VALIDITY STUDY OF THE PERCEPTUAL MEMORY TASK

by

LEE BRINKLEY BRYAN

(Under the Direction of Karen H. Jones, Ed.D.)

ABSTRACT

Individuals with disability are at risk to experience functional limitations that impact attention, concentration and memory capacities, as well as the ability to process information. A recognized component of vocational evaluation and rehabilitation assessment is the identification of learning preferences or learning style. The Perceptual Memory Task (PMT) is an acknowledged learning style assessment and is used frequently along with the Kaufman Brief Intelligence Test – 2 (KBIT-2) in vocational evaluation of individuals with disability. The PMT has not been validated since 1984 when it was compared to the Wechsler Adult Intelligence Scale (1955) as part of the instrument's original norm study. Multiple correlation research design using ANOVAs and simple linear regression determined the relationship between the dependent variables involving the subscales of the PMT and the KBIT-2 and the independent variables of age, gender, level of education and type of disability. A positive Pearson correlation between the two instruments was found at the .05 level of significance and similar patterns of relationships were noted as found in the 1984 correlation study. Results indicated that recent memory is particularly vulnerable to the cognitive implications of disability. The variables of gender and level of education have been found in previous studies to have an impact on test performance. In this study, these variables were noted to have an impact on KBIT-2 subscale scores, but not the subscale scores of the PMT. Extreme variance in distribution was noted on the PMT subscales and one of the KBIT-2 subscales and score transformation was completed using the Box-Cox transformation to explore relationships between the dependent and independent variables.

INDEX WORDS: Perceptual Memory Task, Kaufman Brief Intelligence Test – 2, information processing, intelligence, memory and attention.

VALIDTY STUDY OF THE PERCEPTUAL MEMORY TASK

by

ELLA LEE BRINKLEY BRYAN

B.S., Wingate University, 1981

M.Ed., The University of Georgia, 1988

A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

DOCTOR OF EDUCATION

ATHENS, GEORGIA

2011

VALIDITY STUDY OF THE PERCEPTUAL MEMORY TASK

by

ELLA LEE BRINKLEY BRYAN

Major Professor: Karen H. Jones
Committee: Elaine Adams
Brian A. Glaser
Jack M. Sink
Clifton L. Smith

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
December 2011

DEDICATION

This dissertation is dedicated to the memory of my parents, Rock and Evelyn Brinkley who taught me the love of reading and writing and the importance of education. Their encouragement led me to my doctoral studies and the memory of them inspired me to complete the process.

ACKNOWLEDGEMENTS

There are no words to express my appreciation of Dr. Jack Sink and the impact he has had on my career and my life. I would not have had the many opportunities to grow professionally without him and his participation as a member of my committee made the process even more meaningful. I also thank Dr. Karen Jones for seeing me through the doctoral process and reminding at times that the process needed to move forward despite my enjoyment of being in the doctoral program. She was very patient with me and her feedback along the way allowed me to consider my drafts with new attention to content, detail and presentation. My thanks to Dr. Brian Glaser, Dr. Elaine Adams and Dr. Cliff Smith for their invaluable support and input into my research objectives, methodology and presenting the results of their study. I was very fortunate to have a great committee and will miss our meetings.

I also thank my staff who tolerated my doctoral studies sometimes taking precedent to our work in order to see me through the process. A special thank- you to Angela Welch for her assistance in data collection and proofing my dissertation. Her humor and calm demeanor help ground me as we met deadlines.

Last, but far from least, I thank my family and friends. Their support and enthusiasm kept me moving forward when the loss of my parents and other family members during the pursuit of my doctorate “took the wind from my sails”. I love each of you very much.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS v

LIST OF TABLES ix

LIST OF FIGURES xi

CHAPTER

1 INTRODUCTION 1

Rationale 4

Purpose of Study 5

Research Objectives 6

Theoretical Framework 7

Significance of Study 10

2 REVIEW OF LITERATURE 12

History of Vocational Rehabilitation 12

History of Vocational Evaluation 25

Historical Perspective in the Assessment of Individual Differences 30

Learning Style Theories and Instruments 37

Test and Measurement 43

Perceptual Memory Task 49

Kaufman Brief Intelligence Test - 2 53

3 METHOD 59

Purpose..57

Design 58

Threats to Validity 62

Data Set 66

Instrumentation 70

Perceptual Memory Task 71

Kaufman Brief Intelligence Test - 2 73

Data Collection Procedures..77

Data Analysis 77

4 RESULTS 84

Purpose..84

Analysis of Research Objectives 84

Summary 130

5 SUMMARY, CONCLUSIONS, DISCUSSION AND

RECOMMENDATIONS 132

Rationale 132

Purpose..133

Research Objectives..134

Method 135

Summary of Findings..137

Conclusions...151

Discussion and Implications 154

REFERENCES 161

LIST OF TABLES

Page

Table 3.1: Participant Demography 67

Table 3.2: Participant PMT and KBIT-2 Standard Score Demography 69

Table 3.3: Data Analysis Approach for Validation of the PMT 78

Table 4.1: Frequency Distribution for Age...85

Table 4.2: Frequency Distribution for Disability Type 86

Table 4.3: Summary Statistics of PMT Subscales..88

Table 4.4: Summary Statistics of PMT for Age 90

Table 4.5: Summary Statistics of PMT for Gender 94

Table 4.6: Summary Statistics of PMT for Education Level..96

Table 4.7: Summary Statistics of PMT for Disability type 101

Table 4.8: Summary Statistics of KBIT-2 Subscales..106

Table 4.9: Summary Statistics of KBIT-2 for Age...107

Table 4.10: Summary Statistics of KBIT-2 for Gender...109

Table 4.11: Summary Statistics of KBIT-2 for Education Level 110

Table 4.12: Summary Statistics of KBIT-2 for Disability Type.....................................113

Table 4.13: One-Way ANOVA Comparing PMT by Demographic Variables 117

Table 4.14: Significant Differences in Spatial Concept Memory Score by Disability....120

Table 4.15: Significant Differences in Recent Memory and VIP Scores by Age...........121

Table 4.16: Significant Differences in KBIT-2 Verbal Scores by Education.................124

Table 4.17: Significant Differences in KBIT-2 Verbal Scores by Disability..................124

Table 4.18: Significant Differences in KBIT-2 Nonverbal Scores by Education............125

Table 4.19: Significant Differences in KBIT-2 Composite Scores by Education...........125

Table 4.20: Correlation Analysis of PMT Subscales to KBIT-2 Subscales 126

LIST OF FIGURES

Page

Figure 3.1: Subscales of the PMT..72

Figure 3.2: Subscales of the KBIT-2 75

CHAPTER 1

INTRODUCTION

Cognitive functions involving attention and concentration, as well as the storage and recall of information has been identified in even simple organisms such as the fly (Swinderen, McCartney, Kauffman, Flores, Agrawal, Wagner & Paulk, 2009). The human capacity for storage and retrieval of information is a critical factor for learning and impacts educational development, as well as an individual's level of vocational readiness. Research into the capacity to learn has identified the essential processes of receiving, modifying, storing, retrieving and acting upon information (Atkinson & Schiffrin, 1968; Bower, 1970; McCarron, 1984b; Snow, 1981). During the last century, the measurement of the cognitive functions associated with memory has been incorporated into intellectual and aptitude measurements used by psychologists, neuropsychologists, educational psychologists, educators and vocational assessment specialists. Anomalies in cognitive function or trauma to the brain can impact an individual's capacity for memory and information processing, as well as result in mild to severe disability (Hill, Elliott, Shelton, Pella, O'Jile, & Gouvier, 2010; Getzel, Gugerty, McManus, 2006; McCarron, 1984b; Schall, Cortijo-Doval, Targett & Wehman, 2006; Targett, Yasuda & Wehman, 2006; Wehman, 2006). Symptomology associated with health conditions, chronic pain and mental health disorders may also result in diminished capacity for attention, concentration and memory (McCarron, 1984b; Wehman, 2006).

Cognitive aptitude and learning style assessment are psychometric components of vocational evaluations provided for individuals with disability being served through state vocational rehabilitation (VR) programs in the United States. Each state VR program is overseen by the Rehabilitation Services Administration and the U.S. Department of Education. These state-federal funded programs include 80 general, combined, and blind state agencies. The agencies are not entitlement programs and serve applicants given the limitations of eligibility, funding and available services. The impact of the VR program nationally and in each state program is influenced by the variety of disabilities served by the agency, the impact of participants' disabilities on employment planning and the vocational implications of individual work attitudes and past work experiences. Differences have also been identified in the likelihood of program acceptance and successful closure related to age, gender, race, education level, disability type and severity, and other consumer descriptors (Hayward & Schmidt-Davis, 2003).

Vocational rehabilitation services can include a variety of medical, psychosocial, and other types of assessment; employment-development services including job search training or work adjustment training; vocational training and education (including undergraduate or graduate degree programs); transportation or housing assistance; technical assistance in development of business plans; tools, licenses, and equipment; services for family members; and virtually any other service that will assist individuals with disability to achieve an employment goal consistent with his or her Individualized Plan for Employment (IPE) (Hayward & Schmidt-Davis, 2003). Research has estimated approximately one-third (31%) of participants receive educational or vocational assessment as part of their vocational rehabilitation services (Hayward & Schmidt-Davis, 2003). Population statistics indicate VR consumers have changed significantly in demographics since the beginning of the VR program in 1920, evolving from a consumer base with needs for physical restoration (industrial accidents, war injuries) to an increasing number of individuals seeking services with learning disability, mental illness, traumatic brain injury, and other cognitive disabilities (Haywood & Schmidt-Davis, 2006). Additionally, there has been an increase of persons served with limited or no work history, problematic work behaviors, and other barriers to employment (Hayward & Schmidt-Davis, 2003). Consumer population statistics reflect that:

- Nearly three-fourths (71 %) of VR consumers have acquired, as opposed to congenital, disabilities;
- 75 % of all VR consumers have disabilities classified as severe, including 26 percent who have most severe disabilities;
- 68 % of VR consumers are between the ages of 22 and 49 years old;
- Over half (57%) of VR consumers have a high school diploma or GED as their highest level of education. (Hayward & Tashjian, 1996).

State vocational rehabilitation services available in Georgia date back to 1937 and the program is currently represented in 50 field offices in 12 regions statewide (S. Sherman. personal communication, October 18, 2010). The Georgia VR agency is part of the Georgia Department Labor and served 33,934 – 36,766 participants from 2008 to 2010 (M. Hoffman, personal communication, March 31, 2011). Services provided by the Georgia VR program include guidance and counseling, work adjustment training, post-secondary support, vocational and technical training, supported employment, on-the-job training, work readiness training and deaf, blind and deaf-blind services (Georgia Department of Labor, 2011).

The assessment of consumer abilities and projection of rehabilitation needs and identified strategies for employment success is considered a critical function of vocational rehabilitation counselors. Vocational evaluations have traditionally been used to assess vocational potential since the 1970's and provided by those trained as vocational evaluators or certified as vocational evaluation specialists (Power, 2006; Pruitt, 1986). Despite the acknowledged importance of consumer assessment it has historically been the weakest area of service delivery provided by the state rehabilitation agencies (Elliott & Leung, 2004).

Rationale

A relationship between cognitive abilities and elements of learning style including attention, concentration and memory has been found to be significant in past studies and the combined attributes of cognition and information processing have also been studied in relation to aptitudes that support the success of individuals academically and vocationally (Ackerman, 1988; Corno, Kupermintz, Lohman, Mandianch, Porteus & Talbert, 2002; Hunt & Lansman, 1982; Kyllonen & Christal, 1990; McCarron, 1984b; Pellegrino & Glaser, 1980; Snow, 1981). McCarron (1984) presented research to support the significance of attention, concentration and memory on an individual's ability to process auditory and visual information, as well as impact on education and vocational levels of functioning.

Individuals with disability are at risk for cognitive limitations that result in functional limitations impacting the capacity for attention, perception and memory (Dial, Chan, & Norton, 1990; McCarron, 1984b; Wehman, 2006). Since the introduction of the Perceptual Memory Task (PMT) in 1984 as a measure of focused attention, memory and information processing, the instrument has widely been administered as part of vocational evaluation services provided to individuals with disability. The Kaufman Brief Intelligence Test – 2 (KBIT-2) is also frequently administered as a measure of cognitive abilities or intelligence. Research has suggested that more intelligent individuals can attend to more information and have larger working memory capacity than the less able (Ackerman, 1988; Corno, et al., 2002; Hunt & Lansman, 1982). There have been no prior research studies using these instruments to explore potential phenomena related to intelligence, capacity for attention, memory and information processing.

Purpose of Study

This study provided an opportunity to perform a validation study of the PMT through correlation with the KBIT-2. A previous validity study of the PMT (McCarron, 1984) involved correlation of the WAIS Verbal, Performance and Full-Scale IQ (Wechsler, 1955) standard scores with the factor standard scores of the PMT. Historically, many instruments have been validated through correlation with other well respected published instruments that possess traits logically related (Anastasi & Urbina, 1997; Galguera & Fishman, 2003; Thorndike & Hagen, 1977). A correlation study involving these two instruments allowed exploration of the relationship between intelligence, capacity for attention, memory and information processing using test score data from instruments with a history of publications and professional experience supportive of instrument use with adults with disability (Gregory, 2007; McCarron, 1984b).

This study also examined the impact of measured verbal, nonverbal intelligence, and general intelligence on learning style and information processing capabilities across a variety of disabilities, age groups, educational attainment groups and gender groups. Cognitive abilities support an individual's global capacity to act, think, and deal effectively with their environment. Global or general intelligence is divided into verbal and performance (nonverbal) domains (Kapplan & Saccuzzo, 2005). These domains were measured using the KBIT-2. Learning style differs from cognitive abilities and refers to the cognitive processes used or depended upon when receiving information (Mayer & Massa, 2003). Information processing abilities related to learning style were measured using the PMT.

The research objectives addressed in this study are described below and provided guidance in the data collection and analysis process in this study:

1. Describe demographic characteristics of individuals with disability provided formalized assessment through the Georgia Department of Labor's Vocational Rehabilitation Program.

2. Describe the demographic characteristics of PMT Total, Spatial Concept Memory, Immediate Recall, Sequential Memory, Recent Memory, Auditory Information Processing and Visual Information Processing Standard Scores.

3. Describe the demographic characteristics of KBIT-2 Verbal, Nonverbal and Composite Standard Scores.

4. Determine the relationship between age, gender, level of education, type of disability and information processing as measured by the PMT.

5. Determine the relationship between age, gender, level of education, type of disability and cognitive abilities as measured by the KBIT-2.

6. Correlate the standard scores obtained on the PMT and K-BIT-2 by age, gender, level of education and type of disability.

Theoretical Framework

Framework of the study was dependent upon past empirical research specific to the areas of learning style assessment, neuropsychological constructs and the measurement of intelligence. Therefore, the study was based upon concepts that support the theory that preference in learning style and information processing are dependent upon processes over and above abilities or personality and also the cognitive controls that regulate attention and avoid distraction. The study was also reflective of theories related to the measurement of intelligence acknowledged in educational, psychological and rehabilitation disciplines.

The majority of learning style assessment in adult populations involves self-reporting instruments while few measure learning style through examinee performance (Reed, 1996). Popular self-reporting assessment tools include the Learning Styles Inventory (Dunn, Dunn & Price, 1979) and the Kolb Learning Style Inventory (Kolb, 1976). In contrast, performance based assessment tools include the Perceptual Memory Task (McCarron, 1984b) and the Learning Efficiency Test (Webster, 1992).

Definition of learning style is varied within the fields of education, psychology and vocational rehabilitation. Some definitions address the concept as a specific trait or factor (Blackmore, McCray & Coker, 1984; Pashler, McDaniel, Rohrer & Bijork, 1999) while others define an all-encompassing concept (Keefe, 1982; Messick, 1994; Snow, 1996). The tendency to consider individuals as more than a list of variables was encouraged by Snow (1996) to reflect the integrated activities that individuals must involve in learning. Smith (1982) described learning style related to an adult population as the unique characteristic preferences and tendencies related to processing information and noted a behavioral response toward learning. These preferences and tendencies were quantified by Keefe (1982) to include cognitive, affective and physiological traits that are stable indicators of the way an individual will take in information, interact and respond in learning situations. Messer (1994) theorized that individual style in learning represents processes over and above abilities or personality and involve cognitive controls that regulate attention and avoid distraction. This construct is the one that bests supports the correlation between individual style in learning and cognition.

The field of neuropsychology has been greatly influenced by the theories of Alexander Luria that described the implications of memory dysfunction to include audio verbal and visual-spatial memory deficits, fluctuation of attention, disorganization, perseveration and incapacity for planning and execution (Luria, 1976). The theoretical foundations of Luria emphasized the critical capacity of information processing and memory function on cognitive abilities and the impact of injury on these vital aspects of brain function, as well as consequences on human capacities (McCarron, 1984b). Luria's theories of neuropsychological functioning have been the framework of many test developers and are reflected in measurements of attention and information processing (Kaufman, Kaufman & Shaughnessy, 2007). The theories of Luria were cited as instrumental in the development of the PMT and KBIT-2 and were also a theoretical framework of this study (Kaufman, Kaufman & Shaughnessy, 2007; McCarron, 1984b).

Historically, intelligence testing focused on global intelligence with the theories of Spearman (1927) and Binet (1916) impacting intelligence test development and interpretation throughout the first half of the 19th century. Spearman defined the concept of general intelligence and cited the importance of global traits in individual differences including heredity (Neisser, et al, 1996; Spearman, 1927). Binet (1916) further developed the concept of general intelligence with empirical research reflecting the individual capacity to adjust to circumstances, as well as the impact of common sense and initiative on intelligence. His theories of intelligence challenged previous concepts of well-learned associations, vocabulary development and heredity with focus on the impact of judgment and choice in the demonstration of intelligence in testing procedures prompting further investigation in constructs associated with intelligence and the use of intelligence tests (Neisser, et al, 1996). Louis Thurstone opined that group factors were significant in intelligence testing and supported seven primary mental abilities that included verbal comprehension, word fluency, number facility, spatial visualization, associative memory, perceptual speed and reasoning (Anastasi & Urbina,, 1997; Thurstone, 1938). David Wechsler developed the Wechsler Adult Intelligence Test in 1938, based on a philosophy that intelligence is an overall capacity to act purposefully, think rationally, and deal effectively with the environment (Kapplan & Saccuzzo, 2005). Wechsler's theory reflected verbal and non-verbal areas of intelligence that could be measured separately from global intelligence as had been previously endorsed by Spearman and Binet and included verbal, nonverbal and overall intelligence standard score with a mean or average of 100 and a standard deviation of 15 points (Kapplan & Saccuzzo, 2005).

Wechsler claimed his theory of intelligence supported the development of clinical instruments that reflect unique aspects of individuals (Kaufman, Kaufman & Shaughnessy, 2007). The Wechsler intelligence scales continue in use today and are often credited as the most commonly used psychological assessments (Kapplan & Saccuzzo, 2005). As the development of the KBIT-2 was based upon the theories of Wechsler, the constructs of verbal, nonverbal and overall intelligence, as well as the use of standard scores with a mean of 100 and a standard deviation of 15 points will also provide theoretical framework of this study. Individual differences among a population of individuals with disability served through a state vocational rehabilitation program was the focus of this study with the theories of performance based learning style assessment, neuropsychological perspectives of memory capacities and contemporary intelligence testing providing the supportive framework of the study.

Significance of the Study

The assessment of cognitive abilities and learning style is endorsed as part of comprehensive assessment by the Commission for Certification of Rehabilitation Counselors (CRCC) and the Commission for Certification of Vocational Evaluation and Work Adjustment Specialists (CWAVES). Comprehensive assessment is also a required service mandated by the federal government through the state rehabilitation agency (Rehabilitation Act Amendments, 1998). State rehabilitation programs are evaluated annually to rate the performance of each state's program. Evidence that comprehensive assessment has taken place is an area evaluated by the Rehabilitation Services Administration (RSA).

Individuals with disability are at risk for cognitive limitations that result in functional limitations impacting capacity for attention, perception and memory (Dial et al., 1990; McCarron, 1984b; Wehman, 2006) and functional limitations involving memory functioning can have direct impact on education and vocational potential and supports measurement of memory functions as a component of learning style assessment (McCarron, 1984b; Reed, 1996). As cited earlier, research has suggested that more intelligent individuals can attend to more information and that more intelligent persons have larger working memory capacity than the less able (Ackerman, 1988; Corno, et al., 2002; Hunt & Lansman, 1982). The proposed study provided opportunity to examine the relationship between measured cognitive abilities and information processing capabilities or learning style across a sample reflective of a variety of disabilities.

This study contributes to the body of literature involving individual differences and learning style, as well as provides information that will support the development of individualized rehabilitation, training and instructional strategies for use with individuals with disability. Study findings also add additional perspectives to the comprehensive assessment process mandated by the federal government in the provision of vocational rehabilitation services by the state vocational rehabilitation agencies and perhaps impact the graduate training curriculums in vocational rehabilitation programs impacting vocational rehabilitation planning and potentially participant outcomes.

CHAPTER 2

REVIEW OF LITERATURE

This review of literature focuses on the theoretical frameworks of intelligence, information processing and learning style. The chapter will emphasize eight areas including the history of vocational rehabilitation and vocational evaluation services, historical and philosophical perspectives in the assessment of individual differences, modern theories of intelligence and intellectual assessment, learning style theories and instruments and empirical studies describing the relationship between information processing and cognition. Additionally, the chapter will provide an overview of tests and measurement concepts and profile the PMT and the KBIT – 2.

History of Vocational Rehabilitation

Modern vocational rehabilitation services in the United States are a direct outcome of federal and state vocational rehabilitation initiatives that began in the early 1900's with agencies designed to coordinate the provision of services as needed from different professions (e.g., medicine, education and psychology) to meet the needs of individuals with disability in preparing them for work (Jenkins, Patterson & Szymanski, 1997). The path to modern service delivery models began at a time in the United States when people with disability were typically viewed as the carrions of society and vulnerable to isolation, mistreatment and even death (Elliott & Leung, 2004). The impact of legislation not only resulted in the development of unique professions within the field of vocational rehabilitation, but also served to promote equality and civil rights for individuals with disability (Jenkins, Patterson & Szymanski, 1997).

Early History

Before government involvement in the provision of vocational rehabilitation services, assistance to people with disability was provided by charitable organizations and through institutions founded by known reformers such as Thomas Gallaudet, Dorothy Dix , Samuel Gridley Howell and Washington Gladden (Jenkins, et al., 1997; Martin & Gandy, 1999; Oberman,1980; Peterson & Aguiar, 2004; Reuben & Rossler, 2001). In the middle 1830's, Dr. Samuel Gridley Howell established the New England Asylum for the Blind in Massachusetts after traveling to Europe to study work being done with blind children there. Historically, the school opened initially in the home of Dr. Howell and later became known as the Perkins School for the Blind (Sink, Field & Gannaway, 1978). In 1841, Dorothy Dix began her work on behalf of people with disability that were incarcerated in jails or poor houses. The first residential institution for people with mental retardation was founded by Samuel Gridley Howell at the Perkins Institute in Boston, Massachusetts in 1848. The first vocational training program was established at the Perkins Schools in 1850 to specifically assist individuals in entering the workforce (Sink, Field & Gannaway, 1978).

In 1860, the use of Braille was introduced at the Missouri School for the Blind. President Abraham Lincoln signed the Enabling Act in 1864 providing the Columbia Institution for the Deaf and Dumb and Blind authority to award college degrees and was the first college in the world established for people with disability. The institution's blind students transferred to the Maryland Institution at Baltimore in 1865 and left the college with a student body made up of entirely deaf and hearing impaired students that would eventually be renamed Gallaudet University (Pelka, 1997; Reuben & Rossler, 2001). The late 1880's brought an effort to suppress the use of sign language through the firing of deaf teachers at schools for the deaf. This movement was known as oralism and perceived as a direct attack upon the culture of the deaf. In late 1880, the National Convention of Deaf/Mutes was held in Cincinnati, Ohio and this meeting is credited as the historical beginning of the National Association of the Deaf and the organization's first issue was to address oralism and the suppression of American Sign Language (Pelka, 1997). Sir Francis Galton presented his philosophies regarding eugenics in 1883 with an expressed intent to improve the quality of humanity. Unfortunately, the subsequent movement in America led to passage of laws in the United States that prevented people with disability from marrying, having children, moving to this country and the forced sterilization of many people with disability (Pelka, 1997).

A movement of private rehabilitation efforts and organizations began at the turn of the century and included a group of women in Cleveland, Ohio known as the Sunbeam Girls who raised money to start a day nursery and kindergarten for children with physical disability in 1900. Through the efforts of the Sunbeam Girls and the local school board, the Wilson School for Crippled Children was opened in 1910 where girls were taught sewing and boys learned manual trades. The program added an orthopedics center in 1922 and moved to larger facilities with office space for state rehabilitation staff members that were assigned to the Cleveland area. The facility was later known as the Vocational Guidance and Rehabilitation Services (VGRS) and is considered the first rehabilitation facility in the nation (Sink, Field & Gannaway, 1978). At approximately the same time, the Institute for the Crippled and Disabled (ICD) was established in New York City through a collaborative by philanthropist Jeremiah Millbank and the American Red Cross. A year following the establishment of ICD in New York City, the Junior League in Milwaukee, Wisconsin established an outpatient therapy center for the treatment of children with severe disability. This program later became known as the Curative Workshop of Milwaukee (CWM) and provided work training through crafts with income provided for the program through selling of items made by the clients at the facility (Sink, Field & Gannaway, 1978).

By the early 1920's, many states had formed agencies to serve people with disability. In 1923 representatives of these agencies met and coined the organizational name of the National Civilian Rehabilitation Conference. Yearly conferences followed and in 1927, the organization was re-named the National Rehabilitation Association. This professional organization continues to date to be one of the most influential professional and lobbying organizations in the United States dedicated to improving the lives of individuals with disability.

Franklin Delano Roosevelt's famous trips to Warm Springs, Georgia and his purchase of the resort with therapeutic pools led to the development of the Warm Springs Foundation in 1927 to provide medical, educational and vocational assistance to polio survivors (Persico, 2008). Goodwill Industries of America (GIA) was started by Rev. Edgar Helms in Boston, Massachusetts and was also begun during this time period with an original purpose to serve the poor instead of the handicapped. The program evolved by 1939 to focus only upon increasing employment opportunities for individuals with disability (Obermann, 1980; Sink, Field & Gannaway, 1978). The development of these rehabilitation programs are significant in the history of vocational rehabilitation as they were the first programs to recognize the need for physical, psychological, social, vocational and educational adjustment services (Sink, Field & Gannaway, 1978).

Early Legislation

During the early 1900s, high rates of industrial accidents left workers disabled without recourse to rehabilitation. Workers' compensation legislation was enacted in 1908 as part of the Federal Employees Compensation Act allowing federal workers in hazardous occupations to be provided assistance and not bear the responsibility for injuries resulting from their work (Elliott & Leung, 2004; Reuben & Rossler, 2001). By 1913, twenty-one states had established some form of workers' compensation and by 1919 the number of states had increased to forty-three. (Pelka, 1997). The program not only provided some form of compensation to injured workers, but was also the impetus of formalized programs to study causes for accidents and to determine means of prevention (Elliott & Leung, 2004). The Fess-Smith Civilian Vocational Rehabilitation Act was passed in 1920 (Public Law, 236) and assured vocational education to persons with physical disabilities who were unable to work (Reuben & Rossler, 2001).

Franklin Delano Roosevelt was sworn into office as the first president of the United States with physical disability in 1933 and two years later signed the Social Security Act establishing benefits for old age and grants to states for assisting blind individuals and children with disability, as well as extending the already existing vocational rehabilitation programs established in earlier legislation. A federal program for employing blind vendors at stands in the lobbies of federal office buildings was established through the passage of the Randolph Shepherd Act in 1936. Facility based services for the blind received additional assistance through the passage of the Fair Labor Standards Act in 1938 and resulted in a significant increase in the number of sheltered workshop programs for blind workers. The Georgia state vocational rehabilitation program began in 1937 with the establishment of the Division of Vocational Rehabilitation within the Department of Education (S. Sherman, personal communication, October 18, 2010). In 1940, the National Federation for the Blind was formed in Wilkes-Barre, Pennsylvania to provide advocacy for improved conditions at sheltered workshops and to support more input by blind people into programs (Pelka, 1997).

Impact of War

Response to American soldiers injured during war years has also significantly contributed to the history and development of vocational rehabilitation services in the United States. World War I resulted in an increased need for vocational rehabilitation services for the large number of veterans returning from the war with physical disability. The Soldiers Rehabilitation Act (1918) was passed to provide funding for rehabilitation services for disabled veterans and the Federal Board of Vocational Education was formed to administer these services (Elliott & Leung, 2004; Gelber, 2005). A Veterans Bureau was created in 1921 and later became the Department of Veterans Affairs. The Disabled Veteran's Act (1943) was passed during World War II to assist disabled service personnel in returning to work and the Serviceman's Readjustment Act (1944) authorized further training and education for those whose education had been interrupted by their military service. This act was later expanded in the Veteran's Readjustment Assistance Act in 1952 to include the Korean era veterans (Elliott & Leung, 2004).

Howard Rusk was assigned to the U.S. Army/Air Force Convalescence Center in Pawling, New York in 1944 to develop a rehabilitation program for airmen who had experienced disability. While his efforts were first criticized and his strategies drew skepticism, the program was later recognized as the first physical medicine and rehabilitation medicine program in the United States. This program also led to physical medicine and rehabilitation medicine becoming a medical specialty also known as physiatry (Pelka, 1997) and the long-term medical management necessitating medical expertise in physical medicine and rehabilitation was recognized in 1947 as a specialty board by the American Medical Association (Elliott & Leung, 2004). During this period, the field of public vocational rehabilitation was largely focused on physical restoration and relied heavily on the methodologies used in military hospitals with primary input in rehabilitation planning from physical therapists and occupational therapists (Sink, Field & Gannaway, 1978).

Vocational Rehabilitation Comes of Age

The Federal Social Security Act (1935) provided a federally overseen state vocational program would become a permanent government agency and provided benefits to those who had incurred disabilities that impacted employment. A year later, the Randolph Shepherd and Wagner O' Day Acts (1936) afforded enhanced job opportunities on federal property for persons with visual impairments and established the National Industries for the Blind. The employment needs of individuals with physical disability were addressed in 1940 at the first meeting of the President's Committee on Employment of the Physically Handicapped (Pelka, 1997). Congress passed the Vocational Rehabilitation Amendments in 1943 providing vocational rehabilitation services to persons with mental retardation and mental illness to improve their employability and also added physical rehabilitation and other healthcare services to the goals of federally-funded vocational rehabilitation programs (Elliott & Leung, 2004).

The years that followed World War II have been regarded as a golden period in the history of vocational rehabilitation (Rusalem, 1976) beginning with the Hospital Survey and Construction Act in 1946 that authorized federal grants to the states for the construction of hospitals, public health centers and health facilities for the rehabilitation of people with disability (Pelka, 1997). Awareness of the issues impacting disabled veterans returning to their life and work was heightened in 1947 when Harold Russell won two Academy Awards for his role as soldier returning home with physical disability in *The Best Years of Our Lives.* The Disabled Students Program at the University of Illinois at Galesburg was officially established in 1948 and is credited as the prototype that led to college programs for students with physical disabilities and independent living centers across the country (Pelka, 1997).

Mary Switzer was appointed the first director of the Federal Office of Vocational Rehabilitation in 1950 (Sink, Field & Gannaway, 1978). Howard Rusk opened the Institute of Rehabilitation Medicine at New York University Medical Center in 1951 and began research on assistive aids including electric typewriters, mouth sticks, improved prosthetics and adaptive aids for people with severe disabilities (Pelka, 1997). The Vocational Rehabilitation Act of 1954 provided additional funding to train rehabilitation professionals and resulted in funding of more than 100 university based rehabilitation related programs and amendments to the Vocational Rehabilitation Act passed later that year authorized federal grants to expand training programs available to people with disability (Reuben & Rossler, 2001).

President Kennedy appointed a special panel on mental retardation in 1961 to investigate the status of people with mental retardation and develop programs and reforms for improvement of services. Specifications were published by the American National Standards Institute published in 1961 as a guide to making buildings accessible and usable by individuals with physical disability and this publication is considered the basis for the first architectural access codes in the United States (Pelka, 1997). The President's Committee on Employment of the Physically Handicapped was renamed the President's Committee on Employment of the Handicapped in 1962 reflecting increased interest in employment issues affecting all individuals with disability. Congress passed the Mental Retardation Facilities and Community Health Centers Construction Act in 1963 authorizing federal grants for the construction of public and private nonprofit mental health centers. During the same year, South Carolina became the first state to adopt a statewide architectural access code. The Vocational Rehabilitation Amendments of 1965 authorized federal grants for the construction of rehabilitation centers, expanding the number of existing vocational rehabilitation programs and creating a national commission to address architectural barriers. (Pelka, 1997).

The Developmental Disabilities Services and Facilities Construction Amendments were passed in 1970 and contained the first legal definition of developmental disabilities. The amendments also authorized grants for services and facilities for rehabilitation of individuals with developmental disabilities and mandated that these grants be provided through state developmental disability councils. The Fair Labor Standards Act of 1938 was amended in 1971 to bring individuals with disabilities other than blindness into the sheltered workshop system and led to the development of a large sheltered workshop system for people with cognitive and developmental disabilities throughout the United States (Pelka, 1997; Reuben & Rossler, 2001).

Passage of the Rehabilitation Act of 1973 was also very significant in the history of vocational rehabilitation as it is credited for providing the structural system for the practice of vocational rehabilitation counseling. This legislation focused upon mandates to serve individuals with disability, promoted consumer involvement, stressed the importance of program evaluation, provided support for further research and advanced the civil rights of individuals with disability. An amendment to the Higher Education Act of 1972 was passed in 1976 mandating that services be provided for students with physical disability attending college (Rubin & Roessler, 2001). The California Department of Rehabilitation began nine independent living centers in 1975. The success of these centers demonstrated the potential for independent living for individuals with disability and resulted in replication of this program at centers all over the world. In 1978, Title 7 of the Rehabilitation Act established the first federal funding for independent living and created a National Council of the Handicapped under the U.S. Department of Education (Pelka, 1997).

Legislation and Recent History

The Americans with Disabilities Act (ADA) passed in 1990 and is considered the most significant disability rights legislation in history. It is credited with bringing full equal citizenship to Americans with disabilities through mandating that local, state and federal governments and programs be accessible and that businesses with more than 15 employees make reasonable accommodations for disabled workers. The ADA also mandates public accommodations such as public accessibility and accommodations in restaurants to provide access for people with disability. Additionally, ADA mandates were included that assure access in public transportation, communication and other areas of public life for people with disability and prohibits discrimination based on disabilities in employment (Elliott & Leung, 2004).

By the late 1990's, the federal government began initiatives reflecting new perspectives in vocational rehabilitation services that acknowledged greater recognition of individual rights and placed greater value on the role of the private sector in the provision of vocational rehabilitation services. These initiatives also affirmed a greater realization of service related costs of the vocational rehabilitation services delivery system and resultant financial burdens to the government (Elliott & Leung, 2004). Significant change in legislation appeared in the late 1990s that supported individual choice in the vocational rehabilitation process, as well as efforts to modify traditional links between public sponsored vocational rehabilitation and professions created by earlier legislation to support employment outcomes.

The Rehabilitation Act Amendments of 1998 addressed the quality of the roles and functions of vocational rehabilitation counselors and the need for consumer (the individual with disability) control in vocational rehabilitation services. The amendments also addressed the need for services to be provided by qualified vocational rehabilitation counselors and mandated criteria for knowledge and skills generally acquired through graduate studies in the field of vocational rehabilitation counseling and securing a national certification such as Certified Rehabilitation Counselor (CRC) or Certified

Disability Management Specialist (CDMS). The 1998 amendments were also significant in strengthening services for individuals with disability from an assessment perspective and specifically addressed the need for comprehensive assessment to determine the unique strengths, resources, priorities, concerns, abilities, capabilities, interests and informed choice in the provision of services (Elliott & Leung, 2004).

To facilitate employment and re-employment for people with disability, the 1998 Workforce Investment Act modified provisions of the Rehabilitation Act to more specifically address employment readiness. These provisions supported individuals with disability being served under an occupational match model rather than the traditional model of helping an individual reach full potential characterized in the history of the vocational rehabilitation process (Elliott & Leung, 2004). The Ticket-to-Work/Work Incentive Improvement Act further supported employment as a goal of the vocational rehabilitation program and was implemented in 1999 to initiate the movement of individuals off of financial support from Social Security Disability programs (Elliott & Leung, 2004).

Vocational Rehabilitation Services in Georgia

Evolution of the state vocational rehabilitation program in Georgia as it is known today began in 1964. This period was also significant historically with the establishment of rehabilitation facilities during 1964 and 1965 that included a residential vocational rehabilitation program for the blind at Cave Spring, Georgia, a vocational rehabilitation program to serve individuals with intellectual disability in Augusta, Georgia, a mental health vocational rehabilitation program at Central State Hospital in Milledgeville, Georgia and a residential vocational rehabilitation program as part of the Roosevelt

Warm Springs Foundation. A special vocational rehabilitation unit was also established at the Alto, Georgia state prison during this time period (S. Sherman. personal communication, October 18, 2010).

The state of Georgia opened one of the first halfway houses for people with mental illness in 1965 and during 1966 and 1967 additional rehabilitation centers began in Atlanta, Macon, Rome and Thomasville. In 1974, the Georgia Warm Springs Foundation gave the Roosevelt Warm Springs Institute for Rehabilitation (RWSIR) to the state of Georgia and this program continues to date providing medical and vocational rehabilitation services through the Georgia Department of Labor. The Commission of Blind Vendors was established in Georgia in 1975 and the Client Assistance Program (CAP) was established in 1978 to address consumer concerns regarding the vocational rehabilitation program. A program to serve deaf and blind individuals was established at RWSIR in 1978 and a program for the deaf began at the Atlanta Rehabilitation Center in 1979. An Independent Living Program also began at RWSIR in 1979. In 1982 the Georgia Division of Vocational Rehabilitation was changed in name to the Georgia Division of Rehabilitation Services under the Department of Human Resources (S. Sherman personal communication, October 18, 2010).

The state vocational rehabilitation program in Georgia converted to a computerized case management system in the early 1990's and state standards for the professional certification of rehabilitation counselors were finalized in 1996. In 1998, the Georgia agency added an assistive work technology program and developed positions for rehabilitation engineers, technicians and occupational therapists. State legislation mandated the Georgia agency move from the Department of Human Resources to the

Department of Labor in 2001 and the division director title was changed to Assistant Commissioner of Labor (S. Sherman. personal communication, October 18, 2010). The Georgia agency continues collaborative efforts with school systems, community agencies and the implementation of agency initiatives in keeping with federal legislation and mandates to support individuals entering the workforce (S. Sherman. personal communication, October 18, 2010).

Modern Vocational Rehabilitation Perspectives

While years of federal and state initiatives resulted in professional growth of vocational rehabilitation occupations including vocational rehabilitation counseling and vocational evaluation (Hershenson, 1988), the late 1990's brought changes to how these occupations were viewed. Vocational rehabilitation counseling once grounded in counseling theories has evolved into a more case management model of service delivery characterized by administrative and managerial duties (Elliott & Leung, 2004). The field of case management has grown within the private sector, as well as the provision of private vocational rehabilitation counseling and vocational evaluation services in complex service delivery models outside of the public arena. The working knowledge acquired in the public and private arenas has also led to opening new practitioner roles as expert witnesses and life care planners (Shaw, Leahy & Chan, 2000).

History of Vocational Evaluation

Historical roots of the vocational assessment began after World War I as part of initiatives to assist injured soldiers (Spitznagel, 1995). The profession of vocational evaluation began during the 1950's and 1960's to provide assessment services to assist in vocational rehabilitation planning of individuals with disability. Pruitt (1986) opined that the profession evolved with influence from multiple disciplines including psychology, medicine and vocational and industrial education and was also influenced by industry methodologies, military assessment, sheltered workshop programming and occupational therapy theories. These influences led to research and practice using tools and techniques to evaluate the vocational potential of individuals with disability without discrimination (Pruitt, 1986).

Definition and Professional Influences

A definition of vocational evaluation developed by the Vocational Evaluation and Work Adjustment Association (VEWAA) follows:

> A comprehensive process that systematically uses work, either real or simulated, as the focal point for assessment and vocational exploration, the purpose of which is to assist individuals with vocational development. Vocational evaluation incorporates medical, psychological, social, vocational, educational, cultural, and economic data into the process to attain the goals of evaluation (Dowd, 1993).

The field of psychology is credited with using information from evaluative methods or instruments to understand human behavior and to make predictions about an individual's current and future potential. The concept of a testing laboratory began with early experimental psychologists and the field of vocational evaluation embraced the concept of a laboratory environment. Some evaluation programs still refer to their evaluation centers as a laboratory (Power, 1996; Pruitt, 1986). The development of psychological tests with standardized test administration procedures and the use of age and grade related norms can also be traced to the field of psychology, as well as the expectations of statistical rigor in the development of formalized assessments including the use of work samples (Pruitt, 1986; Spitznagel, 1995). The vocational guidance discipline of psychology also contributed to understanding the importance of vocational interests, as well as accurate matching of interests and abilities with the expectations and demands of jobs (Pruitt, 1986).

Industrial psychology and methodologies used in industry are also reflected in the foundations of the vocational evaluation process and include job analysis techniques, use of situational assessment, the development of behavioral rating scales and use of simulated work activity or work samples. The use of work samples in employee selection is documented as far back as 1913 with the development of the first work sample, a simulated trolley car by industrial psychologist, Hugo Munsterberg to screen potential conductors. Work samples have long been endorsed by the military (Pruitt, 1986). In the 1970's, work samples were used in a variety of industries including the oil industry to screen potential workers. Although the use of work samples met with criticism for being inefficient and expensive (Cronbach, et al.,1989), the development and use of work samples was prevalent in the first twenty five years of the profession (Power, 1996; Pruitt, 1986; Sink, Field & Gannaway, 1978).

The first vocational evaluation battery involving work samples was the Testing, Orientation and Work Evaluation in Rehabilitation (TOWER) System developed at the Institute for the Crippled and Disabled (ICD) in 1937 and included over a hundred work tasks or tests. The May T. Morrison Center in San Francisco, California and the Vocational Guidance and Rehabilitation Service of Cleveland, Ohio are also credited as pioneers of work sample development and the use of standardized administration and norming procedures (Pruitt, 1986; Sink, Field & Gannaway, 1978). Situational assessment approaches were also developed for use in vocational evaluation and were often accompanied by the development of employability readiness scales. Pruitt (1986) opined that in every geographic region of the United States a vocational rehabilitation facility during the first twenty-five years of the profession made contributions to the field of vocational evaluation that provided a leadership model in the area of assessment. Additional factors related to predicting vocational potential that also influenced the history of vocational evaluation included fairness in employee selection, identifying occupational differences and similarities, employer expectations, affirmative action, adverse impact, work place modification and accommodation and legislative mandates (Spitznagel, 1995).

Growth as a Profession

The continued development of the field of vocational evaluation in the 1960's, as well as the disability implications associated with the assessment of individuals with disability led to interest nationally in a professional organization dedicated to the field of vocational evaluation (Spitznagel, 1995). Vocational evaluators developed a professional organization in 1965 at the Roosevelt Warm Springs Institute for Rehabilitation in Warm Springs, Georgia (Hoffman, 1971) that would serve as the impetus for the formation of the Vocational Evaluation and Work Adjustment Association (VEWAA) as a national affiliate of the National Rehabilitation Association (NRA) in 1967. The organization continues to provide training, as well as a quarterly bulletin that is distributed nationally and internationally. By the early 1920's, many states had formed agencies to serve people with disability. In 1923 representatives of these agencies met and coined the organizational name of the National Civilian Rehabilitation Conference. Yearly conferences followed and in 1927, the organization was re-named the National Rehabilitation Association. This professional organization continues to date to be one of the most influential professional and lobbying organizations in the United States dedicated to improving the lives of individuals with disability (NRA, 2011).

Up until 2009, VEWAA also oversaw professional certification of vocational evaluators. This oversight is now provided by the Commission of the Certification of Rehabilitation Counselors (CRCC, 2009). In March, 2011, a registry for professional vocational evaluators was established by the University of Wisconsin-Stout.

Graduate programs in vocational evaluation studies emerged in 1966 with the first vocational evaluation graduate program at the University of Wisconsin-Stout (Pruitt, 1986). Programs of study focusing on vocational evaluation continued to grow throughout the United States until the late 1980's when the focus of vocational rehabilitation services began a shift to other types of vocational assessment methodologies (Pruitt, 1986).

Modern Perspectives

Vocational evaluation began to be criticized in the late 1980's and early 1990's as a process to screen out individuals with disability from employment. Community based assessment, as well as place and train models of service delivery were introduced in the 1990's as more effective strategies for evaluation of individuals with disability (Power, 1996). Traditional service delivery models highly dependent upon psychometric testing and timed work samples and the process were also criticized for not providing an opportunity for individuals with disability to show their true capacities (Condon & Callahan, 2008; Wehman, 2006). Concepts such as person-centered planning, vocational profiles and authentic assessment were encouraged in conjunction with or in place of traditional vocational evaluation (Condon & Callahan, 2008).

The approach to vocational evaluation is now dependent upon the objectives of the assessment and may include interview, psychometric testing, situational and/or authentic assessment, job analysis, transferable skills assessment, work samples and discovery activities (Cordon & Callahan, 2008; Power, 2006). The vocational evaluation process can lead to a variety of outcomes including competitive employment, as well as maximizing quality of life and access to highly customized work activities for individuals with significant functional limitations associated with disability (Power 2006).

Historical Perspectives in the Assessment of Individual Differences

Interest in the readiness of individuals to perform in varied situations is documented as far back as ancient China. Often analogous with the concept of intelligence, individual differences have been measured to predict success as soldiers, students, workers and even capability as voters (Corno, Cronbach, Kupermintz, Lohman, Mandianch, Porteus & Talbert, 2002). Despite the historical roots of studying human differences, the progression of research, philosophies and theoretical framework is not reflective of an orderly progression as noted by Lohman and Rocklin, (as cited in Snow, 1995) in their introduction of modern research on intelligence:

> [It] reads more like a convoluted Russian novel than a tidy American short story. There are general themes, to be sure, but also diverse subplots that crop up – some unexpectedly, others at regular intervals. Sometimes a new cast of characters, in mute testimony to Santayana's epigram for those unable to remember the past, unwittingly repeat controversies played out earlier. Others play a variation on this theme and foist old constructs with new names on a generation of psychologists lost in the present. (p.448)

It is agreed upon that individuals differ from one another in many ways and that their capabilities vary on different occasions and in different situations and that these individual differences impact the ability to understand complex ideas, adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning and to apply thought to overcome obstacles (Neisser, Boodoo, Brouchard, Boykin, Brody, Ceci, Halpern, Loehlin, Perloff, Sternberg & Urbina, 1996). Corno, et al. (2002) affirmed that society thrives on the performance of its members and that one of the main questions often asked by applied psychologists is how to realize a maximum level of performance from individuals, but note that after a century of research, the question remains elusive. It is noted by researchers that attempts to define individual differences have become more challenging through the years as the questions have become increasingly complex as scholars have attempted to explain the impact of the individual, their learning situations and unique capabilities (Corno, et al., 2002; Mayer & Massa 2003; Snow, 1981; Snow, 1992). Research involving "intelligence" has attempted to clarify and structure the concept of individual differences, but has yet to achieve this goal (Corno, et al., 2002).

Learning and Intelligence Theories

Historical perspectives related to theories of individual differences begin with the Chinese and their use of tests of intelligence and educational achievement to select civil servants as early as 2357 BC. Confucius (500 BC) advised teachers and parents to recognize aptitudes for learning and stressed that the success of education would depend on adapting teaching to the individual differences among learners (Corno, et al., 2002). In the Greek civilization, Socrates adapted his teaching strategies while Isocrates employed mental activities directed towards improvement of broad mental faculties. Plato supported the identification of specialized aptitudes for various occupations in his Republic and mandated behavioral tests of these aptitudes as part of the selection process with particular interest in identifying essential military aptitudes needed by his

Guardians. Aristotle endorsed distinguishing a person's concrete observable activity from their hypothetical capacity (Corno, et al., 2002).

During the Roman period, Quintilian advised teachers in 90 AD to adapt classroom instruction to meet individual student needs. Corno, et al. (2002) noted that Quintilian's suggestions about individual preferences are as relevant to educational practice today as they were in first-century Rome:

- Identify apparent aptitudes and in-aptitudes of each learner.
- Guide learners in choosing courses according to their aptitudes.
- Seek to develop all aptitudes relevant to the end-goal of instruction, even if some are weak at the start; adapt alternative instructional designs to the individual's aptitude pattern, so as to remove defects and build up needed strengths.
- Do not teach in a way that runs counter to the individual's aptitudes as that may weaken those aptitudes.

The concept of individual differences grew narrow as the period of enlightenment paralleled philosophies included the impact of being well born and the power of wealth and birth versus innate abilities. The progression into very narrow views of intelligence and capabilities continued into the late 1800's and included John Stuart Mill who suggested that a mental test be given as a determination of how many political votes should be given to citizens. His philosophy resulted in every Oxford and Cambridge graduate being allowed two votes for almost a century (Corno, et al., 2002). In the United States, Charles Darwin wrote of a harmony between creatures and their environment, which was interpreted by Herbert Spencer as a social progress theory focusing on a concept of the fittest that supported identifying those with the greatest ability and providing them opportunity and responsibility (Corno, et al., 2002). Galton's *Inquiries into Human Faculty and Its Development* (1883) initiated the eugenics movement in England and the United States which endorsed improving individuals' capacities by preventing people with disability, as well as other minority groups from having children (Polka, 1997).

The Concept of General Intelligence

Charles Spearman defined the concept of general intelligence in 1904 and noted the importance of global traits in individual differences (Neisser, et al., 1996; Spearman, 1927). Alfred Binet's research led to the development of intelligence tests that distinguished children with intellectual limitations from those with behavioral problems (Corno, et al., 2002; Neisser, et al., 1996). His theories were grounded in the capacity to adapt to circumstances, demonstrate initiative, good sense and practical sense (Binet, 1916). Binet believed that intelligence included the regulatory processes of judgment and choice and that intelligence was not a fixed trait or a trait based upon well-learned associations, procedures or size of an individual's vocabulary. His instructional strategies were ignored by researchers that followed, as great weight was placed upon the impact of heredity on intelligence. Binet's research is credited with influencing the investigation of intelligence, as well as the use of psychometric tests in Europe and the United States (Neisser, et al., 1996).

Cyril Burt purported research findings in 1931 supporting that intellectual abilities were based upon an innate general cognitive ability influenced by genetic and environmental contributions (Burt, 1931). Burt's research was criticized as falsified, leading to scandal regarding the legitimacy of his work (Joynson, 1989). In contrast to

Binet's global perspective of intelligence, Louis Thurstone opined that specific group factors were significant in cognitive ability (Neisser, et al., 1996; Thurstone, 1938). Thurstone presented empirical research in 1938 supporting seven primary mental abilities that included verbal comprehension, word fluency, number facility, spatial visualization, associative memory, perceptual speed and reasoning. He noted that while these abilities were not completely uncorrelated, they did show a moderate degree of independence (Pashler, McDaniel, Rohrer & Bijork, 1999).

In 1939, David Wechsler developed the Wechsler Adult Intelligence Scale (WAIS) that was later re-named the Wechsler-Bellevue Intelligence Test. His research was based upon his work with patients at the Bellevue clinic and his dissatisfaction with the Binet IQ test used at that time (Wechsler, 1944). He later developed the Wechsler Intelligence Scale for Children (WISC) in 1949 and the Preschool and Primary Scale of Intelligence (WPPSI) in 1967. Wechsler's theories of intelligence were based on a philosophy that supports intelligence as the overall capacity to act purposefully, think rationally, and deal effectively with the environment (Kaplan & Saccuzzo, 2005).

The Wechsler scales reflected areas of intelligence that could be measured separately as opposed to measuring only global intelligence previously endorsed by Spearman. An overall intelligence quotient was based upon a mean or average of 100 and a standard deviation of 15 and divided general intelligence into verbal and performance (non-verbal) domains. These two domains were further divided into subscales that allowed further exploration of differences within the two domains. Wechsler's theories of intellectual functioning are still reflected in the Wechsler scales used today with the Wechsler instruments often credited as the most commonly used psychological tests (Kapplan & Saccuzzo, 2005).

A new research approach to individual differences was introduced in 1983 by Howard Gardner that was unique in that it encouraged research to go beyond the average abilities of normal individuals, but to also include the extremes of gifted individuals (Gardner, 1983; Neisser, et al., 1996). Gardner's theory of multiple intelligences includes eight domains of narrow capabilities and achievements that cannot be measured through testing, with a foundational philosophy that while general intelligence exists, it is most closely related to academic achievement and school related activities Gardner, 1983; Gottfredson, 1998). While Gardner's theories have been applied in education, there is criticism that his theories lack empirical support and are not consistent with cognitive neuroscience research findings (Cherniss, Extein, Goleman & Weissberg, 2006; Rauscher & Hinton, 2006; Waterhouse, 2006). Additional critique of Gardner's theories of intelligence include that without testing, the independence of Gardner's intelligences from general intelligence cannot be evaluated (Gotfredson, 1998).

In 1985, Robert Sternberg introduced a triarchic theory of intelligence and cited three fundamental aspects of intelligence – analytical, creative and practical (Sternberg, 1985, Neisser, et al., 1996). While this theory has been described as focusing on goal-directed, adaptive behavior and has not been free of criticism (Neisser, et al., 1996; Schmidt & Hunter, 1993), it is acknowledged as a philosophy that separates analytic and practical intelligence (Neisser et al., 1996; Jenson, 1993). The concept of intelligence was further challenged in 1995 with the publication of *The Bell Curve: Intelligence and Class Structure in American Life* (Murray and Hernstein, 1995). Intelligence was purported by the authors to be inherited and the main determinant of success and prosperity in the United States. Intelligence tests scores are cited as the best way to quantify intelligence and the theory purports intelligence cannot be improved with disproportion of intelligence among those perceived most cognitively inferior including minorities. There was strong reaction and outrage to the book with reviewers citing ungrounded empirical research to support the strong opinions expressed related to minorities, unemployment, crime, industrial accidents and the poor. Some even expressed concern that the book supported a return to the theologies of social Darwinism (Shannon, 1995). Despite the extreme views expressed by Murray and Hernstein (1995), the impact of general intelligence or the "*g* factor" has been argued by Gottfredson (1998) to be the most effective predictor of school and work performance.

Anastasi & Urbina (1997) opined that over 400 different theories of traits have been identified during the last hundred years of research regarding individual differences. The most prevalent theories in the United States have involved multiple-factor theories that recognize group factors and potential individual impact of each factor on different tests in varying weights of influence depending upon the construct being measured (Anastasi & Urbina, 1997). This theory is not a simple explanation of traits as the relationship between a single general factor can be significant in a small battery of tests, but in a larger battery may only be common to some, but not all of the tests. Recognition of the significant influence of multiple factors has been identified in studies related to verbal, perceptual, memory and reasoning tests (Anastasi & Urbina, 1997).

Learning Style Theories and Instruments

Learning style refers to an individual's preferred mode of learning and the cognitive processing used or depended upon during learning. It was noted by Mayer & Massa (2003) that learning style is different from cognitive abilities such as verbal ability or spatial ability. The history of learning style theories is traced back to C. G. Jung, a psychiatrist and psychoanalyst who became the first modern typological theorist. Jung's theories were incorporated into the Myers-Briggs Type Indicator Test that became very popular in the 1940's and remains popular today. This instrument is developed around a group of categories and the match of a person to a category is purported to be helpful in making occupational decisions and in interpersonal relationships (Pashler, McDaniel, Rohrer & Bijork, 1999).

According to Pashler, et al. (1999), current popular learning style assessments include the Dunn & Dunn learning style model (Dunn, 1990) and Kolb's Learning Style Inventory (1984). The Dunn & Dunn theory of learning style is described as the way each individual concentrates, processes, internalizes, and remembers new and difficult information (Dunn & Stevenson, 1997). The Kolb Learning Style Inventory was developed based upon the developmental theories of John Dewey and Jean Piaget (Garner, 2000), as well as the psychological theories of Carl Jung (Evans, Forney & Guido-DiBrito, 1998). The Learning Styles Inventory classifies individuals into four types based upon their relationship to these dimensions with the following classifiers: divergers (concrete, reflective), assimilators (abstract, reflective), convergers (abstract, active), and accommodators (concrete, active) (Kolb, 1985). The Dunn and Dunn instrument, as well as the Kolb instrument are self-reporting measures of learning style (Reed, 1996).

In a review of literature, Pashler et al, (1999) reported 71 different learning style schemes and noted in disclaimer it was not an exhaustive list. The commercial activity related to learning styles was described as largely centering around the publishing and selling of measurement devices to evaluate individual learning styles in educational settings (Pashler, et al., 1999). The concept of learning styles and potential influence on learning is embraced in current educational psychology textbooks (Ormrod, 2008). Mayer (2009) described the learning style hypothesis with an example that verbal learners will learn best with verbal methods of instruction (e.g. instruction that emphasizes words) and visual learners will learn best with visual methods of instruction (e.g. instruction that emphasizes graphics).

Mayer (2009) cited research by Pashler, et al. (1999) that reflected there had been only a small number of scientifically rigorous experimental tests of learning style with no sufficient evidence to support that one kind of learner benefited from one kind of instructional method versus another kind of learner benefiting from another kind of instructional method. Paschel, et al. (1999) strongly noted that based upon their research they could not support learning style hypothesis. Learning style concepts within the education field often focus upon preferences for how information should be presented to an individual rather than projecting a person's ability to process one kind of information or another. The concept of learning styles as a set of preferences and the concept of learning style as a specific aptitude are very closely intertwined in many discussions of learning style (Paschel, et al., 1999). Messick (1994) described a theory of individual style representative of information processes over and above abilities or personality and involving cognitive controls described styles of regulating attention and avoiding distraction.

In the field of vocational rehabilitation, the concept of learning style is considered a critical component in the assessment process. Dial, et al. (1990) described the measurement of information processing abilities as fundamental in the development of appropriate educational and vocational rehabilitation programs. The importance of assessing learning style was affirmed in McCarron (1984) as not only important in the design of strategies for education and vocational training, but also noted to be critical in the planning of individualized vocational evaluation services. Consideration of learning style as a unique category included in the assessment process is one of the best practice principles in the *Code of Professional Ethics* (2008) for Vocational Evaluation Specialists, Work Adjustment Specialists and Career Assessment Associates. Evidence of learning style assessment being included in the vocational evaluation process is also endorsed by the *Commission for the Accreditation of Rehabilitation Facilities* (2010).

Reed (1996) noted that the majority of learning style assessment tools used with adult populations are self-reporting instruments with very few tools measuring learning style through examinee performance and these instruments include the Perceptual Memory Task and the Learning Efficiency Test. The Perceptual Memory Task was developed to assess perceptual memory processing as the foundation for learning style preferences (McCarron, 1984). The Learning Efficiency Test was noted by Reed (1996) to have been developed in 1992 to assess visual and auditory processing and the ability to retain information. Learning styles were described by Keefe (1982) as relatively stable cognitive, affective and physiological traits that predict how a learner will perceive, interact within and respond to a learning environment. Reed (1996) encouraged use of learning style assessments in vocational evaluation that support a comprehensive approach through assessment of the cognitive, affective and physiological factors that impact how an individual interacts and responses in learning situations. In contrast to measured performance, the self-report assessment model in vocational rehabilitation was noted by Prachyl (1998) by history to be vulnerable to overestimation of both interests and aptitudes and cited empirical findings that self-estimate taps different constructs than those measured through standardized tests. Several researchers (Lowman & Williams, 1997; Parker & Schaller, 1994) opined that the use of self-reporting measures should be limited to career exploration activities.

Information Processing and Cognition

Alexander Luria researched brain function from the perspective of memory and described brain dysfunction as potentially impacting memory function in the areas of audioverbal and visuospatial processions, as well as manifesting in limitations including fluctuation of attention, disorganization and an inability to plan a program of action (Luria, 1976). The ability to process information and maintain memory storage is noted by McCarron (1984) to be dependent upon the functioning of many areas of the brain and vulnerable to injury, as well as anomalies in development. Memory and information processing abilities are noted to be complex and a crucial life process depended upon for most daily life activities (McCarron, 1984a). Support of memory assessment as part the evaluation of learning style, as well as developing teaching strategies and vocational rehabilitation planning strategies has been endorsed as part of the vocational evaluation process (Leconte & Rothenbacher, 1997; Taylor, Musgrave & Crimando, 1995).

Between 1960 and 1990, an understanding of working memory and resultant impact upon cognition became the focus of research and was referred to by Corno, et al. (2002) as the most important shift in research involving individual differences during this time period. While researchers are often in agreement regarding the impact of short term memory on information processing ability, researchers differ widely on tasks designed to estimate the capacity of working memory, with suggestions that abler individuals can attend to more information or perhaps that abler persons have larger working memories than the less able (Corno, et al., 2002). Researchers have opined that a relationship exists between cognition and attention and higher attention demands and cognition (Ackerman, 1988; Corno, et al., 2002; Hunt and Lansman, 1982). Additional theories include a capacity hypothesis explaining working memory in terms of the amount of information that can be held at any time, with the concept of capacity as a structural limitation much like a fixed number of slots that are available for use. In contrast, others argue that abler people can refresh memory banks more rapidly and as a result can hold more information for use with more advanced cognitive demands when the stored information must be transformed, reorganized or elaborated on (Corno, et al., 2002).

Theories of cognition also have addressed the relationship of memory functions and reasoning. Pellegrino and Glaser (1980) cited a relationship between working memory and reasoning ability, but their study offered no quantitative estimate of the relationship. However, more recently, Kyllonen and Christal (1990) completed four large studies and reported high correlation between reasoning ability and working memory.

These findings were significant, as working memory had been not been included in previous studies of reasoning ability (Corno, et al., 2002).

Corno, et al. (2002) noted that the "working memory" of newer theories differ from the older concept of short-term memory that assumed passive storage and that the new theoretical models endorsed a continually active, control processing of information. A relationship between processing capacity and storage capacity is endorsed by some researchers (Daneman and Carpenter; 1980; Snow, 1981) while others such as Baddeley (1996) support a working memory with multiple components that include the capacity for a storage component and an executive system attending to one stimulus while performing other functions, inhibiting the perception of another, coordinating performance and switching strategies, as needed.

Gender and Educational Attainment

Test and measurement has been used to analyze the relationship between gender and cognition, as well as educational attainment and cognition. Kaufman, Kaufman, Liu & Johnson (2009) provided research to support the influence of gender and educational attainment on test performance. The relationship of ethnicity has also been cited as a key variable in predicting test performance, but has been described as a complex variable that can lead more questions than answers (Kaufman, et al., 2009). Kaufman, et al. (2009) noted that empirical findings as far back as the studies completed by Wechsler in 1955 reflected a relationship between years of education and verbal, performance and overall intelligence test performance with verbal intelligence consistently related most strongly to educational attainment. In the analysis of the relationship of gender and test performance, a relationship has been noted between the stronger test performance of men on measures of spatial abilities and mathematics while women outpaced men on measures of processing speed (Kaufman, et al., 2006; Manly, Heaton & Taylor, 2000; Reynolds, Chastain, Kaufman & McLean, 1987).

Test and Measurement

Methods used to gather information about people is referred to as *assessment* and a *test* is a type of assessment that is dependent upon specific procedures to obtain information that is converted to numbers or scores for interpretation based upon norm studies (Friedenberg, 1995). Formalized testing is quantified by Friedenberg (1985) as an objective measure in comparison to subjective measures such as observation or interview in an assessment. In determining the use of tests in the assessment process, the characteristics of tests should be considered from the perspective of validity (Friedenberg, 1995, Gall, Gall & Borg, 2007).

Concept of Validity

The concept of test validity is described by Gall, Gall, and Borg (2007) as involving determination of whether the inferences made from test scores are appropriate, meaningful and useful. Three major interpretative factors impact the selection of testing instruments used in the provision of vocational rehabilitation services and include: 1) the validity of instruments used in the vocational assessment process; 2) the appropriateness of the instrument for use with special populations; and 3) the explanation of the test scores (American Education Research Association, American Psychological Association & National Council on Measurement in Education, 1999; Camara & Lane, 2006; Messick, 1994).

The vocational rehabilitation profession grew from decades of federal and state funding (Hershenson, 1988) with influential leaders in the field well versed in psychometrics and assessment, (Power, 2006; Elliott & Leung, 2004). Instruments and work evaluation systems were grounded in the traditional concepts of validity originally introduced by Cronbach (1954) and acknowledged by the American Psychological Association. In 1954, the Technical Recommendations for Psychological Tests and Diagnostic Techniques was published and reflected Cronbach's research and conceptualization of validity divided into four parts: concurrent validity, predictive validity, content validity and construct validity. Concurrent validity was defined as the extent to which an individual's scores on a new test compared to scores on an established test again at approximately the same time reflective of the same construct. In contrast, predictive validity was defined as the extent to which a test score predicted or was related to scores on another measure to a degree that was consistent with the nature of the other measure.

Content validity was described as the extent to which items in a test represent the domain of content that the test was designed to measure and construct validity was defined as the extent to which a measure operationalized the concepts being studied (Gall, et al., 2007). Cronbach later coupled predictive and concurrent validity into a term that became known as criterion validity (Cronbach & Meehl, 1955). This type of validity incorporated predictive and concurrent validity and involved a specific standard related to an instrument's ability to measure accurately an individual's level of mastery of the test domains and has also been utilized when comparing an individual or a population to pre-specified standard or performance (Gall, et al., 2007). The validity of a testing instrument can be evaluated through scrutinizing content, relating scores obtained on a test to other test scores or other measures and performing a comprehensive analysis of how the instrument is understood within some theoretical framework for understanding the construct the test was designed to measure (Cohen, Swerdlik, & Phillips, 1996).

Re-Defined Concepts of Validity

Cronbach's theories were scrutinized over the years and Cronbach himself expressed dissatisfaction with validity procedures and validity concepts (Cronbach, 1989). The end of the 1990's brought the first major shift in the concept of validity since Cronbach's theories of the 1950's. Messick (1989) described the concept of validity as impacting the interpretations and actions on the basis of test scores or other methods of assessment and it was argued that validity was not a property of the test or assessment, but rather a property of the meaning of the test score. Additional criticism was expressed that the old view of validity was not complete and it failed to take into account the evidence related to value implications of score meaning as a basis for action, as well as social consequences that occur from score use (Messick, 1994). He proposed a new concept of validity including a more comprehensive theory of construct validity addressing both score meaning and social values as they relate to test interpretation and test use. Messick's new philosophy of validity integrated considerations of content criteria and consequences into a construct framework for the empirical testing of rational hypotheses regarding score meaning and theoretically relevant relationships with six aspects of construct validity identified to address central issues crucial to a unified concept of validity described as content, substantive, structural, generalizability, external and consequential aspects of construct validity (Messick, 1989).

Largely based upon the theories of Messick, the *Standards for Educational & Psychological Testing* were revised in 1999 through representation of the American Educational Research Association (AERA), American Psychological Association (APA), and the National Council on Measurement in Education (NCME). Areas of revision to the 1999 standards included validity, fairness, accommodation and compliance influenced by Messick's model of validity and included five types of validity supporting evidence described as significant from a historical perspective as the revised standards did not address the classic model of validity involving, content, criterion and construct validities (Camara & Lane, 2006). Validation is described in the new standards as a process of gathering evidence to provide a scientific basis for interpreting the scores as proposed by the test developer and/or the test user and the five categories of the evidence based support or question of the validity of an interpretation noted in the following categories: 1) test content, 2) response processes, 3) internal structure, 4) relations to other variables and 5) consequences of testing (Camara & Lane, 2006).

In keeping with the revised standards, Ferrara (2007) recommended following specific steps to identify threats to validity. While some are specific to test developers, others are applicable to the use of vocational assessment instruments and include defining the knowledge and skills to be assessed, administration of appropriate instruments and with correct procedures and fair interpretation of test results. The specific steps recommended by Ferrara (2007) include:

- Define the knowledge and skills to be assessed;
- Interpret test performance in relation to the targeted knowledge and skills;

- Evaluate assessment tasks to determine alignment with content, standards or job analysis;
- Assessment to determine if content and skills are adequately represented in test construction;
- Assessment to determine if assessment tasks and items elicit intended knowledge and skills;
- Determination of the appropriateness of test accommodations for special populations.

Ferrara (2007) also stressed the importance of the consideration of the consequences of testing and any evidence based upon the relation of other variables and importance of evaluating threats to validity based upon the 1999 revised standards.

In addition to standard revisions that tremendously changed the concept of validity, the 1999 standards also addressed fairness in testing and the societal implications of test and measurement. Four areas of fairness are defined:

- Fairness as a lack of bias – item or test bias;
- Fairness as equitable treatment in the testing process – examinees have comparable opportunity to demonstrate knowledge;
- Fairness as equality in outcomes across group;
- Fairness in opportunity to learn – the extent individuals have adequate instruction or exposure to test content (Camara & Lane, 2006).

Test Validity and Disability

As graduate programs emerged in vocational rehabilitation from the 1960's to the 1980's some programs included coursework in test and measurement and basic test interpretation while others developed dedicated tracks in vocational evaluation (Pruitt, 1986). Vocational evaluation textbooks have routinely provided overview of traditional validity concepts that included content validity, construct validity, predictive validity, as well as face validity (Power, 2006).

The passage of the ADA further reinforced the importance of validity in test selection and use with individuals with disabilities and reliance on sound psychometric principles has also been analogous with codes of ethics of Certified Rehabilitation Counselors and Certified Vocational Evaluators (Commission for Certification of Rehabilitation Counselors, 2009). Organizations certifying rehabilitation facilities also cite the importance of traditional concepts of validity in serving individuals with disabilities within programs receiving certification (Commission for the Accreditation of Rehabilitation Facilities, 2010).

Though vocational evaluation has continued to be an important component in the vocational rehabilitation process, many instruments used in the mid to late 20th century were found to not be appropriate for some populations and others were found to not be easily administered (Elliott & Leung, 2004). Additionally, the further validation of instruments developed for use with individuals with disability did not attract the interest of mainstream educational and psychological researchers and the incidence of many different types of disabilities limited norm specific research (Elliott & Leung, 2004; Parker & Schaller, 1996). The validity of instruments used in the vocational evaluation process were further questioned when aptitude testing fell out of favor with the U.S. Department of Labor in the late 1980’s (Power, 2006). Research also questioned the validity of aptitude assessment to project vocational success and supported the validity of the "g" factor as most predictive of employment success (Gottfredson, 1998).

Perceptual Memory Task

McCarron (1984b) developed the PMT to assess focused attending and perceptual memory skills from 1972 to 1982 with a norm population of 200 individuals with disabilities from age 4 through young adulthood in an effort to understand fundamental perceptual memory processes and relationship to learning skills, acquisition, vocational potential and neuropsychological disabilities (McCarron, 1984b). Reliability of the instrument reported in the test manual as determined through the use of two methods: a) pre- and post-testing; and b) split-half reliability. Pre- and post-testing was completed over a one month period with the same group to obtain reliability coefficients and standard error of measurement in a norm population of normal preschool children and adults with neuropsychological disabilities. Pre and post-test correlation coefficients of $r = .91$ for the children and $r = .93$ for the adult population were reported. Coefficients of determination of .83 and .87 indicated that approximately 83% and 87% of the variance for the respective groups could be explained by perceptual memory skills. The second method to determine the reliability of the PMT involved a split-half reliability estimate using the Spearman-Brown prophecy formula. This formula was supported for use as the two halves of the instrument were comparable in means, standard deviation, skew of distribution and test content allowing the instrument to be divided into odd and even numbers in comparability. Standard error of measurement (SEM) based upon split-half reliability reflected a SEM of 6.94 for the children and 8.24 for the adult population (McCarron, 1984b).

The construct validity of the PMT is described in the test manual (McCarron, 1984b) to be demonstrated through empirical findings for various groups of individuals with no disability, as well as individuals with developmental and neuropsychological disabilities. Specific populations included in empirical research include children of normal intelligence with diverse cultural and socioeconomic backgrounds, individuals with learning disability, intellectual disability, physical disability and neurological disability. Additional groups in which research using the PMT was conducted include individuals with autism, dyslexia, hearing impairment and mental illness. A statistically significant relationship ($r = .64$) between the PMT Total standard score and the Wechsler Adult Intelligence Scale (1955) is reported, as well as a moderate statistically significant relationship between the Visual Information Processing Standard Score ($r =.58$) and the Auditory Information Processing Score ($r = .45$) in a population of adults receiving vocational rehabilitation services (McCarron, 1984b).

The PMT manual purports the instrument's content, construct, concurrent and predictive validity for use with the general population and individuals with a variety of disabilities. Content validity is described by McCarron (1984b) as how well the content of the PMT samples an appropriate range of perceptual memory skills. The instrument content is noted to include measures of memory of spatial relations, visual recognition and visual sequential memory; auditory recognition and auditory sequential memory; intermediate recall and verbally mediated visual memory skills allowing involvement of both cognitive problem solving strategies, as well as visual and auditory sensory processes.

Spatial Relations

Spatial relations included in the PMT were designed in three dimensional configurations with horizontal, vertical and depth representation with conceptualization requiring spatial analysis and higher cognitive skills. Testing includes the perception of cubes in spatial designs that involve spatial analysis, quantification and organizational skills. Individuals with anomalies in neuropsychological functioning are at risk for functional limitations that can impact planning and organization required to perceive and reconstruct materials. They are also at risk for functional limitations involving the analysis and synthesis of information, as well as memory for what has been visually perceived or heard through auditory modalities (McCarron, 1984b).

Discrimination Recall

Long-term recall is defined as recall of visual materials after a 15-20 minute interval. Materials are requested to be selected that were previously encountered requiring discrimination, as well intermediate memory functions. Proactive inhibition is noted to be required to manage distraction of stimuli and interference with memory recall (McCarron, 1984b).

Discrimination Recall

Long-term recall is defined as recall of visual materials after a 15-20 minute interval. Materials are requested to be selected that were previously encountered requiring discrimination, as well intermediate memory functions. Proactive inhibition is noted to be required to manage distraction of stimuli and interference with memory recall (McCarron, 1984b).

Visual Designs Recognition and Sequencing

Each abstract design consists of two colors and is outlined in black with each color repeated on two items. Cognitive demands of the designs require recognition of the design, as well as visual perceptual processing including form recognition, figure-ground discrimination, visual sequential memory and perceptual motor integration. Memory processes are also required to recognize and sequence the designs (McCarron, 1984b).

Auditory-Visual Colors Recognition and Sequencing

The ability to process auditory information is measured through 12 basic colors used as auditory cues. Colors were selected to allow sufficient recognition by most persons except for individuals with color blindness in the gray-green and blue-purple discriminations (McCarron, 1984b).

Validity of the PMT

The construct validity of the PMT is demonstrated through empirical findings for various groups of individuals with no disability, as well as individuals with developmental and neuropsychological disabilities. Specific populations included in empirical research include children of normal intelligence with diverse cultural and socioeconomic backgrounds, individuals with learning disability, intellectual disability, physical disability and neurological disability (McCarron, 1984b). Additional groups in which research using the PMT was conducted include individuals with autism, dyslexia, hearing impairment and mental illness (McCarron, 1984b). A statistically significant relationship (r = .64) between the PMT Total standard score and the Wechsler Adult Intelligence Scale (1955) is reported, as well as a moderate statistically significant relationship between the Visual Information Processing Standard Score (r =.58) and the

Auditory Information Processing Score (*r* = .45) in a population of adults receiving vocational rehabilitation services (McCarron, 1984b).

The PMT was investigated by Janikowski & Bordieri (1995) with results supporting construct validity when compared to the Wechsler Adult Intelligence Scale-Revised. The construct validity of the instrument was also endorsed by Musgrave, Flowers & Shelton (1990) in the assessment of capabilities related to competitive employment and supportive employment. Construct validity of the PMT has also been demonstrated in empirical research to reflect a relationship of all measures of the PMT and the driver's license status of individuals with disabilities (Geiger, Musgrave, Welshimer & Janikowski, 1995).

Kaufman Brief Intelligence Test – 2

The Kaufman Brief Intelligence Test – 2 (KBIT-2) is described as a brief, individually administered measure of verbal and nonverbal intelligence with norm studies reflective of 4 through 90 years of age (Kaufman, 1997). The norm group totaling 2,120 is defined as a U.S. population of children, adolescents and adults who are non-institutionalized, and without functional limitations that would prevent them from being able to perform the tasks (Kaufman, 1997). This instrument was introduced in 1997 as a revision to the Kaufman Brief Intelligence Test (KBIT-2, 1984). Kaufman & Kaufman (1997) indicate that the KBIT-2 was developed in combination with the Kaufman Assessment Battery for Children, Second Edition (KABC-II) and that the two verbal subtests of the KBIT-2 belong to the KABC-II. The third subtest, a measure of nonverbal abilities is acknowledged as part of the original K-BIT, but also included items from the

KABC-II. The KBIT-2 consists of two Verbal subtests and one Nonverbal subtest with the performance on these measures resulting in an IQ Composite Score.

Verbal Knowledge

This domain includes two item types with one item type measuring general information and the other measuring receptive language. Kaufman and Kaufman (1997) cite these items types as primary components of Crystallized Ability (Gc) in the Cattell-Horn-Carroll theory of cognitive abilities. The vocabulary items are described as related to the Stanford-Binet Pictorial Identification task (Terman, 1916) and similar to the items of the Picture Vocabulary Test (Dunn & Dunn, 1997). Words selected for stimulus items were noted to be selected from two graded word lists, the Basic Reading Vocabularies (Harris & Jacobson, 1982) and the Index of Words Found in the Johnson O'Conner Research Foundation Vocabulary Item Bank (Gershon, 1988). Kaufman and Kaufman (1997) indicate that words selected for use were intended to cover a full range of difficulty for preschoolers to college-educated adults. Words that could not be depicted in simple illustration were eliminated, as well also words that would require a specialized area of knowledge base. Stimulus pictures were represented through illustrations rather than pictures to emphasize a specific feature or concept. Items measuring general information are described as accessing the same kinds of abilities as the Information subtest on the Wechsler scales (Kaufman & Kaufman, 1997).

Riddles

Unlike oral vocabulary tests that require defining specific words, the Riddles subtest provides a set of attributes or functions of an object or concept with an expectation of the analysis and synthesis of these features in order to supply a relevant word or respond by pointing to a picture. Kaufman & Kaufman (1997) credit the Riddles subtest as a direct adaptation of the Conceptual Inference test in Kagan Klein's (1973) cross cultural battery and found in Wechsler scales measures of executive functioning and intellectual ability.

Matrices

The development of the Matrices subtest is noted to have origins in the research of Raven (1981) in the use of abstract matrices as a method to assess intelligence while limiting the impact of culture on test performance. Raven's techniques and tests are noted to have broad acceptance within the field of psychology with inclusion in numerous instruments including the Wechsler scales (Kaufman & Kaufman, 1997). In his theories of information processing, Sternberg (1977) opined that the ability to solve analogies had been found to be a good indicator of general intelligence. Kaufman & Kaufman (1997) describe analogies and analogical thinking as significant to areas of psychology focused upon cognitive processing and theories of intelligence.

Validity of the KBIT-2

Using the split-half method, the KBIT-2 computations with mean scores ranging from .78 to .91 are reported to reflect internal-consistency reliability with weakest reliability among the youngest children in the norm sample. Test-retest reliability was reported to range from .88 to .92 with standard error of measurement (SEM) for the Verbal subtest ranging from 4 to 5 standard score points, the Nonverbal subtest ranging from 4-7 standard score points and the IQ Composite from 3 to 5 standard score points. Studies of the KBIT-2 in comparison to the original Kaufman Brief Intelligence Test reflect correlations ranging from .80 to .86. Multiple empirical studies support the interpretation of the KBIT-2 Verbal and Nonverbal scores as valid measures of crystallized ability and fluid/visual abilities. The IQ Composite score also has empirical support as an effective measure of general intelligence or the *g* factor. The correlation of the KBIT-2 to the Wechsler Adult Intelligence Scale – III (WAIS-III) is reported as strong with the KBIT-2 and WAIS-III Verbal IQ correlation of .81, Nonverbal with Performance IQ of .79 and IQ Composite with Full Scale IQ of .81 (Kaufman, 1997). A strong correlation between scores obtained on the KBIT-2 and the WAIS-III results in the credibility of the KBIT-2 as a measure of verbal, nonverbal and overall intelligence (Kaufman & Kaufman, 1997).

Kaufman (2004) noted that the K-BIT is not intended to be used for diagnostic purposes as more comprehensive assessment would likely be needed in for this purpose. A recent review of the KBIT-2 cited the use of the instrument as a screening of intellectual abilities and appropriate for use as part of assessment procedures for job applicants, forensic purposes and use as part of test batteries when an intellectual profile is not paramount (Bain & Jaspers, 2010).

Individuals with disability are at risk to experience functional limitations that impact cognitive functions, educational attainment and vocational potential. Differences among a population of consumers served through a state vocational rehabilitation program was the focus of this study with theories of performance based learning style assessment, neuropsychological perspectives of memory capacities and contemporary intelligence testing providing a supportive framework to investigate the relationship between the PMT and the K-BIT-2.

CHAPTER 3

METHOD

Purpose

Framework of this study was based upon past empirical research specific to the areas of learning style assessment, neuropsychological constructs and the measurement of intelligence that form a foundation acknowledging learning style as cognitive, affective and physiological traits impacting an individual's ability to receive information, interact and respond to their environment. This study was dependent upon theories of learning style that purport memory is dependent upon processes over and above abilities or personality and impacted by cognitive controls that regulate attention and avoid distraction (Keefe, 1982; McCarron, 1984b; Messick, 1994; Reed, 1996; Snow, 1996). These theories of performance based learning style assessment, neuropsychological perspectives of memory capacities and contemporary intelligence testing provided a framework for selecting independent (predictor) variables for this study (Luria, 1976; Reed, 1996; Wechsler, 1944). This study examined the relationship between measured verbal, nonverbal intelligence, and general intelligence and information processing capabilities or learning style across a variety of disabilities, age groups, educational attainment groups and gender groups.

The objectives addressed in this study are described below:

1. Describe demographic characteristics of individuals with disability provided formalized assessment through the Georgia Department of Labor's Vocational Rehabilitation Program.

2. Describe the demographic characteristics of PMT Total, Spatial Concept Memory, Immediate Recall, Sequential Memory, Recent Memory, Auditory Information Processing and Visual Information Processing Standard Scores.

3. Describe the demographic characteristics of KBIT-2 Verbal, Nonverbal and Composite Standard Scores.

4. Determine the relationship between age, gender, level of education, type of disability and information professing as measured by the PMT.

5. Determine the relationship between age, gender, level of education, type of disability and cognitive abilities as measured by the KBIT-2.

6. Correlate the standard scores obtained on the PMT and K-BIT-2 by age, gender, level of education and type of disability.

There has been no comparison of the PMT (1984) to other intelligence measures through correlational research since validation studies were completed as part of the instrument's development. This research study tested the relationships of variables as they have occurred without treatment interventions or clinical trials. Participants included individuals with a variety of disabilities; however, no preference was given to one group of disabilities over another in test administration or procedures. At the time that the evaluations were completed none of the participants or the evaluator was aware that a study of correlation between instruments administered during the vocational evaluation would be conducted.

Design

Descriptive statistics was used to describe the study participants demographically according to age, gender, level of education and type of disability. These factors are identified as independent variables. The demographic characteristics of the independent variables were also compared to the dependent variables of the PMT and KBIT-2.

A correlation design was used to examine the relationship between age, gender, level of education, type of disability, measured cognitive abilities, and learning style. The use of a correlation research design allowed the study of the degree, direction (positive or negative), and magnitude of the relationships between the variables age, gender and educational attainment (Gall, Gall & Borg, 2007). Strengths of the correlation research design include the simplicity of the basic design that has produced meaningful studies in the social sciences including the fields of education (Gall, Gall & Borg, 2007) and rehabilitation (Fitzgerald, Rumrill & Schenker, 2004). Correlation research design allows the study of a large number of variables within a single study and allows the analysis of multiple variables that could impact intervention planning, as well as program outcome. The use of a correlation design also allows the degree of relationship to be measured between variables without manipulation of independent variables through treatment experiment or varying interventions.

Multiple correlation analysis was used to examine, in combination, whether age, gender, level of education, type of disability and measured cognitive abilities, is related to information processing and learning style performance. The basic correlational design will be built upon to examine multiple independent variables and their unique or in combination influence upon a relationship using Multiple Correlation Analysis (MCA). Huberty (2003) noted that the research question related to using a MCA allowed examination of the *relationship* between a single response variable (*Y*) and a collection of response variables (*X's*). He further espoused that the design of this type of relationship study would reflect *X variables* that make sense and are reflective of substantive theory related to some extent to the *Y variable*. Multiple regression analysis was not chosen as the statistical method of analysis in this study as the focus of the study was not prediction or explanation of a phenomenon (Pedhazer, & Schmelkin, 1991).

While research reflects the attributes of correlation research design (Rogers & Nicewander, 1988), the use of correlation design has also been attributed to less than the best evidence regarding causal relationships (Gall, Gall & Borg, 2007) in contrast to experimental research designs that allow causal conclusions to be reached through randomized trials (Thompson, Diamond, McWilliams, Snyder & Snyder, 2005). Research planning should include whether the purpose of a correlation research design is for the purpose of prediction or explanation. For example, a predictive study could include whether a relationship exists between the number of functional limitations experienced by individuals with disability as a predictor of employment success. However, this study was explanatory making use of theoretically chosen predictor variables to clarify for variance (Pedhazer, E. & Schmelkin, L., 1991). In the aforementioned example, variables found from prior research to support occupational success such as age, family support, socioeconomic status, locale and access to public transportation would also be included in the research design. Fitzgerald, et al. (2004)

determined that the majority of correlation research that has been published in vocational rehabilitation journals has been explanatory in nature.

Use of Analysis of Variance (ANOVA) is a statistical method of analysis when independent variables have two or more levels and is used with an assumption that changes in the dependent variables are the result of changes in the independent variables (Hwang, Zhang & Chen, 2001 in Farmer & Rojewski, 2001). A one-way ANOVA is used to examine differences between groups when there is belief prior to data collection that one group will have a larger mean than others (Jaccard & Becker, 2002). In this study it was believed that study participants with cognitive related limitations would have lower test scores than those participants without cognitive disability.

General linear regression can be used to compute the correlation coefficient between an entire set of independent variables and a single dependent variable. Multiple linear regression can also serve to isolate the relative contribution of each independent variable to the size of the variables (Lewis, 2001). Multiple linear regression analysis was performed as part of this research study to learn more about the individual relationships between each of the PMT subscales and the KBIT-2.

It has been opined that most statistical analyses are based upon the assumption that the population being sampled or investigated will have a normal distribution and common variance (Sakia, 1992). When this assumption is satisfied, traditional approaches can be used to make inferences about unknown variables of interest (Sakia, 1992). In the event that data does not conform to assumptions of variance, researchers must consider options to improve normality of distribution, equalize variance and improve effect sizes as part of data cleaning for statistical analysis (Osborne, 2010).

Traditional approaches are known as power transformations and include the square root transformation, log transformation, inverse transformation, arcsine transformation and the Box-Cox transformation (Osborne, 2010). Social science research is cited by Osborne (2010) as frequently involving data that do not have normal distribution or variance. The Box-Cox transformation was introduced in 1964 (Box & Cox, 1964) and is acknowledged for simplicity involving a range of power transformation in contrast to the classic square root, log and inverse procedures. (Osborne, 2010). Box-Cox transformations were used in this study to normalize the variance of data not conforming to the assumptions of normality.

Researchers involved in pair wise comparisons frequently want to examine each group in comparison to every other group in a study. Tukey's procedure is considered the simplest pairwise comparison and known as the *t* test for multiple comparisons and quantifies the significance of the difference between larger than two sample means (Gall, Gall & Borg, 2007). It was used in this study for pair wise comparisons of independent variables in relation to the dependent variables. Fisher's procedure or Least Significant Differences (LSD) test can also be used for pairwise comparisons (Keppel & Wickens, 2004). Sequential steps control error rate through a series of steps dependent upon the outcome of the previous step and continued only when significance is identified. (Keppel & Wickens, 2004). This procedure was also used in this study for pair wise comparisons involving the dependent variables by independent variables.

Threats to Validity

This study included consideration of *sample size* as statistical power increases with the sample size, *level of significance* or the *p* value and *directionality,* the observed differences and relationships between two variables whether positive or negative in significance (Gall, et al., 2007). Analysis also provided a framework for the interpretation of research findings from the perspective of practice significance. According to Olejnik (1984), a minimum sample size of 42 for medium effect size and a maximum sample size of 384 is sufficient for statistical analysis using the Pearson Correlation. This study involved review of over 200 consumer files in possession of the researcher. The review resulted in a sample size of 102 participants and data sets that included only those consumers with disabilities administered both the K-BIT2 and PMT during 2005 – 2009 by the researcher. Determination of the appropriate sample size for multiple correlation analysis was made based upon Cohen's (1992) table. This method for the calculation of sample size is based upon four criteria that includes a significance criteria, an estimate of either the sample size or the known sample size, statistical power and applicable to this study, the number of independent variables (Cohen,1992). An alpha level of .05 was utilized in determining significance and is acknowledged as one of the most common alpha levels in educational research studies (Gall, et al., 2007).

Quantitative research is also known to be vulnerable to errors involving data analysis and data interpretation (Onwuegbuzie & Daniel, 2003). Data analysis errors can include eliminating cases from the final data set (*mortality*), a practice noted by Onwuegbuzie & Daniel (2003) as often used to control outliers and resulting in analytical errors if eliminated cases are valid to the research study in their like in kind or difference in comparison to other cases included in a research study. They also opine that the deletion of cases from a study introduces researcher bias into an analysis and also may have influence on the effect size. Mortality was eliminated by this researcher by not deleting cases from the final data set unless evidence was identified that a case or cases were not consistent with the variables defined within the research study. Another analytical error is non-interaction seeking bias and is defined by Onwuegbuzie & Daniel (2003) as “interpreting a model that does not accurately or validly represent the underlying nature of a reality”. The potential to avoid this type of error can be reduced by thoroughly reviewing prior research and theories related to the existence and degree of interaction between variables as part of the research design process. Previous research in the validation of the PMT supports the existence of interaction of variables involving the test construct, as well as measures of intelligence. Research since the development of the PMT has reflected the relationship between intelligence and memory supporting that a relationship exists between cognition and memory. (Ackerman, 1988; Corno, et al, 2002; Hunt & Lansman, 1982).

Interpretation errors can also involve confirmation bias and this can occur when there is an over dependence on a prior hypothesis (Greenwald, Pratkanis, Leippe & Baumgardner, 1996). This type of error can be avoided by not assuming that the theory underlying a hypothesis is still correct. Failure to do so can place the researcher in the non-objective position of trying to rationalize the supportive theoretical framework of the hypothesis vs. acknowledging the interpretations and conclusions of the current study. A tendency to overestimate a relationship between variables is known as illusory correlation and this occurs when variables are either not related or only slightly related and can be influenced by confirmation bias or when researchers assume that their perceptions of a relationship are consistent with those of others (Johnson & Johnson, 2000). Thorough research related to the supportive theories of variables included in hypotheses helps reduce the occurrence of this type error.

Another type of error or phenomenon occurs in correlational research design when two or more independent variables are highly related is known as multicollienarity. This phenomenon occurs when two or more independent variables are highly related. Fox (1997) espoused that when one independent variable is perfectly correlated with other independent variables that the parameter estimates cannot be uniquely determined resulting in large standard error of measurement and wide confidence intervals. In an extreme scenario, a perfect correlation will occur (D'Ambra & Sarnacchiaro, 2010; Fox, 1997). Mutlicollinearity as a phenomenon can potentially impact research involving memory processes and intelligence (Ackerman, 1988; Corno, et al., 2002; Hunt and Lansman, 1982; McCarron, 1984b); however, this was not be problem in this study as the testing instruments compared along with the independent variables of age, gender, education and type of disability.

Another type of threat to validity can occur when using instruments that rely on self-report of attributes or characteristics. Validity concerns of self-reporting tools of assessment have included problems with individuals accurately rating their own characteristics, responding with perceived acceptable or positive traits and potentially an impaired ability to self-report (Reed, 1996). The PMT and KBIT-2 are assessment tools that measure individual differences through performance rather than self-report. Validity can also be impacted when a researcher or participants are aware that testing outcomes will be used as part of a research study. In this study, none of the participants or the researcher was aware that test results would be used in a research study at the time of test administration.

Data Set

Participants

Participants for this study included 102 individuals with disability served through the Georgia Department of Labor's Vocational Rehabilitation Program and provided vocational evaluations by the researcher from 2005 - 2009. During this time period, over 200 clients were provided vocational evaluations by the researcher, but only data from those consumers who were administered both the PMT and KBIT-2 were utilized in the research study. The consumers were referred for services provided by the researcher from the twelve (12) field offices of the Georgia Department of Labor's Vocational Rehabilitation Program throughout Georgia. Selection of referrals for services provided by the researcher was at the sole discretion of the field counselors with approximately 90% of the referrals from offices in northeast Georgia. Broken down by gender, 55% of the study population was male and 45% was female. Approximately 57% of study participants were below age 21 and 34% ranged in age from 22 – 49. The least reflected age groups in the study population were individuals ages 30 – 39 and ages 50 – 59 with only 9% in each of these age groups. No study participants were above age 59. Half of the participants (50 %) had less than a high school level of education and only 6% were college graduates. Ethnicity was not included as part of this study as the impact of ethnicity was not included in the research design.

The disability of each participant was coded into one of ten disability classifications used by the Rehabilitation Services Administration (RSA) in longitudinal research related to the federal vocational rehabilitation program (Rehabilitation Services Administration, 2003). The disability type classifications included orthopedic, intellectual disability, non-orthopedic physical, mental retardation, hearing impairment, learning disability, vision impairment, substance abuse, traumatic brain injury and other types of disability. Gender was categorized as male or female. Age was recorded for each participant using the age categories used by the RSA for longitudinal research. The educational level of each participant was also categorized using the same ranges used by the RSA. In addition to disability code, gender, age and educational level, standard scores were recorded for each individual and included the PMT Total, Spatial Concept Memory, Immediate Recall, Sequential Memory, Recent Memory, Auditory Information Processing, Visual Information Processing standard scores and the Verbal, Nonverbal and IQ Composite standard scores of the KBIT-2. Table 3.1 provides a breakdown of the categorical variables that were used to collect participant demographic information related to age, gender, education and type of disability. Table 3.2 reflects the standard scores recorded from the PMT and the KBIT-2. This convenience sampling of participant data was retrieved through archival data maintained by the researcher.

Table 3.1

Participant Demography

Variable	Response Category	Variable	Response Category
Age	1 - Below 21	Disability	1 - Orthopedic
	2 - Ages 22 – 29		2 - Mental Illness
	3 - Ages 30 – 39		3 – Intellectual Disability

Table 3.1 (continued)

Participant Demography

Variable	Response Category	Variable	Response Category
Gender	4 - Ages 40 – 49	Disability	4 - Non-orthopedic, Physical
	5 - Ages 50 – 59		5 - Hearing Impairment
	6 - Ages 60 – 64		6 - Learning Disability
	7 - Above 64		7 - Vision Impairment
Gender	1 - Male		8 - Substance Abuse
	2 - Female		9 - Traumatic Brain Injury
			10 - All Other Disability
Education	1 - Less than high school		
	2 - High school or GED		
	3 - Two-year associate's degree		
	4 - Four-year bachelor's degree		
	5 - Master's degree		
	6 - Doctoral degree		

The above demographics reflect a population of Georgia VR consumers.

Table 3.2

Participant PMT and KBIT-2 Standard Score Demography

Variable	Response Category	Variable	Response Category
PMT Standard Scores	PMT Total	KBIT-2 Standard Scores	Verbal
	Spatial Concept Memory		Non-Verbal
	Immediate Recall		Composite
	Sequential Memory		
	Recent Memory		
	Auditory Information Processing		
	Visual Information Processing		

The above demographics reflect a population of Georgia VR consumers.

Archival data collection is sometimes critiqued from the perspective of use in research and concerns can include the implications of data recorded by others for reasons at the time of the data collection. Data can also be at risk to become lost, destroyed or otherwise contaminated over time resulting in concerns regarding the integrity of the data. The data for this study is maintained as the property of the researcher in keeping with the professional codes set forth by the Commission for the Certification of Rehabilitation Counselors and the Commission for the Certification of Vocational Evaluation and Work Adjustment Specialists (Commission for Certification of Rehabilitation Counselors, 2009). All testing was completed in an environment conducive to test and measurement by a Certified Vocational Evaluator. Test administration was limited to the researcher who possesses a graduate degree in vocational evaluation and vocational rehabilitation counseling with over twenty years of experience working as a practitioner. The researcher is a Certified Vocational Evaluator (CVE) through the Commission on Certification of Work Adjustment and Vocational Evaluation Specialists (CCWAVES) and a Certified Vocational Rehabilitation Counselor (CRC) through the Commission for Certification of Rehabilitation Counselors. Assistance in data retrieval was provided by a retired Certified Rehabilitation Counselor with direction and oversight provided by the researcher. Professional certification requirements include completion of specific graduate level coursework that included curriculum in test and measurement, vocational evaluation, occupational studies, vocational rehabilitation counseling and the vocational implications of disability, as well as obtaining a passing score on a certification examination (CCRC, 2009). Test administration was in keeping with the specific test administration procedures and scoring procedures set forth in the manual of each instrument.

Instrumentation

Two instruments were identified for use in the study to include measures of intelligence, as well as information processing and memory. Standard scores of the PMT were used to project information processing, memory and learning preferences and standard scores of the KBIT-2 were used to project intellectual abilities. The scoring procedures of the PMT and KBIT-2 convert raw scores to standard scores with a mean of 100 and a standard deviation of 15 allowing commonality and comparison of these scores from a test and measurement perspective (McCarron, 1984b; Kaufman, 1997).

Perceptual Memory Task

The PMT manual purports the instrument's content, construct, concurrent and predictive validity for use with the general population and individuals with a variety of disability. Content validity is described by McCarron (1984) as "how well the content of the PMT samples an appropriate range of perceptual memory skills" (p.36). Instrument content is noted to include measures of memory of spatial relations, visual recognition and visual sequential memory; auditory recognition and auditory sequential memory; intermediate recall and verbally mediated visual memory skills allowing involvement of both cognitive problem solving strategies, as well as visual and auditory sensory processes.

PMT Subscale Standard Scores

The standard score on the Spatial Concept Memory subscale reflects performance on the Spatial Relations and Discrimination Recall subtests. In contrast, the Immediate Memory standard score is based upon accuracy in visual and auditory recognition memory on the Visual Designs and Auditory-Colors subtests. The Sequential Memory standard score is reflective of accuracy in visual and auditory sequential memory on the Visual Designs and Auditory-Colors subtests and the Recent Memory subscale standard score is a composite score of performance on the Spatial Relations and Discrimination Recall subtests. Accuracy in auditory recognition memory and sequencing memory are the subscales that are used to compute standard scores on the Auditory Information Processing subscale. The Visual Information Processing standard score is based upon accuracy in visual recognition memory and sequencing memory. Overall performance on each of the PMT subscales is reflected in a composite standard score for the PMT Total score. Figure 3.1 reflects the subscales of the PMT.

Figure 3.1

Subscales of the PMT

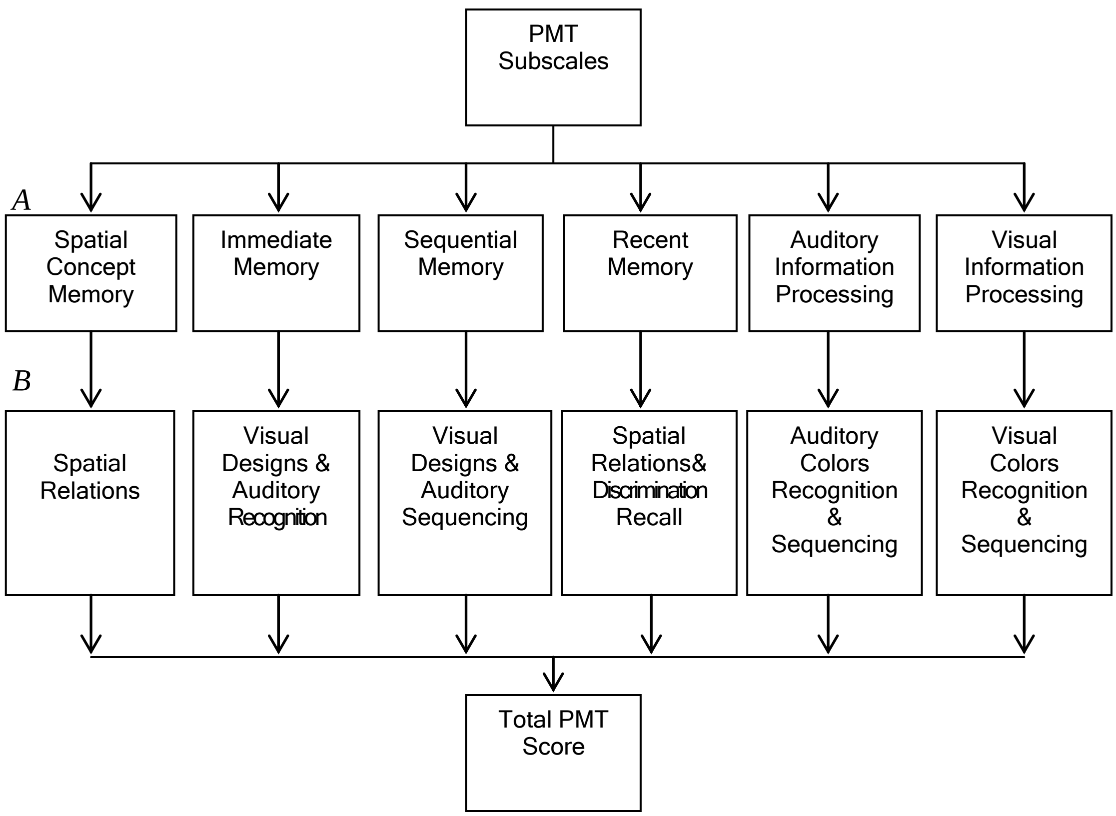

Figure 3.1. Subset A includes factors measured by the PMT. Subset B includes

Administration and Scoring

One point is awarded for every correct response. PMT standard scores have a mean of 100 and a standard deviation of 15 and standard scores ranging from 85 – 115 are considered average. Statistical significance is considered when standard scores reflect discrepancies of one or more standard deviations. The test is untimed with each subtest of the PMT usually administered in less than 10 minutes and the entire instrument requiring 30 – 40 minutes for administration. Rapport is encouraged in the administration of the instrument to explain the purpose and the importance of test findings. Reassuring comments are allowed during testing to encourage motivation and effort. The examiner is trained to position beside the participant to view the materials from the same perspective, as well as supporting a position to demonstrate instructions and provide an advantage for scoring purposes. While the PMT subtests involve both visual and auditory reception, only visual-motor abilities are used for participant responses. This removes the impact of poor expressive language abilities on test performance. Visual demands of the instrument are estimated to be 20/400 (or better) in either eye. Age related norm groups are used for converting raw scores to standard scores (McCarron, 1984b). Training in test and measurement is required to purchase the instrument and training on PMT administration and interpretation provided through McCarron-Dial Systems, Inc. is recommended to all purchasers.

PMT development and validity studies support the use of the instrument in keeping with current validity concepts, as well as for use with a variety of individuals with disability. The development of the PMT, as well as the reliability and validity of the instrument in the measurement of memory, information processing abilities and learning style is described fully in Chapter 2 on pages 49 - 53.

Kaufman Brief Intelligence Test - 2

Kaufman & Kaufman (1997) indicate that the KBIT-2 was developed in combination with the Kaufman Assessment Battery for Children, Second Edition (KABC-II) and that the two verbal subtests of the KBIT-2 belong to the KABC-II. The third subtest, a measure of nonverbal abilities, is acknowledged as part of the original K-BIT, but also included items from the KABC-II. The KBIT-2 consists of two Verbal subtests and one Nonverbal subtests with the performance on these measures resulting in an IQ Composite Score.

Verbal Domain

Verbal Knowledge. This subtest is a measure of receptive vocabulary and general information related to nature, geography, the arts and sciences. Each evaluee is presented a variety of six color illustrations and/or photographs and asked to indicate which of the pictures is most like or similar to the single word spoken by the evaluator (i.e.: ball, weary, city associated with Carl Sandburg, etc.). A raw score is obtained on this subtest that is combined with the raw score on the Riddles subtest.

Riddles. This subtest has 48 questions that measure verbal comprehension, reasoning and knowledge of vocabulary. Evaluees are read a riddle and directed to provide a one word response to answer the riddle. Examples of the riddles include: What has doors that you sleep in at night? (bedroom); What holds your teeth in place? (gums); What has buttons and goes up and down? (elevator). The raw score of this subtest is combined with the raw score on the Verbal Knowledge subtest for conversion to a standard score using age group based norms.

Non-Verbal Domain

Matrices. This subtest consists of 46items that measure visual problem solving abilities in the areas of people, objects, designs and symbols. Each evaluee is administered this subtest to assess non-verbal reasoning and problem-solving.

KBIT-2 Composite

This standard score is a composite score based upon the standard scores of the Verbal and Non-Verbal domain standard scores. Figure 3.2 reflects the subscales of the KBIT-2.

Figure 3.2
Subscales of the KBIT-2

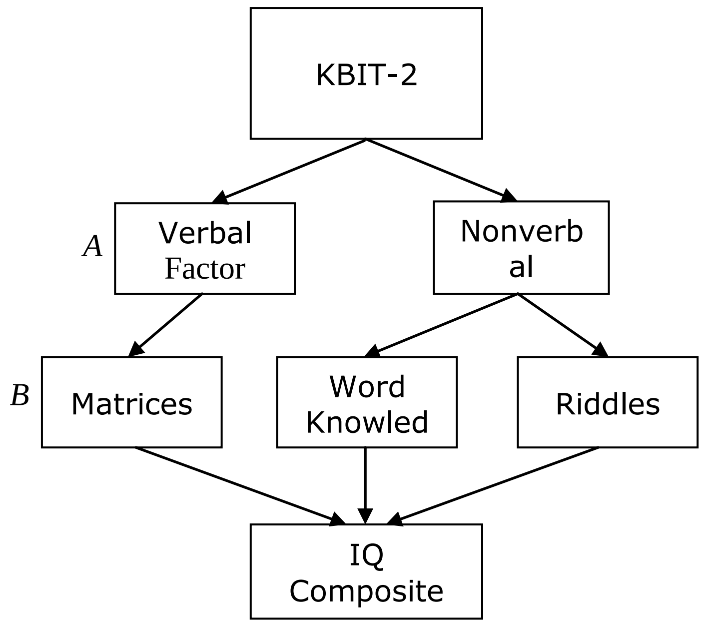

Figure 3.2 reflects the subscales of the KBIT-2

Administration and Scoring

The KBIT-2 is untimed and a point is awarded for every correct response and responses are recorded on a paper record form. The instrument has a basal of three items passed dropping back one starting point as needed to obtain a basal of three items passed for each subtest. Age directed starting points are identified on the score sheet and a ceiling is identified as the highest item administered on each of the subtests. Test discontinuation occurs on any subtest with four consecutive scores of zero. The length of test administration is approximately 30 minutes. Like the PMT, the scoring of the

KBIT-2 is based upon a standard score system with a mean of 100 and a standard deviation of 15. Age related norm tables are included in the test manual (Kaufman & Kaufman, 1997).

Recommended testing preparation includes seating with the examinee and examiner at adjacent sides of a table. Both the Word Knowledge and Matrices subtests are presented from a colorful easel style booklet. The Matrices test items are read from the printed record form eliminating the use of the easel during the subtest. Instructions are presented orally with visual demonstration and teaching to facilitate an understanding of concepts during presentation of examples items. Examiner qualifications for administration and interpretation of the KBIT-2 include competent test administration experience, as well as thorough knowledge of at least the following six areas:

- errors of measurement;
- the meaning of derived scores such as standard scores or percentile ranks;
- the use of statistical procedures to determine whether the evaluee scored at the same level or at different levels on the KBIT-2 Verbal and Nonverbal scores;
- the educational and practical implications of a person's level of performance in the two areas mental functioning and on the IQ Composite;
- the integration of the person's obtained scores with other test results and with relevant background information about the person, and;
- the dangers inherent in labeling or making other decisions based on limited data (Kaufman & Kaufman, 1997, p. xi).

The development of the KBIT-2 and the reliability and validity of the instrument as a measure of verbal, nonverbal and overall intelligence is described fully in Chapter 2 on pages 53 – 56. Instrument development and validity studies support the use of the KBIT-2 as a measure of intelligence with individuals participating in a vocational evaluation.

Data Collection Procedures

The identity of the participants or any other personal information that could identify the individual with disability or referring vocational rehabilitation counselor was not disclosed as part of this study. Approval for the study was obtained from the University of Georgia Institutional Review Board (IRB) and the study was completed in keeping with institutional regulations, professional standards and guidelines specific to human-subject protection.

Data retrieval began in July, 2011 and included a four week period to complete the file review process and the documentation of each individual's disability code and standard scores obtained on the KBIT-2 and the PMT. Each participant was referred to as Participant 1, Participant 2, Participant 3, etc. To further ensure anonymity, no identifying information regarding participants was maintained in a secured computer file containing subject data. The computer also has password protection accessible only by the researcher.

Data Analysis

The PMT was correlated with the WAIS (1955) as part of the instrument validation process and the KBIT-2 has been correlated with the WAIS-III (McCarron, 1984b; Kaufman, 1997). Prior to this research study, no empirical research had been completed regarding the relationship between the PMT and the KBIT-2. Correlation analyses was used to explore, calculate and interpret the strength of the relationship between the four independent variables age, gender, level of educational attainment and type of disability and the dependent variables of intelligence and information processing or learning style. Table 3.3 provides an overview of the data analysis approach for the study.

Table 3.3.

Data Analysis Approach for Validation of the PMT

Research Objective	Independent Variables	Dependent Variables	Statistical Analysis
1. Describe demographic characteristics of sample.	1. Age 2. Gender 3. Education 4. Type of disability		Descriptive statistics (mean, median, standard deviation, sample distribution)
2. Describe the Characteristics of the PMT Total, Spatial Concept Memory, Immediate Recall, Sequential Recall, Recent Memory, Auditory Information Processing and Visual Information Processing	1. Age 2. Gender 3. Education 4.Type of disability	PMT Total, Spatial Concept Memory, Immediate Recall, Sequential Recall, Recent Memory, Auditory Information Processing and Visual Information Processing Standard Scores	Descriptive statistics (mean, median, standard deviation, sample distribution
3. Describe the Characteristics of the KBIT-2 Verbal Non-Verbal and IQ Composite Standard Scores	1. Age 2. Gender 3. Education 4. Type of disability	Verbal, Non-Verbal and IQ Composite Standard Scores	Descriptive statistics (mean, median, standard deviation, sample distribution

Table 3.3 (continued)

Data Analysis Approach for Validation of the PMT

Research Objective	Independent Variables	Dependent Variables	Statistical Analysis
4. Determine the relationship between age, gender, level of education, type of disability and information processing as measured by the PMT.	1. Age 2. Gender 3. Education 4.Type of disability	PMT Total, Spatial Concept Memory, Immediate Recall, Sequential Recall, Recent Memory, Auditory Information Processing, Visual Information Standard Scores	ANOVAs Box-Cox Transformation
5. Determine the relationship between age, gender, level of education, type of disability and measured cognitive abilities by the KBIT-2.	1. Age 2. Gender 3. Education 4.Type of disability	Verbal, Non-Verbal and IQ Composite Standard Scores	ANOVAs Box-Cox Transformation
6. Correlation of PMT and KBIT-2	1. Age 2. Gender 3. Education 4. Type of Disability	PMT and KBIT-2 Standard Scores	Correlation Matrix General Linear Model

Conceptualization and Treatment of Variables

The design of a research study is dependent upon the identification of a problem or question that supports inquiry into the relationship between two or more properties or constructs that are known as variables (Kerlinger & Lee, 2000). Any reasonable set of values is appropriate for use as a variable and may include categorical or dichotomous variables such as gender with only two variables (Gall, et al., 2007) or may involve a continuous variable such as a test score that reflects the capacity to be part of an ordered set or continuum ranging from high to low levels (Moore, 2007). In some research, attribute variables are not manipulated and are used to assign groups on the basis of variables such as age, gender, level of education, etc.

Research planning should identify categorical or continuous variables. Raw test scores are often used in research that have been converted to a derived score such as a standard score to provide quantitative measurement in comparison to an age or grade related norm group (Gall, et al., 2007). A research study's foundation is built upon the problem or question that support inquiry and the identification of the properties or constructs that will provide the observations and the construct validity of the study. Theory, prior research and reliability of test measures should guide the researcher in the selection of categorical and/or continuous variables (Gall, et al., 2007). Variables can be independent or dependent. Independent variables are considered the antecedent and the dependent variable the consequent. Through research the relationship between independent variables, different phenomena may be revealed with the dependent variables reflective of the phenomenon that is the purpose of the study and investigation (Moore, 2007).

Descriptive Statistics

Descriptive statistics included calculation of the mean, median, standard deviation and sample distribution of the study population. The mean calculation is reflective of the arithmetic average resulting from the added values of each set of categorical variables divided by the number of participants. In contrast, the median is the statistical midpoint of an ordered distribution with the location of the median as the center observation in an odd list of observations and the mean or average of the two center observation in an even list of observations. The mean and median are used for comparison in a distribution and will be close together or exactly the same in a symmetric distribution. Analysis will reveal a mean farther from the median in a skewed distribution. The mean is acknowledged to be more vulnerable to the impact of outliers in the data set that fall outside the overall pattern of distribution. Standard deviation is used to measure the spread of distribution and is closely related to the concept of variance. The sampling distribution is the numerical distribution reflected through all possible samples of the same size within the same population (Moore, 2007) and was described in this study as the minimum and maximum scores. These principles of descriptive statistics were utilized in this study to describe observations from the study population.

Analysis of Variance

An analysis of variance procedure is used to test hypotheses concerning means when there are several populations and is known as an ANOVA (Jaccard & Becker, 2002; Moore, 2007). A one-ANOVA was used to test the null hypothesis with an assumption of a normal distribution (Hwang, Zhang & Chen, 2001 in Farmer & Rojewski, 2001). An ANOVA is appropriate to analyze the relationship between two variables when the dependent variables are quantitative in nature and measured in a manner that approximates interval characteristics (Moore, 2007). Dependent variables in this study included standard scores of the PMT and the KBIT-2. Independent variables are between-subjects in nature and quantitative or qualitative with three or more levels (Jaccard & Becker, 2002; Moore, 2007). In this study, the independent variables were quantitative and included age, gender, level of education and type of disability. Calculation of an *F*-statistic was used to determine if there was a significant difference among the means serving as a preliminary test to indicate if more thorough analysis of test scores would be necessary. A more thorough analysis of the factor-level effects was conducted by calculating a *P*-Value (Moore, 2007).

An F-test can result in the identification of different means or the potential that the same mean may have occurred by coincidence (Jaccard & Becker, 2002; Moore, 2007). Calculation of a *P*-Value quantified the probability that random sampling would result in a different sample mean in a population as large or larger as originally analyzed (Jaccard & Becker, 2002, Moore, 2007). The *F*-statistic was used to calculate a *P*-Value to project the probability of observing differences in two population means. For example, if a *P*-value was 0.05 a difference smaller than was observed in this study would be anticipated in 95% and larger than was observed in this study in 5% of a random sample from an identical population (Moore, 2007). If a *P* – value was as small or smaller than a significance level of 0.05, it was described as significant at level 0.05 (Moore, 2007). Data analysis also included how well a regression line approximated real data points using the statistical R-Squared measure allowing perspective as to the predictive value of the dependent and independent variables in the study.

The R-Square of 1.0 is considered predictive of the value of other data points and conversely, the lowest value of 0.0 is not predictive of other data points. A Mean Squared Error (MSE) was calculated to measure the closeness of fit of the data points and calculated to prevent negative values from canceling positive values. The smaller the MSE, the closer of fit of data is assumed **(**Moore, 2007). A Root Mean Squared Error

(Root MSE) was calculated to quantify the average distance of a data points from the fitted line. The Root MSE is the square root of the MSE and has the same units as the data points on a vertical line and considered preferable for goodness of fit than a correlation coefficient (Moore, 2007). As previously noted, social science research frequently involves data that do not have normal distribution or variance (Osborne, 2010). Box-Cox (1964) transformation was used in this study to improve the ability to generalize results of the study and the method of Least Significant Differences was applied to determine the significance of differences between the independent and dependent variables

CHAPTER 4

RESULTS

Purpose

The purpose of this study was to examine the relationship between the PMT and the KBIT-2 in a population of individuals served through the Georgia Department of Labor's Vocational Rehabilitation program with various types of disability. Participants completed vocational evaluations performed by the researcher from 2005 – 2009 that included administration of both the PMT and the KBIT-2 as part of the assessment process. In addition to analysis of the test scores obtained by each participant, statistical analyses of the impact of age, gender, level of education and type of disability were also completed. Independent variables of the study included age, gender, level of education and type of disability and dependent variables were the subscale standard scores of the PMT and the K-BIT-2.

Analysis of Research Questions

This chapter presents findings of the analysis related to each of six research objectives and concludes with a brief summary of the overall study results. Specifically, this study addressed the following six research questions:

Demographic Characteristics of Sample Population

Research Objective One

Describe demographic characteristics of a sampling of individuals with disability provided formalized assessment through the Georgia Department of Labor's Vocational Rehabilitation Program.

Age. The frequency distribution of age among participants is presented in Table 4.1. More than half of the participants were below age 21 (57%), while a comparatively small percentage of the participants were within the ages of 30 – 39 (9%) and 50 – 59 (9). There were no participants in the sample population above age 60. While the majority were under 21, those in the other groups were fairly well-distributed between ages 22 and 29.

Table 4.1

Frequency Distribution for Age

Characteristic	*n*	%
Age		
21 and below	58	56.86
22 – 29	14	13.73
30 – 39	9	8.82
40 – 49	12	11.76
50 – 59	9	8.82
60 and above	0	0

Note: n = 102

Gender: Statistical analysis revealed that the subjects were relatively evenly split between males and females with a population of 55% males and 45% females.

Education: Statistical analysis revealed that one-half (50%) of the population were not high school graduates and 41% were high school graduates or had completed a

GED. The remaining population of 9% had completed a two or four-year degree program.

Disability Type: Statistical analysis reflected a fairly even distribution across a variety of types of disability. The least common type of disability reflected in the sample population was Non-Orthopedic Physical (7%) and the most common disability in the sample population was Learning Disability (22%). Significant numbers of participants were also noted from the categories of Orthopedic (15%), Mental Illness (18%) and All Other Disability (15%). The All Other Disability category was comprised primarily of 10 individuals with Autism Spectrum Disorder or approximately 67% of the group.

Table 4.2

Frequency Distribution of Disability Type

Characteristic	*n*	%
Disability Type		
Orthopedic	15	14.71
Mental Illness	18	17.65
Non-Orthopedic, Physical	7	6.86
Mental Retardation	8	7.84
Hearing Impairment	0	0
Learning Disability	22	21.57
Vision Impairment	8	7.84

Note: n = 102

Table 4.2 (continued)

Frequency Distribution of Disability Type

Characteristic	*n*	%
Substance Abuse	0	0
Traumatic Brain Injury	9	8.82
Other Disability	15	14.71

Note: n = 102

Research Objective Two

Describe the demographic characteristics of PMT Total, Spatial Concept Memory, Immediate Recall, Sequential Memory, Recent Memory, Auditory Information Processing and Visual Information Processing Standard Scores.

Using descriptive statistics, the sample size or N of 102 was analyzed to determine the statistical Mean (numerical average), Median (middle score) and standard deviation (measure of typical variation from the mean) for each of the PMT subscales and the Total PMT. The Minimum (lowest standard score) and Maximum (highest standard score) were also identified for each PMT standard score. Standard scores of 85 – 115 on the PMT are considered average with a standard deviation of 15. Table 4.3 provides the summary statistics of the demographic characteristics of the PMT. All mean and median standard scores were within the average range with minimum standard scores at the lower extreme to maximum standard scores above the average range. Standard deviations were at or above the PMT standard deviation (SD) except for Spatial Concept Memory (24.27) which was significantly above the SD of the instrument.

Table 4.3.

Summary Statistics of PMT Subscales

Variable	*M*	Median	SD	Min	Max
PMT Total	96.10	98.5	16.72	33	120
Spatial Concept Memory	97.91	104.0	24.27	25	130
Immediate Recall	98.96	102.0	16.14	25	125
Sequential Memory	99.47	104.0	17.01	30	127
Recent Memory	89.32	92.5	18.20	25	125
Auditory Information Processing	97.42	99.0	15.21	44	130
Visual Information Processing	102.18	105.0	18.93	57	130

Note: M = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Descriptive statistics also included analysis of PMT standard scores by the independent variables of age, gender, education level and type of disability. Analysis of these variables provided opportunity to determine the impact of the independent variables on PMT standard scores.

Age. For the population age 21 and below, the mean and median standard scores for each subscale of the PMT was within the average range. The spread of scores were statistically wide and variable for each PMT subscale with standard scores ranging from the lower extreme (25) to significantly above the average range (130). Standard deviations were very close to the instrument SD with the exception of Spatial Concept Memory (26.09). The population for age 22 - 29 reflected mean standard scores within the average range for each PMT subscale, but was significant for this age population demonstrating average median standard scores for each subscale of the PMT with the exception of the Recent Memory subscale which was below the average range (83.5). Analysis revealed standard deviations just above the standard deviation of the instrument standard scores. The spread of scores were fairly wide and variable for each PMT subscale with scores ranging from significantly below average (45) to significantly above the average range (130).

Mean and median standard scores were within the average range for each PMT subscale for the age population 30 - 39. The spread of standard scores was wide and variable for each PMT subscale with standard scores ranging from the lower extreme (25) to significantly above the average range (130). Standard deviations in this age population reflected the majority of subscales significantly higher than the SD of the PMT and mean of the age population. Analysis of the population age 40 - 49 was significant for a below average recent memory mean (80.67) and median (81.5) standard scores below average performance on VIP mean (80.67). All other mean and median standard scores were within the average range for all other PMT subscales. Standard deviations were at or below the SD of the instrument and showed the least overall distance from the mean of any age population. The spread of scores were fairly wide and variable for each PMT subscale with scores ranging from within a standard deviation of the average range to above average scores.

Analysis for the age 50 – 59 population reflected just below the average range to average range mean standard scores with the lowest mean standard score in recent memory (82.33). Median standard scores ranged from below average range to average on each PMT subscale with the lowest median standard score in recent memory (80.0). The analysis revealed standard deviations fairly consistent with the SD of the instrument with the exception of Spatial Concept Memory (28.82). The spread of scores were wide and variable for each PMT subscale with standard scores ranging from a minimum score below average (45) to maximum standard scores above the average range (123). As noted previously, there were no participants above the age of 59 included in the study population. Table 4.4 reports the analysis of the PMT for age.

Table 4.4

Summary Statistics of the PMT for Age

Variable	*n*	*M*	Median	SD	Min	Max
Below Age 21						
PMT Total	58	97.72	102.5	17.28	33	120
Spatial Concept Memory	58	97.72	105.0	26.09	25	130
Immediate Recall	58	100.14	102.0	18.39	25	125
Sequential Memory	58	102.55	104.0	14.70	58	127
Recent Memory	58	93.33	96.0	18.38	25	125
Auditory Information Processing	58	97.41	99.0	16.61	44	130
Visual Information Processing	58	106.91	107.0	17.17	57	130

Note: n = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.4 (continued)

Summary Statistics of the PMT for Age

Variable	*n*	*M*	Median	SD	Min	Max
Age 22 – 29						
PMT Total	14	97.07	101.0	15.52	68	119
Spatial Concept Memory	14	99.57	99.0	19.53	62	130
Immediate Recall	14	101.50	102.5	14.21	74	120
Sequential Memory	14	99.57	106.5	17.80	68	115
Recent Memory	14	85.21	83.5	17.89	45	120
Auditory Information Processing	14	102.86	103.5	12.53	74	117
Visual Information Processing	14	100.00	108.0	19.33	60	125
Age 30 – 39						
PMT Total	9	93.78	106.0	24.60	41	113
Spatial Concept Memory	9	99.22	113.0	22.65	53	118
Immediate Recall	9	95.44	98.0	14.32	63	113
Sequential Memory	9	95.78	110.0	28.41	30	117
Recent Memory	9	88.44	95.0	25.31	40	120

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.4 (continued)

Summary Statistics of the PMT for Age

Variable	*n*	*M*	Median	SD	Min	Max
Age 30 – 39						
Auditory Information Processing	9	93.44	98.0	15.72	65	115
Visual Information Processing	9	97.56	107.0	23.75	58	130
Age 40 - 49						
PMT Total	12	92.92	95.5	10.82	78	108
Spatial Concept Memory	12	98.25	100.5	20.65	63	125
Immediate Recall	12	96.58	96.5	8.91	85	115
Sequential Memory	12	93.25	94.5	16.21	73	112
Recent Memory	12	80.67	81.5	8.89	70	98
Auditory Information Processing	12	99.00	100.5	7.99	90	110
Visual Information Processing	12	80.67	94.0	18.87	68	120

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.4 (continued)

Summary Statistics of the PMT for Age

Variable	*n*	*M*	Median	SD	Min	Max
Age 50 - 59						
PMT Total	9	90.67	90.0	13.05	69	108
Spatial Concept Memory	9	94.78	103.0	28.82	45	123
Immediate Recall	9	94.11	97.0	12.89	69	108
Sequential Memory	9	91.44	90.0	14.67	69	115
Recent Memory	9	82.33	80.0	13.85	60	110
Auditory Information Processing	9	90.89	88.0	15.68	67	123
Visual Information Processing	9	94.89	92.0	17.64	67	117

Note: n = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Gender: Descriptive statistics also included an analysis of the PMT by gender. No significant score discrepancies were noted for gender with mean and median scores falling within the average range. Score ranges were also fairly consistent. Table 4.5 reports summary statistics for the PMT by gender. Male mean and median scores were all within the average range. Standard deviations of subscale scores were at or fairly near the instrument SD of 15. Scores ranged from minimum scores within the lower extreme (30) to maximum scores significantly above the average range (130). Females in the population also reflected mean and median scores within the average range and consistency in standard deviation in comparison to the male population with the exception of Spatial Concept Memory (SD = 26.47).

Table 4.5

Summary Statistics of the PMT for Gender

Variable	*n*	*M*	Median	SD	Min	Max
Male						
PMT Total	56	96.5	102.5	16.29	33	130
Spatial Concept Memory	56	101.2	105.0	21.94	30	130
Immediate Recall	56	97.32	100.0	16.34	40	123
Sequential Memory	56	98.63	104.0	16.25	58	123
Recent Memory	56	89.27	95.0	18.59	25	120
Auditory Information Processing	56	95.4	99.0	16.04	44	118
Visual Information Processing	56	100.91	103.0	18.85	60	130
Female						
PMT Total	46	95.85	97.5	17.40	40	120
Spatial Concept Memory	46	93.91	99.0	26.47	25	130
Immediate Recall	46	100.96	102.5	5.84	25	125
Sequential Memory	46	100.50	102.5	18.02	30	127
Recent Memory	46	89.39	90.0	17.93	25	125

Note: *n* = 102, *M* = 100, SD = 15, Lowest Min = 25, Highest Max = 130

Table 4.5 (continued)

Summary Statistics of the PMT for Gender

Variable	*n*	*M*	Median	SD	Min	Max
Auditory Information Processing	46	99.85	100.5	13.92	65	130
Visual Information Processing	46	103.72	106.0	19.12	57	130

Note: n = 102, M = 100, SD = 15, Lowest Min = 25, Highest Max = 130

Education: Population educational attainment related to standard scores on the PMT was analyzed and summary statistics are reported in Table 6. A pattern of average mean and median scores were noted in this population with standard deviations near or at the instrument SD and highest standard deviation noted in Spatial Concept Memory (26.70) and Recent Memory (21.93). A wide discrepancy of score distribution from the minimum lower extreme (25) to the significantly above the average range (130) maximum is noted in the population with less than a high school education. In contrast, those in the population with a high school diploma or GED reflected mean and median scores very near the instrument mean standard score of 100. This population had standard deviations at or near the instrument SD with a slightly lower standard deviation in Spatial Concept Memory (20.95). While the lowest minimum score (40) is significantly below average, it is not considered within the lower extreme as noted in among those not completing high school. The maximum scores for those in high school ranged from the above average to significantly above the average range (130).

Participants with more than a high school education reflected average mean and median scores on all subscales except Recent Memory which fell slightly below the average range (83.67, 83). Standard deviations in this population reflected scores significantly below the instrument SD of 15 on the Immediate Recall subscale (7.47) and less width in score patterns from the population mean on the subscale. Below instrument SD was also noted in the PMT Total (8.87). All other standard deviations were fairly near the instrument mean. In contrast to those with only a high school education or GED and those with less than a high school education, the minimum and maximum spread of scores narrowed closer to the mean with below average minimum standard scores in Spatial Concept Memory (45) and Recent Memory (60). The maximum standard scores above the average range decreased in this group to occurring only in the subscales of Spatial Concept Memory (130) and Visual Information Processing (120).

Table 4.6

Summary Statistics of the PMT for Education Level

Variable	*n*	*M*	Median	SD	Min	Max
Less than High School						
PMT Total	51	94.45	102.0	19.80	33	117
Spatial Concept Memory	51	96.22	103.0	26.70	25	130
Immediate Recall	51	98.59	102.0	17.23	25	125
Sequential Memory	51	97.96	103.0	18.74	30	125
Recent Memory	51	89.43	95.0	21.93	25	125

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.6 (continued)

Summary Statistics of the PMT for Education Level

Variable	*n*	*M*	Median	SD	Min	Max
Less than High School						
Auditory Information Processing	51	95.80	99.0	15.11	44	122
Visual Information Processing	51	102.70	105.0	21.00	57	130
High School Diploma/ GED						
PMT Total	42	98.05	99.0	13.58	69	120
Spatial Concept Memory	42	99.76	105.0	20.50	48	130
Immediate Recall	42	99.33	102.0	16.38	40	125
High School Diploma/ GED						
Sequential Memory	42	101.26	104.5	15.76	68	127
Recent Memory	42	90.40	90.0	13.70	55	120
Auditory Information Processing	42	99.69	101.0	16.22	44	130
Visual Information Processing	42	101.45	106.0	17.69	64	130

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.6 (continued)

Summary Statistics of the PMT for Education Level

Variable	*n*	*M*	Median	SD	Min	Max
More than High School						
PMT Total	9	96.33	93.0	9.87	83	109
Spatial Concept Memory	9	98.89	110.0	27.75	45	130
Immediate Recall	9	99.33	98.0	7.47	92	115
Sequential Memory	9	99.67	92.0	12.33	85	113
Recent Memory	9	83.67	83.0	13.17	60	105
Auditory Information Processing	9	96.00	95.0	10.05	78	110
Visual Information Processing	9	102.78	107.0	12.56	88	120

Note: n = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Disability Type: Using the disability types acknowledged by the Rehabilitation Services Administration (RSA), the impact upon PMT standard scores by disability was analyzed. Among the orthopedic population of disability, mean and median scores were within the average range with fairly even distribution noted in minimum to maximum score with the exception of Spatial Concept Memory with a minimum score of 45 and maximum score of 123. While the remaining minimum scores were significantly below average, the maximum scores were in the average to above average range. Standard deviations were at or near the instrument SD with the exception of Spatial Concept Memory (25.35).

For the population of individuals with mental illness, all mean scores were within the average range and median scores were also all within the average range except recent memory (84). Standard deviations were at or near the SD of the PMT. Minimum scores were below average on all PMT subscales, but most were near or at the lower end of the average range except Recent Memory (55) which fell significantly below the average range. Average to above average scores were reflected in the maximum scores. The non-orthopedic, physical disability population had mean scores within the average range with the exception of Recent Memory (84.14). Median scores were all within the average range and standard deviations ranged from significantly below the instrument SD in the PMT Total (6.85) and Immediate Recall (4.91) scores to just under the instrument SD in all other subscales except Spatial Concept Memory (21.33) which was above the instrument SD. The minimum and maximum scores were within the average range with the exception of Spatial Concept Memory (60) and Recent Memory (60).

Those with mental retardation had mean scores within the average range with the exception of Recent Memory (83.13) which fell just below the average range. Median scores were all within the average range. This group reflected the largest standard deviation in comparison to the disability population, as well as the instrument SD. Most significant standard deviations included Spatial Concept Memory (30.18) which was twice the instrument SD and the PMT Total (24.94) and Recent Memory (26.05) that was significantly above the PMT SD of 15 standard score points. Overall, the population of individuals with mental retardation had significant variation from the PMT mean. The distance between the minimum and maximum scores ranged from the lower extreme (25) to maximum scores from above average (120) or significantly above average (130).

Descriptive statistics of the population with learning disability reflect standard scores within the average range for both mean and median scores. Standard deviations were at or near the instrument SD. Minimum and maximum scores vary from the lower extreme (25) to the above average range (130). Individuals in the population with visual impairment reflect average mean and median scores. Minimum and maximum scores range from below average (63) to the above average range (130) with only Spatial Concept Memory (63) and Recent Memory (75) with minimum scores below the average range. Standard deviations were at or near the instrument SD. Those in the population with traumatic brain injury had mean and median scores below the average range in recent memory (76.33, 80.0). Average mean and median scores were noted in all other subscales. The standard deviations of this population were at or near the instrument SD with below instrument SD in Immediate Recall (9.82) and above the instrument SD in Spatial Concept Memory (20.28). Minimum standard scores ranged from below the average range (45) in Recent Memory to significantly above the average range in Spatial Concept Memory (130). The population containing all other disability types reflected mean scores within the average range on all subscales with the exception of Spatial Concept Memory (82.33). Median scores were all within the average range. A wide distribution of scores was noted from minimum scores within the lower extreme in Spatial Concept Memory (25) and Immediate Recall (25) to maximum scores significantly above the average range in Spatial Concept Memory (130) and Visual Information Processing (130). As noted previously, the majority of this population was comprised by individuals with Autism Spectrum Disorder.

Table 4.7

Summary Statistics of PMT Subscales for Disability Type

Variable	*n*	*M*	Median	SD	Min	Max
Orthopedic						
PMT Total	15	95.60	93.0	13.58	69	115
Spatial Concept Memory	15	92.60	95.0	25.35	45	123
Immediate Recall	15	100.00	103.0	13.45	69	118
Sequential Memory	15	99.33	102.0	16.43	69	120
Recent Memory	15	90.27	90.0	11.52	70	110
Auditory Information Processing	15	96.93	98.0	13.93	67	123
Visual Information Processing	15	103.33	108.0	20.20	67	130
Mental Illness						
PMT Total	18	97.50	100.0	13.33	69	119
Mental Illness						
Spatial Concept Memory	18	102.94	105.0	18.52	73	130
Immediate Recall	18	99.39	101.0	13.77	63	120
Sequential Memory	18	99.33	104.0	14.82	73	115
Recent Memory	18	86.78	84.0	15.94	55	120
Auditory Information Processing	18	99.28	99.5	11.71	75	117

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.7 (continued)

Summary Statistics of PMT Subscales for Disability Type

Variable	*n*	*M*	Median	SD	Min	Max
Mental Illness						
Visual Information Processing	18	99.39	105.0	18.97	64	125
Non-Orthopedic, Physical						
PMT Total	7	96.43	96.0	6.85	87	106
Spatial Concept Memory	7	100.00	103.0	21.33	60	118
Immediate Recall	7	97.86	98.0	4.91	92	105
Sequential Memory	7	99.71	102.0	8.12	89	110
Recent Memory	7	84.14	88.0	11.45	60	95
Auditory Information Processing	7	98.00	98.0	8.79	89	113
Visual Information Processing	7	99.71	99.0	8.86	88	115
Mental Retardation						
PMT Total	8	87.38	92.0	24.94	33	113
Spatial Concept Memory	8	87.00	91.5	30.18	30	120
Immediate Recall	8	93.63	93.0	13.18	68	115
Sequential Memory	8	90.25	93.0	15.36	63	108
Recent Memory	8	83.13	87.0	26.05	25	110

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.7 (continued)

Summary Statistics of PMT Subscales for Disability Type

Variable	*n*	*M*	Median	SD	Min	Max
Mental Retardation						
Auditory Information Processing	8	90.63	90.0	18.06	54	113
Visual Information Processing	8	97.75	98.5	19.05	69	130
Learning Disability						
PMT Total	22	103.95	105.5	12.49	69	120
Spatial Concept Memory	22	112.05	115.0	18.45	53	130
Immediate Recall	22	103.59	105.5	16.45	40	125
Sequential Memory	22	106.09	106.0	12.86	68	125
Recent Memory	22	97.00	98.0	18.97	25	125
Auditory Information Processing	22	100.55	102.0	15.65	44	130
Visual Information Processing	22	109.45	113.0	15.94	64	130
Vision Impairment						
PMT Total	8	103.13	106.5	11.13	88	115
Spatial Concept Memory	8	102.13	107.5	17.46	63	115
Immediate Recall	8	105.0	105.0	11.10	89	123

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.7 (continued)

Summary Statistics of PMT Subscales for Disability Type

Variable	*n*	*M*	Median	SD	Min	Max
Vision Impairment						
Sequential Memory	8	108.50	113.0	14.71	85	127
Recent Memory	8	93.63	95.0	14.79	75	120
Auditory Information Processing	8	106.00	108.0	12.84	86	119
Visual Information Processing	8	107.38	107.5	13.90	89	130
Traumatic Brain Injury						
PMT Total	9	89.22	91.0	14.17	68	108
Spatial Concept Memory	9	92.44	92.0	20.28	58	130
Immediate Recall	9	92.33	93.0	9.82	74	105
Sequential Memory	9	91.67	90.0	16.93	68	113
Recent Memory	9	76.33	80.0	18.74	45	98
Auditory Information Processing	9	97.00	97.0	11.02	74	110
Visual Information Processing	9	88.22	92.0	16.60	60	110

Note: n = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.7 (continued)

Summary Statistics of PMT Subscales for Disability Type

Variable	*n*	*M*	Median	SD	Min	Max
All Other						
PMT Total	15	88.27	92.0	24.64	40	117
Spatial Concept Memory	15	82.33	85.0	29.90	25	130
Immediate Recall	15	94.73	99.0	26.98	25	125
Sequential Memory	15	94.73	100.0	25.64	30	123
Recent Memory	15	91.40	95.0	21.05	40	120
Auditory Information Processing	15	90.13	95.0	21.17	44	122
Visual Information Processing	15	102.80	113.0	25.29	57	130

Note: n = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Research Objective Three

Describe the demographic characteristics of KBIT-2 Verbal, Nonverbal and Composite Standard Scores.

Sample size of N of 102 was analyzed to determine the statistical Mean (numerical average), Median (middle score) and standard deviation (measure of typical variation from the mean) for each of the KBIT-2 Verbal and Non-Verbal subscales and the Composite standard score. Minimum (lowest standard score) and Maximum (highest standard score) were identified for each KBIT-2 subscale standard score. Average mean and median scores were noted with all standard deviations at or near the KBIT-2

SD of 15. Minimum scores ranged from 40 – 57 and maximum scores ranges from 121 - 131. Table 4.8 reports summary characteristics of the subscales of the K-BIT-2.

Table 4.8.

Summary Statistics of KBIT-2 Subscales

Variable	*M*	Median	SD	Min	Max
Verbal	91.70	92.5	14.20	57	125
Non-Verbal	94.18	98.0	18.55	40	132
Composite	102	92.18	16.00	46	121

Note: n = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Age. The demographic variable of age was also analyzed to quantify the mean, median, standard deviation and minimum and maximum scores on the K-BIT-2. The population below age 21 reflected mean and median scores within the average range and standard deviations at or near the SD of the instrument. Minimum scores range from significantly below average (40) to significantly above average (132). For those in the population age 22 – 29, mean and median scores were within the average range, but standard deviations increased above the instrument SD and ranged up to a standard deviation of 23.60 reflective of greater variation from the mean with this age population. The population age 30-39 reflected mean and median scores within the average range. Standard deviations were below the instrument SD in all subscales. Minimum scores were within one standard deviation of the average range (72) to a maximum score (109) within the average range.

Individuals within the population for age 40-49 were reflective of low average mean scores on all subscales and had the lowest mean score of any population. Median scores ranged from just below average (84.5) in the verbal domain to average in both non-verbal and composite scores. Standard deviations varied from at or near the instrument SD to higher with a Non-Verbal standard deviation of 24.474. Minimum scores ranged from significantly below average (42) to within a standard deviation (73) of the average range. Maximum scores were above average in the Verbal domain and KBIT-2 Composite (117). For the age population of 50–59, both mean and median scores were within the average range and reflective very consistent standard deviations just below the SD of the instrument. Minimum scores ranged from just below average (84) to above the average range (125). Table 4.9 reports the impact of age on the scores of the KBIT-2.

Table 4.9

Summary Statistics of KBIT-2 Subscales for Age:

Variable	*n*	*M*	Median	SD	Min	Max
Below Age 21						
KBIT-2 Verbal	58	90.74	91.5	13.27	63	117
KBIT-2 Non-Verbal	58	95.21	97.5	17.26	40	132
KBIT-2 Composite	58	91.97	93.5	14.54	46	120

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.9 (continued)

Summary Statistics of KBIT-2 Subscales for Age:

Variable	*n*	*M*	Median	SD	Min	Max
Age 22-29						
KBIT-2 Verbal	14	91.29	98.0	17.66	57	115
KBIT-2 Non-Verbal	14	90.43	95.0	23.60	47	120
KBIT-2 Composite	14	90.00	96.5	21.59	49	119
Age 30-39						
KBIT-2 Verbal	9	89.67	91.0	9.46	72	106
KBIT-2 Non-Verbal	9	95.67	98.0	11.52	79	109
KBIT-2 Composite	9	91.78	92.0	11.27	72	108
Age 40-49						
KBIT-2 Verbal	12	89.25	84.5	15.15	73	117
KBIT-2 Non-Verbal	12	86.58	98.5	24.47	42	112
KBIT-2 Composite	12	87.58	94.0	18.67	59	116
Age 50-59						
KBIT-2 Verbal	9	103.78	98.0	14.00	84	125
KBIT-2 Non-Verbal	9	102.00	103.0	13.06	78	118
KBIT-2 Composite	9	103.44	100.0	13.35	84	121

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Gender: An analysis of gender and KBIT-2 standard scores was completed to quantify the mean, median, standard deviation and minimum and maximum scores on the

K-BIT-2 and are reported in Table 4.10. Both males and females had average mean and mean scores on the KBIT-2. Standard deviations were fairly similar between each gender population with the exception of the KBIT-2 Non-Verbal standard deviation (21.07). Minimum and maximum scores were evenly distributed between the two groups with a male minimum score of 40 and a female minimum score of 47. Maximum scores were slightly higher among the male population with a maximum score of 132 and in comparison to a maximum score of 125 for females.

Table 4.10

Summary Statistics of KBIT-2 -2 Subscales for Gender

Variable	*n*	*M*	Median	SD	Min	Max
Male						
KBIT-2 Verbal	56	93.48	95.0	12.83	61	117
KBIT-2 Non-Verbal	56	95.86	98.5	18.74	40	132
KBIT-2 Composite	56	94.07	97.5	15.08	46	120
Female						
KBIT-2 Verbal	46	89.52	88.5	15.59	57	125
KBIT-2 Non-Verbal	46	92.13	94.5	18.31	47	119
KBIT-2 Composite	46	89.87	93.0	16.93	49	121

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Education: An analysis of the impact of educational attainment on population scores on the K-BIT-2 is reported in Table 4.11. The population with less than a high school education had the lowest overall standard scores on the K-BIT-2 with mean scores within the average range and the KBIT-2 Verbal (85.75) score just within the average range. With the exception of the KBIT-2 Verbal score (83.0) median scores were in the average range. Standard deviations were at or near the instrument mean with the exception of the KBIT-2 Verbal (21.07). Minimum to maximum scores ranged from significantly below average (40) to significantly above average (132).

Mean and median scores for those who completed high school or obtained a GED reflected average scores very close to the instrument mean of 100. Standard deviations were at or near the SD of the instrument. Minimum scores were within two standard deviations from the mean and maximum scores were within one standard deviation of the mean with scores ranging from 50 to 125. For the population with education beyond high school, mean and median scores were at or near the instrument mean and reflected standard deviations across all subscales below the instrument SD. Both minimum scores were in the average range for those with education beyond high school and maximum scores were all above average.

Table 4.11

Summary Statistics of KBIT-2 Subscales for Education Level

Variable	*n*	*M*	Median	SD	Min	Max
Less than High School						
KBIT-2 Verbal	51	85.75	83.0	13.83	57	113
KBIT-2 Non-Verbal	51	89.06	92.0	21.07	40	132
KBIT-2 Composite	51	85.98	89.0	17.05	46	120

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.11(continued)

Summary Statistics of KBIT-2 Subscales for Education Level

Variable	*n*	*M*	Median	SD	Min	Max
High School Diploma/ GED						
KBIT-2 Verbal	42	96.74	97.0	12.29	73	125
KBIT-2 Non-Verbal	42	98.38	99.5	14.92	50	118
KBIT-2 Composite	42	97.31	97.5	12.58	64	121
More than High School						
KBIT-2 Verbal	9	101.89	98.0	10.01	91	117
KBIT-2 Non-Verbal	9	103.56	103.0	8.26	92	120
KBIT-2 Composite	9	103.33	100.0	8.92	95	119

Note: n = 102, M = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Disability Type: Standard scores of the KBIT-2 obtained by the study population were also analyzed from the perspective of disability type and reported in Table 4.12. Mean and median standard scores were within the average range for all disability types with the exception of those with mental retardation. Standard deviations were at or near the instrument SD for all disability types with the exception of those with mental retardation and traumatic brain injury. Analysis of minimum and maximum scores reflected the closet range of scores to the mean in the orthopedic population with a below average minimum score (78) and above average maximum score (120). Those with mental illness demonstrated a significant range of scores from significantly below average (42) to above average (125). Minimum scores of the population that included mental retardation revealed a fairly consistent lowest minimum score (42) with the population of individuals with mental illness, however, the maximum scores of this group were in the average range (107 -115).

Analysis of scores in the population of individuals with non-orthopedic, physical disability revealed average performance on all KBIT-2 areas of measurement from mean and median perspectives. Minimum scores were within one deviation of the average range with all three domains at or near a standard score of 70. While this population was not reflective of an intellectual related disability and yielded average maximum scores (106, 109, 108), they were the lowest group in maximum scores on the KBIT-2 by disability type. Those with learning disability revealed a pattern of average mean and median scores on the KBIT-2 with minimum scores within a standard deviation below average and the KBIT-2 Verbal score (82) just below the average range. Maximum scores were reflected of high average to significantly above average scores.

Those with vision impairments performed as well as the other disability types without vision disability except those with mental retardation and were the second best performing group with only those with learning disability exceeding their scores. Minimum scores ranged from below a standard deviation below average (50) to maximum scores on the KBIT-2 within the average range. The population of individuals with traumatic brain injury demonstrated average mean and median scores, but reflected a wider variance of scores with the lowest minimum score ranging from over two standard deviation below average to significantly below average on the non-verbal subscale. Other subscales ranged from a minimum score below over one standard deviation below average (60) to maximum scores just above the average range. Score analysis revealed that the population of individuals with other types of disability had the third lowest mean and median verbal scores of all the population groups while still in the average range. Minimum scores ranged from over two standard deviations below average (48) to a maximum score significantly above the average range on the non-verbal domain. A fairly similar pattern while not as extreme was noted in score range of the verbal and composite domains.

Table 4.12

Summary Statistics of KBIT-2 Subscales for Disability Type

Variable	*n*	*M*	Median	SD	Min	Max
Orthopedic						
KBIT-2 Verbal	15	96.87	96.0	12.53	81	120
KBIT-2 Non-Verbal	15	97.60	98.0	12.30	78	118
KBIT-2 Composite	15	97.13	97.0	11.43	82	120
Mental Illness						
KBIT-2 Verbal	18	94.50	95.5	12.50	77	125
KBIT-2 Non-Verbal	18	92.56	98.0	20.80	42	115
KBIT-2 Composite	18	92.72	96.0	15.61	59	121
Non-Orthopedic, Physical						
KBIT-2 Verbal	7	88.71	95.0	14.19	70	106
KBIT-2 Non-Verbal	7	93.57	92.0	13.89	70	109
KBIT-2 Composite	7	90.71	95.0	14.26	71	108

Note: N = 102, M = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.12 (continued)

Summary Statistics of KBIT-2 Subscales for Disability Type

Variable	*n*	*M*	Median	SD	Min	Max
Mental Retardation						
KBIT-2 Verbal	8	76.00	74.0	17.28	57	115
KBIT-2 Non-Verbal	8	79.38	89.0	23.22	40	107
KBIT-2 Composite	8	75.25	79.5	21.12	46	113
Learning Disabilities						
KBIT-2 Verbal	22	93.77	94.0	10.81	77	113
KBIT-2 Non-Verbal	22	100.18	100.5	11.18	82	132
KBIT-2 Composite	22	96.23	97.5	10.03	79	117
Vision Impairment						
KBIT-2 Verbal	8	94.25	93.5	9.82	77	112
KBIT-2 Non-Verbal	8	98.13	105.0	20.47	50	115
KBIT-2 Composite	8	96.13	98.5	12.72	70	111
Traumatic Brain Injury						
KBIT-2 Verbal	9	90.67	95.0	18.43	61	117
KBIT-2 Non-Verbal	9	89.33	98.0	26.94	47	120
KBIT-2 Composite	9	89.00	96.0	23.73	60	119

Note: *n* = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Table 4.12 (continued)

Summary Statistics of KBIT-2 Subscales for Disability Type

Variable	*n*	*M*	Median	SD	Min	Max
All Other						
KBIT-2 Verbal	15	89.13	87.0	15.92	65	117
KBIT-2 Non-Verbal	15	92.87	95.0	20.43	48	130
KBIT-2 Composite	15	90.13	93.0	17.87	52	120

Note: n = 102, *M* = 100, SD = 15, Min = Minimum SS, Max = Maximum SS

Research Objective Four

Determine the relationship between age, gender, level of education, type of disability and information processing as measured by the PMT.

In the application of statistical models and tests in data analysis there is an underlying assumption that the errors in the prediction of the models are independently and identically distributed as normal random variables with a mean of 0 and a constant variance. An example of this is the bell curve that assumes a normal distribution. This assumption was violated in all PMT score variables when subscale scores were predicted by demographic variables or other test scores. Prior to completing Analysis of Variance (ANOVA) and General Linear Model (GLM) analysis, all of the PMT subscale scores were transformed according to the Box-Cox transformation procedure (Box, 1964). This procedure chooses a power transformation based on the power that most normalizes the residual scores. Scores of each variable were squared prior to analysis and predictions made based upon the transformed score rather than the original variable scores. The Box-

Cox transformation was completed on PMT scores to ensure that the data produced would be considered as reasonably normal as possible. Analyses were performed of both the original variables, as well as the transformed variables with statistics reported reflective of means in the original variables. For the purpose of determining where significant relationships exist between variables, only the transformed variables were used.

The PMT subscales were identified as continuous variables and the demographic variables as categorical supporting use of One-way ANOVAs to determine if demographic variables individually have significant relationships with the PMT subscales. A P-test value less than 0.05 was indicative of a significant relationship between unique variables and individual PMT subscales. The One-way ANOVA was indicative of a significant relationship between disability type and Spatial Concept Memory scores. Age was found to have a significant relationship with Recent Memory scores and Visual Information Processing scores. Gender and education attainment analysis revealed no significant relationship with any of the PMT subscales. Age was the most frequent factor in significance of demographic variables on PMT scores. Table 4.13 reports ANOVA results of the relationship of demographic variables on PMT scores.

Table 4.13

Results of One-way ANOVA Comparing PMT Scores (Transformed) by Demographic Variables

Demographic Variable	F Statistic	P-Value	R^2	Root MSE	Orig. Scale Root MSE
PMT Total					
Age	.77	.5460	.0309	2887.57	16.88
Gender	.01	.9275	.0001	2888.72	16.80
Education Level	.34	.7125	.0068	2893.47	16.80
Disability Type	2.05	.0579	.1323	2775.48	16.14
Spatial Concept Memory					
Age	.03	.9981	.0013	4404.79	24.70
Gender	2.00	.1608	.0196	4298.34	24.08
Education Level	.12	.8847	.0025	4357.50	24.42
Disability Type	2.82	.0103	.1738	4069.89	22.84
Immediate Recall					
Age	.89	.4710	.0355	2816.27	16.29
Gender	1.59	.2096	.0157	2802.08	16.12
Education Level	.03	.9694	.0006	2837.67	16.30
Disability Type	1.13	.3539	.0773	2798.17	16.19

P-Value Significance = .05

Table 4.13 (continued)

Results of One-way ANOVA Comparing PMT Scores (Transformed) by Demographic Variables

Demographic Variable	F Statistic	P-Value	R-Square	Root MSE	Orig. Scale Root MSE
Sequential Memory					
Age	1.60	.1794	.0620	3073.81	16.84
Gender	.48	.4883	.0048	3118.35	17.07
Education Level	.37	.6920	.0074	3129.97	17.11
Disability Type	1.74	.1086	.1148	3033.37	16.64
Recent Memory					
Age	2.84	.0285	.1047	2842.36	17.86
Gender	.00	.9960	.0000	2958.57	18.29
Education Level	.77	.4658	.0153	2950.62	18.29
Disability Type	2.01	.0620	.1301	2846.11	17.81
Auditory Information Processing					
Age	1.12	.3512	.0442	2739.46	15.20
Gender	2.17	.1441	.0212	2730.28	15.13
Education Level	1.07	.3455	.0212	2743.99	15.25
Disability Type	1.26	.2790	.0857	2721.66	15.07

P-Value Significance = .05

Table 4.13 (continued)

Results of One-way ANOVA Comparing PMT Scores (Transformed) by Demographic Variables

Demographic Variable	F Statistic	P-Value	R-Square	Root MSE	Orig. Scale Root MSE
Vocational Information Processing					
Age	2.74	.0331	.1014	3555.83	18.33
Gender	.63	.4282	.0063	3682.75	18.97
Education Level	.12	.8865	.0024	3708.48	19.11
Disability Type	1.54	.1630	.1029	3609.02	18.65

P-Value Significance = .05

In Table 4.13, the F statistic was used to determine each P-Value and the proportion of variation in each PMT score explained by each demographic variable was the R-Square. Disability type was found to explain 17.38% of variance in the Spatial Concept Memory Scores and age to explain 10.47% of variance in the Recent Memory Scores and 10.14% variance in the Visual Information Processing scores.

As disability type was a significant predictor at the 0.05 level for the Spatial Concept Memory Scores and age a significant predictor at the 0.05 level for the Recent Memory and Information Processing scores, an analysis of where significant differences exist within each of the demographic variables was also completed. Results indicated that individuals with learning disability scored significantly higher in Spatial Concept Memory than those with mental illness, orthopedic disability, mental retardation, traumatic brain injury and those with all other types of disability. Individuals with mental illness were also noted to perform better on the Spatial Concept Memory subscale than those with all other types of disability. In contrast, those with all other types of disability performed significantly lower than all other disability types on the Spatial Concept subscale. Table 4.14 reflects the impact of disability type on scores on the Spatial Concept Memory subscale with means listed in descending order and use of line segments to indicate non-significant means. Means with the same letter do not differ significantly from one another.

Table 4.14

Significant Differences in Spatial Concept Memory Score (Transformed) by Disability Type

Disability Type	*n*	*M*	SD	Org. Scale Mean	Org. Scale SD	Significantly Different
Learning Disability	22	12879	3617	112.05	18.45	A
Mental Illness	18	10921	3760	102.94	18.52	A B
Vision Impairment	8	10696	3130	102.13	17.46	A B C
Non-Orth., Physical	7	10390	3913	100	21.33	A B C
Orthopedic	15	9174	4331	92.6	25.35	B C
Traumatic Brain Injury	9	8911	3894	92.44	20.28	B C
Mental Retardation	8	8366	4704	87	30.18	B C
All Other	15	7613	4945	82.33	29.90	C

Note: Means with same letter do not differ significantly

Significant differences by age were further analyzed in the Recent Memory and Visual Information Processing subscales of the PMT and are reported in Table 4.15. Those under age 21 had higher scores on the Recent Memory subscale than those 40 – 49 and 50 – 59. On the Visual Information Processing subscale, those under 21 had significantly higher scores than the 40 – 49 age group population. Analysis revealed no further evidence of significant differences by independent variables on the PMT subscales.

Table 4.15

Significant Differences in Recent Memory and Visual Information Processing Score (Transformed) by Age

Disability Type	*n*	*M*	SD	Orig. Scale Mean	Org. Scale SD	Significantly Different
Recent Memory						
Below 21	58	9042	2875	93.33	18.38	A
30-39	9	8392	3974	88.44	25.31	A B
22-29	14	7558	2997	85.21	17.89	A B
50-59	9	6949	2381	82.33	13.85	B
40-49	12	6579	1470	80.67	8.89	B

Note: Means with same letter do not differ significantly

Table 4.15 (continued)

Significant Differences in Recent Memory and Visual Information Processing Score (Transformed) by Age

Disability Type	*n*	*M*	SD	Orig. Scale Mean	Org. Scale SD	Significantly Different
Visual Information Processing						
Below 21	58	11720	3479.91	106.91	17.17	A
22-29	14	10346	3597.41	100	19.33	A B
30-39	9	10018	4360.75	97.56	23.75	A B
50-59	9	9280	3272.82	94.89	17.64	A B
40-49	12	8561	3439.63	90.75	18.87	B

Note: Means with same letter do not differ significantly

Research Objective Five

Determine the relationship between age, gender, level of education, type of disability and cognitive abilities as measured by the KBIT-2.

Variable transformation took place using the Box-Cox transformation in order to normalize only the KBIT-2 Non-Verbal scores due to the subscale scores not resulting in a normal distribution. Statistical analysis included the use of One-way ANOVAs to determine whether the independent variables of age, gender, level of education and disability type would have significant relationships with the KBIT-2 subscales. Results from the ANOVA analysis on the Verbal subscale, F = 11.38, p = 0.0000, indicated that educational level was a predictor at the 0.05 level for the KBIT-2 verbal subscale. The

ANOVA analysis, $F = 2.17$, $p = 0.0441$, also indicated that disability type was also a predictor of KBIT-2 verbal subscale performance.

As noted previously, a Box-Cox transformation was used to normalize the subscale scores for the ANOVA analysis of the Non-Verbal subscale. This transformation was used for one-way ANOVA analysis, $F = 4.16$, $p = 0.0184$, reflective of education level being a predictor of the KBIT-2 Non-Verbal subscale. Statistical analysis also included the impact of independent variables on the KBIT-2 Composite subscale. One-way ANOVA analysis, $F = 9.56$, $p = 0.0002$, revealed educational level as a predictor for the KBIT-2 Composite subscale. The statistical analysis of the KBIT-2 for determination of the prediction of the independent variables on test scores revealed at 0.05 that education level had a significant impact on all three subscales and that disability type was significant in performance on the KBIT-2 Verbal subscale.

Analysis then considered whether there would be significant differences between the independent variables of education level and disability type through One-way ANOVA analysis. Individuals with an educational level less than high school were noted to score significantly lower on all domains of the KBIT-2 than those with a high school diploma or GED or those in the population with education beyond high school. While education beyond high school had somewhat higher scores on each of the KBIT-2 subscales, the small sample size (9) impacted the interpretative substance of this finding. Individuals with mental retardation were noted to score significantly below the performance level of individuals with orthopedic, mental illness, learning disability, vision impairment and all other disabilities. No other evidence of significant score differences were identified. The following four tables report the differences noted on the KBIT-2 by the independent variables of education level and disability.

Table 4.16

Significant Differences in the KBIT-2 Verbal Scores by Education Level

Level	*n*	*M*	SD	Significant Difference	
Less than High School	51	85.75	13.83	A	
High School of GED	42	96.74	12.29	A	
More than High School	9	101.89	10.01		B

Note: Means with same letter do not differ significantly

Table 4.17

Significant Differences in KBIT-2 Verbal Scores by Disability Type

Level	*n*	*M*	SD	Significant Difference	
Orthopedic	15	96.87	12.53	A	
Mental Illness	18	94.50	12.50	A	
Non-Orthopedic, Physical	7	88.71	14.19	A	B
Mental Retardation	8	76.00	17.28	A	B
Learning Disability	22	93.77	10.81	A	
Vision Impairment	8	94.25	9.82	A	
Traumatic Brain Injury	9	90.67	18.43	A	B
All Other	15	89.13	15.92	A	B

Note: Means with same letter do not differ significantly

Table 4.18

Significant Differences in KBIT-2 Non-Verbal Scores (Transformed) by Education Level

Level	*n*	*M*	SD	Orig. Scale Mean	Org. Scale SD	Significantly Different	
Less than High School	51	8367	3520	89.06	21.07	A	
High School or GED	42	9896	2651	98.38	14.92		B
More than High School	9	10784	1761	103.56	8.25		B

Note: Means with same letter do not differ significantly

Table 4.19

Significant Differences in KBIT-2 Composite Scores by Education Level

Level	N	Mean	SD	Significant Difference	
Less than High School	51	85.98	17.05	A	
High School of GED	42	97.31	12.58		B
More than High School	9	103.33	8.92		B

Note: Means with same letter do not differ significantly

Research Objective Six

Correlate the standard scores obtained on the PMT and K-BIT-2 by age, gender, level of education and type of disability.

As a preliminary analysis, the relationship of each of the transformed PMT subscales to each KBIT-2 subscale was examined through use of the Pearson correlation in order to determine the degree of association between the two subscales. A number between – 1 and + 1 is calculated for correlation with a positive value indicative of a positive association and a negative value associated with a negative or inverse association. Using the Pearson correlation, it was determined that all the correlations between the PMT subscales and KBIT-2 subscales are statistically significant and positively correlated. The pattern of correlation indicates that when a score is “high” on a PMT subscale, it is likely that the KBIT-2 instrument subscale will be “high”, as well. Table 4.20 reports the Pearson correlation for the PMT and the KBIT-2 subscales. The correlation of subscale scores are found at row intersections. For example, the correlation between the PMT Total score and the KBIT-2 Verbal scores is where the PMT Total row intersections the KBIT-2 Verbal column (R = 0.4865).

Table 4.20

Correlation Analysis of PMT Subscales to KBIT-2 Subscales

Subscale	KBIT-2 Verbal	KBIT Non-Verbal	KBIT Composite
PMT Total	.49	.61	.62
Spatial Concept Memory	.44	.49	.52
Immediate Recall	.39	.47	.48
Sequential Memory	.44	.56	.56
Recent Memory	.31	.53	.48
Auditory Information Processing	.33	.32	.35
Visual Information Processing	.37	.55	.52

Note: R = number between – 1 and + 1

Analysis also examined whether there were any individual relationships between each of the PMT subscales and the KBIT-2 subscales. Twenty-one (21) separate linear regressions were performed to predict each of the PMT subscales after transformation with each of the KBIT-2 subscales. This statistical analysis was chosen to model a continuous response of the PMT subscales with the continuous variables of KBIT-2 subscales. Like ANOVA, a P-value indicated whether or not the KBIT-2 was significant in predicting PMT subscales. Each regression also provided a parameter estimate indicative of how much on average the transformed PMT subscale would be expected to increase for a one-point increase in the KBIT-2 subscale. A positive parameter estimate was expected to indicate a positive relationship or as one score would go up, on average so would the other. In contrast, a negative parameter estimate was expected to reflect the likelihood that as one score goes up, the other would go down. All P-values were significant at the 0.05 level of significance suggesting that not only were the individual KBIT-2 subscales highly significant predictors of PMT subscale scores, but that any one of the KBIT-2 subscales is significantly related to each of the PMT subscales.

Further examination included exploration of which KBIT-2 subscale was most related to the PMT subscales and the impact of demographic variables on the predictive power of KBIT-2 subscales on PMT subscales given the demographic variables of age, gender, level of educational attainment and type of disability. The General Linear Model was used for analysis due to the categorical demographic independent variables, the continuous independent variables of the KBIT-2 subscales and the continuous dependent variables of the PMT subscales. A backward variable selection technique was used to identify the variables that significantly predicted the PMT subscales together. Using this technique, all of the variables of interest were selected and then the least significant variable was dropped as long as it was not significant at the 0.05 level. This process was continued by successively re-fitting a reduced model and applying the same rule until all the remaining variables were statistically significant. This approach was chosen in contrast to forward selection as the addition of a new variable was at risk to result in one or more of the already included variables becoming non-significant. Using the backward selection process, a significant subset of the KBIT-2 scores and demographic variables were determined for predicting each PMT subscale.

PMT Total. Analysis revealed that the KBIT-2 Verbal scores, KBIT-2 Non-Verbal, age and gender had no impact on the prediction of the PMT Total score and subsequently, these variables were not included in the final model. The most significant variable in prediction of the PMT Total score was the KBIT-2 Composite score and other significant variables were identified as education level and disability type. These factors comprised the model for analysis and resulted in an R-square of 0.5121 indicating that together education level, disability type and KBIT-Composite explain 51.21% (Root MSE = 2115) of the variation in PMT Total subscale.

Spatial Concept Memory. Using the same model of analysis as used for the PMT Total, the two significant variables in predicting the Spatial Concept Memory subscale were Disability Type and KBIT-2 Composite with the latter noted as the most significant variable in the predictive model. Again, the KBIT-2 Verbal and KBIT-2 Non-Verbal subscales scores were found to provide no contribution in the prediction of Spatial Concept subscale scores and were not used in the final analysis. The *R*-Square for the two-variable model was 0.4000 (Root MSE = 3487) indicating that together disability type and the K-BIT-2 Composite explain 40.00% of the variation in Spatial Concept Memory subscale score.

Immediate Recall. A backward selection process was again used to select independent and dependent variables for further analysis of significance on the Immediate Recall subscale scores. Significant variables were noted to include gender, education level, KBIT-2 Verbal and KBIT-2 Non-Verbal with the most significant variable of these noted to be the KBIT-2 Verbal subscale. In contrast to the PMT Total and Spatial Concept Memory subscales, the KBIT-2 Verbal and KBIT-2 Non-Verbal scales were noted to contribute significantly to the prediction of the Immediate Recall subscale. An *R*-Square of the three-variable model was 0.3294 (Root MSE = 2376) indicating that together gender, education level, KBIT-2 Verbal and KBIT-2 Non-Verbal explain 32.04% of the variation in the Immediate Recall subscale scores.

Recent Memory. Backward selection identified the most significant independent and dependent variables in predicting the Recent Memory subscale scores to include age and KBIT-2 Composite. Analysis revealed that the KBIT-2 Verbal and the KBIT-2 Non-Verbal provided no significant weight to the prediction of Recent Memory. Age and KBIT-Composite scores were noted to explain 35.68% of the variation of Recent Memory subscale scores with a *R*-Square of 0.3568 (Root MSE = 2422).

Auditory Information Processing. Consistency with the previously described model of variable selection resulted in significance identified in the variables of age, gender and KBIT-2 Verbal subscale scores. The KBIT-2 Non-Verbal score, education level and disability type did not significantly impact the prediction of Auditory Information Processing subscale scores. Together age, gender and KBIT-2 Verbal were found to account for 22.88% of the variation in Auditory Information Processing subscale scores with a *R*-Square of 0.2278 (Root MSE = 2488).

Visual Information Processing. Variables were again identified through a backward selection process to determine significant independent and dependent variables in the prediction of Visual Information Processing subscale scores. Age, gender and KBIT-2 Composite subscale scores were found to be the most contributory to this subscale. Neither the KBIT-2 Verbal, KBIT-2 Nonverbal, education level or disability type were found to contribute significantly to the Visual Information Processing subscale score. Analysis of the three-variable model reflected that together age, gender and KBIT-2 Verbal subscale score explain 41.53% of the variation in the Visual Information Processing subscale score with an *R*-Square of 0.4153 (Root MSE).

Summary

Through analysis of the PMT and the KBIT-2, statistical evidence indicated that the subscales of these two instruments are all significantly related to one another. The study also revealed that the independent variables of the study had impact on the results of the KBIT-2 and some of the PMT subscales. Education level was found to impact all subscales of the KBIT-2 as was disability type found to impact the KBIT-2 Verbal subscale. Recent Memory and Visual Information Processing were identified as being affected by age and disability type impacted outcome on the Spatial Concept Memory subscale of the PMT. Analysis revealed that of the PMT subscales, all but the Immediate Recall subscale were closely related to the KBIT-2 Composite. In contrast, the Immediate Recall subscale was most significantly related to the KBIT-2 Verbal and KBIT-2 Non-Verbal subscales and the Auditory Information Processing subscale score was most related to the KBIT-2 Verbal. While all the PMT subscales shared a positive overall relationship and at times unique relationship with the KBIT-2 subscales, the relationships were noted to be significantly different in the presence of the independent or demographic variables.

CHAPTER 5

SUMMARY, CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

This chapter provides reaffirmation of the study purpose, rationale for completion and outlines again the research objectives of the study. Methodology used for the study is also reviewed, as well as the results of the analysis that took place as part of the study. Conclusions from the study with recommendations for best practice and future research end the chapter.

Rationale

Past research has found that a significant relationship exists between cognitive abilities and elements of learning style. Studies have also focused upon the impact of cognition and information processing abilities related to the aptitudes supportive of success in academic and vocational activities (Ackerman, 1988; Corno, Kupermintz, Lohman, Mandianch, Porteus & Talbert, 2002; Hunt & Lansman, 1982; Kyllonen & Christal, 1990; McCarron, 1984b; Pellegrino & Glaser, 1980; Snow, 1981). Research regarding the specific cognitive processes of attention, concentration and memory on an individual's ability to process auditory and visual information, as well as impact on education and vocational levels of functioning has resulted in significant findings (McCarron, 1984). It has also long been acknowledged that individuals with disability are at risk for cognitive limitations that result in functional limitations impacting the capacity for attention, perception and memory (Dial et al., 1990; McCarron, 1984b; Wehman, 2006).

The PMT is a measure of focused attention, memory and information processing and has been administered to individuals with disability as part of vocational rehabilitation services since 1984. Cognitive abilities are also frequently assessed during rehabilitation assessment using the KBIT-2. Prior research findings have purported that the less cognitively able have less capacity for learning and memory than more intelligent individuals (Ackerman, 1988; Corno, et al., 2002; Hunt and Lansman, 1982). No prior research studies using these instruments have been conducted to explore potential phenomena related to intelligence, capacity for attention, memory and information processing. The rationale for the study was also grounded in theories of performance based learning style assessment, neuropsychological perspectives of memory capacities and contemporary intelligence testing.

Purpose

This study provided an opportunity to perform a validation study of the PMT through correlation with the KBIT-2 as a follow-up to the original validity study of the PMT (McCarron,1984) that involved correlation of the WAIS Verbal, Performance and Full-Scale IQ (Wechsler, 1955). A correlation study involving these two instruments allowed intelligence, capacity for attention, memory and information processing using test score data from instruments to be explored from a statistical perspective. Individuals with disability are at risk to experience functional limitations that can impact these domains and the PMT and the KBIT-2 are frequently used in the vocational assessment as psychometric measures. Both instruments are well respected in the fields of education and rehabilitation and were chosen based upon a history of publications and professional experience supportive of these assessment tools for use with adults with disability (Gregory, 2007; McCarron, 1984b).

The study design also provided an opportunity to explore the impact of measured verbal, nonverbal intelligence, and general intelligence on learning style and information processing capabilities across a variety of demographic variables that included age, gender, educational attainment and types of disability. General intelligence is divided into verbal and performance (nonverbal) domains (Kapplan & Saccuzzo, 2005) and these domains support an individual's ability to act, think and deal effectively with their environment. These domains were measured using the KBIT-2. In contrast, learning style refers to the cognitive processes used or depended upon when receiving information (Mayer & Massa, 2003) and these information processing abilities related to learning style were measured using the PMT. The independent variables of the study were age, gender, education level and disability type and the dependent variables were the PMT and KBIT-2 subscale scores.

Research Objectives

The following research objectives were addressed in this study:

1. Describe demographic characteristics of individuals with disability provided formalized assessment through the Georgia Department of Labor's Vocational Rehabilitation Program.

2. Describe the demographic characteristics of PMT Total, Spatial Concept Memory, Immediate Recall, Sequential Memory, Recent Memory, Auditory Information Processing and Visual Information Processing Standard Scores.

3. Describe the demographic characteristics of KBIT-2 Verbal, Nonverbal and Composite Standard Scores.

4. Determine the relationship between age, gender, level of education, type of disability and information processing as measured by the PMT.

5. Determine the relationship between age, gender, level of education, type of disability and cognitive abilities as measured by the KBIT-2.

6. Correlate the standard scores obtained on the PMT and K-BIT-2 by age, gender, level of education and type of disability.

Method

The independent variables of age, gender, level of education and type of disability of the study population were explored through descriptive statistics. Demographic characteristics of the independent variables were also compared to the dependent variables of the PMT and KBIT through descriptive statistics. The relationship between age, gender, level of education, type of disability, measured cognitive abilities, and learning style were examined through correlation design allowing the exploration of the degree, direction (positive or negative), and magnitude of the relationships between the variables age, gender and educational attainment (Gall, Gall & Borg, 2007). A degree of relationship was measured between variables without any manipulation of the independent variables through treatment experiment or varying interventions. While the simplicity of correlation research in basic design is well established, this research method has produced meaningful studies in the social sciences including the fields of education (Gall, Gall & Borg, 2007) and rehabilitation (Fitzgerald, Rumrill & Schenker, 2004). Correlation research has also provided opportunity for the analysis of multiple variables potentially impacting intervention planning, as well as program outcome. This study was explanatory in nature in keeping with the majority of correlation research that has been published in vocational rehabilitation journals (Fitzgerald, et al., 2004).

Participants

The study population included 102 individuals with disability served through the Georgia Department of Labor's Vocational Rehabilitation Program. Each participated in vocational evaluations provided by the researcher with selection of individuals to receive services provided by the researcher at the sole discretion of the field counselors employed by the Georgia Department of Labor. Demographically, 55% of the study population was male and 45% was female. Age characteristics of the study population included over half (57%) of study participants below age 21 and 34% ranging in age from 22 – 49. The smallest age groups in the study population were individuals ages 30 – 39 and ages 50 – 59 with only less than 10% of the study population in each of these age groups. No study participants were above age 59. Educationally, half of the participants (50.0 %) had less than a high school level of education and less than 10% were college graduates.

Instrumentation

Instruments used for this study were the PMT, a measure of information processing and memory and the KBIT-2, a measure of intelligence. Standard scores of the PMT were recorded to project information processing, memory and learning preferences and standard scores of the KBIT-2 were recorded to project intellectual abilities.

Research Procedures

Data retrieval was completed by the researcher and an assistant employed by the researcher who has the same education and professional credentials as the researcher. A master data collection sheet was used to record demographic variables and test scores. The confidentiality of each participant was safeguarded by assigning a numerical identification number to each member of the study population with the master list of participants and identification numbers maintained by the researcher on a password protected computer.

Data Analysis

For purposes of analysis a combination of statistical programs were used for this study. Descriptive statistics were obtained using the Statistical Package for the Social Sciences (SPSS) version 19. Variance was analyzed using multiple analyses of variance using the SAS version 9.2. An alpha level of 0.05 was used for determining significance of variance between the independent and dependent variables. A correlation analysis compared the subscales of the PMT with the subscales of the KBIT-2 to calculate a Pearson correlation coefficient. The independent variables (age, gender, level of education and type of disability) were treated as categorical variables and the dependent variables (PMT and KBIT-2 subscales) were treated as continuous variables and analyzed using multiple ANOVAs and regression analysis.

Summary of Findings

The study population was first analyzed from the perspective of descriptive statistics regarding age, gender, level of education and disability type. Statistics revealed that over half of the population (57%) were below the age of 21 reflective of a significant percentage of the study population comprised of students in transition from school to work or post-secondary training. The next largest percentage of the population included those 22 – 29 (14%) which also was reflective of a fairly significant number of participants attempting to transition from school to some type of employment or training after completing high school and potentially students in post- secondary training experiencing academic difficulty in their program of study or choosing a major given their functional limitations, interests and programmatic academic expectations. The third largest group included in the population included age 40 – 49 (12%) and reflected individuals in the population either displaced from employment due to their disability, the economic downturn or potentially not working due to disability with aspiration of developing a plan for employment. The lowest frequency (9%) in the population was those 30 – 39 and those 50 – 59. In combination with the group age 40 – 49, approximately 29% of the population above age 29 was attempting to regain their employment status or potentially develop an employment plan for the first time. No one in the study population was above age 60.

A relatively even distribution was noted between males (55%) and females (45%). Over half of the population were not high school graduates reflecting individuals with disability still in high school during their assessment or unsuccessful in completing high school exit requirements. Approximately 41% had completed high school or GED requirements suggesting that despite the completion of high school or equivalent education; formalized assessment was needed to assist in vocational rehabilitation planning. A fairly small percentage (9%) of the population had education beyond high school indicating that despite post-secondary training, individuals within the study population had experienced barriers to employment planning that resulted in them completing a vocational evaluation.

Disability type analysis quantified those with learning disability (22%) as the largest group in the study with a fairly equal representation of individuals with mental illness (18%), orthopedic disability (15%) and all other types of disability (15%) that included a significant number of individuals with autism spectrum disorder. The lowest percentage of individuals with disability included those with non-orthopedic physical disability (7%), mental retardation and vision impairment (8%) and traumatic brain injury (9%). There were no individuals included in the study with hearing impairment or substance abuse disabilities.

Overall PMT Performance by Subscale, Age, Gender, Education and Disability

As a preliminary step in realizing research objectives, the PMT scores of all participants were quantified to determine the mean, median, standard deviation and identify minimum and maximum scores. Despite a population of individuals with disability, all mean and median scores were within the average range and standard deviations for each subscale at or near the instrument standard deviation. The significant impact of disability on attention, concentration and memory, as well as the relative strengths of individuals with disability in these cognitive areas were observed in the minimum and maximum scores with PMT scores ranging from the lower extreme to significantly above average.

Overall analysis noted that by age, the standard deviations were fairly close to the instrument SD for most age groups. Those 22 – 29 reflected the closest standard deviations to the instrument SD with scores at or above 15. Standard deviations were noted to be below the instrument SD on a number of subscales of the PMT for the 30 – 39 population. Standard deviations in this age population reflected the majority of subscales significantly higher than the SD of the PMT and mean of the age population. The age group 40 – 49 was at or above the SD of the instrument and showed the least overall distance from the subscale means of any age population. For those below 21 and 50 – 59, the standard deviations were at or near the instrument SD with the exception of Spatial Concept Memory for below age 21 and 50 -59 that were almost two standard deviations above the instrument SD. Analysis revealed that Spatial Concept Memory had the largest standard deviation across all age domains. Lowest minimum scores were reflected in the below age 21 population and the highest maximum mean scores were in this age population resulting in wide variance of score patterns. The least variance in minimum and maximum scores was in the age group 40 – 49.

Gender analysis revealed a fairly consistent pattern of mean and median scores of males and females with all means within the average range. Standard deviations were also very consistent across gender and at or above the instrument SD with the exception of the standard deviation for Immediate Recall in the female group which was significantly below the instrument SD of 15. Consistent with analysis by age, the Spatial Concept Memory continued to reflect the highest standard deviation and was above the SD of the instrument. Minimum and maximum scores for each group ranged from the lower extreme to significantly above average.

Educational attainment related to standard scores on the PMT was also analyzed. A pattern of average mean and median scores was noted in the below high school population with standard deviations near or at the instrument SD and highest standard deviation noted in Spatial Concept Memory and Recent Memory. A wide discrepancy of score distribution from the lower extreme to significantly above the average range maximum was noted in the below high school population. Those with a school diploma or GED reflected mean and median scores very near the instrument mean standard score of 100. This population also had standard deviations at or near the instrument SD with a slightly lower standard deviation in Spatial Concept Memory (20.947). While the lowest minimum score was significantly below average, it was not considered within the lower extreme as noted in among those not completing high school. Maximum subscale scores for those with a high school education or GED ranged from the above average to significantly above the average range.

Individuals with more than a high school education reflected average mean and median scores on all subscales, but Recent Memory with mean and median subscale scores just below the average range. Standard deviations in this population reflected scores significantly below the instrument SD of 15 on the Immediate Recall subscale and less width in score patterns than other education groups from the population mean on this subscale. The PMT Total standard deviation was significantly below the instrument SD and all other standard deviations were very near the instrument mean. In comparison to the group with a high school education or GED and those with less than a high school education, the minimum and maximum spread of scores were closer to the mean with below average minimum standard scores in Spatial Concept Memory and Recent Memory. Maximum standard scores above the average range decreased in this group and included only the Spatial Concept Memory subscale that was a standard deviation above the average range and the Visual Information Processing subscale that was just above the average range.

Disability types and the PMT were also analyzed through descriptive statistics reflective of both similar patterns, as well as differing patterns of mean, median scores and standard deviations. For the orthopedic population of disability, mean and median scores were found to be in the average range with a fairly even distribution from minimum to maximum score with the exception of Spatial Concept Memory with a minimum score of over two standard deviations below average and maximum score just above the average range. While the remaining minimum scores were significantly below average, the maximum scores were in the average to above average range. All standard deviations were at or near the instrument SD with the exception of a statistically above instrument SD on the Spatial Concept Memory subscale.

For the group of individuals with mental illness, all mean scores were within the average range and median scores were also all within the average range except recent memory which was just below average. Examination also revealed standard deviations at or near the SD of the PMT. Minimum scores were below average on all PMT subscales, but most were near or at the lower end of the average range except Recent Memory which was over two standard deviations below the average range. Average to above average scores were reflected in maximum scores. Individuals with non-orthopedic, physical disability had mean scores within the average range with the exception of Recent Memory which was just below the average range. Median scores were all within the average range. Standard deviations ranged from significantly below the instrument SD on the PMT Total and Immediate Recall scores to just under the instrument SD in all other subscales except for the Spatial Concept Memory subscale. Minimum and maximum scores were noted to be within the average range for all subscales for this group with the exception of Spatial Concept Memory and Recent Memory with scores over two standard deviations below average.

Despite intellectual disability, those within the group of individuals with mental retardation reflected performance within the average range on the PMT with the exception of Recent Memory which was just below average. This group's median scores were also within the average range. In comparison to each of the other disability population, this group reflected the largest standard deviation in subscale scores. For this group, the Spatial Concept Memory standard deviation was twice the instrument SD and the PMT Total and Recent Memory were both significantly above the instrument SD. The distance between the minimum and maximum scores for this population ranged from the lower extreme to maximum scores ranging from above average to significantly above average.

Those in the study population with learning disability reflected average mean and median scores and standard deviations were at or near the instrument SD. This group had minimum and maximum scores ranging from the lower extreme to significantly above the average range. Those with visual impairment also had average mean and median scores, but reflected less variance in minimum and maximum score ranges with scores from below average to the above average range. Despite visual disability, this group's only below average minimum scores were noted in Spatial Concept Memory and Recent Memory and standard deviations were at or near the instrument SD.

The study population of individuals with traumatic brain injury reflected mean and median scores below the average range only on the recent memory subscale. Standard deviations noted in this population were at or near the instrument SD with below instrument SD only in Immediate Recall and above instrument SD in Spatial Concept Memory. This group had minimum standard scores ranging from below over two standard deviations below the average range on the Recent Memory subscale to significantly above average maximum score on the Spatial Concept Memory subscale.

Those with all other disability types reflected mean scores within the average range on all subscales except for Spatial Concept Memory that was just below the average range. This group's median scores were all within the average range. A wide distribution of scores was observed in this group ranging from minimum scores within the lower extreme in Spatial Concept Memory and Immediate Recall to maximum scores significantly above the average range in Spatial Concept Memory and Visual Information Processing. As noted previously, the majority of this population was comprised by individuals with Autism Spectrum Disorder.

Analysis revealed that all PMT mean and median scores were generally within the average range across a variety of disability groups. The subscale observed to be the most vulnerable to functional limitations associated with disability was the Recent Memory subscale. The subscales with consistently the largest standard deviations included Recent Memory and Spatial Concept Memory. The disability type with the most variance in scores was the group comprised of individuals with mental retardation.

Overall KBIT-Performance by Subscale, Age, Gender, Education and Disability

Despite a study population of individuals with disability, average mean and median scores were observed across all domains of the KBIT-2 with standard deviations at or near the KBIT-2 SD of 15. The overall population performance on KBIT-2 reflected minimum scores ranging significantly below average to maximum scores ranging from above average to significantly above average. These observations were fairly consistent with the pattern of performance noted on the PMT. From the perspective of age, all group means and median scores were observed to be within the average range with the exception of the 40 – 49 age group who had a just below average KBIT-2 Verbal median score. This group also had the lowest mean verbal subscale score. Across age groups, standard deviations were fairly close to the instrument SD except for those in the age group 22 -29. Observations noted standard deviations significantly above the instrument SD on the KBIT-2 Non-Verbal subscale and the greatest variation from the mean in comparison to the other age populations. Variance between minimum and maximum scores on the KBIT-2 were observed from significantly below average to above average was noted in all groups except for those 30 – 39. Those in 30 – 39 reflected minimum scores within one standard deviation of the average range and maximum score within the average range resulting in just over a two standard deviation spread of scores on the KBIT-2 for this population.

Consistent with score analysis of the PMT, males and females demonstrated average mean and mean subscale scores on the KBIT-2. Minimum and maximum scores were evenly distributed between the two groups. The impact of educational attainment on the K-BIT-2 performance was also analyzed and findings were significant that the population with less than a high school education had the lowest overall standard scores on the K-BIT-2 with lowest mean score on the KBIT-2 Verbal subscale just within the average range. This education group also had a below average median score on the KBIT-2 Verbal subscale which was the lowest median score performance; however, all other median scores were in the average range. It was noted that mean and median scores for those who had completed high school or obtained a GED and those with education beyond high school had average scores on the KBIT-2 subscales very close to the instrument mean of 100. Standard deviations by education group fairly consistent with the instrument SD across all groups with the exception of those who had not completed high school. This group also had the largest standard deviation of any age group on the KBIT-2 Verbal subscale. Minimum to maximum scores ranging from significantly below average to significantly above average were observed in the population with and without high school education or GED. In contrast, minimum scores were in the average range and maximum scores were all above average for those with education beyond high school.

Standard scores were also analyzed by disability with all mean and median scores within the average range for all disability types except those with mental retardation. Standard deviations were at or near the instrument SD for all disability types other than mental retardation and traumatic brain injury. Minimum and maximum scores were closest to the mean in the orthopedic population and reflected a below average minimum score and above average maximum score. Those with mental illness demonstrated a significant range of scores that ranged from over two standard deviations below average to above average. In contrast, observed minimum scores of the population of individuals with mental retardation were fairly consistent with the lowest minimum score of those with mental illness; however, the maximum scores of the group with mental retardation were significantly lower although in the average range.

Mean and median scores in the population of individuals with non-orthopedic, physical disability reflected average performance on all KBIT-2 subscales. Minimum scores were within one deviation of the average range. Significant findings also included that while this group was not reflective of intellectual related disability they were the lowest group in maximum scores by KBIT-2 by disability analysis with no maximum scores above the average range. Learning disability scores were also observed to have a pattern of average mean and median scores on the KBIT-2. Minimum scores were within a standard deviation of the average range and maximum scores were observed to range from average to significantly above the average range.

It was significant to observe that individuals with vision impairments performed as well as the other disability types on the KBIT-2 subscales except those with mental retardation. They were also the second best overall performing group with only those with learning disability exceeding the scores of those with vision impairment. Minimum scores ranged from just over two standard deviations below average to maximum scores on the KBIT-2 within the average range. In contrast, the population of individuals with traumatic brain injury was observed to have average mean and median scores, but scores revealed a wider variance of scores with the lowest minimum score ranging from over two standard deviations below average to significantly below average. Observations also included that individuals in the population with other types of disability had the third lowest mean and median verbal scores of all the population groups although still within the average range. This group also demonstrated significant variance on the KBIT-2 ranging from well below average minimum scores to above average maximum scores.

Relationship of Independent Variables and the PMT

One-way ANOVAs were selected to explore the relationship of the independent variables and the PMT subscales as instrument subscales scores were continuous variables and the demographic variables were categorical. A P-test value less than 0.05 indicated if significant relationships existed between the independent variables and the PMT subscales. A significant relationship was noted between disability type and Spatial Concept Memory. Age was found to have a significant relationship with Recent Memory and Visual Information Processing. Age was the most frequent factor in significance of demographic variables on PMT scores. Analysis also included the proportion of variation in each PMT subscale score that could be explained by each demographic. Using R-Square calculations, it was noted that disability type explained 17.38% of variance in the Spatial Concept Memory Scores and age explained 10.47% of variance in the Recent Memory Scores and 10.14% variance in the Visual Information Processing scores.

As disability type was a significant predictor for the Spatial Concept Memory Scores and age a significant predictor for the Recent Memory and Information Processing scores, an analysis of where significant differences exist within the disability demographic variables was also completed. This analysis revealed that individuals with learning disability scored significantly higher in Spatial Concept Memory than those with orthopedic disability, mental retardation, traumatic brain injury and those with all other types of disability. It was also observed that individuals with mental illness performed better on the Spatial Concept Memory subscale than those with all other types of disability.

Recent Memory and Visual Information Processing subscales of the PMT were further explored to determine significant differences by age. Analysis revealed that those under age 21 had higher scores on the Recent Memory subscale than those 40 – 49 and 50 – 59. A consistent pattern of performance was noted involving the Visual Information Processing subscale with significantly higher scores for those under 21 than the 40 – 49 age group population.

Relationship of Independent Variables and the KBIT-2

Statistical analysis of the KBIT-2 revealed that education level had a significant impact on all three subscales and that disability type was significant in performance on the KBIT-2 Verbal subscale. Analysis also considered whether there would be significant differences between education level and disability type. It was found that individuals with an educational level less than high school were noted to score significantly lower on all domains of the KBIT-2 than those with a high school diploma or GED or those with education beyond high school. While those with education beyond high school had somewhat higher scores on each of the KBIT-2 subscales, a small sample size impacted the substance of prediction from this observation. Individuals with mental retardation scored significantly below the performance level of individuals with orthopedic, mental illness, learning disability, vision impairment and all other disabilities.

Correlation of the PMT and K-BIT-2 Subscales

A statistically significant correlation was calculated using the Pearson correlation between the PMT and KBIT-2 subscale scores. Through this calculation it was also determined that all the correlations between the PMT subscales and KBIT-2 subscales were positive. These findings indicate that when a score is “high” on a PMT subscale, it is likely that a KBIT-2 subscale will also be “high”. This correlation analysis did not include consideration of the impact of the independent variables of age, gender, level of education or disability type.

Correlation of the PMT and K-BIT-2 Subscales by Independent Variables

Further analysis examined whether there were significant relationships between each of the PMT subscales and the KBIT -2 subscales and the independent variables. A General Linear Model was used for analysis to identify the variables that significantly predicted the PMT subscales. Specific to the PMT Total score, it was noted that the KBIT-2 Verbal scores, KBIT-2 Non-Verbal and the independent variables of age and gender had no impact on the prediction of the PMT Total score. The most significant variable in prediction of the PMT Total score was the KBIT-2 Composite score. Additional significant variables in predicting the PMT Total score were noted to include education level and disability type. The two significant variables in predicting the Spatial Concept Memory subscale were disability type and the KBIT-2 Composite score. Analysis indicated that the most significant variable of prediction was the KBIT-2 Composite score. As in the PMT Total score, the KBIT-2 Verbal and KBIT-2 Non-Verbal subscales scores were found to provide no information in the prediction of Spatial Concept subscale scores.

For the immediate Recall subscale, significant variables were noted to include gender, education level, the KBIT-2 Verbal score and KBIT-2 Non-Verbal score. The most significant variable was found to be the KBIT-2 Verbal subscale. In contrast to the

PMT Total and Spatial Concept Memory subscales, the KBIT-2 Verbal and KBIT-2 Non-Verbal subscales were noted to contribute significantly to the prediction of the Immediate Recall subscale score. Analysis revealed that most significant independent and dependent variables in predicting the Recent Memory subscale scores included age and KBIT-2 Composite score. No significant contribution in the prediction of Recent Memory subscale scores were associated with the KBIT-2 Verbal scores and the KBIT-2 Non-Verbal scores.

Statistical analysis revealed that the KBIT-2 Non-Verbal score, education level and disability type did not significantly impact the prediction of Auditory Information Processing subscale scores. Together age, gender and KBIT-2 Verbal scores were found to have the most impact on the Auditory Information Processing subscale scores of the PMT. In contrast, while age and gender were also significant in the prediction of Visual Information Processing scores, the KBIT-2 Composite subscale scores was found to be the most contributory to this subscale. Significantly, the KBIT-2 Verbal, KBIT-2 Nonverbal, level of education or disability type were found to be contribute significantly to the Visual Information Processing subscale score.

Conclusions

Based on the findings of this research study, the following conclusions were drawn:

1. Detailed analysis of the subscales of the PMT and the KBIT-2 resulted in statistical evidence that the correlation between these two instruments is highly significant. In the correlation of the PMT with the WAIS (1955) by McCarron in 1984, a significant correlation was found to exist between the PMT subscales and WAIS Verbal,

Performance and Full IQ scores supporting the importance of visual and auditory information processes as a substructure of intellectual ability (McCarron, 1984). Initial correlation of the PMT reflected that the Auditory Information Processing subscale score was related to WAIS Verbal IQ scores and a significant relationship. A significant correlation was also noted to exist between Visual Information Processing scores and the WAIS Performance IQ. This study revealed the same pattern of correlation with the Auditory Information Processing subscale and the KBIT-2 Verbal subscale. In contrast, the Visual Information Processing subscale was found to be significantly correlated with the KBIT-2 Composite score. Overall analysis revealed that the KBIT-2 subscales are all related to the PMT subscales with the KBIT-2Verbal and KBIT-2 Composite s being the most significant predictors of PMT subscale scores. While the least frequent in the predictive model, the KBIT-2 Non-Verbal was found to be significant in the prediction of the Immediate Recall subscale.

2. The PMT was designed to measure auditory and visual modalities related to memory, but also to measure organization and encoding strategies to further evaluate individual differences in the recall of information (McCarron, 1984). Individuals with disability are at risk to experience functional limitations that impact their recall of information (Hill, et al, 2010; Getzel et al., 2006; McCarron, 1984b; Schall, et al, 2006; Targett et al., 2006; Wehman, 2006). This study revealed that the PMT subscale most vulnerable to the impact of disability was Recent Memory.

3. Previous studies have observed the impact of gender and level of education on test performance (Kaufman, et al., 2006; Manly, Heaton & Taylor, 2000; Reynolds, Chastain,

Kaufman & McLean, 1987). These variables were not found to be significant in the examination of PMT subscale scores.

4. A relationship between level of education and verbal, performance and overall intelligence test performance with verbal intelligence consistently related most strongly to educational attainment has been noted in previous research (Kaufman, et al., 2009). This research also identified education as the strongest predictor of KBIT-2 Verbal, Non-Verbal and Composite subscale scores.

5. Prior research has purported that more intelligent individuals can attend to more information and more intelligent persons have larger working memory capacity than the less able (Ackerman, 1988; Corno, et al., 2002; Hunt & Lansman, 1982). Results of this research reflected a significant relationship between disability type and PMT Recent Memory, the subscale reliant upon recall of information seen in prior subtests. This subscale reflected the most frequent below average mean and mean scores across disability groups.

6. The incidence of many different types of disabilities and a wide array of resultant functional strengths and limitations has limited norm specific research regarding vocational evaluation instruments (Elliott & Leung, 2004; Parker & Schaller, 1996). This research study revealed extreme variance in test scores obtained by different disability types on the PMT reflective of the extremes of information processing abilities among a population of individuals with disability. The lack of normalcy in distribution highlights the challenge of research involving individuals with disability from a test and measurement perspective. These findings also reinforce the importance of identifying

and understanding unique differences rather than assumptions made from disability classifications.

Discussion and Implications

A significant amount of emphasis is placed on the assessment of individuals as part of the vocational rehabilitation services delivery system in both the public and private sectors (Elliott & Leung, 2004; Hagner, 2010, Shaw, Leahy & Chan, 2000). As individuals with disability vary in functional strengths and limitations, it is important that rehabilitation assessment be individualized to assess individual capacities in the manner that is most appropriate to the individual with disability. Methods of assessment have grown to include not only psychometric assessment options, but also discovery based assessment methods that are not dependent upon test and measurement (Cordon & Callahan, 2008). Rehabilitation practitioners have the ethical obligation to provide rehabilitation assessment in a fair and appropriate manner, as well as in the environment and setting that encourages successful vocational rehabilitation outcomes. The vocational assessment process should also include input into the evaluation process by the evaluee and participation should be a dynamic and informative process.

Understanding the unique information processing capacities of individuals with disability can be critical to providing instruction, job coaching and developing education and training strategies from both a verbal and visual information perspective. The verbal information processing capacities of a potential worker can impact the ability to receive work instructions, interact effectively with co-workers and the public, understand policies and procedure and limitations in this area could potentially impact safety in the workplace. Visual information processing abilities are critical in the workplace to meet work accuracy and productivity expectation and can also impact safety in performing worker functions (Power, 2006; McCarron, 1984). Memory functions allow workers to learn new tasks and remember the order of steps to complete tasks, as well as details of information heard and seen in the workplace (Power, 2006). In the general population, memory functions are mature at approximately 13 years of age (McCarron, 1984). Individuals with limitations in information processing and memory are at greater risk for problems in retaining new information and requiring additional time for learning. In some situations, accommodations for learning problems have to compensate for information and memory limitations in school and employment settings (Dial, et al., 1990, McCarron, 1984). Variability in information processing and learning performance can lead to challenging dynamics in self-understanding for the vocational rehabilitation consumer and vocational rehabilitation planning (Power, 2006). This research has shown the vulnerability of individuals with disability in memory functions, particularly recent memory. While past research has noted the barriers and unlikelihood of disability specific disability instrument norms (Elliott & Leung, 2004; Parker & Schaller, 1996), this research highlights the unique differences in information processing and memory capacities among a population of individuals with disability and the validation of the PMT as an instrument to gain better insight into these individual differences. Research outcomes continue to support the use of the instrument in vocational rehabilitation assessment and planning.

Based upon the results of this research study, the following recommendations are made for future research:

1. McCarron (1984) opined that a relationship exists between memory functioning and rate of learning. Development of educational and vocational rehabilitation strategies that are consistent with an individual's memory capacities has also been endorsed in prior research (Leconte & Rottenbacher, 1997; Taylor, Musgrave & Crimando, 1995) . A research study specific to the PMT and the amount of information individuals are able to retain during testing from individual point scores documented on the Spatial Concept Memory, Visual Design and Auditory – Colors subtests with comparison to academic achievement and intellectual assessment is warranted. Increased understanding of the units or "chunks" of information individuals with disability can process and retain could provide insight into best practice in transition planning, job coaching, and development of educational and vocational training strategies for use with individuals with disabilities.

2. This study examined the variables of gender, education level and type of disability in relation to the PMT. Additional research is warranted with the PMT to include additional variables such as use and type of medications, degree of chronic pain symptoms, pre-testing self-report of anxiety or problems attending and concentrating, pre-testing report of learning preferences, length of time out of the workforce and documented secondary diagnoses (anxiety, depression, learning disability, etc.) that could contribute to test performance (Constantinidou & Baker, 2002; Nikendei, Waldherr, Schiltenwolf, Herzog, Rohrig, Walther, Weisbrod, Henningsen, & Hanel, 2009). Prior research has indicated that people follow their strengths (Buckingham, 2007). The variables of hobbies, use of

technology, expressed vocational interests, as well as past employment history would also provide interesting perspectives for future research.

3. Over half of the participants in this study were below age 21 and had not completed high school or a GED reinforcing the frequency that vocational rehabilitation assessment is provided to students preparing to transition from high school. Transition from school to work is a significant juncture for any student, however, students with disability experience a loss of supports and assistance that can be challenging if not impossible to replicate after existing high school (Wehman, 2006). Understanding of individual difference in learning capacity not only supports effective educational planning, but also vocational rehabilitation planning (Leconte & Rottenbacher, 1997; Taylor, Musgrave & Crimando, 1995). Additional research is warranted in the use of the PMT to support individualized transition planning and would add to the existing body of empirical research focused upon understanding the importance of student individual differences educationally, as well as in vocational rehabilitation planning. This research would also support increased use of evidence based practice in the provision of vocational rehabilitation services (Barker, Kazukauskas & Bernacchio, 2008).

4. The groups of individuals included in this study ranging in age from 30 - 59 were potentially reflective of individuals displaced from work with disability due to the economic downturn, unemployed due to a chronic health condition or injury and individuals experiencing aging with disability who are unable to maintain their employment status. This age group could have feasibly also included soldiers returning from war with disability. The impact of chronic pain and medication use and cognitive implications of displaced workers would be an interesting topic and worthy to research

related to the public and private sectors, as well as provide increased understanding of the implication of aging with disability and further understand the vocational implications of chronic pain (Constantinidou & Baker, 2002; Nikendei, Waldherr, Schiltenwolf, Herzog, Rohrig, Walther, Weisbrod, Henningsen, & Hanel, 2009).

The following recommendations for practice are made based upon the findings of this research study:

1. It was opined by McCarron (1984) that individuals with limitations in information processing are at risk to require information provided in smaller units or "chunks" of information and potentially require re-teaching of tasks previously acquired. Additionally, it was noted that those who perform well in measures of information processing may be advanced learners. Memory and learning rate has also been noted in prior research to support educational and vocational rehabilitation planning (Leconte & Rottenbacher, 1997; Taylor, Musgrave & Crimando, 1995). This research study reinforces the need to consider individual differences and the importance of not assuming capabilities or lack of capabilities due to diagnostic classifications.

2. The world of work has changed drastically since emergence of the post-World War II industrial era in the United States and the impact of technology has drastically changed the way work is performed and the demands of workers (Gunderson, Jones, & Scanland, 2005; Judy & D'Amico, 1997; Kincheloe, 1999). Technology can provide accommodations for individuals with disability not imagined twenty years ago and it is important that vocational rehabilitation practitioners understand the unique demands of current and emerging occupations to maximize employment success for individuals with disability (Barzegarian, 2011). It is recommended that along with measuring worker traits such as

those associated with information processing and intellectual abilities that job analysis and task analysis be utilized to identify the essential functions of unique positions and critical steps of task completion to better plan job placement activities and the development of job coaching and instructional strategies in keeping with the information processing and memory capacities of the individual being provided services (Leconte & Rottenbacher, 1997; Taylor, Musgrave & Crimando, 1995) .

3. The use of assistive technology (AT) provides additional opportunities for individuals with disability to experience vocational success (Barzegarian, 2011; Gamble, Dowler & Orslene, 2006; Powers, 2006). Additional focus on the use of AT in the vocational rehabilitation service delivery process has also been supported in past research (Barzegarian, 2011). An understanding of unique individual differences in information processing and intellectual abilities should be considered in vocational assessment and use of assistive technology considered as part of planning vocational rehabilitation services.

4. As vocational assessment activities take place in a controlled setting in keeping with test and measurement procedures, the opportunity to evaluate individuals in real work and community based settings should be incorporated in best practice whenever possible. Creative opportunities exist for the provision of vocational evaluation services (Cordon & Callahan, 2008; Hagner, 2010) that can incorporate test and measurement, as appropriate, as well as community based assessment allowing real work experience and situational assessment.

5. Vocational rehabilitation counseling is a part of the vocational rehabilitation process (Elliott & Leung, 2004). It is encouraged that the review of any type of assessment

findings completed as part of vocational rehabilitation assessment be an engaging activity for the individual with disability to promote self-awareness, self-advocacy and self-determination in achieving personal and vocational goals.

REFERENCES

Ackerman, P. L. (1988). Determinants of individual differences during skills acquisition: Cognitive abilities and information processing. *Journal of Experimental Psychology:General.* 117, 284-318.

Atkinson, R.C. & Shiffrin, R.M. (1968). Human memory: A proposed system and its control processes. In Spence, K.W. & Spence, J.T. (Eds.), *The psychology of learning and motivation* (Vol. 2) (pp. 89–195). New York, NY: Academic Press.

American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (1999). *Standards for educational and psychological testing.* Washington, DC: American Educational Research Association.

Anastasi, A. & Urbina, S. (1997). *Psychological Testing* (7th ed.). Upper Saddle, NJ: Prentice-Hall.

Baddeley, A.D. (1996). Exploring the central executive. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology.* 49, 5-28.

Bain, S.K. & Jaspers, K.E. (2010). Review of the Kaufman Brief Intelligence Test, Second Edition. *Journal of Psychoeducational Assessment.* 28(2), 167-174.

Barker, E. J, Kazukauskas, K. & Bernacchio, C. (2008, November). Ethics in vocational rehabilitation: The need for evidence-based practice. Paper session presented at the NCRE/CSAVR/RSA Annual Conference, San Diego, CA.

Barzegarian, B. (2011, November). Rehabilitation professional's role in identifying assistive technology solutions. In M. M. Weiss (Chair.), Paper session presented at the International Association of Rehabilitation Professional Forensic Conference, Las Vegas, NV.

Binet, A. (1916). New methods for the diagnosis of the intellectual level of subnormals. *L'Année Psychologique, 12*, 191-244.

Blackmore, T., McCray, P. & Coker, C. (1984). *A guide to learning style assessment*. Menomonie, WI: Vocational Rehabilitation Institute, University of Wisconsin-Stout.

Box, G. E. & Cox, D. R. (1964). An Analysis of Transformation. *Journal of the Royal Statistical Society*, 26(2), p. 211-252.

Bower, G. H. (1970) Imagery as a relational organizer in associative learning. *Journal of Verbal Learning and Verbal Behavior*, 9, 529-533.

Buckingham, M. (2007). *Go put your strengths to work. Six powerful step to achieve outstanding performance.* New York, NY: Simon & Shuster.

Camara, W. J. & Lane, S. (2006). A historical perspective and current view on the Standards for Educational and Psychological Testing. *Educational Measurement: Issues and Practice*, 25(3), 35-45.

Cherniss, C., Extein, M., Goleman, D. & Weissberg, R. P. (2006). Emotional intelligence: What does the research really indicate?. *Educational Psychologist.* 41, 239-245.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*¸155-159.

Cohen, R.J., Swerdik, M.E. & Phillips, S.M. (1996). *Psychological testing and assessment: An introduction to tests and measurement.* (3rd ed.). Mountain View, CA: Mayfield.

Commission for the Accreditation of Rehabilitation Facilities (2011). *Employment and community services program.* CARF International: Tucson, AZ.

Commission on Rehabilitation Counselor Certification. (2009). *CVE/CWA/CCAA code of ethics.* Commission on Rehabilitation Counselor Certification: Schaumburg, IL.

Commission on Rehabilitation Counselor Certification (2009) *Professional ethics for rehabilitation counselors.* Commission on Rehabilitation Counselor Certification: Schaumburg, IL.

Condon, E. & Callahan, M. (2008). Individual career planning for students with significant support needs utilizing the discovery and vocational profile process, cross-agency collaborative funding and social security work incentives. *Journal of Vocational Rehabilitation*. 28, 85-96.

Corno, L., Cronbach, L.J., Kupermintz, H., Lohman, D.F., Mandianch, E.B., Porteus, A.W. & Talbert, J.E. (2002). *Remaking the concept of aptitude: Extending the legacy of Richard E.Snow.* Mahwah, NJ: Lawrence Erlbaum Associates.

Cronbach, L. J. (1970). *Essentials of psychological testing.* (3rd ed.). New York, NY: Harper & Row.

Cronbach, L. J. (1989). Construct validity after thirty years. In R. L. Linne (Eds.) *Intelligence: Measurement, theory, and public policy.* (pp. 147-171). Urbana, IL: University of Illinois Press.

Cronbach, L. J. & Meehl, P.E. (1955). Construct validity in psychological tests. *Psychological Bulletin*, 52, 282-302.

D'Ambra, A. D. & Sarnacchiaro, P. (2010). Some data reduction methods to analyze the dependence with highly collinear variables: A simulation study. *Asian Journal of Mathematics and Statistics*, 3, 69-81.

Daneman, M. & Carpenter, P.A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior*, 19, 450-466.

Dial, J. G., Chan, F. & Norton, C. (1990). Neuropsychological assessment of brain damage. Discriminative validity of the McCarron-Dial System. *Brain Injury*, 4(3), 239 – 246.

Dowd, L. (Ed.) (1993). VEWAA glossary of terminology for vocational assessment, evaluation and work adjustment. Menomonie, WI: Materials Development Center, University of Wisconsin-Stout.

Dunn, R. (1990). Rita Dunn answers questions on learning styles. *Educational Leadership*, 48, 15-19.

Dunn, L. M. & Dunn, L.M. (1997). *Peabody Picture Vocabulary Test – Third Edition.* Circle Pines, MN: American Guidance Service.

Dunn, R., Dunn, K. & Price, G. (1979) *Learning Style Inventory Manual*. Lawrence, KS: Price Systems.

Dunn, R. & Stevenson, J. M. (1997). Teaching diverse college students to study with a learning styles prescription. *College Student Journal*, 31(3), 333-339.

Elliott, T. R. & Leung, P. (2004). Vocational rehabilitation: History and practice. In W. Walsh & M. L. Savickas (Eds.), *Handbook of vocational psychology: Theory, research, and practice* (3rd ed.), (pp. 319-343). Mahwah, NJ: Erlbaum Associates.

Evans, N. J., Forney, D. S., & Guido-DiBrito, F. (1998). *Student development in college: Theory, research, and practice*. San Francisco, CA: Jossey-Bass.

Farmer, E. I. & Rojewski, J.W. (Ed.). (2001). *Research pathways. Writing professional papers, theses, and dissertation in workforce education.* Lanham, MD: University Press of America.

Ferrara, S. (2006). Educational measurement: Issues and practice. *National Council on Measurement in Education*, 25(4), 1-75.

Fishman, J.A. & Galguera, T. (2003). *Introduction to test construction in the social and behavioral sciences. A practical guide.* Lanham, MD: Rowman & Littlefield Publishers.

Fitzgerald, S, Rumrill, P. D. & Schenker, J. D. (2004). Correlational designs in rehabilitation research. *Journal of Vocational Rehabilitation,* 20(2), 143-150.

Fofi, C. & Baker, S. (2002). Stimulus modality and verbal learning performance in normal aging. *Brain & Language,* 82 (2002), 296-311.

Fox, J. (1997) *Applied regression analysis, linear models, and related methods.* Thousand Oaks, CA: Sage Publications.

Friedenberg, L. (1985). *Psychological testing. Design, analysis and use.* Needham Heights, MA: Simon & Schuster.

Gall, M.D., Gall, J. P., & Borg, W.R. (2007). *Educational research: An introduction.* Boston, MA: Allyn & Bacon.

Gamble, M. J., Dowler, D.L. & Orslene, L.E. (2006). Choosing the right tool for the right job. *Journal of Vocational Rehabilitation.* 24(2), 73-80.

Gardner, H. (1983). *Frames of Mind: The theory of multiple intelligences.* New York, NY: Basic Books.

Garner, I. (2000). Problems and inconsistencies with Kolb's learning styles. *Educational Psychology*, 20(3), 341-348.

Geiger, J.M., Musgrave, J.R., Welshimer, K.J. & Janikowski, T.P. (1995). The relationship between the perceptual memory task scores on driver's licensing status among persons with cognitive disabilities. *Vocational Evaluation and Work Adjustment Bulletin*, 28(4), 99-104.

Gelber, S. (2005). A "hard-boiled order": The reeducation of disabled WWI veterans in New York City. *Journal of Social History*, 39(1), 161-180.

Georgia Department of Labor (2011). *Directory of Vocational Rehabilitation Offices*. Georgia Department of Labor: Atlanta, GA.

Gershon, R. C. (1988). *Index of words in the Johnson O'Connor Research Foundation, Inc., vocabulary item bank.* Johnson O'Connor Research Foundation Human Engineering Laboratory.

Getzel, E.E., Gugerty, J. J. & McManus, S. (2006). Applications for youth with learning disabilities. In P. Wehman (Ed.). *Life beyond the classroom: Transition strategies for young people with disabilities.* Baltimore, MD: Paul H. Brookes.

Gottfredson, L. S. (1998). The general intelligence factor. *Scientific American.* 4, 24-29.

Greenwald, A. G., Pratkanis, A. R., Leippe, M.R. & Baumgardner, M. H. (1996). Under what conditions does theory obstruct research progress? *Psychological Review*, 93, 216-229.

Gregory, R. J. (2007). *Psychological Testing. History principles and applications* (5^{th} Ed.). Boston, MA: Allyn & Bacon.

Gunderson, S, Jones, R. & Scanland, K. (2005). *The jobs revolution: Changing how America works.* Chicago, IL: Copwriters Incorporated.

Hagner, D. (2010). The role of naturalistic assessment in vocational rehabilitation. *Journal of Rehabilitation,* 76(1), 28-34.

Harris, A.J. & Jacobson, M.D. (1982). *Basic Reading Vocabularies.* New York, NY:Macmillan.

Hayward, B. J. & Schmidt-Davis, H. (2003). Longitudinal study of the vocational rehabilitation services program. Final report 2: VR services and outcomes. RTI International: Chapel Hill, NC

Hayward, B. J. & Tashjian, M. D. (1996). Longitudinal study of the vocational rehabilitation service program. Second interim report: Characteristics and perspectives of vocational rehabilitation consumers. RTI International: Chapel Hill, NC.

Hershenson, D. (1988). Along for the ride: The evolution of rehabilitation counselor education. *Rehabilitation Counselor Bulletin*, 31, 204-217.

Hill, B. D., Elliott, E.M., Shelton, J.T., Pella, R.D., O'Jile, J.R. & Gouvier, W. D. (2010). Can we improve the clinical assessment of working memory? An evaluation of the Wechsler Adult Intelligence Scale – Third Edition using a working memory criterion construct. *Journal of Clinical & Experimental Neuropsychology.* 32(3), 315-323.

Hoffman, P.R. (1971). History of the vocational evaluation and work adjustment association. *Vocational Evaluation and Work Adjustment Bulletin.* 4(3), 6-16.

Huberty, C.J. (2003). Multiple correlation versus multiple regression. *Educational and Psychological Measurement.* 63, 271-278

Hunt, E. & Lansman, M. (1982). Unified model of attention and problem solving. *Psychological Review.* 93, 446-461.

Jaccard, J. & Becker, M.A. (2002). *Statistics for the Behavioral Sciences* (4th Ed.). Belmont, California: Wadsworth/Thomson Learning.

Janikowski, T. P., Bordieri, J. & Musgrave, J. (1995). Construct validity of the perceptual memory task's behavioral trait scores. *Vocational Evaluation and Work Adjustment Bulletin,* 28(2), 38-42.

Janikowski, T. P., Bordieri, J. & Musgrave, J. (1992). The impact of vocational evaluation on client self-estimated aptitudes. *Rehabilitation Counseling Bulletin.* 36(2), 70-83.

Jenkins, W. H., Patterson, J. B., & Szymanski, E.M. (1997). Philosophical, historical, and legislative aspects of the rehabilitation counseling profession. In R. M. Parker & E.M. Szymanski (Eds.), *Rehabilitation counseling: Basics and beyond,* (pp. 1-31). Austin, TX: Pro-Ed.

Jenson, A. R. (1993). Test validity: g versus "tacit knowledge". *Current Directions in Psychological Science,* 2(1), 9-10.

Johnson D. W. & Johnson, F. P. (2000). *Joining together: Group theory and group skills* (7th ed.). Boston, MA: Allyn and Bacon.

Joynson, R. B. (1989). *The Burt affair.* London, England: Routledge.

Judy, R.W., & D'Amico, C. (1997). *Workforce 2020: Work and workers in the 21st century*. Indianapolis, IN: Hudson Institute.

Kapplan, R. M. & Saccuzzo, D. P. (2005). *Psychological testing: Principles, applications, and issues.* Belmont, CA: Thomson Wadsworth.

Kaufman, A.S. & Kaufman, N. L. (2004). *Kaufman brief intelligence test – 2 test manual.* Circle Pines, MN: American Guidance Services.

Kaufman, A. S. & Kaufman, N. L. (1997). *Kaufman brief intelligence test.* Minneapolis, MN: NCS Pearson.

Kaufman, A.S., Kaufman, N.L, Liu, X. & Johnson, C.K. (2009). How do educational attainment and gender relate to fluid intelligence, crystallized intelligence, and academic skills at 22- 90 years? *Archives of Clinical Neuropsychology,* 24, 153-163.

Kaufman, A. S., Kaufman, N.L. & Shaughnessy, M. F. (2007). An interview with Alan and Nadeen Kaufman. *North American Journal of Psychology,* 9(3), 611-626.

Keefe, J. W. (1982). Assessing student learning styles: An overview. *Student Learning Styles and Brain Behavior,* (pp.43-53). Reston, VA: National Association of Secondary School Principals.

Keppel, G., & Wickens, T. D. (2004). *Design and analysis: A researcher's handbook* (4th ed.). Upper Saddle River, NJ: Pearson.

Kerlinger, F., & Lee, H. *Foundations of behavioral research.* (4th ed.). New York, NY: Hartcourt College.

Kincheloe, J.L. (1999). *How do we tell the workers? The socioeconomic foundations of work and vocational education.* Boulder, CO: Westview Press.

Kolb, D, A, (1985). *Learning styles inventory.* Boston: McBer.

Kolb, D. A. (1984). *Experimental learning.* Englewood Cliffs, NJ: Prentice-Hall.

Kolb, D. A. (1979). *Learning styles inventory: Technical Manual.* Boston,MA: McBer and Company.

Kyllonen, P. C.& Christal, R. E. (1990). Reasoning ability if (little more than) working memory capacity? *Intelligence.* 14, 389-433.

Leconte P. J. & Rothenbacher, C. A. (1997). Cognitive and learning styles in vocational assessment: Important Practice. *The Issues Papers*. (pp. 159-167). Menomonie: WI: Materials Development Center, University of Wisconsin – Stout.

Lerner, J. (2006). *Learning disabilities and related disorders* (10th ed.). Boston, MA: Houghton Mifflin.

Lohman, D. F. & Rocklin, T. (1995). Current and recurring issues in the assessment of intelligence and personality. In H.D. Saklofske & M. Zeidner (Eds.). *International handbook of personality and intelligence.* (pp. 447-474). New York, NY: Plenum.

Lowman, R. L. & Williams, R.E. (1997). Validity of self-rating of abilities and competencies. *Journal of Vocational Behavior.* 31, 1-13.

Luria, A. (1976). *The neuropsychology of memory.* New York, NY: V.H. Winston & Sons.

Manley, J.J., Heaton, R.K. & Taylor, M.J. (2000). The effects of demographic variables and the development of demographically adjusted norms for the WAIS-III and WMS-III. In D.S. Tulsky & D. Saklofske (Chairs). *The clinical interpretation of the WAIS-III and the WMS-III: New research findings.* Symposium presented at the meeting of the American Psychological Association, Washington, D.C.

O'Neill, R. & Wetherill, G. B. The Present State of Multiple Comparison Methods. *Journal of the Royal Statistics*, 33(2), 218-250.

McCarron, L. T. (1984a). Assessment of individual learning style: The Perceptual Memory Task. *Vocational Evaluation and Work Adjustment Bulletin,* 17(2), 52-58.

McCarron, L. T. (1984b). *Assessment of Individual Learning Style: The Perceptual Memory Task.* Dallas, TX: Common Market Press.

Martin, E. D., Jr. & Gandy, G. L. (1999). The development of the rehabilitation enterprise in America: A recent history of the rehabilitation movement in the United States. In G. Gandy & E. D. Martin (Eds.), *Counseling in the rehabilitation process: Community service for mental and physical disabilities* (2nd ed.), pp. 75-103. Springfield, IL: Thomas Publishing.

Mayer, R. E. & Massa, L. J. (2003). Three facets of visual and verbal learners: Cognitive ability, cognitive style, and learning preference. *Journal of Educational Psychology*, 95(4), 833-846.

Mayer, R. E. (2009). Advances and applying the science of learning and instruction to education. *Psychological Science in the Public Interest.* 9(3).

Messick, S. (1989). Validity. In R. L. Linn (Ed.), *Educational measurement* (3rd ed., pp. 13–103). Washington, DC: American Council on Education-Macmillan.

Messick, S. (1994). The matter of style: Manifestations of personality in cognition, learning, and teaching. *Educational Psychologist.* 29(3), 121-136.

Moore, D. S. (2007). *The basic practice of statistics.* (4th Edition). New York, NY: W. H. Freeman and Company.

Murray, R. & Herrnstein, C. *The bell curve: Intelligence and class structure in American life.* New York, NY: Simon & Schuster.

Musgrave, J., Flowers, C. and Shelton, D. (1990). Vocational evaluation, work adjustment, and supported employment: Complementary services. *Vocational Evaluation and Work Adjustment Bulletin*, 23(1), 5-9.

Neisser, U., Boodoo, G., Brouchard, T. J., Boykin, A.W., Brody, N., Ceci, S. J., Halpern, D. F., Loehlin, J.C., Perloff, R., Sternberg, R. J. & Urbina, S. (1996). Intelligence: knowns and unknowns. *American Psychologist.* 51(2), 77-101.

Nikendei, C., Waldherr, S., Schiltenwolf, M., Herzog, W., Rohrig, M., Walther, S. Weisbord, M., Henningsen, P. & Hanel, G. (2009). Memory performance related to organic and psychosocial Illness attributions in somatoform pain disorder patients. *Journal of Psychomatic Research,* 67 (2009) 199-206

Obermann, C. E. (1980). *A history of vocational rehabilitation in America.* (2nd Edition). New York, NY: Arno Press.

Olejnik, S. (1984). Planning educational research: Determining the necessary sample size. *Journal of Experimental Education,* 53, 40-48.

Onwuegbuzie, A. J. & Daniel, L. T. (2003). Typology of analytical and interpretational errors in quantitative and qualitative educational research. *Current Issues in Education*, 6(2), 1-4.

Ormrod, J.E. (2008). Educational psychology, Developing learners. Upper Saddle River, NJ: Pearson Prentice Hall.

Osborne, J. W. (2010). Improving your data transformations: Applying the Box-Cox transformation. *Practical Assessment, Research & Evaluation.* 15(12).

Parker, R. M. & Schaller, J. (1994). Relationships among self-rated and psychometrically determined vocational aptitudes and interests. *Educational and Psychological Measurement*, 54(1), 155-159.

Pashler, H., McDaniel, M., Rohrer, D. & Bijork, R. (1999). Assessing learning style concepts and evidence. *Psychological Science in the Public Interest.* 9(3).

Pedhazer, E. & Schmelkin, L., (1991). *Measurement, design, and analysis: An integrated approach.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Pelka, F. (1997). The disability rights and independent living movement timeline. Retrieved from http://bancroft.berkeley.edu/collections/drilm/resources/timeline.html.

Pellegrino, J. W. & Glaser, R. (1980). Components of inductive reasoning. In R. Snow, P.A. Frederico & W.F. Montague (Eds.). *Aptitude, learning and instruction: Vol.1. Cognitive process analysis of aptitude.* (pp. 177-217). Hillsdale, NJ: Lawrence Erlbaum Associates.

Persico, J.E. (2008). *Franklin and Lucy.* (pp. 168-169). New York, NY: Random House.

Peterson, D. B. & Aguiar, L. (2004). History and systems: United States. In T.R. Riggar & D.R. Maki (Eds.) (pp.50-75). *The handbook of rehabilitation counseling.* New York, NY: Springer.

Power, P.W. (2006). *A guide to vocational assessment.* (4th Ed.). Austin, TX: Pro-Ed.

Power, P.W. (1996). *A guide to vocational assessment.* (3rd Ed.). Austin, TX: Pro-Ed.

Prachyl, P. (1998). Consumer self-estimated vocational aptitudes and interest. *Vocational Evaluation and Work Adjustment Bulletin*, 3, 44-49.

Pruitt, W.A. (1986). *Vocational Evaluation* (2nd ed.). Menomonie, WI: Walt Pruitt and Associates.

Rauscher, F. H. & Hinton, S.C. (2006). The Mozart effect: Music listening is not music instruction. *Educational Psychologist*, 41, 233-238.

Raven, J. (1981). *Manual for Raven's Progressive Matrices and Vocabulary Scales. Research Supplement No.1: The 1979 British Standardisation of the Standard Progressive Matrices and Mill Hill Vocabulary Scales, Together With Comparative Data From Earlier Studies in the UK, US, Canada, Germany and Ireland.* San Antonio, TX: Harcourt Assessment.

Reed, B. J. (1996). Assessment of preferred learning styles: Self-report versus performance based approach. *Vocational and Work Adjustment Bulletin*, 1, 119-124.

Rehabilitation Act, 29 U.S.C. § 701 (1973).

Rehabilitation Act, 64 U.S.C. § 300.347 (1998).

Reynolds, C.R., Chastain, R.L., Kaufman, A.S., & McLean, J.E. (1987). Demographic characteristics and IQ among adults: Analysis of the WAIS-R standardization samples as a function of the stratification variables. *Journal of School Psychology*, 25, 323-342.

Rodgers, J. L.& Nicewander, W. A. (1988). Thirteen ways to look at the correlation coefficient. *The American Statistician*, 42(1), 59-66.

Rubin, S. E. & Roessler, R. T. (2001). *Foundations of the vocational rehabilitation process* (5th ed.). Austin, TX: Pro-Ed.

Rusalem, H. (1976). *Coping With the Unseen Environment: An Introduction to the Vocational Rehabilitation of Blind Persons.* New York, NY: Teachers College Press.

Sakia, R.M. (1992). The Box-Cox transformation technique: A review. *The Statistician. 41, 169-178.*

Schall, C., Cortijo-Doval, E., Targett, P.S., & Wehman, P. (2006). Applications for youth with Autism spectrum disorders. In P. Wehman (Ed.), *Life beyond the classroom: Transition strategies for young people with disabilities*, (4th ed.), (535-575). Baltimore,MD: Paul H. Brookes Publishing.

Scheffler, I. (1985). *Of Human Potential*. London, England: Routledge and Kegan Paul.

Schmidt, F. L. & Hunter, J. E. (1993). Tacit knowledge, practical intelligence, general mental ability and job knowledge. *Current Directions in Psychological Science,* 2(1), 8-9.

Shannon, P. (1995). Review of the bell curve wars: Race, intelligence and the future of America. *Green Left Weekly.* Retrieved from http://www.hartford-hwp.com/archives/45/025.html.

Shaw, L. R., Leahy, M. & Chan, E. (2000). Case management: Past, present, and future. In F. Chan and M. Leahy (Eds.). (pp. 39-59). *Health care and disability management,* Lake Zurich, IL: Vocational Consultants Press.

Sink, J. M., Field, T. F. & Gannaway, T. W. (1978). History and scope of adjustment services in rehabilitation. *Journal of Rehabilitation,* 1, 16-19.

Smith, R. M. (1982). *Learning how to learn: Applied theory for adults.* Chicago, IL:Follett.

Snow, R.E. (1981). Aptitude and achievement. In W. B. Schrader (Ed.), *Measuring achievement: Progress over a decade. Proceedings of the 1979 ETS Invitational Conference.* San Francisco: Jossey-Bass.

Snow, R. E. (1992). Aptitude theory: Yesterday, today, and tomorrow. *Educational Psychologist,* 27, 5-22.

Snow, R.E. (1996). Aptitude development and education. *Psychology, Public Policy and Law*, 2, 536-560.

Spearman, C. (1927). General intelligence: Objectively determined and measured. *American Journal of Psychology*, 15(2), 201-293.

Spitznagel, R.J. (1995). The vocational evaluation and work adjustment association. *Journal of Rehabilitation Counseling*, 61(4), 54-57.

Sternberg, R. J. (1977). *Intelligence, information processing, and analogical reasoning: The componential analysis of human abilities.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Sternberg, R. J. (1985). *Beyond IQ: A triarchic theory of human intelligence.* New York: Cambridge University Press.

Swinderen, B.V., McCartney, A., Kaufman, S., Flores, K., Agrawal, K., Wagner, J. & Paulk, A. (2009). Shared visual attention and memory systems in the drosophila brain. *PLoSONE,* 4(6). doi:10.1371/journal.pone.0005989.

Targett, P. S., Yasuda, S. & Wehman, P. (2006). Applications for Youth with Traumatic Brain Injury. In P. Wehman (Ed.). *Life beyond the classroom: Transition strategies for young people with disabilities.* Baltimore, MD: Paul H. Brookes.

Taylor, K., Musgrave, J. & Crimando, W. (1995). A comparison of the perceptual memory task and memory assessment scales. *Vocational and Work Adjustment Bulletin*, 1, 105-108.

Thompson, B., Diamond, K.E., McWilliams, R., Snyder, P. & Snyder, S. W. (2005). Evaluating the quality of evidence from correlational research for evidence-based practice. *Exceptional children,* 71(2), 181-194.

Thorndike, R. L. & Hagen, E. P. (1977). *Measurement and Evaluation in Psychology and Education* (4th Ed.). New York: John Wiley & Sons.

Thurstone, L. L. (1938). *Primary mental abilities.* Chicago, IL: University of Chicago Press.

University of Georgia, Institutional Review Board. (2011). http://ovpr.uga.edu/hso/guidelines.

Vail, P. (1992). *Learning Styles.* Rosemont, NJ: Modern Learning Press.

Waterhouse, L. (2006). Inadequate evidence for multiple intelligences, Mozart effect, and emotional intelligence theories. *Educational Psychologist,* 41, (4), 247-255.

Webster, R.E. (1992). *Learning Efficiency Test,1992 Revision Manual.* Novato, CA: Academic Therapy Publications.

Wechsler, D. (1944). *The measurement of adult intelligence* (3rd ed.). Baltimore, MD: Williams & Wilkins.

Wechsler, D. (1955). *Wechsler Adult Intelligence Scale.* New York: Psychological Corporation.

Wehman, P. (2006). *Life beyond the classroom: Transition strategies for young people with disabilities* (4^{th} ed.). Baltimore, MD: Paul Brookes Publishing.