQUARE	.716	.530	.464	.588	.390	.238	.281	.198	.198
CONSTANT	26.424**	58.767**	28.259**	30.231**	36.332**	69.768**	50.006**	57.588**	57.996**
STD ERR	6.196	6.426	9.640	11.350	14.635	9.483	15.899	22.454	25.267

** $p_t < .01$ * $p_t < .05$

The results of the multiple regression suggest that the prediction equations may be unsuitable for clinical use. The standard errors of the estimate range from 6.2 for Aptitude G, to 25.3 for Aptitude M. Only Aptitude G: General Intelligence is 71.6% explained by the combination of WAIS-R subtests (Information, Comprehension, Block Design, Arithmetic, and Digit Span) --- and this does not address the redundancy as does the canonical analysis. Other squared multiple correlations range from only .59 for Aptitude S to .20 for Aptitudes F and M.

Generally speaking, the GATB GVN cognitive factor appears to be best accounted by combinations of WAIS-R subtests. The Information, Comprehension, and Block Design subtests contribute most to this GATB dimension. The GATB SPQ spatial/perceptual factor is best accounted by combinations of Picture Arrangement, and Object Assembly. The GATB KFM psychomotor dimension is best accounted by WAIS-R on the Digit Symbol subtest, and to some degree on Block Design, and as a supressor, Arithmetic. The WAIS-R Vocabulary, Similarities, and Picture Completion subtests display little or no ability to explain GATB aptitudes. The WAIS-R Block Design, Digit Symbol, Information, Object Assembly, and Picture Arrangement subtests contribute most to the explained variance of GATB aptitudes.

Summary of Chapter IV

The results of the data analysis are presented in Chapter IV. The 148 GATB and WAIS-R sample data sets closely approximate their respective standardization groups with respect to distribution, factor structure, and intercorrelations. The sample is 82% adult LD, and 3:1 male.

The results of the canonical correlation analysis suggests that 33.99% of the variance in GATB aptitude scores can be explained by three significant canonical composites of WAIS-R subtest scaled scores. Similarly, 31.28% of the variance in WAIS-R subtest scaled scores can be explained by three significant canonical composites. Thus, the WAIS-R is only a fair predictor of GATB aptitude.

There are, however, very similar underlying constructs in both the GATB and WAIS-R. They do not overlap significantly, but they are clearly along the same dimensions. The first underlying construct seems to be a very strong verbal comprehension, or _g_ dimension. This construct is reflected best on the WAIS-R Information, Vocabulary, Comprehension, and Block Design subtests; and in the GATB on Aptitude G, Aptitude V, and Aptitude N. The second underlying construct seems to exhibit moderately strong perceptual organization and/or motor coordination elements. This is reflected best on the WAIS-R Block Design and Object Assembly subtests; and in the GATB by the Aptitude F, Aptitude M, and Aptitude P. The third construct is a spatial/visual-speed/attention dimension that is reflected in WAIS-R Digit Span, Arithmetic, and Digit Symbol; and in GATB on the Aptitude S, Aptitude P, and Aptitude Q.

The results of the regression analysis to predict individual GATB aptitudes from combinations of WAIS-R subtest scaled scores suggests that this strategy should not be used clinically due to large error variance. Generally speaking, the GATB GVN cognitive factor appears to be best accounted by combinations of the Information, Comprehension, and Block Design subtests. The GATB SPQ spatial/perceptual factor is best accounted by combinations of Picture Arrangement, and Object Assembly. The GATB KFM psychomotor dimension is best accounted by WAIS-R on the Digit Symbol subtest, and to some degree on Block Design, and as a supressor, Arithmetic. The WAIS-R Vocabulary, Similarities, and Picture Completion subtests display little or no ability to explain GATB aptitudes. The WAIS-R Block Design, Digit Symbol, Information, Object Assembly, and Picture Arrangement subtests contribute most to the explained variance of GATB aptitudes.

CHAPTER V

Discussion and Recommendations

Chapter Five presents a review of the purpose and the results of the study with a discussion of findings relative to the literature, and relative to implications for the profession of school psychology. A final section contains recommendations for future research in this particular area of measurement using the GATB and the WAIS-R.

Summary of the Study

The purpose of the study was (a) to investigate from an exploratory standpoint the amount of overlap among constructs estimated by the GATB and constructs estimated by the WAIS-R, and (b) to provide an exploratory schema by which the WAIS-R standardized scaled scores could be validly interpreted from a perspective of vocational aptitude. This could assist psychologists providing multi-dimensional assessment services for young adult LDs.

The fundamental question addressed in the study was to what extent could a psychologist interested in making initial, exploratory vocational aptitude predictions rely on traditionally available psychometric data such as that contained in sets of WAIS-R intellectual ability estimates. All subjects were participants in an adult learning disability vocational rehabilitation assessment phase at a state supported rehabilitation facility. There were

N = 148 subjects with full sets of GATB and WAIS-R test scores included in the analysis. Mean test age for the sample was 20 years with 76% of the sample being male, and 82% diagnosed as learning disabled (LD).

Eleven WAIS-R standardized subtest scaled scores and nine GATB standardized uncorrected aptitude scores were the variables of interest collected ex-post-facto for each subject. Both test batteries were given to subjects by certified examiners within a two-week assessment period that was a step in each subject's application for admission to vocational training at the rehabilitation center.

The following research questions were proposed for the investigation and will serve as a framework for summarizing concerns, findings and conclusions.

1. Is there statistical overlap among constructs measured by WAIS-R and constructs measured by GATB?

   Analysis of data to answer this question involved a canonical correlation analysis of the two sets of variables defined in GATB and WAIS-R.

2. Can linear combinations of WAIS-R subtest scores be used to estimate specific vocational aptitudes?

   Analysis of data involved a multiple regression procedure to construct parsimonious equations that estimate GATB Aptitudes from a combination of WAIS-R subtest scaled scores.

In addition to these analyses, distribution statistics and correlational data were presented with respect to the sample for each of the 20 variables under study. Principal component factor studies of GATB and WAIS-R data sets were undertaken to estimate the degree to which the data reflect known characteristics of the standardization groups.

<u>Summary Findings Regarding WAIS-R</u>

Examination of the distribution of WAIS-R data suggests that the sample mean subtest scaled score for the verbal scale is 6.78 ($\overline{SD}$ = 2.2) which is slightly below the first deviation for the standardization groups (mean = 10; SD = 3). The sample mean for the performance scaled scores is 8.33 ($\overline{SD}$ = 2.5) which is not significantly different from the mean of the standardization groups. As would be expected from these observations, the mean Verbal IQ for the sample under study was 84 (SD = 9.3), the mean Performance IQ was 90 (SD = 12.4), and mean Full Scale IQ was 85 (SD = 9.1). Standard deviations and standard errors associated with each of the WAIS-R means calculated are slightly lower than observed for standardization groups (Wechsler, 1981, p. 33).

Correlational data for the WAIS-R sample suggests that intercorrelations within set are generally low between verbal and non-verbal tests, and moderate for scores within each scale. The correlations, overall, are consistent with trends noted in the standardization groups, yet consistently lower in magnitude, especially for verbal/non-verbal tests.

Factor analysis of the WAIS-R sample data set reveals the well documented three factor solution that includes the Verbal Comprehension and Perceptual Organization factors, as well as Factor III (Vernon, 1950; Cohen, 1957; Silverstein, 1982a; Gutkin, Reynolds, & Galvin, 1984). Degree of fit for this oblique three factor model seems to be convincing by criteria discussed by Gutkin et al. (1984) and most closely approximates the model described by Silverstein (1982a). Factor I contained variables of Vocabulary, Comprehension, Similarities, and Information and accounted for 33% of the common variance extracted. Factor II contained variables of Block Design and Object Assembly, to a much lesser degree Picture Completion, Picture Arrangement, and Digit Symbol, and accounted for an additional 17% of common variance. Factor III contained the Digit Span, Arithmetic, and Digit Symbol subtests typically found, as well as Picture Arrangement which would be expected for the 18-19 age group (40% of this sample).

Summary Findings Regarding GATB

Examination of the distribution of sample GATB data reveals that the mean aptitude score for the GVN or Cognitive cluster of aptitudes was 75 ($\overline{SD}$ = 11.7); for the SPQ or Perceptual cluster the mean was 89 ($\overline{SD}$ = 15.6); and for the KFM or Psychomotor cluster the mean sample aptitude score was 78 ($\overline{SD}$ = 23.7). The GVN and KFM test clusters seem to be significantly lower than observed in the GATB standardization (each GATB aptitude mean = 100; SD = 20). The SPQ cluster in the sample data more consistently reflect the GATB standardization with respect to mean performance. Mean standard deviations and standard errors, particularly with respect to Aptitudes G, V, and N are lower than expected based on the norms (USES 1970; 1980).

Correlational data for the GATB set of scores in the study suggests that aptitudes within set are all low to moderate and consistent with trends in the GATB norm group. The GVN cluster of aptitudes in the sample correlates least with the KFM cluster, yet both are moderately related to the SPQ cluster. This correlational finding is consistent with the GATB standardization groups (USES, 1983a, 1983b). Correlational data for the GATB aptitudes and WAIS-R subtests are all low to moderate with GVN and WAIS-R Verbal Scale most highly related; SPQ is moderately related to WAIS-R Performance Scale; and KFM is generally independent from WAIS-R except for a few low moderate correlations with the Performance Scale.

Principal Component VARIMAX rotation factor analysis of the GATB sample data yields the best three factor solution consistently found with norm groups (Hammond, 1984; Watts & Everitt, 1980; USES, 1983b). Factor I extracted for the GATB sample data reflects the cognitive GVN factor together with some elements of Aptitude Q, Aptitude P, and Aptitude K. Factor I accounts 39% of common explained variance. Factor II reflects the KFM or psychomotor factor with Aptitudes K, F, and M loading significantly --- also to some degree Aptitude Q, Clerical, and Aptitude P, Form Perception. Factor II accounts another 21% of common variance. Factor III in the GATB sample is less easy to characterize; it does not neatly fit the expected SPQ perceptual factor. Factor III of the sample contains Aptitude S, Spatial exclusively, and it contains some element of Aptitude P, but also Aptitude G. It does not load Aptitude Q at all. Factor III accounts another 12% of explained common factor variance.

Summary Findings Regarding GATB/WAIS-R Overlap

The overlap of constructs measured by GATB and WAIS-R was the first major research question for this study. This overlap was estimated by use of a multivariate, multiple linear regression technique known as canonical correlation analysis. Three significant canonical correlations were interpreted as meaningful. The first canonical correlation (Rc = .87) between variates accounts 55% of the common variance that is explained with all possible GATB/WAIS-R composites. This construct is clearly *g* or a verbal comprehension factor whose structure coefficients reveal WAIS-R Information, Vocabulary, Comprehension, and Block

Design to load most significantly along with GATB Aptitudes G, V, N, and S. The second significant canonical correlation (Rc = .73) accounts 19% of variance explained by all possible composites. This is clearly a perceptual organization and/or motor coordination factor that loads most highly the WAIS-R scores from Block Design and Object Assembly, and from GATB Aptitudes F, M, P, and S. The third significant canonical correlation between variates (Rc = .61) accounts an additional 10% of variance explained by all composites. This root loads most highly tests that reflect a spatial/visual-speed/attention dimension underlying both GATB and WAIS-R. GATB Aptitudes S, P, Q, and K load most highly on this pair of variates along with WAIS-R scores from Digit Span, Arithmetic, and Digit Symbol.

Analysis of the redundancies (unique overlap) of these first three pairs of canonical composites show, however, that the original variance in the sample WAIS-R subtest scaled scores explained by their own WAIS-R canonical variates is 49%. The amount of variance in the sample WAIS-R subtest scaled scores explained by the three significant GATB variates is only 31%. Generally, it can be said that the constructs estimated by GATB aptitude scores overlap (explain) only to moderate degree constructs estimated by the WAIS-R subtest scores from an LD sample.

Analysis of the redundancies (unique overlap) of the first three pairs of canonical composites showed that the variance of the original GATB aptitude scores explained by the GATB canonical variates is 52%. The amount of variance in original GATB aptitude scores explained by the first three WAIS-R variates is 34%. Generally, it can be said that the constructs estimated by WAIS-R scaled scores overlap (explain) only to a moderate degree constructs measured by the GATB aptitudes scores from an LD sample.

Summary Findings Regarding the Multiple Regressions

In an effort to examine further how WAIS-R subtests relate to GATB aptitudes, a series of multiple regression equations were generated to predict each of the nine GATB aptitudes from some parsimonious set of WAIS-R scores. The results of the backward multiple regressions suggest WAIS-R is an unreliable clinical predictor of GATB aptitudes and as such the associated equations would not be suitable for categorical use. Standard errors of the estimate range from 6 for Aptitude G, to 25 for Aptitude M.

Generally, the GATB GVN cluster of tests appears to be best accounted by WAIS-R Information, Comprehension, and Block Design subtests, with some elements of DSPAN and ARITH. The GATB SPQ cluster of tests is best accounted by combinations of Picture Arrangement, Object Assembly, and some elements of DSYMBOL. The GATB KFM test cluster is best accounted by Digit Symbol on the WAIS-R, and to some degree by BD and ARITH. Squared multiple regression coefficients range from .72 for prediction of Aptitude G from WAIS-R, to .20 for prediction of Aptitudes F and M from various WAIS-R subtest composites. These findings are broadly consistent with the findings of the WISC/GATB study conducted by Miller (1977/1978) discussed in Chapter II. The regressions also certainly confirm the findings of Modahal (1981) that GATB Aptitudes S and G are the better predictors as they account much of the variance extracted.

Discussion of Findings

Methodological Issues

There are some methodological issues relative to this study and its sample that will necessarily impact the findings. The primary limitations of this study are: (a) the variable-to-subject ratio of 7.4, and (b) the restricted, homogeneous sample of young adult LDs.

Canonical correlation takes advantage of sample-specific co-variation among variables (Pedhazur, 1982). Canonical correlation produces redundancy statistics that are biased with small samples (i.e., $n < 10[p + q]$). This number-of-subjects issue is arbitrary despite the convention suggested. Regardless, the purpose of the larger sample is to reduce the chances of capitalizing on sample-specific co-variation, which will inflate the estimate of the overlap between the GATB and WAIS-R. Although the sample in this study is less than the 10:1 recommended in the mathematical literature, the operation of a strong positive bias seems unlikely, especially in relation to the relatively small magnitude of the redundancy obtained (about one-third). Also, the analysis seems to have provided at least two, and perhaps three correlations that are stable given the amount of unique variance they account, and given the pattern of original variables that load on the variates --- they would seem to be consistently interpretable. This sample ratio of 7.4:1 is also at least as high, if not higher, than the typical subject/variable ratio reported for a substantial number of multivariate studies in the current educational-psychological literature. (e.g., Estabrook, 1984). Overall, the sample size for this study is considered more than adequate to answer the exploratory research questions.

Restriction in range as applied to test scores means that the scores for a particular group are concentrated in a small portion of the possible range. In statistical language, these groups have smaller standard deviations. The scores may be heavily concentrated in some particular range in the domain of possible score distributions. As such, the correlations among scores <u>may</u> be lower for this group than within a group not so restricted.

Examination of the means and other measures of central tendency and dispersion for GATB and WAIS-R scores in this study does suggest the sample is restricted in range. Mean WAIS-R Full Scale IQ, Verbal IQ, mean verbal scaled scores, and their associated standard deviations and errors are all significantly lower than values obtained for the norm group. Sample WAIS-R within set correlations are all lower in magnitude than for the norm groups. The conclusion is that the WAIS-R sample in the study is biased towards low average, borderline verbal ability (Wechsler, 1981). This can be frequently associated with LD, dyslexic samples (e.g., Vellutino, 1987).

Examination of the GATB means and associated statistics for the sample similarly reflect a restriction in range particularly for the GVN, Cognitive, and KFM, PsychoMotor clusters of tests. Relative to the means of the standardization groups, mean performances and standard deviations on GVN aptitude tests are significantly lower than reported for the norm groups. Mean KFM aptitude scores are also lower, but also are less precise based on the large standard deviations for this LD sample. Within set correlations are also lower than expected relative to the norm group. This is consistent with the findings for WAIS-R Verbal and Full Scale IQs.

In summary, this study has adequate sample size to explore the underlying constructs in GATB and WAIS-R and to estimate the nature of their redundancy with some reliability. However, given the homogeneous LD sample, it seems reasonable to suggest that the magnitude of relationships extracted in this study may be underestimates of the true values for a sample not so restricted. Given the intent of this study to explore the characteristics of WAIS-R and GATB relative to the LD adult, and not make selection decisions based on inferences from the data, the restriction in range issue need only be acknowledged.

Issues Relative to the GATB and the LD Adult

There have been no previous studies which examine the GATB within a sample of learning disabled. Principal components of GATB scores within this sample of adult LDs fairly well describes the three dimensions of GATB aptitude previously documented in the norm groups (USES, 1982; 1983a; 1983b; Hammond, 1984; Watts & Everitt, 1980). The GVN, SPQ, and KFM factors are all discernible, as is the mutual independence of the Cognitive and Psychomotor factors, and their strong relatedness to the Perceptual factor. G is clearly the best predictor of IQ (Hanners & Bishop, 1975). The individual aptitude loadings on the sample factors, however, are not fully consistent with the norm groups. This is particularly noted on the SPQ and KFM factors. This may suggest that some aptitude tests (particularly those measuring Aptitudes Q, and Aptitude P)

are not necessarily valid with LD adults. These aptitudes tend to correlate highly with the Cognitive factor or PsychoMotor factor as well as with the Perceptual factor to which they typically belong (USES, 1983a).
But also, this finding among tests that assess perceptual, and visual analysis aptitude is not surprising considering the known difficulty that LDs present with these skills (Buchanan & Wolf, 1986).

As stated previously, mean performance on GVN and KFM aptitudes are lower for the LD group, while SPQ is within normal limits. This implies restriction in range, yet it may also imply that GATB may underestimate the vocational aptitude of LD adults in the area of general cognitive and/or psychomotor ability. It may imply that GATB scores alone, would be inappropriate estimates of these aptitudes among LDs, and thus inappropriate for use alone to make selections for employment or training among LDs.

Issues Relative to the WAIS-R and LD Adults

Means and standard deviations for the WAIS-R sample data from the group of adult LDs is interesting to examine closely. Mean Full Scale (85) and Verbal (84) IQs are clearly low average for the LD sample, but mean Performance IQ of 90 is not significantly different from norm group expectations. The Verbal Comprehension factor and Factor III are also low average (both 82) while the Perceptual

Organization factor is clearly average (92). There are no significant (i.e., +/- 3) mean differences between any of the six subtest mean scaled scores and the overall mean of the verbal scale (6.8). Similarly, there are no significant mean differences between five performance scale scores and the mean of its scale (8.3). Mean Verbal IQ and Performance IQ significant differences are not observed as expected (Frauenheim & Heckerle, 1983), although the trend to significantly lower Verbal IQ may be present.

These findings are not in keeping with the usual conventionalizations regarding the typical "profile" of the LD individual (e.g., Performance IQ significantly lower than Verbal IQ; or a particular subtest score significantly lower than others within set; or etc.). It is interesting to speculate that a large difference between Verbal and Performance IQs, with verbal being lower, as noted in this sample, may indeed be more frequently observed with the adult LD (Frauenheim & Heckerle, 1983). Vellutino (1987) strongly suggests that the common beliefs about LD stemming from primarily visual perceptual deficits is in error. LD in adulthood is most likely seen clinically as a subtle language deficiency as a consequence, perhaps, of limited facility using language to code other types of information. Given this perspective, low mean verbal IQ within an adult LD sample may not be all that surprising. Similarly, other researchers, notably Buchanan and Wolf (1986), and Byring and Pulliainen (1984), consistently observe in LD adults a lack of organization ability and continued psychomotor difficulty. These LD behaviors may be reflected in the sample mean score for Factor III, Freedom from Distractibility which is certainly low relative to expectation based on the norm groups.

This is speculation only since Kavale and Forness (1984), in their meta-analysis of over 90 studies related to global and subtest Wechsler score interpretation, clearly suggest that "patterns" are best avoided; and particularly in complex clinical groups (Blaha & Wallbrown, 1982). Additionally, it is necessary to consider the possibility that the lower overall Verbal, and Factor III scores in this LD sample are due to other sources of systematic variance such as a selection bias; that is, "experimentally accessible population vs. target population" bias. The self selected sample may NOT be best labeled LD at all. Rather, the sample may better be labeled as "culturally disadvantaged" or simply "chronic unemployed, handicapped."

Issues Relative to the GATB/WAIS-R Overlap

The overall findings in terms of the one-third redundancy between GATB and the WAIS-R, suggest that the WAIS-R and GATB do share at least two strongly similar underlying constructs of cognitive ability, and most likely a third: (a) verbal, (b) perceptual organization/motor, and (c) psychomotor/attentional. This seems reasonable given the known factor structure of the GATB and WAIS-R norm groups, and given the moderate to strong approximation to that structure revealed in the principal components of the GATB and WAIS-R data sets in this study.

The results of the canonical analysis show that, for this sample, the amount of overlap between the WAIS-R and the GATB appears to be much less than was anticipated on the basis of early estimates provided by squaring bivariate and canonical correlations among variables, and also given the theoretical similarity in principal factor structures. Only 34% of GATB aptitude variance is redundant with (predictable from) linear combinations of WAIS-R subtest scores. These findings, support a conclusion that for young adults experiencing learning difficulties these two tests appear to be measuring similar cognitive abilities but that significant differences may exist in the kinds of behavior sampled by the specific tests (Appendix B, and C).

The results of the canonical correlation analysis do not "neatly" fit the theoretical model expected based on known factorial characteristics of the respective standardization groups. For purposes of illustration, the theoretical model for <u>GVN</u> might look something like <u>GVN</u> = [INFO + VOCAB + COMP + SIM], or <u>GVN</u> = VCDQ = <u>g</u>. The model extracted by canonical correlation in this adult LD sample seems to suggest that *g* = GVN[S] = [INFO + VOCAB + COMP + BD]. Similarly the theoretical model for *SPQ* might be *SPQ* = [BD + OA], or *SPQ* = PODQ. But, the sample model seems to be better illustrated as *SP* = [DSPAN + ARITH + DSYMBOL], or *SP* = FACTOR III. The theoretical model for *KFM* might have been *KFM* = [DSPAN + ARITH + DSYMBOL] = FACTOR III given its psychomotor characteristics, but the sample LD data suggests that FM[PS] = [BD + OA], or FM[PS] = PODQ.

The *g* dimension, or *GVN* is clearly the best estimated by linear composites of LD WAIS-R scores. Although WAIS-R and GATB have certain elements in common, the results of this analysis clearly suggest that a substantial portion of the variance in these two test batteries is independent in LD samples. Or, that for young adults with learning disabilities *these two tests appear to estimate similar, but independent dimensions of the same cognitive abilities*.

Using the Cattell (1963) model of fluid *vs*. crystallized ability for illustration purposes, it may be appropriate based on these findings that GATB should be thought of as a test of crystallized (concrete) ability or aptitude. The WAIS-R may be better conceptualized as a measure of fluid intelligence (ability to solve problems). The GATB *may* tap crystallized intelligence to a greater extent than the WAIS-R, and/or WAIS-R *may* tap fluid intelligence to a greater extent than the GATB. Thus, there is 34% redundancy in constructs but since specific behaviors measured by the component tests differ significantly, the unique overlap is not more substantial. These two sets of tests may provide different information on the same three underlying constructs.

From another perspective, however, the 34% redundancy between WAIS-R and GATB may not, in fact, be particularly poor. Matarazzo (1972), Zimmerman and Woo-Sam (1973), Wechsler (1981), and Sprandel (1985) report or review vast numbers of WAIS and WAIS-R validity studies that examine these tests relative to other tests, and other constructs such as achievement. Variance in these variables that is accounted by Wechsler scores alone varies from about 25% to 75%. The correlation, for example, between WAIS/WAIS-R and Stanford Binet LM generally is about .85; and with other tests of intelligence the correlations average approximately .75. The correlation between WAIS/WAIS-R and a construct such as school achievement is generally .50. None of these studies utilize canonical correlation to examine the redundancies so the unique explained variance may be even lower. Estabrook (1984) performed a canonical correlation analysis between the WISC-R and the WJTCA (Woodcock Johnson Tests of Cognitive Ability) and found that 28.6% of WJTCA is redundant (predictable from) three linear combinations of WISC-R. In light of these findings, the overlap in this LD sample is moderately good.

In summary of the overlap issue, WAIS-R is probably at least as good a predictor of vocational aptitude as any other non-vocationally oriented test, if not significantly superior, particularly when paired with achievement data, or as a component of a full examination (Rogers, 1982).

Strengths of the Study and Implications for Practice

Lindemann and Matarazzo (1984) cite that the WAIS-R is almost universal in clinical use with a wide variety of persons; including, in their own experience, persons seeking vocational guidance. They state that the WAIS-R can contribute to effective career counseling more than is generally recognized in the literature. This confidence in the WAIS-R as a potential contributor in exploratory vocational assessment is echoed by House and Lewis (1985): the "richness of hypotheses" available from WAIS-R, they state, are "invaluable in suggesting profitable lines of inquiry for further vocational counseling." (p. 363)

These WAIS-R hypotheses have generally been based on clinical judgement more than vocationally oriented research with the WAIS-R (Ryan et al. 1984). The Miller (1977/1978) dissertation study of WISC relative to the GATB seems to have been the only pure attempt to look at the Wechsler scales from a vocational perspective. The results of the Miller study are presented fully in Chapter II. However, the general findings of the Miller study of WISC/GATB in an MR sample, are similar to the general findings of GATB/WAIS-R in this LD sample; that is, similar Wechsler subtests load on the regression equations for each of the GATB aptitudes. The major contribution of the present study was to examine for the first time sets of WAIS-R and GATB scores relative to each other so that this "richness of hypotheses" described by House and Lewis (1985) and called for by Ryan et al. (1984) can begin to be empirically based. The study also contributes to the further examination of GATB and WAIS-R scores as they may reflect characteristics of an adult learning disabled population in a vocational rehabilitation setting.

It can be said with some confidence that the WAIS-R performs adequately in the LD population given the factor structure of the sample data. WAIS-R is also a fair to moderate predictor of vocational aptitude based on its redundancy with the GATB. The predictions have some psychometric reliability, but generally poor clinical reliability. That is, inferences made about vocational aptitude potential based on WAIS-R scores alone are <u>un</u>suitable for selection or placement decisions, but are certainly acceptable as starting points for further vocational exploration. This is an excellent way for psychologists in the schools to contribute to making educational <u>and</u> vocational options available to students.

The results of the study do provide an initial strategy for examining traditionally available data such that school psychologists, in particular, need not turn to highly specialized tests to generate vocational exploration hypotheses (Levinson & Shepard, 1982; Shepard & Levinson, 1985) that will address the many unique, and demanding, vocational needs of LD students (Cohen, 1985; Bingham, 1978, 1980, 1981; Kendall, 1980, 1981; and White et al., 1980).

It can also be claimed with some confidence that this study provides good evidence to support the extension of the concept of LD into adulthood, as well as the continued clinical use of WAIS-R with adult LDs; at least as a component of a multi-dimensional assessment (Rogers, 1982). Factor structure for the LD sample on the WAIS-R is essentially identical to the norm groups and best fits the three factor model described by Silverstein (1982a), or the two factor model described by Gutkin et al. (1984). The data from this study certainly demands attention to the notion that the factor structure of clinical groups may indeed be more complex than for the norm groups (Blaha & Wallbrown, 1982). There is also some evidence that low Verbal IQ and FACTOR III scores relative to perceptual-performance ability may be correlated to adult LD. This seems reasonable given the continued psychomotor problems observed in adult LDs (Kendall 1980, 1981) and especially given Vellutino's (1987) comment that LDs appear to be language deficient as well as and in ability to retrieve linguistic representations stored in memory. There is also some evidence to suggest that WAIS-R may be a better estimate of fluid intelligence than it is of crystalized ability (Cattell, 1963; Estabrook, 1984).

This study presents good evidence that the GATB may not be fully appropriate for vocational decision making with adult LDs. The factor structure of the LD sample for the GATB offers only a reasonable approximation to the structure of the norm groups. There is evidence that certain aptitudes, particularly Aptitude Q, Clerical, and Aptitude P, Form Perception may offer inappropriate estimates among LDs. Aptitudes G, General Intelligence, and S, Spatial are clearly the overall best predictors of IQ (Modahal, 1981; Hanners & Bishop, 1975) as well as Aptitudes V, Verbal, and N, Numerical. But, GATB may well underestimate the true aptitude of adult LDs particularly relative to verbal and psychomotor clusters of cognitive abilities. There is also some evidence to suggest that the GATB is a better estimate of crystalized ability or aptitude than it is of fluid ability or aptitude.

In general, the implications for practice are that school psychologists must begin to address the vocational needs of secondary level special education students. In particular, the needs of LD students are the most difficult to properly address and are often overlooked. In order to circumvent the "series of ongoing psychological processes that become interrelated with various aspects of ego functioning and development" (Cohen, 1985, p. 178) psychologists must recognize the impact of vocational immaturity among LDs (Bingham, 1980), and begin to address the need for early vocational guidance (Kendall, 1981). This study provides an initial understanding of the vocational characteristics of the WAIS-R in a sample of LD young adults such that psychologists might easily make exploratory inferences about the vocational aptitudes of their students. Diagnostic, final inferences about vocational aptitudes from WAIS-R data alone is not, however, recommended based on the results of this study.

Recommendations for Future Research

Conclusions from this research lend themselves to further investigation and substantiation with the broad population of young adult LDs. It would be important to verify the generalizability of this study's findings relative to the canonical correlations between WAIS-R and GATB with a cross-validation on an independent sample of LDs. It would also be very interesting to examine the GATB/WAIS-R overlap in a larger, heterogeneous sample to explore the magnitude and direction of relations extracted without the restriction in range. Additionally, a sample from a secondary level public school setting might be more appropriate than another sample taken from a state supported rehabilitation facility. Although it is felt that generalization to the population of adult LDs enrolled in such vocational rehabilitation is possible, this group is not specifically typical of LD groups found in public school settings. Overall, the magnitude of relations found in this study are thought to be underestimates of relations that may be found in a more typically heterogeneous LD sample from a secondary public school setting.

It is important to cross-validate the principal components found in the GATB factor analysis on an independent sample of LDs. This would help to determine if the findings obtained were sample specific or generalizable to the population of adult LD. Certainly more research is needed before the GATB can be reliably considered inappropriate for the adult LD as might be suggested from this study involving LD subjects in vocational rehabilitation. The specific characteristics of the GATB within the broader LD population remain essentially unknown.

Unaddressed in this study were the composite WAIS-R variables of VIQ, PIQ, FSIQ, VCDQ, PODQ, or FACTOR III. This was because they are linear combinations of the original subtests, but an examination of GATB relative to the Global and Factor scores of WAIS-R would certainly be helpful in further understanding of the vocational characteristics of the Wechsler scales. Similarly, GATB raw scores from the 12 individual subtests, and/or three composite mean scores for the generalized factors GVN, SPQ, KFM might prove interesting dependent variables to study relative to the WAIS-R, rather than the standardized uncorrected aptitude scores.

Important also would be an inquiry into the validity and reliability of making specific occupational inferences based on particular composites of WAIS-R scores. That is, what kind of specific occupations or, more likely, what groups of occupations may be appropriately suggested based on particular WAIS-R performances? At this point, only very broad hypotheses can be made --- such as "good" or "fair" potential for success in occupations requiring verbal comprehension; or potential for success in occupations requiring perceptual organization or motor aptitude; or in occupations requiring spatial/ visual-speed/attentional aptitudes. An inquiry into how specific combinations of WAIS-R scores could estimate GATB composite scores, for example, would be especially helpful in this regard. Generating vocationally oriented recommendations based on WAIS-R scaled scores might then go beyond initial, exploratory hypotheses for a planned career development, and take on a higher degree of reliability and validity for clinical screening with a broader population.

BIBLIOGRAPHY

Atkinson, L., & Cyr, J. J. (1984). Factor analysis of the WAIS-R: Psychiatric and standardization samples. Journal of Consulting and Clinical Psychology, 52, 714-716.

Bannatyne, A. (1974). Diagnosis: A note on recategorization of the WISC scaled scores. Journal of Learning Disabilities, 7, 272-274.

Barbaro, F. (1985). Support services for the learning disabled college student. Social Work, 30(1), 12-18.

Bingham, G. (1981). Exploratory process in career development: Implications for LD students. Career Development in Exceptional Individuals, 4, 77-80.

Bingham, G. (1980). Career maturity of learning disabled adolescents. Psychology in the Schools, 17, 135-139.

Bingham, G. (1978). Career attitudes among boys with and without learning disabilities. Exceptional Children, 44, 341-342.

Blaha, J., & Wallbrown, F. H. (1982). Hierarchical factor structure of the WAIS-R. Journal of Consulting and Clinical Psychology, 50, 652-660.

Borgen, F. H. (1982). General Aptitude Test Battery. (review.) In J. T. Kapes, & M. M. Mastie, A counselor's guide to vocational guidance instruments. Falls Church, VA: American Association for Counseling and Development.

Briscoe, C. D., Muelder, W., & Michael, W. B. (1981). The concurrent validity of self-estimates of abilities relative to criteria provided by standardized test measures of the same abilities for a sample of high school students eligible for participation in a CETA program. _Educational and Psychological Measurement_, _41_, 1285-1093.

Brolin, D. E. (1976). _Vocational preparation of retarded citizens_. Columbus, OH: Charles E. Merrill.

Brolin, D. E. (1973). Vocational evaluation: Special education's responsibility. _Education and Training of the Mentally Retarded_, _39_, 619-624.

Brolin, D. E., & Kolstoe, O. P. (1978). _The career and vocational development of handicapped learners_. Columbus, OH: The ERIC Clearinghouse on Adult, Career, and Vocational Education.

Brolin, D. E., & Kokaska, C. J. (1979). _Career education for handicapped children and youth_. Columbus, OH: Charles E. Merrill.

Brown, D. T. (1981). A synthesis and review of the conference for school psychologists on vocational education for handicapped students. In T. H. hohenshil, & W. T. Anderson (Eds.), _School psychological services in secondary vocational education: Roles in programs for handicapped students_. Blacksburg, VA: Virginia Tech

University, in cooperation with the Virginia State Department of Education, and the NASP National Committe on Vocational School Psychology. (ERIC Reproduction Number ED 215245), pp. 96-99.

Brown, L. S. (1982). Vocational assessment for learning disabled students. In T. H. Hohenshil, W. T. Anderson, & J. F. Salwan (Eds.), Secondary school psychological services: Focus on vocational assessment procedures for handicapped students. Blacksburg, VA: Virginia Tech University. (ERIC Reproduction Number ED 229704), pp. 13-17.

Buchanan, M., & Wolf, J. S. (1986). A comprehensive study of learning disabled adults. Journal of Learning Disabilities, 19(1), 34-38.

Byring, R., & Pulliainen, V. (1984). Neurological and neuropsychological deficiencies in a group of older adolescents with dyslexia. Developmental Medicine and Child Neurology, 26(6), 765-773.

Cato, C., & Rice, B. D. (1982). Report from the study group on rehabilitation of clients with specific learning disabilities. St. Louis, MO: National Institute of Handicapped Research.

Cattell, R. B. (1963). Theory of fluid and crystallized intelligence: A critical experiment. Journal of Educational Psychology, 54, 1-22.

Cohen, J. (1985). Learning disabilities and adolescence: Developmental considerations. Adolescent Psychiatry, 12, 177-196.

Cohen, J. (1983). Learning disabilities and the college student: Identification and diagnosis. Adolescent Psychiatry, 11, 177-198.

Cohen, J. (1957). The factorial structure of the WAIS between early adulthood and old age. Journal of Consulting Psychology, 21, 283-291.

Cook, L. D. (1979). The adolescent with a learning disability: A developmental perspective. Adolescence, 14, 697-707.

Cooper, S. (1982). The clinical use and interpretation of the Wechsler Intelligence Scale for Children-Revised. Springfield, IL: Charles C. Thomas.

Cordoni, B. K., O'Donnell, J. P., Ramaniah, N. V., Kurtz, J., & Rosenshein, K. (1981). Wechsler adult intelligence score patterns for LD young adults. Journal of Learning Disabilities, 14, 404-407.

Cowen, S. (1985). College choice for LD students: Know your "SWIS." Academic Therapy, 21(1), 77-82.

Dawis, R., & Lofquist, L. (1968). Minnesota studies in vocational rehabilitation: A theory of work adjustment. (Volume 23). Minneapolis, MN: Industrial Relations Center, Work Adjustment Project, University of Minnesota Press.

Decker, T. W., Polloway, E. A., & Decker, B. B. (1985). Help for the LD college student. Academic Therapy, 20(3), 339-345.

Drasgow, J., & Dreher, R. G. (1965). Predicting client readiness for training and placement in vocational rehabilitation. Rehabilitation Counseling Bulletin, 8, 94-98.

Dulcan, M. K. (1985). The psychopharmacologic treatment of children and adolescents with ADD. Psychiatric Annals, 15(2), 69-86.

Dunn, L. M. (Ed.). (1973). Exceptional children in the schools: Special education in transition. New York: Holt, Rhinehart, and Winston, Inc.

Dunteman, G. H. (1984). Introduction to multivariate analysis. Beverly Hills, CA: Sage Publications Inc.

Dvorak, B. J. (1947). The new USES General Aptitude Test Battery. Occupations, 26, 42-44.

Erikson, E. H. (1968). Identity: Youth and crisis. New York: W. W. Norton.

Estabrook, G. E. (1984). A canonical correlation analysis of the WISC-R and the WJTCA in a sample referred for suspected learning disabilities. Journal of Educational Psychology, 76(6), 1170-1177.

Fafard, M., & Haubrick, P. A. (1981). Vocational and social adjustment of learning disabled young adults. Learning Disability Quarterly, 4, 122-130.

Fagan, T. K. (1981). Role expansion in the eighties: Counseling and vocational school psychology. NASP Communique, 9(6), 1-2.

Flynn, R. J., & Nitsch, K. E. (1980). Normalization, social integration, and community services. Baltimore, MD: University Park Press.

Frank, G. (1983). The Wechsler enterprise: An assessment of the development, structure, and use of the Wechsler tests of intelligence. New York: Pergamon Press.

Frauenheim, J. G., & Heckerle, J. R. (1983). A longitudinal study of psychological and achievement test performance in severely dyslexic adults. Journal of Learning Disabilities, 16, 339-347.

Frostig, M., & Maslow, P. (1973). Learning problems in the classroom. New York: Grune and Stratton.

Gardner, H. (1983). Frames of mind. New York: Basic.

Gauthier, M. (1984). Stimulant medications in adults with attention deficit disorder. Canadian Journal of Psychiatry, 29(5), 435-440.

Ginzberg, E., Ginsberg, S. W., Axelrod, S., & Herma, J. L. (1951). Occupational choice: An approach to a general theory. New York: Columbia University Press.

Gottfredson, L. S. (1981). Circumscription and compromise: A developmental theory of occupational aspirations. Journal of Counseling Psychology Monographs, 28, 545-579.

Grossman, F. M. (1983). Percentage of WAIS-R standardization sample obtaining verbal-performance discrepancies. Journal of Consulting and Clinical Psychology, 51, 641-642.

Guilford, J. P. (1975). Factors and factors of personality. Psychological Bulletin, 82, 802-814.

Gutkin, T. B., Reynolds, C. R., & Galvin, G. A. (1984). Factor analysis of the Wechsler Adult Intelligence Scale-Revised: An examination of the standardization sample. Journal of School Psychology, 22, 83-93.

Hakstian, A. R., & Bennet, R. W. (1978). Validity studies using the Comprehensive Ability Battery (CAB): Relationships with the DAT and GATB. Educational and Psychological Measurement, 38, 1003-1015.

Hammond, S. M. (1984). An investigation into the factor structure of the GATB. Journal of Occupational Psychology, 57, 43-48.

Hanners, E. F., & Bishop, T. D. (1975). Predicting success in vocational training by using the GATB. Journal of Employment Counseling, 12(2), 59-65.

Hechtman, L., Weiss, G., Perlman, T., & Amsel, R. (1984). Hyperactives as young adults: Initial predictors of adult outcome. Journal of the American Academy of Child Psychiatry, 23(3), 250-260.

Hechtman, L., Weiss, G., Perlman, T., & Tuck, D. (1981). Hyperactives as young adults: Clinical outcomes. Adolescent Psychiatry, 9(2), 295-306.

Heinlein, W. E., Nelson, M. D., & Hohenshil, T. H. (1984). Vocational aspects of psychological assessment. (Part II). NASP Communique, 13(4), p. 7.

Hermann, D. O. (1982). Demographic factors in performance on WAIS-R. In D. Herman (Ed.), WAIS-R factor structures and patters of performance in various groups. Washington, DC: 19th APA Symposium.

Herr, E. L., & Cramer, S. H. (1979). Career guidance through the life span: Systematic approaches. Boston: Little, Brown and Company.

Hill, T. D., Reddon, J. R., & Jackson, D. N. (1985). Factor structure of the Wechsler scales: A review. Clinical Psychology Review, 5, 287-306.

Hohenshil, T. H. (in press). The Carl Perkins Act: What's it mean for school psychologists. NASP Communique.

Hohenshil, T. H. (1984). The vocational aspects of school psychology: 1974-1984. School Psychology Review, 13(4), 503-509.

Hohenshil, T. H. (1982). Secondary school psychological services. In T. H. Hohenshil, W. T. Anderson, & J. F. Salwan (Eds.), Secondary school psychological services: Focus on vocational assessment procedures for handicapped students. (ERIC Reproduction Number ED 229704), pp. 1-7.

Hohenshil, T. H. (1981). Roles for school psychology in vocational education programs for handicapped students. In T. H. Hohenshil and W. T. Anderson (Eds.), School psychological services in secondary vocational education: Roles in programs for handicapped students. Blacksburg, VA: Virginia Tech University, in cooperation with the Virginia State Department of Education, and the NASP National Committee on Vocational School Psychology. (ERIC Reproduction Number ED 215245), pp. 11-25.

Hohenshil, T. H. (1974). The vocational school psychologist: A specialty in quest of a training program. Psychology in the Schools, 11, 16-18.

Hohenshil, T. H., Ryan, C., & Warden, P. (1978). Enter the school psychologist: Needed member of the vocational evaluation team. American Vocational Journal, 53(3), 48-50.

Hohenshil, T. H., & Warden, P. (1978). The emerging vocational school psychologist: Implications for special needs youth. The School Psychology Digest, 7(1), 5-17.

Hohenshil, T. H., Levinson, E. M., & Heer, K. B. (1985). Best practices in vocational assessment for handicapped students. In A. Thomas & J. Grimes (Eds.), Best practices in school psychology, Kent, OH: The National Association of School Psychologists, pp. 215-228.

Holland, J. L. (1959). A theory of vocational choice. *Journal of Counseling Psychology*, *6*, 35-45.

Hooper, P. G. (1980). Guidance and counseling: Potential impact on youth unemployment. *Journal of Career Education*, *6*, 270-287.

House, A. E., & Lewis, M. L. (1985). Wechsler Adult Intelligence Scale-Revised. In C. S. Newmark (Ed.), *Major psychological assessment instruments*. Boston, MA: Allyn and Bacon, Inc., pp. 323-379.

Huessy, H. R., & Howell, D. C. (1985). Relationship between adult alcoholism and childhood behavior disorders. *Psychiatric Journal*, *10*(2), 114-119.

Humes, C. W. (1974). The secondary school counselor and learning disabilities. *School Counselor*, *51*, 210-215.

Humes, C. W., & Brammer, G. (1985). LD career success after high school. *Academic Therapy*, *21*(2), 171-176.

Insua, A. M. (1983). WAIS-R factor structure in two cultures. *Journal of Cross-Cultural Psychology*, *14*, 427-438.

Johnston, C. L. (1984). The learning disabled adolescent and young adults: An Overview and critique of current practices. *Journal of Learning Disabilities*, *17*(7), 386-391.

Kaufman, A. S. (1985). Review of the Wechsler Adult Intelligence Scale-Revised. In J. V. Mitchell, Jr. (Ed.), The ninth mental measurements yearbook, (Volume II). Lincoln, NE: The Buros Institute of Mental Measurements, pp. 1699-1703.

Kaufman, A. S. (1979). Intelligent testing with the WISC-R. New York: John Wiley & Sons.

Kaufman, A. S. (1975). Factor analysis of the WISC-R at 11 age levels. Journal of Consulting and Clinical Psychology, 43, 135-147.

Kavale, K. A., & Forness, S. R. (1984). A meta-anlaysis of the validity of Wechsler scale profiles and recategorizations: Patterns or parodies? Learning Disability Quarterly, 7(2), 136-156.

Keesling, J. W. (1985). Review of the USES General Aptitude Test Battery. In J. V. Mitchell, Jr. (Ed.), The ninth mental measurements yearbook, (Volume II). Lincoln, NE: The Buros Institute of Mental Measurements, pp. 1645-1647.

Kendall, W. S. (1981). Affective and career education for the learning disabled adolescent. Learning Disability Quarterly, 4, 69-75.

Kendall, W. S. (1980). Affective and career education for the LD adolescent. Prairie View, TX: A & M University. (ERIC Reproduction Number ED 188772).

Kerlinger, F. N. (1973). Foundations of behavioral research. New York: Holt, Rinehart, and Winston.

Knight, R. G. (1983). On interpreting several standard errors of the WAIS-R: Some further tables. Journal of Consulting and Clinical Psychology, 51, 671-673.

Kroll, L. G. (1984). LDs: What happens when they are no longer children? Academic Therapy, 20(2), 133-148.

Kujoth, R. (1973). The validity of the GATB for the educationally deficient. Journal of Employment Counseling, 10(1), 44-48.

Lawley, D. N., & Maxwell, A. E. (1971). Factor analysis as a statistical method. London: Butterworths Ltd.

Lee, H. B., & Comrey, A. L. (1979). Distortions in a commonly used factor analytic porcedure. Multivariate Behavioral Research, 14, 301-321.

Lefebvre, R. C. (1984). A psychological consultation program for learning disabled adults. Journal of College Student Personnel, 25(4), 361-363.

Lerner, J. (1981). Learning disabilities: Theories, diagnosis, and teaching strategies. Boston, MA: Houghton-Mifflin Publishers, Inc.

Levin, E. K., Zigmond, N., & Birch, J. W. (1985). A follow-up study of 52 learning disabled adolescents. Journal of Learning Disabilities, 18(1), 2-7.

Levinson, E. M., & Shepard, J. W. (1982). Integrating vocational assessment data into psychological evaluations. In T. H. Hohenshil, W. T. Anderson, & J. F. Salwan (Eds.), Secondary school psychological services: Focus on vocational assessment procedures for handicapped students. Blacksburg, VA: Virginia Tech University, pp. 68-70.

Lindemann, J. E., & Matarazzo, J. D. Intellectual assessment of adults. (1984). In G. Goldstein & M. Hersen (Eds.), Handbook of psychological assessment. New York: Pergamon Press, pp.77-99.

Lombana, J. (1982). Guidance for handicapped students. New York: Holt & Company.

Lowe, C. M. (1967). Prediction of posthospital work adjustment by the use of psychological tests. Journal of Counseling Psychology, 14(3), 248-252.

McCue, M., Shelly, C., Goldstein, G., & Kat-Garris, L. (1984). Neuropsychological aspects of learning disability in young adults. International Journal of Clinical Neuropsychology, 6(4), 229-233.

Maloney, M. P., & Ward, M. P. (1979). Psycnological assessment: A conceptual approach. New York: Oxford University Press.

Mannuzza, S., & Gittelman, R. (1984). The adolescent outcome of hyperactive girls. Psychiatry Research, 13(1), 19-29.

Marascuilo, L. A., & Levin, J. R. (1983). Multivariate statistics in the social sciences: A researcher's guide. Monterey, CA: Brooks/Cole Publishing Company.

Markel, G., Bizer, L., & Wilhelm, R. (1985). The LD adolescent and SAT. Academic Therapy, 20(4), 397-409.

Matarazzo, J. D. (1985). Review of the Wechsler Adult Intelligence Scale-Revised. In J. V. Mitchell, Jr. (Ed.), The ninth mental measurements yearbook, (Volume II). Lincoln, NE: The Buros Institute of Mental Measurements, pp. 1703-1705.

Matarazzo, J. D. (1972). Wechsler's measurement and appraisal of adult intelligence. (5th ed.). Baltimore, MD: Williams & Wilkins.

Matarazzo, J. D., Carmody, T. P., & Jacobs, L. D. (1980). Test-retest reliability and stability of the WAIS: A literature review with implications for clinical practice. Journal of Clinical Neuropsychology, 2, 89-105.

Matarazzo, J. D., & Herman, D. O. (1984). Base rate data for the WAIS-R: Test-retest stability and VIQ-PIQ differences. Journal of Clinical Neuropsychology, 6(4), 351-366.

Mattes, J. A., Boswell, L., & Oliver, H. (1984). Methylphenidate effects on symptoms of attention deficit disorder in adults. Archives of General Psychiatry, 41(11), 1059-1063.

Michelsson, K., Byring, R., & Bjorkgren, P. (1985). Ten year follow-up of adolescent dyslexics in Finland. Journal of Adolescent Health Care, 6(1), 31-34.

Mick, L. B. (1985). Connecting links between secondary and postsecondary programs for LD persons. Journal of College Student Personnel, 26(5), 463-465.

Miller, J. T. (1978/1977). A study of WISC subtest scores as predictors of GATB occupational aptitude patterns for EMH students in a high school occupational orientation course. (Doctoral dissertation, Auburn University, 1977). Dissertation Abstracts International, 38, 7272A.

Mitchell, J. V. (1985). The ninth mental measurements yearbook. Lincoln, NE: The Buros Institute of Mental Measurements.

Modahl, T. A. (1980). A differential profile analysis of the GATB for rehabilitation clients. (Doctoral dissertation, University of Northern Colorado, 1979). Dissertation Abstracts International, 40, 5822A.

Nagliere, J. A., & Kaufman, A. S. (1983). How many factors underlie the WAIS-R? Journal of Psychoeducational Assessment, 1, 113-119.

NASP - National Association of School Psychologists. (1984). Standards for provision of school psychological services. Washington: National Association of School Psychologists.

O'Grady, K. E. (1983). A confirmatory maximum likelihood factor analysis of the WAIS-R. Journal of Consulting and Clinical Psychology, 51, 826-831.

Omizo, M. M., Cubberly, W. E., & Longano, D. M. (1984). The effects of group counseling on self-concept and locus of control among learning disabled children. Journal of Humanistic Education and Development, 23(2), 69-79.

Osgood, C. E., & Sebeok, T. A. (1954). Psycholinguistics: A survey of theory and research problems. Baltimore, MD: The Waverly Press.

Osman, B. B. (1982). No one to play with: The social side of learning disability. New York: Random House.

Parker, K. (1983). Factor analysis of the WAIS-R at nine age levels between 16 and 74 years. Journal of Consulting and Clinical Psychology, 51, 302-308.

Pedhazur, E. J. (1982). Multiple regression in behavioral research: Explanation and prediction (2nd ed.). Philadelphia: Holt, Rinehart and Winston, Inc.

Pierce, R. M. (1968). Comments on the prediction of posthospital work adjustment with psychological tests. Journal of Counseling Psychology, 15(4), 386-387.

Polloway, E. A., Smith, J. D., & Patton, J. R. (1984). Learning disabilities: An adult development perspective. Learning Disabilities Quarterly, 7(1), 179-186.

Rogers, J. C. (1982). Current clinical concepts of dyslexia in college students. In M. R. Schmidt, & H. Z. Sprandel (Eds.), Helping the LD student. San Francisco: Jossey-Bass, pp. 27-38.

Ryan, J. J., Georgemiller, R. J., Geisser, M. E., & Randall, D. M. (1985). Test-retest stability of the WAIS-R in a clinical sample. Journal of Clinical Psychology, 41(4), 552-556.

Ryan, J. J., Prifitera, A., & Larsen, J. (1982). Reliability of the WAIS-R with a mixed patient sample. Perceptual & Motor Skills, 55, 1277-1278.

Ryan, J. J., Rosenberg, S. J., & DeWolfe, A. S. (1984). Generalization of the WAIS-R factor structure with a vocational rehabilitation sample. Journal of Consulting and Clinical Psychology, 52, 311-312.

SAS Institute, Inc. (1982). User's guide. Cary, NY: Author.

Scarborough, H. S. (1984). Continuity between childhood dyslexia and adult reading. British Journal of Psychology, 75(3), 329-348.

Schulman, S. S. (1984). Psychotherapeutic issues for the learning disabled adult. Professional Psychology, 15(6), 856-867.

Shepard, J., & Hohenshil, T. H. (1983). Career development functions of practicing school psychologists: A national study. Psychology in the Schools, 20, 445-449.

Shepard, J., & Levinson, E. (1985). Vocational assessment procedures for school psychologists at the secondary level. Journal of Psychoeducational Assessment, 3, 257-266.

Silverstein, A. B. (1985). Cluster analysis of the Wechsler Adult Intelligence Scale-Revised. Journal of Clinical Psychology, 41(1), 98-100.

Silverstein, A. B. (1984). Pattern analysis: The question of abnormality. Journal of Consulting and Clinical Psychology, 52(6), 936-939.

Silverstein, A. B. (1982a). Factor structure of the Wechsler Adult Intelligence Scale-Revised. Journal of Consulting and Clinical Psychology, 50, 661-664.

Silverstein, A. B. (1982b). Validity of Staz-Mogel-Yudin type short forms. Journal of Consulting and Clinical Psychology, 50(1), 22-21.

Silverstein, A. B. (1982c). Pattern analysis as simultaneous statistical inference. Journal of Consulting and Clinical Psychology, 50(2), 234-240.

Simpson, E. (1979). Reversals. Boston: Houghton-Mifflin.

Sprandel, H. Z. (1985). The psychoeducational use and interpretation of the Wechsler Adult Intelligence Scale-Revised. Springfield, IL: Charles C. Thomas.

SPSS Inc. (1983). SPSS X user's guide. Chicago: Author.

Staff, Division of Occupational Analysis, War Manpower Commission. (1945). Factor analysis of occupational aptitude tests. Educational and Psychological Measurement, 5, 147-155.

Sternberg, R. J. (1979). The nature of mental abilities. American Psychologist, 34, 214-229.

Stevenson, D. T., & Romney, D. M. (1984). Depression in learning disabled children. Journal of Learning Disabilities, 17(10), 579-582.

Strauss, A., & Lehtinen, L. (1947). Psychopathology and education of the brain injured child. New York: Grune and Stratton.

Strichart, S. S., & Mangrum, C. T. (1985). Selecting a college for the LD student. Academic Therapy, 20(4), 475-479.

Super, D. E. (1957). The psychology of careers. New York: Harper & Row.

Super, D. E., & Hall, D. T. (1978). Career development, exploration and planning. Annual Review of Psychology, 29, 333-372.

Tatsuoka, M. M. (1971). Multivariate analysis: Techniques for educational and psychological research. New York: John Wiley & Sons.

Tiedeman, D. V., & O'Hara, R. P. (1963). Career development, choice and adjustment. New York: College Entrance Examination Board.

USES - United States Employment Service. (1983a). Overview of validity generalization for the U.S. Employment Service. *USES Research Report No. 43*. Washington: United States Department of Labor, Division of Test Development.

USES - United States Employment Service. (1983b). The dimensionality of the General Aptitude Test Battery (GATB) and the dominance of general factors over specific factors in the prediction of job performance for the U. S. Employment Service. *USES Research Report No. 44*. Washington: United States Department of Labor, Division of Test Development.

USES - United State Employment Service. (1980). *Manual for the General Aptitude Test Battery, Section IV: Specific aptitude test batteries*. Washington: United States Department of Labor, Government Printing Office.

USES - United States Employment Service. (1979a). *Guide for occupational exploration*. Washington: United States Department of Labor, Government Printing Office.

USES - United States Employment Service. (1979b). *Manual for the General Aptitude Test Battery, Section II: Occupational aptitude patterns*. Washington: United States Department of Labor, Government Printing Office.

USES - United States Employment Service. (1970). Manual for the General Aptitude Test Battery, Section III: Development. Washington: United States Department of Labor, Government Printing Office.

Vellutino, F. R. (1987). Dyslexia. Scientific American, 256(3), 34-41.

Vernon, P. E. (1950). The Structure of Human Abilities. New York: John Wiley & Sons.

Vogel, S. A., & Adelman, P. (1981). College and university programs designed for learning disabled adults. Exceptional Children Quarterly, 30, 12-18.

Watts, F. N., & Everitt, B. S. (1980). The factorial structure of the General Aptitude Test Battery. Journal of Clinical Psychology, 36(3), 763-767.

Weatherley, R. (1985). Counseling learning disabled students. Canadian Counselor, 19(3-4), 199-207.

Webster, D. E. (1979). Utility of the WAIS in predicting vocational success of psychiatric patients. Journal of Clinical Psychology, 35(1), 111-116.

Webster, D. E. (1974). Predictive applicability of the WAIS with psychiatric patients in a vocational rehabilitation setting. Journal of Community Psychology, 2(1), 141-144.

Wechsler, D. (1981). Manual for the Wechsler Adult Intelligence Scale-Revised. New York: The Psychological Corporation.

Wechsler, D. (1975). Intelligence defined and undefined. _American Psychologist_, _30_(2), 135-139.

Wechsler, D. (1974). _Manual for the Wechsler Intelligence Intelligence Scale for Children-Revised_. New York: The Psychological Corporation.

Wechsler, D. (1958). _The measurement and appraisal of adult intelligence_. Baltimore: Williams and Wilkins.

Wechsler, D. (1955). _Manual for the Wechsler Adult Intelligence Scale_. New York: The Psychological Corporation.

Wechsler, D. (1949). _Manual for the Wechsler Intelligence Scale for Children_. New York: The Psychological Corporation.

Weiss, E. (1984). Learning disabled children's understanding of social interactions of peers. _Journal of Learning Disabilities_, _17_(10), 612-615.

Weiss, G., Hechtman, L., Milroy, T., & Perlman, T. (1985). Psychiatric status of hyperactives as adults: A controlled prospective 15 year follow-up. _Journal of the Academy of Child Psychiatry_, _24_(2), 211-220.

Wender, P. H. (1971). _Minimal brain dysfunction in children_. New York: John Wiley & Sons.

Wender, P. H., Reimherr, F., Wood, D., & Ward, M. (1985). A controlled study of methylphenidate in the treatment of ADD, residual type, in adults. American Journal of Psychiatry, 142(5), 547-552.

White, J., Schumaker, J., Warner, M., Alley, G., & Dreshler, D. (1980). The current status of young adults identified as learning disabled during their school career. (Research Paper No. 21). Lawrence, KS: University of Kansas, Institute for Research in Learning Disabilities.

Whyte, L. A. (1984). Characteristics of learning disabilities persisting into adolescence. Journal of Educational Research, 30(1), 14-25.

Willson, V. L., & Reynolds, C. R. (1985). Normative data on the WAIS-R for Selz and Reitan's index of scatter. Journal of Clinical Psychology, 41(2), 254-258.

Wood, M. H. (1985). Learning disabilities and human sexuality. Academic Therapy, 20(5), 543-547.

Zimmerman, I. L., & Woo-Sam, J. M. (1973). Clinical interpretation of the Wechsler Adult Intelligence Scale. New York: Grune and Stratton.

Ziv, A. (1980). The school psychologist at work. Israeli Journal of Psychology & Counseling in Education, 12, 25-33.

Zytowski, D. G., & Borgen, F. H. (1983). Assessment. In W. B. Walsh & S. H. Osipow (Eds.), *Handbook of Vocational Psychology*, (Volume II). Hillsdale, NJ: Lawrence Erlbaum Inc., pp. 5-40.

Zytowski, D. G., & Warman, R. E. (1982). The changing use of tests in counseling. *Measurement and Evaluation in Guidance*, *15*(2), 147-152.

APPENDIX A

WWRC RESEARCH COMMITTEE LETTER OF PERMISSION

COMMONWEALTH *of* VIRGINIA

DEPARTMENT OF REHABILITATIVE SERVICES

WOODROW WILSON REHABILITATION CENTER
FISHERSVILLE, VIRGINIA 22939

ALTAMONT DICKERSON JR
COMMISSIONER
TEL (804) 257-0316

KENNETH L KUESTER
DIRECTOR WWRC
TEL (703) 885-9600

October 24, 1986

Mr. William E. Heinlein
P. O. Box 2635
Christiansburg, VA 24068

Dear Bill:

Consistent with the concensus of the Center's Research Review Committee, your research proposal, The Utility of the Wechsler Adult Intelligence Scale-Revised in the Prediction of Vocational Aptitude of Special Needs Youth, was reviewed and approved by the Committee as submitted. There are, however, a number of procedural or coordinating issues I would like you to incorporate into your proposed work plan:

1. Please let me know three to five working days in advance of your planned data collection visit so I can let the Record Library staff and L.D. Project Staff know of your need to access their clinical records. If you wish to use our Switzer Building lodging facilities, I think I'll need approximately 10-15 days' notice to see if they have vacancies available. I believe their per/night lodging charge is about $18.00.

2. Ms. Robin Hawks, our L.D. Project Coordinator, will be your overall site contact person, and as such, will help you with most interdepartmental linkage matters you might encounter.

3. I would like you to contact and use Dr. Joseph Salwan of the Center's Psychology Service, to "get at" whatever GATB data you need to identify and collect.

4. Once your dissertation research is completed, I would like to arrange a telephone conference call with Robin, Joe, and me to determine the staff professionals here at the Center and in our parent agency's field operation, who would most likely be interested in your results. The outgrowth of this conference call will be the scheduling of a research dissemination session here on campus during which you will be expected to present your results to selected staff, along with your recommendations for how these results might be incorporated into their clinical work. It seems as though some of our counselors, vocational evaluators, and psychologists would be interested professionals.

I appreciate your interest in the Center and will await word from you once you're ready to start.

Sincerely,

F. James Hoffmann, Ph.D.
Director of Research

FJH/mrc
Enclosure - Approval Form

WOODROW WILSON REHABILITATION CENTER
RESEARCH REVIEW COMMITTEE

Certification of Review and Approval of
Projects Involving Human Subjects

In accordance with all applicable state and federal regulations involving the conduct of applied and/or clinical research involving human subjects - it is hereby certified that:

Title of Project: The Utility of the Wechsler Adult Intelligence Scale-Revised in the Prediction of Vocational Aptitude of Special Needs Youth

Principle Investigator: William E. Heinlein
under staff supervision of Robin Hawks

was reviewed by the Research Review Committee and, in its present form,

Approved on: 10/20/86

provided that:

Reference letter dated 10/24/86 to Mr. Heinlein.

Human subjects are/are not at risk.

Signature:
F. James Hoffmann, Ph.D.
Director of Research
Chairperson
Research Review Committee

10/20/86
(date)

APPENDIX B

WECHSLER ADULT INTELLIGENCE SCALE - REVISED

WECHSLER ADULT INTELLIGENCE SCALE - REVISED

The most widely used psychometric instrument by the majority of practicing professional school psychologists for the assessment of secondary level students or special education candidates are the Wechsler intelligence scales (Zytowski & Warman, 1982). This includes both the Wechsler Intelligence Scale for Children-Revised [WISC-R] (Wechsler, 1974); and the Wechsler Adult Intelligence Scale-Revised [WAIS-R] (Wechsler, 1981). Both scales had earlier, essentially equivalent forms including the WISC and WAIS (Wechsler, 1949, 1955). The Wechsler scales are widely accepted, proven, basic tests of defined intelligence (Wechsler, 1975). They are the supreme valid diagnostic tools used for intellectual appraisal and research in most western, English speaking cultures (Kaufman, 1985; Matarazzo, 1985). In fact, the Wechsler scales have become the standard by which all other IQ tests, or approaches to the understanding of human intelligence, have been appraised (Hill, Reddon, & Jackson, 1985). The professional literature using the WISC/WISC-R and WAIS/WAIS-R in the investigation of a wide variety of clinical, educational, rehabilitational research questions in surprisingly diverse settings, conditions, and samples within the 1977 to 1984 period is well beyond one thousand studies (Mitchell, 1985).

The WAIS-R is a well standardized test (*N*= 1880) of intelligence developed by David Wechsler in 1981. The WAIS-R consists of eleven (11) subtests suited for individuals aged 16 to 74-years. In linear combinations recommended by Wechsler, three valid and reliable global factor scores are produced: the Full Scale IQ (FSIQ), the Verbal Scale IQ (VIQ), and the Performance Scale IQ (PIQ) with a mean = 100, and standard deviation = 15. The VIQ is a linear combination of deviation age scores on six (6) subtests. The PIQ is a linear combination of deviation age scores for five (5) subtests. The FSIQ is a similar linear combination for all 11 subtests.

These subtests, in other linear combinations, yield at least three additional factor scores comparable in magnitude to the three Wechsler IQs: Verbal Comprehension Deviation Quotient (VCDQ), Perceptual Organization Deviation Quotient (PODQ), and the Factor III Deviation Quotient known variously as the Memory Deviation Quotient, or Freedom From Distractibility Deviation Quotient (FDDQ) (Kaufman, 1979; Wechsler, 1981; Silverstein, 1982a; Gutkin, Reynolds, & Galvin, 1984). The specific subtests are as follows:

Information. Consists of 29 items on the Verbal IQ scale that Wechsler (1958) describes as measuring the "subject's range of information" (p. 65). It asks the subject to answer verbally to questions of general information. Most of the information is learned information and demands remote memory skills. A few changes are made from the 1955 WAIS Information test. The average test-retest reliability coefficient is .89 with little variation by age group reported in the manual (Wechsler, 1981). The standard error of measurement averages .93 across ages. This test may measure memory, reading range, range of interest, or cultural opportunities (Sprandel, 1985). This test factors on the Verbal Comprehension Deviation Quotient (Gutkin, Reynolds, & Galvin, 1984; Silverstein, 1982a).

Picture Completion. Consists of 20 timed items on the Performance IQ scale usually considered a measure of visual analysis, alertness, perception of missing details, and of long-term memory (Sprandel, 1985). It asks the subject to identify and name the missing part of an incompletely drawn picture. Some minor changes were made from the 1955 WAIS. The split-half reliability coefficients average .81 with some variation by age group. The stability, test-retest coefficients reported in the manual range from .86 to .89. The average standard error of measurement is 1.25. This test generally shows considerable variation by age group especially with older subjects. The Picture Completion test does not load on any other global factor with consistency.

Digit Span. This subtest requires the subject to orally repeat a number of series of numerals, each progressively one digit greater than the previous one. After the digits forward series (containing up to nine digits) the subject is asked to repeat digits in reverse order. Two trials are given on each series, both forwards and backwards. The test is unchanged from the 1955 WAIS except in administration directions and scoring. The test is part of the Verbal IQ scale. Test-retest reliability coefficients average .83 with little variation across age groups. The average standard error of measurement is 1.23 as reported in the manual. Cooper (1982) suggests that the Digit Span subtest seems to include at least two kinds of cognitive functioning. Digits forward tap short term memory ability. Digits backward tap somewhat different processes that include visualization of the sequence as well as short term memory ability. Sprandel (1985) sites considerable evidence for Digit Span being a measure of short term memory, anxiety, and susceptibility to distractibility. For these reasons, the Digit Span test usually loads on the Factor III Deviation Quotient (Silverstein, 1982a).

Picture Arrangement. This timed, up to ten item test is part of the Performance IQ scale and asks the subject to re-arrange a series of comic-strip-like pictures into an order that tells a story. Skills required for this task include perceptual organization, ability to comprehend whole situations, sequencing, verbal comprehension, and social knowledge. The subtest tasks reflect the ability to organize visual material into a logical, sequential order that reflects social or interpersonal intelligence (Sprandel, 1985). Changes were made in both the content, administration and scoring of the test from the 1955 WAIS. Picture Arrangement has one of the lowest average reliabilities (.74) as determined by split-half correlations. Test-retest stability is also quite low at .76. The average standard error of measurement across age groups is 1.41. There seems to be little consistency in correlation with other factors, or other subtests across age groups. The test shows the greatest degree of cultural bias of all the subtests. It generally requires a high level of logical, sequential thought applied to a situation of a social nature.

Vocabulary. The Vocabulary subtest is a part of the Verbal IQ scale that is generally recognized as a measure of both receptive and expressive elements of language. It is also an indication of verbal comprehension and factors on the Verbal Comprehension Deviation Quotient (Gutkin, Reynolds, & Galvin, 1984; Silverstein, 1982a). Wechsler (1958) and others credit this test with being the best single measure of general intelligence. It requires abstract thinking and verbal conceptualization (Sprandel, 1985). The test consists of 35 words progressively more difficult to define that are presented both in visual and auditory modes. Seven words were dropped and two added from the 1955 WAIS. Split-half reliabilities are consistently high across all age groups ranging from .94 to .96. Test-retest stability coefficients are also the highest of all the WAIS-R subtests ranging from .93 to .91. Standard errors of measurement are the lowest of all subtests with an average of .61 across all ages. The test is a measure of cognitive style, long term memory, educational level, word knowledge, and confidence (Sprandel, 1985; Zimmerman & Woo-Sam, 1973).

Block Design. This test is a component of the Performance IQ scale and is considered to be a test of nonverbal, abstract, synthesizing ability (Wechsler, 1958; Zimmerman & Woo-Sam, 1973; Sprandel, 1985). Cognitive skills involved in Block Design include perceptual organization, recognition of part-whole relations, the reproduction of visually presented abstract block designs, visual-motor coordination, as well as the ability to work under pressure of being timed. Nine of the ten designs in the 1955 WAIS were retained in the WAIS-R; but, rules for scoring were changed. In general, the cognitive functions the subject must perform include visual inspection and analysis of the block design presented to be copied, a decision about the way the blocks can be arranged to duplicate this design, and the visual-motor integration of this analysis and synthesis (Sprandel, 1985). Output is a three-dimensional representation of the two-dimensional stimulus. Split-half reliabilities are consistently high across all age groups with an average of .87, the highest of any Performance scale test. Standard errors of measurement are also the best for any Performance scale test with an average of .98. Block Design factors on the Perceptual Organization Deviation Quotient (Gutkin, Reynolds, & Galvin, 1984; Silverstein, 1982a).

Arithmetic. Arithmetic is a part of the Verbal IQ scale that provides a timed measure of the ability to manipulate numbers in solving problems and of the level of reasoning used in solving these 14 mental computation items. Only elementary school mathematics concepts are necessary for completion of the most difficult items. Wechsler (1958) feels the skills in this subtest are those which might be considered basic to an individual's effective functioning in western culture. There are some minor modifications from the 1955 WAIS. Split-half reliability coefficients range from .73 at ages 16-17, up to .81 for ages 18-19, on up to .87 for ages 55-69. The average across all ages is .84. Test-retest correlations demonstrate stability coefficients of .80 for ages 25-34 and .90 for ages 45-54.

The average standard error of measurement is 1.14. This has all been suggested to be attributed to the influence of increased education and use of mathematics in day-to-day living across the years (Sprandel, 1985). The test is generally considered a measure of arithmetic ability, and ability to concentrate without being distracted. For this latter reason, Arithmetic generally loads on the Factor III Deviation Quotient (Silverstein, 1982a) especially in the 16-17 and 20-24 age groups. There is no evidence of gender bias in this test as has been suggested (Sprandel, 1985).

Object Assembly. Object Assembly is a timed, Performance IQ scale subtest often perceived as a set of four simple jigsaw puzzles. It is generally considered a measure of visual analysis, psychomotor behavior and analytic and synthetic spatial thinking (Sprandel, 1985; Zimmerman & Woo-Sam, 1973). Success on this subtest requires the ability to comprehend the total situation and go from the parts to the whole. Perceptual organization and related visual-motor coordination are both necessary. Only one puzzle was redrawn and updated from the 1955 WAIS. Split-half reliability coefficients range from .52 to .73 with an average of .68. Test-retest coefficients, reflecting stability, are a more consistent .67 to .72 across age groups. The standard error of measurement is the largest of any of the subtests on the WAIS-R with an average of 1.54. Object Assembly factors on the Perceptual Organization Deviation Quotient (Gutkin, Reynolds, & Galvin, 1984; Silverstein, 1982a). In general, this subtest is most useful in providing information about the examinee's level of perceptual organization and about problem solving ability when confronted by a new task (Sprandel, 1985).

Comprehension. Comprehension is one of the most interesting subtests of the WAIS-R because of the constructs it measures and the clinical/educational insights it can provide. It is part of the Verbal IQ scale but is frequently, and erroneously omitted from the full battery when various short-forms are administered by some examiners. Comprehension is usually presented as a measure of social judgment and verbal concept formation, requiring the organization of fairly common knowledge and the application of reasoning to what is essentially a social situation (Sprandel, 1985). It is seen as an indicator of verbal comprehension and verbal conceptualization (Wechsler, 1958; Zimmerman & Woo-Sam, 1973). There were some major changes in this test from the 1955 WAIS. Sixteen current items are generally questions of a common sense nature (e.g., "Why should people pay taxes?") that can give the skilled examiner an understanding of the psychological makeup of the individual in addition to their understanding of social concepts. Split-half reliability coefficients range from .77 for the 20-24 age group to .90 for the 65-69 age group. Test-retest correlations are some of the lowest of the Verbal IQ scale subtests but are satisfactory with a range of .79 to .82. The average standard error of measurement is 1.20. The Comprehension subtest factors on the Verbal Comprehension Deviation Quotient (Gutkin, Reynolds, & Galvin, 1984; Silverstein, 1982a). Limited social experience and interaction is probably one of the most influential bias factors in this test.

Digit Symbol. Digit Symbol is a component of the Performance IQ scale and is a 90 second measure of the "ability to master a new and essentially alien task within a brief time span" (Zimmerman & Woo-Sam, 1973, p. 121). As on the 1955 WAIS, Digit Symbol consists of nine symbols paired with the nine numerals and the subject is asked to fill in blanks under a sequence of numerals, matching the correct symbol with each numeral. This task requires visual acuity, visual-motor coordination, memory, and speed (Sprandel, 1985). Attention and freedom from distractibility are also needed in order to earn high scores on this subtest. For this reason, Digit Symbol usually factors on the Factor III Deviation Quotient (Silverstein, 1982a). In addition, Cooper (1982) says this type of task involves "sequential shifting, scanning, and focusing" (p. 194), in order to determine the correct symbol quickly. Since this speed test is not appropriate for split-half reliability calculations, only test-retest correlations are provided in the manual with an average of .82. The standard error of measurement average is 1.27. The major factors related to performance on this subtest would seem to be visual acuity, attention span, anxiety, and reaction to being timed (Sprandel, 1985).

Similarities. Similarities is a component of the Verbal IQ scale and is a measure of verbal comprehension and of the ability to find relationships or to formulate generalizations based on these relationships (Sprandel, 1985). Classification is an integral part of this generalization process and thus the test can be thought of as primarily a measure of logical, categorical thinking. The subtest also requires long-term memory. Minor changes were made in the present 14 paired-associate items on the test (e.g., "Coat-Suit" deleted) from the 1955 WAIS. Split-half reliability as shown in the manual (Wechsler, 1981) is satisfactory, ranging from .78 to .87 with a trend toward increased reliability with age; average reliability is .84. Test-retest reliability is also in the eighties. The standard error of measurement averages 1.24. The test is a good indicator of verbal comprehension and thus usually factors on the Verbal Comprehension Deviation

Quotient (Gutkin, Reynolds, & Galvin, 1984; Silverstein, 1982a). Good long term memory, fluidity of thought, creativity, synthesis of knowledge are also required (Sprandel, 1985). Maloney and Ward (1979) suggested four levels of concept formation on the WAIS Similarities subtest: (a) no recognition of similarities, (b) concrete similarity, (c) functional similarity, and (d) abstract similarity. A lack of cultural opportunities or verbal fluency may depress performance on this subtest.

APPENDIX C

GENERAL APTITUDE TEST BATTERY

GENERAL APTITUDE TEST BATTERY

The prototype vocationally oriented aptitude test in use today is the General Aptitude Test Battery (GATB) published by the Division of Counseling and Test Development of the United States Employment Service (USES, 1970, 1980), a branch of the U. S. Department of Labor, Employment and Training Administration. Developed for national United States Employment Service use in its vocational counseling and placement services in 1947, the GATB is the most frequently and widely used test of vocational aptitude with over 500 studies documenting the extent to which it predicts future job performance (USES, 1983a). It is unequaled for vocationally oriented instruments in the size of its occupational data base (Zytowski & Borgen, 1983); and for its apparent comprehensive research and development over the last forty years (Keesling, 1985). The history of the GATB is extensive and instructive in the development of over 400 criterion-related Occupational Aptitude Patterns (OAPs) keyed to 12,000 occupations statistically defined in the Department of Labor's _Dictionary of Occupational Titles_.

The GATB is a well standardized test ($\underline{N}$ = 4,000) of multi-aptitudes developed by the United States Employment Service since 1947 for grade nine to adult. It can be hand or machine scored. The GATB consists of eight (8) paper-and-pencil, and four (4) apparatus tests designed to measure nine (9) aptitudes found to be important for successful performance in jobs. The raw scores are converted into aptitude scores with a mean of 100 and a standard deviation of 20. Nine standardized aptitude scores are then used to construct percentiles and pass/fail Occupational Aptitude Patterns (OAPs) which are constantly undergoing study (USES, 1979b, 1980). GATB is one link in a the comprehensive USES Counselee Assessment and Occupational Exploration System now used in all 50 states. Also included in this integrated, cross-referenced system is the 800 page Guide for Occupational Exploration (USES, 1979a) and the well known Dictionary of Occupational Titles. The GATB battery takes about 2.5 hours to administer. The full USES program offers GATB pre-testing orientation exercises for both of its GATB forms: a non-reading battery (NATB), and the regular GATB with its reading level of sixth grade. It is intended as a group test but can be given individually. It should be administered under USES license and only by trained, USES certified GATB/NATB testing specialists. Research with GATB has additionally found good evidence to reduce nine aptitudes in various linear combinations to three factors known as the GATB Cognitive Factor, the GATB Perceptual

Factor, and the GATB Psychomotor Factor (Watts & Everitt, 1980; Hammond, 1984; USES, 1983b). The tests range from 45-second to 90-second apparatus measures to paper-and-pencil tasks requiring five to seven minutes of working time.

GATB Subtests

Part 1 - Name Comparison. This test consists of two columns of names. The examinee inspects each pair of names, one in each column, and indicates whether the names are the same or different. The test alone measures Aptitude Q - Clerical Perception. This test usually loads onto the GATB Perceptual Factor (Hammond, 1984).

Part 2 - Computation. This test consists of a number of paper-and-pencil arithmetic exercises requiring the addition, subtraction, multiplication, or division of whole numbers. This test, together with Part 6, measures Aptitude N - Numerical. This test usually loads onto GATB Cognitive Factor (Hammond, 1984; Watts & Everitt, 1980).

Part 3 - Three-Dimensional Space. This test consists of a series of exercises containing a stimulus figure and four drawings of three dimensional objects. The stimulus figure is pictured as a flat piece of metal which is to be either bent, or rolled, or both. Lines indicate where the stimulus figure is to be bent. The examinee indicates which one of the four drawings of three-dimensional objects could be made from the stimulus figure. This test, with Parts 4 and 6, measures Aptitude G - Intelligence and by itself measures Aptitude S - Spatial. This test usually loads onto GATB Cognitive Factor as well as GATB Perceptual (Hammond, 1984; Watts & Everitt, 1980).

Part 4 - Vocabulary. This test consists of sets of four words. The examinee indicates which two words has either the same or opposite meanings. This test, together with Parts 3 and 6 measures Aptitude G - Intelligence and by itself Aptitude V - Verbal. Part 4 usually loads onto the GATB Cognitive Factor (Hammond, 1984; Watts & Everitt, 1980).

Part 5 - Tool Matching. This test consists of a series of exercises containing a stimulus drawing and four black-and-white drawings of simple shop tools. The examinee indicates which of the four is the same as the stimulus drawing. Variations exist only in the distribution of black and white. This test, together with Part 7, measures Aptitude P - Form Perception which usually loads on the GATB Perceptual Factor (Hammond, 1984).

Part 6 - Arithmetic Reasoning. This test consists of a number of arithmetic problems expressed verbally. This test, together with Parts 3 and 4, measures Aptitude G - Intelligence; and with Part 2 it measures Aptitude N - Numerical. Part 6 usually loads on the GATB Cognitive Factor (Hammond, 1984; Watts & Everitt, 1980).

Part 7 - Form Matching. This test consists of two groups of variously shaped line drawings. The examinee indicates which figure in the second group is exactly the same size and shape as each figure in the stimulus group.
This test, along with Part 5, measures Aptitude P - Form Perception. This test loads onto GATB Perceptual Factor.

Part 8 - Mark Making. This subtest consists of a series of squares in which the examinee is to make three pencil marks, working as rapidly as possible. The marks to be made are very short lines, two vertical and the third a horizontal line beneath them. This test, by itself, measures Aptitude K - Motor Coordination. This test loads onto the GATB Psychomotor Factor (Hammond, 1984).

Part 9 - Peg Placement. This apparatus test consists of a rectangular pegboard divided into two sections, each section containing 48 holes. The upper section contains 48 cylindrical pegs. The examinee removes the pegs from the holes in the upper part of the board and inserts them in the corresponding holes in the lower part of the board, moving two pegs simultaneously, one in each hand. This performance is done three times, with the examinee working rapidly to move as many pegs as possible during the time allowed for each of the three trials. This test, along with Part 10, measures Aptitude M - Manual Dexterity. This subtest factors onto GATB Psychomotor Factor.

Part 10 - Peg Turning. This apparatus test consists of the same equipment described in Part 9 with the lower section of the pegboard containing the 48 cylindrical pegs. The examinee removes the wooden pegs from a hole, turns the peg over so that the opposite end is up, and returns the peg to the hole from which it is taken, using only the preferred hand. The examinee works rapidly to turn and replace as many of the 48 cylindrical pegs as possible during the time allowed. Three trials are given for this performance. This test, along with Part 9, measures Aptitude M - Manual Dexterity.

Part 11 - Assembly. This test consists of a small rectangular board (Finger Dexterity Board) containing 50 holes and a supply of small rivets and washers. The examinee takes a small metal rivet from a hole in the upper part of the board with preferred hand and at the same time removes a small metal washer from a vertical rod with the the other hand; examinees put the washers on the rivets, and inserts assembled pieces into the corresponding holes in the lower part of the board using only preferred hand. The examinee works rapidly to move and replace as many rivets and washers as possible during the time allowed. This test, along with Part 12, measures Aptitude F - Finger Dexterity. This subtest loads onto the GATB Psychomotor Factor (Hammond, 1984).

Part 12 - Disassembly. This subtest consists of the same equipment described in Part 11. The examinee removes the small metal rivet in the assembly from a hole in the lower part of the board, slides the washer to the bottom of the board, puts the washer on the rod with one hand and the rivet into the corresponding hole in the upper part of the board with the preferred hand. The examinee works rapidly to move and replace as many rivets and washers as possible during the time allowed. This test, along with Part 11, measures Aptitude F - Finger Dexterity. It loads onto GATB Psychomotor Factor (Hammond, 1984).

GATB Aptitudes

Aptitude G - Intelligence. Also called General Learning Ability. The ability to "catch on" or understand instructions and underlying principles; the ability to reason and make judgements (USES, 1970, 1980). Measured by Parts 3, 4, and 6 and it loads onto GATB Cognitive Factor. A reliability of .88 is reported (USES, 1983b).

Aptitude *V* - Verbal. The ability to understand meaning of words and to use them effectively (USES, 1970, 1980). Measured by Part 4 and loading onto GATB Cognitive Factor. A reliability coefficient of .85 is reported for *N* = 23,428 (USES, 1983b).

Aptitude *N* - Numerical. Ability to perform arithmetic operations quickly and accurately (USES, 1970, 1980). Measured by Parts 2 and 6. It loads onto GATB Cognitive Factor. A reliability coefficient of .83 is reported for *N* = 23,428 (USES, 1983b).

Aptitude *S* - Spatial. Ability to think visually of geometric forms and to comprehend the two-dimensional representation of the three-dimensional objects. The ability to recognize the relationships resulting form the movement of objects in space (USES, 1970, 1980). Measured by Part 3 and loading onto GATB Perceptual Factor. A reliability coefficient of .81 is reported (USES, 1983b).

Aptitude *P* - Form Perception. Ability to perceive pertinent detail in objects or in pictorial or graphic material. Ability to make visual comparisons and discriminations and see slight differences in shapes and shadings of figures and widths of lines (USES, 1970, 1980). Measured by Part 3 and loading onto GATB Perceptual Factor. A reliability coefficient of .79 is reported (USES, 1983b).

Aptitude Q - Clerical Perception. Ability to perceive pertinent detail in verbal or tabular material. Ability to observe differences in copy, to proofread words and numbers, and to avoid perceptual errors in arithmetic computation. A measure of speed of perception which is required in many industrial jobs even when the job does not have verbal or numerical content (USES, 1970, 1980). Measured by Part 1 and loading onto GATB Perceptual Factor. A reliability coefficient of .75 is reported (USES, 1983b).

Aptitude K - Motor Coordination. Ability to coordinate eyes and hands or fingers rapidly and accurately in making precise movements with speed. Ability to make a movement response accurately and swiftly (USES, 1970, 1980). Measured by Part 8 and loading onto GATB Psychomotor Factor. A reliability of .86 is reported (USES, 1983b).

Aptitude F - Finger Dexterity. Ability to move the fingers, and manipulate small objects with the fingers, rapidly or accurately (USES, 1979b). Measured by Parts 11 and 12 and loading onto GATB Psychomotor Factor. A reliability coefficient of .76 is reported for N = 23,428.

Aptitude M - Manual Dexterity. Ability to move the hands easily and skillfully. Ability to work with the hands in placing and turning motions (USES, 1970, 1980). Measured by Parts 9 and 10 and loading onto GATB Psychomotor Factor. A reliability coefficient of .77 is reported (USES, 1983b).

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