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Procedia - Social and Behavioral Sciences 47 (2012) 665 – 673

Procedia
Social and Behavioral Sciences

CY-ICER 2012

The use of Woodcock-Johnson tests for identifying students with special needs-a comprehensive literature review

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Abstract

The **Woodcock-Johnson Tests (WJ III)** is a valid and reliable assessment tool of both cognitive abilities and achievement among children and adults. It is based on the most current theoretical model of intelligence, Cattell-Horn-Carroll (CHC) theory. The broad CHC abilities measured on one or more of the WJ Tests are: Long-Term Retrieval (*Glr*), Auditory Processing (*Ga*), Fluid Reasoning (*Gf*), Processing Speed (*Gs*), Short-Term Memory (*Gsm*), Visual-Spatial Thinking (*Gv*), Comprehension-Knowledge (*Gc*), Reading-Writing (*Grw*), and Quantitative Knowledge (*Gq*). The **WJ III** proves to be a valuable diagnostic tool to be used to identify exceptional children including high incidence disabilities like head injury, Attention Deficit and Hyperactivity Disorder ADHD; low incidence disabilities such as visual impairment and autism; and gifted students including those with a learning disability. Higher education students have benefit from **WJ III** tests as well.

Keywords: WJ III Tests, CHC Theory, Cognitive and Achievemnt Tests, and Students with Special Needs

1. Introduction

The main aims of most intelligence and achievement tests are to determine the intellectual and academic levels of students, particularly exceptional students who are far behind or far ahead of classmates. Examples of these exceptionalities are learning disability, mild intellectual disability, hearing impairment, and giftedness. The idea of a complete battery of **WJ Tests** was developed more fully as part of Woodcock's neuropsychology postdoctoral research at the Tuft's New England Medical Center in 1974–1975. At Tuft's, Woodcock's plan was to use scientific-empirical methodology to construct a set of tests that would tap many different aspects of cognitive functioning defined by extant cognitive and neuroscience research (R. W. Woodcock, personal communication, June 20, 2008). The first edition of the WJ was published in 1977, the revised edition in 1989, the third edition in 2000, and the normative update in 2007.

The Woodcock-Johnson III Tests (WJ III) is one of the most widely used tools across the world because of its distinguished features. First, the additional tests, clusters, and interpretive procedures have strengthened and increased the instrument's diagnostic capabilities. It is intended for use in educational, clinical, and research settings

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1877-0428 doi:10.1016/j.sbspro.2012.06.714

(Mather & Woodcock, 2001). Second, the WJ III consists of two distinct, co-normed batteries: WJ III Tests of Cognitive Abilities (WJ III COG) and the WJ III Tests of Achievement (WJ III ACH). Together they provide a comprehensive system for measuring general intellectual ability (*g*), specific cognitive abilities, scholastic aptitude, oral language, and achievement. Accordingly, the WJ III batteries were designed to provide the most valid methods for determining patterns of strengths and weaknesses based on actual discrepancy norms (Mather & Schrank, 2001). Third, the norms for the WJ III COG and WJ III ACH are based on data from the same sample of subjects. This feature allows direct comparisons among and within a subject's scores that provides a degree of accuracy not possible when comparing scores from separately normed tests (Mather & Woodcock, 2001). Fourth, although the number correct are scored by hand, all other scores are obtained by using the Compuscore (*r*) and Profiles software program (Schrank & Woodcock, 2007a).

Recent advances in current theory and research on the structure of human cognitive abilities have resulted in a new empirically derived model commonly referred to as the *Cattell-Horn-Carroll Theory* (CHC theory) (Carroll, 1993; Cattell, 1941; & Horn 1965). The CHC theory of cognitive abilities is identified by researchers as one of the most validated models of cognitive abilities (Alfonso, Flanagan, & Radwan, 2005; Flanagan & Ortiz, 2001; McGrew, 2005; McGrew & Flanagan,1998; McGrew & Woodcock, 2001). CHC theory is grounded in a body of historical analytic research, as well as developmental studies of cognitive abilities, neurocognitive analyses, and research on genetic heredity research to substantiate its validity (Horn & Noll, 1997). The WJ III was aligned with a stratified model of intellectual abilities defined and refined by Cattell, Horn, and Carroll (Flanagan & Harrison, 2005). The fundamental criteria for developing cognitive abilities in the WJ III were derived from the Cattell-Horn-Carroll (CHC) theory of cognitive abilities as described in the WJ III COG examiner's manual (Mather & Woodcock, 2001). CHC Theory is a three level model of human cognitive abilities that includes general intelligence (*g*), nine broad cognitive abilities, and more than 100 narrow cognitive abilities (McGrew & Flanagan, 1998). The broad CHC abilities measured by the WJ III are: Long-Term Retrieval (*Glr*), Auditory Processing (*Ga*), Fluid Reasoning (*Gf*), Processing Speed (*Gs*), Short-Term Memory (*Gsm*), Visual-Spatial Thinking (*Gv*), Comprehension-Knowledge (*Gc*), Reading-Writing (*Grw*), and Quantitative Knowledge (*Gq*) (see Table 1 for definitions).

The **WJ III** literature review is organized into six parts. Part one focuses on validity and reliability studies. Part two presents the use of **WJ III Tests** with high incidence disabilities that includes head injury, Attention and Deficit Hyperactivity Disorder (ADHD), language impairment, mild intellectual disability, specific reading, math, and written language disabilities. Part three reviews the use of **WJ III Tests** with low incidence disabilities such as; hearing impairment, visual impairment, and autism. Part four addresses the use of **WJ III Tests** with gifted students including gifted students with a learning disability. Part five explains the use of the WJ for higher education students. Part six reviews the international use of WJ.

2. Validity and Reliability Studies of WJ III

Timothy and Donald (2003), in the Eighteenth Mental Measurements Yearbook, reviewed the WJ III reliability and validity. They explained that reliability data of WJ III were generated using two primary means: Split-half reliabilities were calculated by age for eight of the subscales, whereas the reliability estimates for three subscales were calculated (also by age) using the Rasch analysis procedures. Split-half reliability coefficients for the eight subscales were in the acceptable range of .80 or above (five were >.90), and the Rasch procedures suggested acceptable reliability for the three subscales. The reliability of 15 defined clusters was also examined, and all of the coefficients were above .80 (many were above .90). In addition, WJ III validity was examined using a variety of methods including content, concurrent, and construct methods. Data reported in the test manual describe factor analyses that support the theoretical (CHC) factor structure. Concurrent validity evidence is presented in the manual indicating the correlations between the WJ III subscales and clusters scores and other established measures of cognitive ability (e.g., WPPSI-R, WISC-III, and WAIS-III). Overall the reliability and validity data provide

empirical support for WJ III Tests when it is used in appropriate situations. Consistently, several other studies have investigated the use of the WJ III Tests with a variety of student populations, and have added to the base of information on its validity and reliability (Lohman, 2003; Mather & Woodcock, 2001).

Table 1. Broad CHC Cognitive Factor Definitions

Factor	Symbol	Definition
Fluid Reasoning	*Gf*	Ability to reason, form concepts, and problem solve, using novel information and/or procedures
Comprehension-Knowledge)	*Gc*	Measures an individual's breadth and depth of general knowledge of a culture, including verbal communication and reasoning with previously learned procedures
Visual Processing	*Gv*	Ability to analyze and synthesize visual information
Auditory Processing	*Ga*	Ability to analyze and synthesize auditory information
Processing Speed	*Gs*	Ability to quickly perform automatic cognitive tasks, particularly when under pressure to maintain focused concentration
Short-Term Memory	*Gsm*	Ability to temporarily hold information in immediate awareness and then use it within a few seconds
Long-Term Retrieval	*Glr*	Ability to store information and retrieve it later through association
Quantitative Knowledge	*Gq*	Ability to comprehend quantitative concepts and relationships and to manipulate numerical symbols
Reading-Writing	*Grw*	A common factor underlying both reading and writing, including basic reading and writing skills and the skills required for comprehension and expression.

Source: (Mather & Woodcock, 2001).

Recently in Jordan, two studies have been conducted to test the psychometric properties of the **WJ III** Tests by Al-Karaan and Al-Tit (2010). The results of the two studies showed that the scale demonstrates sufficient construct validity, positive correlations with statistical significance between the scale subtests on one hand, and with other academic achievement tests on the other hand. The coefficient results also presented appropriate reliability by using either the internal reliability (consistency) measured with Cronbach's alpha or the stability using a test–retest procedure. These results are very promising in terms of standardizing the **WJ III** Tests in Jordan.

3. The Use of WJ Tests with High Incidence Disabilities

Researchers have shown that WJ is a good tool in identifying high incidence disabilities such as language impairment, head injuries, ADHD, mild intellectual disability, and reading, math and written language disabilities (Dalke, 1988; Fidler, Plante, & Vance, 2011; Hoy & Gregg, 1986; Schrank, 2005; Tupper, 2001).

3.1. The Use of WJ Tests with Language Disorders

The WJ III Tests can be used with confidence for identifying students with language disorders. McGrew, Schrank, and Woodcock (2007) administered the WJ III Tests to a sample that included 156 children and adolescents with articulation disorders, communication disorders, expressive language disorders, mixed receptive-expressive language disorders, and central auditory processing disorders. Results showed that the presence of a language disorder is typically related to lower cognitive ability scores on the Listening Comprehension and Fluid Reasoning clusters (See Table 1 for definitions). These findings were consistent with the literature that describes the cognitive profile for persons who have language impairment (Fidler et al., 2011).

3.2. The Use of WJ Tests with Head Injury

Results from the Technical Manual of WJ III (McGrew et al., 2007) indicate that Processing Speed and Working Memory are among the lowest areas of performance for both children and adults with head injuries. A sample includes scores from 123 children and adolescents with a number of different types of brain injury from an

externally inflicted trauma, including traumatic brain injury, closed head injury, fractured skull, hemorrhage, contusion, and post-concussive disorder were administered the WJ III Tests. The cognitive consequences of these injuries are broad and can vary by the severity of the injury. Some of the most persistent problems associated with head injury include memory impairments and difficulties in attention and concentration (National Institutes of Health, 1998); these problems are evident in the patterns of scores provided in WJ Tests scores (Tupper, 2001).

3.3. The Use of WJ Tests with Attention-Deficit/Hyperactivity Disorder (ADHD)

The diagnosis and treatment of ADHD is complicated because of the similarities in features and patterns of performance on neuropsychological measures of ADHD with other disorders. Individuals with ADHD may demonstrate cognitive profiles similar to those with learning disabilities, traumatic brain injuries, and social-emotional problems. Most importantly, identification and diagnosis of ADHD are further complicated by validity problems found with the diagnostic criteria in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorder (DSM-IV) (Stage, Finch, Trinkle, & Dean, 2005). Schrank (2005) suggested that the Report Writer for the WJ III is useful in documenting behavioral manifestations of ADHD particularly for parents and teachers. The researcher investigated the performance of a sample of individuals with ADHD who were administered various combinations of WJ III tests. The results showed that the sample scored the lowest on Cognitive Efficiency, Processing Speed, Short-Term Memory, and Long-Terms Retrieval. Also, the results showed that the Academic Fluency cluster was the lowest and the Oral Language cluster was the highest. A recent study conducted by McQuade et al. (2010) has reached similar conclusions.

3.4. The Use of WJ Tests with Mild Intellectual Disability

Results from the Technical Manual for children with intellectual disability suggest that the median general intellectual ability scores were consistent with intellectual ability criterion of Intellectual Disability. The results also showed that the scores were low in all academic subtests; Brief Reading, Brief Math, Brief Writing, and Academic Knowledge (McGrew et al., 2007). On the other hand, Shaver and Floyd (2003) investigated the use of the WJ III Cattell-Horn-Carroll (CHC) factor clusters with children with mild intellectual disability. The results showed that children with intellectual disability demonstrated a rather wide range of performance across the CHC broad cognitive abilities.

3.5. The Use of WJ Tests with Reading Disorders

Reading disorders are estimated to be involved in at least 80% of all learning disabilities (Torgesen, 2002). Reading disorders are characterized by reading achievement (i.e., accuracy, speed, or comprehension) that falls substantially below an expectation on the basis of the individual's chronological age, general intellectual ability, and an age-appropriate educational history (APA, 2000). The most common type of specific learning disability, dyslexia, significantly interferes with academic achievement or activities of daily living that require the application of basic reading and spelling skills. Their reading problems are not explainable by inadequate learning opportunities (Benson, 2007; U.S. Department of Education, 2004). Because of the sheer number of students who experience reading problems, it is important that practitioners have a better understanding of the full range of cognitive abilities and their relative importance to the growth and maintenance of basic reading skills (Floyd, Keith, Taub, & McGrew, 2007). Previous research has identified several cognitive and linguistic variables that are implicated as correlates or causes of reading disabilities (e.g., Badian, 2005; Bishop & League, 2006; Fawcett, Singleton, & Peer, 1998; Scarborough, 1998). Specifically, hypotheses about the causation of dyslexia has been derived from theories regarding the relationships between and among basic reading skills and Phonological Awareness (PA), Rapid Automatized Naming (RAN), and Processing Speed (PS), and Working Memory (WM). All of these abilities are measured by WJ III Tests. One example is a study conducted by Mockler (2003) who investigated the relationship among cognitive abilities and reading achievement using WJ III Tests. The study indicates significant contributions

of both RAN and PA to the prediction of reading achievement. Recently, Abu-Hamour (2010) examined the relationships among WJ III measures of cognitive abilities and word reading. The word reading measures were predicted by using multiple cognitive abilities including PA, RAN, PS, and WM. Specifically, a model consisting of RAN, PA, and PS provided the most powerful prediction of all reading skills. These findings lend more support to the use of WJ III Tests to explain the variance in reading skills.

3.6. The Use of WJ Tests with Mathematics Disorders

Mathematics disorders, sometimes referred to as dyscalculia, significantly interfere with academic achievement or activities of daily living that require the application of mathematical skills. Current estimates indicate that approximately 5 to 7% of the school-age population has remarkable difficulty in math achievement which negatively affects schooling, daily living, and employment (Swanson, Jerman, & Zheng, 2008). The cognitive abilities that have been the focus of most investigations of math skills are information retrieval (Geary, 1994; Geary, Brown, & Samaranayake, 1991), working memory (Geary, 1994; Hitch & McAuley, 1991; Shafir & Siegel, 1994; Swanson & Hsieh, 2009), and processing speed (Bull & Johnston, 1997; Geary, 1994). Floyd et al. (2003) investigated the students performance on the WJ III Math Calculation Skills and Math Reasoning clusters. They found that Comprehension-Knowledge (Gc) demonstrated moderate relations with Math Calculation Skills after the early school-age years and moderate to strong relations with Math Reasoning. Fluid Reasoning (Gf), Short-term Memory (Gsm), and Working Memory generally demonstrated moderate relations with the mathematics clusters. Processing Speed (Gs) demonstrated moderate relations with Math Reasoning during the elementary school years and moderate to strong relations with Math Calculation Skills.

3.7. The Use of WJ Tests with Written Language Disability

This type of specific learning disability significantly interferes with academic achievement or activities of daily living that require the application of writing. Researchers have shown that written language is related to Comprehension-Knowledge (Gc), Fluid Reasoning (Gf), Processing Speed (Gs), and Long-term Retrieval (Glr) (Floyd et al., 2008; McGrew & Knopik, 1993). Recently, Floyd et al. (2008) have searched for most important cognitive abilities for understanding the writing skills of children during the school-age years using the WJ III Tests. Their findings confirmed the previously mentioned research results.

4. The Use of WJ Tests/CHC Theory with Low Incidence Disabilities (Hearing Impairment, Visual Impairment, and Autism)

More school psychologists and other education professionals who work with deaf and hard of hearing students are becoming aware of the advantages of CHC theory and its applications. Therefore, they may identify a broader picture of strengths and weaknesses among cognitive abilities through CHC-based assessment that in turn could lead to increased instructional recommendations for teachers. Teachers may then possibly increase the number and variety of instructional strategies to help deaf and hard of hearing students acquire and retain academic skills, such as reading, by increasing the number of identified ability strengths and needs in assessment that are known to relate to reading development in different age periods (Miller, 2008). When selecting tests for students with low vision as well as for those who are blind, an evaluator must ensure that any adaptation or accommodation does not make the task more difficult or complicated. This is also a concern when translating a written test into Braille. To date, the Woodcock-Johnson III Tests of Achievement–Braille Adaptation (Jaffe, 2009; Jaffe, Henderson, Evans, McClurg, & Etter, 2009; Schrank & Woodcock, 2007) is the only standardized academic achievement battery that has been specifically adapted for Braille readers.

In terms of autism, McGrew et al. 2007 in the WJ III Technical Manual present data pertaining to the performance of 155 children and adolescents with autistic spectrum disorders, including autistic disorder and Asperger's disorder and unspecified pervasive developmental disorder. These disorders are often characterized by impaired social interaction or communication skills (APA, 2000). The data presented in the manual suggest that children and adolescents with autistic spectrum disorders show low performance on Processing Speed, Working Memory, Reading, Brief Math, and Writing.

5. The Use of WJ Tests with Giftedness

Most of the literature on the identification of gifted and talented students has suggested the use of multiple criteria including scores on standardized measures of cognitive ability, academic achievement, classroom performance, teacher reports, and parent nomination (Borland, 1989; Davis & Rimm, 1994; Renzulli & Reis, 1997). Similarly, Kaufman and Harrison (1986) support the use of multiple criteria for assessing gifted and talented but they strongly encourage the use of intelligence tests. In a validity study, Newton, McIntosh, Dixon, Williams, and Youman (2008) investigated the accuracy of three shortened measures of intelligence for predicting giftedness as assessed by the Stanford–Binet Intelligence Scale, Fifth Edition-Full Scale IQ score (SB5 FSIQ) : the Woodcock–Johnson Tests of Cognitive Ability, Third Edition Brief Intellectual Ability (WJ III COG BIA) score; the Stanford–Binet Intelligence Scale, Fifth Edition Abbreviated IQ (SB5 ABIQ); and the Kaufman Brief Intelligence Test IQ Composite (K-BIT). The results revealed that overall, the WJ III score was the most accurate and the K-BIT score was the least accurate in identifying giftedness using the SB5 Full Scale.

Rizza, McIntosh, and McCunn (2001) investigated the WJ III CHC factors among a group of gifted individuals and typical individuals. The researchers found that gifted students performed significantly higher across the CHC factor clusters compared to the typical group. Brody and Mills (1997) defined students with Gifted/Learning Disability as "those who possess an outstanding gift or talent and are capable of high performance, but who also have a learning disability that makes some aspect of academic achievement difficult" (p. 282). In a recent study, Abu-Hamour, Urso, and Mather (in press) have administered several tests from the WJ III Tests of Cognitive and Achievement Abilities (WJ III COG; Woodcock, McGrew, & Mather, 2001/2007; WJ III ACH; Woodcock, McGrew, & Mather, 2001/2007) to evaluate a gifted student with specific reading disability. The student's fluid reasoning ability and oral language abilities were significantly higher than all of his other abilities. Conversely, his long-term retrieval, short-term memory, auditory attention, processing speed, and cognitive fluency were all significantly lower than predicted by his other abilities. These findings indicated that the student has dyslexia which was caused by weaknesses in both memory and speed of symbol perception. Based on the findings, the student was provided with a 24-week effective intervention. This study demonstrates the value of using valid normative-based assessments such as WJ III Tests for an accurate diagnosis of a gifted student with dyslexia then providing appropriate intervention.

6. The Use of WJ Tests with Higher Education Students

The number of students with Learning Disabilities (LD) electing to continue their formal education beyond high school has increased over the last decades (Krasa, 2007). University students require intelligence testing for a variety of reasons. The most obvious one is to identify the possibility of a disability (Ofiesh & McAfee, 2000). Although most Learning Disabilities are diagnosed before a student arrives at college, some receive their initial diagnosis during their first years of university study (Morgan, Sullivan, Darden & Gregg, 1997). Dalke (1988) conducted a study to compare college students with and without learning disabilities, by compared patterns of performance on the WJ of 72 college freshmen, 36 with LD and 36 without LD. The results indicated that cognitive and academic deficits commonly associated with the presence of a Learning Disability do continue into young adulthood. Thus, among older students and adults, the WJ III can also provide information that is valuable for postsecondary planning and career decisions (Krasa, 2007).

7. The International Use of WJ Tests

International editions of the WJ have been introduced in Latvia, Slovakia, Czech Republic, and Hungary in 1998. The WJ III was also normed on Brazilian children in 2010. Results indicated strong validity evidence for the Brazilian adaptation (Wechsler et al., 2010). The Spanish version of WJ III (*Batería III Woodcock-Muñoz*) was normed in 2005. The parallel English and Spanish versions, related through the equated U.S.A norms procedure, provide the specific and comparative information often required for program placement and instructional planning (Schrank, McGrew, Ruef, Alvarado, Sandoval, & Woodcock, 2005).

Conclusion

In conclusion, the WJ III is a reliable and valid assessment tool of both cognitive abilities and achievement among children and adults. It is based on the most current theoretical model of intelligence, CHC theory. The WJ III proves to be a valuable diagnostic tool to be used to identify exceptional children including: high incidence disabilities such as ADHD, language impairment, mild intellectual disability, specific reading, math, and written language disabilities, and traumatic brain injury; and low incidence disabilities such as hearing impairment, visual impairment, and autism; and gifted students including those with a learning disability. Higher education students have also benefited from information obtained from the WJ III tests. In addition, the widespread use of the WJ around the world affirms the value of this test.

Acknowledgements

This work has been prepared with generous help provided by Fredrick Schrank and Mary Ruef from Woodcock-Muñoz Foundation

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