The Value of IQ Scores in Detecting Reading Patterns in Younger and Older Elementary Aged Children Referred for Learning Difficulties

by

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ABSTRACT

This study examined the contribution of cognitive factors on the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003) to oral reading rate, accuracy, fluency, comprehension, and overall reading ability as measured by the Gray Oral Reading Tests-Fourth Edition (GORT-4; Wiederholt & Bryant, 2001). Though a highly used measure of intellectual functioning, few studies exist using the WISC-IV. Analysis will help psychologists determine the best cognitive patterns to describe children's functioning as related to different areas of reading. Comparisons between younger and older elementary aged readers highlight skills relevant at different developmental stages.

The sample included 114 children, aged 6 to 11, referred for comprehensive psychoeducational batteries due to academic, attention, or social-emotional problems. Significant linear relationships were found between most WISC-IV subtests and GORT-4 scores. While the WISC-IV subtests and process scores collectively explained the most variance within all oral reading comprehension scales, the Verbal Comprehension Index (VCI) emerged as the most important cognitive factor. The Working Memory Index (WMI) was significantly and positively related to oral reading accuracy. This sample did not support the use of ACID or SCAD profiles in reliably predicting oral reading and comprehension beyond the contribution of VCI.

Regression analyses compared the relationship between WISC-IV subtests and the reading performance of younger (Grades 2 and 3) and older elementary-aged readers (Grades 4 and 5). While verbal comprehension subtests were most consistently correlated with oral reading skills within both groups, working memory subtests functioned differentially, seeming more highly related for younger readers in all areas of reading. Perceptual reasoning subtests yielded small to moderate, significant associations with oral reading comprehension for younger reader but almost no association for older readers. Processing speed subtests contributed minimally to both groups. Results highlight the diagnostic utility of understanding the relationship between cognitive factors on the WISC-IV and reading disabilities. Particular attention must be paid to cognitive factors relevant to the development of reading skills in younger and older elementary-aged readers.

CHAPTER I

Introduction

Reading is a fundamental skill that is essential for most of academic learning (Aaron & Joshi, 1992; Rayner, Foorrman, Perfetti, Pesetsky, & Seidenberg, 2001). For some, reading comes easily. Children "crack the code" and effortlessly master the alphabetic principle and phonological processes needed to become accurate and fluent readers. Yet, others laboriously engage in frustrating attempts to make connections between sounds and symbols and recognize them as words (Rayner et al., 2001). The focus of reading in early elementary schooling is on decoding and word identification skills (Aaron & Joshi, 1992; Berninger, 2001; Kuhn & Stahl, 2003; Shaywitz, 2003). As children build phonemic awareness, phonological processing, and sight vocabularies their decoding skills become more automatic leading to fluent oral reading that includes good rate, accuracy, and prosody (Berninger, Abbott, Billingsley, & Nagy, 2001; Torgesen, Rashotte, & Alexander, 2001). Comprehension of written language must also develop in order for children to become good readers (National Institute of Child Health and Human Development [NICHD], 2000; Snow, Sweet, Alvermann, Kamil, & Strickland, 2001/2002). It is not enough to only decode the words; it is critical that one understands the meaning of text. Reading comprehension is a multicomponential skill that includes the ability to recall story details as well as make inferences and predictions (Nicholson & Tan, 1999).

It is estimated that approximately 25% of the school population has some form of reading problem (Joshi, 2003). Lerner (1989) approximates that 80% of children identified as having learning disabilities (LD) have their primary difficulty in learning to read. However, the reading disabled population is heterogeneous (Berninger, 2001; Lipka, Lesaux, & Siegel, 2006; Lyon, 1996). Students may exhibit primary difficulties with decoding, reading comprehension, or both (Aaron & Joshi, 1992). Additionally, readers with weaknesses in orthographic processing and reading speed may constitute a fourth group (Aaron, Joshi, & Williams, 1999). It is not unusual to find reading disabilities (RD) co-occurring with other learning issues as well as certain behavioral or emotional disorders (Lyon, 1996; Schwean & Saklofske, 2005). Moats (2002) noted that "reading failure begins early, takes root quickly and affects students for life" (p. 5). Unresolved cognitive and language weaknesses have the potential to impair decoding, spelling, and reading comprehension in adolescence and beyond (Catts, Adolf, & Weismer, 2006; Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998). As such, it is important that research consider factors that contribute to RD.

There is a long history supporting the relationship between reading and basic intelligence (Naglieri, 2001; Oh, 2002; Tiu, Thompson, & Lewis, 2003; Watkins, Glutting, & Lei, 2007) as well as other cognitive and neuropsychological processes (Pennington & Lefly, 2001; Stanovich, 1988, 1991; Wolf, Bally, & Morris, 1986). Authors of most tests of intelligence correlate their tests with measures of reading to establish validity, show the degree to which the traits underlying intelligence tests can be identified, and the extent to which these traits reflect the theoretical model upon which

the test is based (Wechsler, 2003). Similarly, authors of reading tests look for correlations with intelligence tests. Reading tests measure achievement, or a child's mastery of reading at a certain level. However, intelligence measures do not, and are not meant to fully explain all of the processes that make children strong or weak readers. Research has identified many abilities included in cognitive assessment that are essential for reading. Among those skills which are measured by traditional intelligence tests are: cognitive ability (Naglieri, 2001; Oh, 2002; Oh, Glutting, Watkins, Youngstrom, & McDermott, 2004; Tiu et al., 2003; Watkins et al., 2007), verbal comprehension (Berninger & O' Donnell, 2005; Greenblatt, Mattis, & Trad, 1990; Oh, 2002; Vellutino, Scanlon, & Tanzman, 1991), vocabulary development (Aarnoutse, van Leeuwe, & Verhoeven, 2005; Aaron & Joshi, 1992; Joshi, 2003; Nagy & Scott, 2006; Stahl & Fairbanks, 2006), world knowledge (Cook & Gueraud, 2005; Shaughnessy, 2005; Snow et al., 2001/2002) working memory (WM; Gathercole, Hitch, Service, & Martin, 1997; Mayes & Calhoun, 2004; Swanson, Howard, & Sáez, 2006), and processing speed (Hale, Naglieri, Kaufman, & Kavale, 2004; Lovett, 1987; Weiss, Saklofske, & Prifitera, 2005).

While researchers have moved away from the use of IQ-achievement discrepancies to diagnose learning disabilities (Berninger, 2001; Francis, Fletcher, Shaywitz, Shaywitz, & Rourke, 1996; Kavale & Forness, 1984; Stage, Abbott, Jenkins, & Berninger, 2003; Stuebing et al., 2002), measures of cognitive ability are frequently administered as part of testing batteries assessing children's learning issues. The solution is to use IQ test results in more meaningful and flexible ways (Berninger, Hart, Abbott, & Karofsky, 1992). While discrepancies alone do not provide for accurate diagnoses,

subtest and index patterns help informed clinicians integrate information from a myriad of sources as they make clinical judgments (Berninger & O' Donnell, 2005; Prifitera, Saklofske, Weiss, & Rolfhus, 2005). As such, further research is needed to better understand the nature of a currently used measure, such as the Wechsler Intelligence Scale for Children-Fourth Edition (Wechsler, 2003), and its ability to contribute to the interpretation of different types of reading patterns, particularly among children referred for academic difficulties.

CHAPTER II

Literature Review

This chapter presents a review of the research literature examining reading difficulties in children as well as the contribution of cognitive factors as assessed by intelligence measures. The literature review begins with an overview of historical developments in intelligence testing as related to reading. The Wechsler Intelligence Scales (Wechsler, 1949, 1974, 1991, 2003) and pattern analyses associated with different learning styles are emphasized. This includes a review of the changes and focus of the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003), the most current version of the measure. This is followed by an examination of reading disorders and attempts to define different possible subtypes. Research includes the contributions of word recognition, reading comprehension, reading rate, and fluency to the understanding of reading disabilities (RD). Contributions of verbal skills such as vocabulary, world knowledge, and comprehension as well as short-term memory and processing speed are reviewed. The concluding section discusses one of the major goals of the present study, the investigation of various aspects of intelligence measures and their influence on reading difficulties in children.

Brief Review: Historical Perspectives on the Relationship between Wechsler Intelligence Measures and Reading

Intelligence testing has a long, distinguished history that extends over the past century (Wechsler, 2003). Although other factors were also included at that time, conceptualization of intelligence has moved beyond the single construct of intelligence prevalent in the early 20th century when Spearman (1904) described the *g*-factor as representing an individual's performance on all mental tasks. Binet and Simon (1905) published an intelligence scale in response to the French government's wish to identify children unable to benefit from regular education. The 1905 scale became the prototype for future assessments of mental ability. It is considered one of the first practical intelligence tests since the items were rank ordered by difficulty and included specific administration instructions (Sattler, 1992).

Along with his colleagues at Stanford University, Terman (1916) revised and standardized Binet and Simon's scale for use in the United States. He adapted the concept of *mental quotient,* which is found by dividing mental age by chronological age (Stern, 1914) and renamed this ratio the *intelligence quotient* (IQ). While test methodology improved at this time, assessment goals mainly included the identification of intellectual deficiency. With the beginning of World War I, the need to screen army recruits resulted in the development of an intelligence measure named Army Alpha. However, the test's emphasis on verbal skills proved problematic because of the recruits' limited literacy. This led to the creation of Army Beta, a nonverbal measure of intelligence (Sattler, 1992). Wechsler (1939) developed the Wechsler-Bellevue Intelligence Scale (Wechsler-

Bellevue) which provided verbal and performance scales and an overall composite score. The Wechsler-Bellevue was considered innovative because it offered deviation IQ scores based on standard scores which were computed using the same distributional characteristics at all ages.

In the 1950s, the special education system experienced expansion. As such, there was an increased need to identify and diagnose learning difficulties in children. The focus of intelligence testing shifted to individuals' discrete cognitive functions (Wechsler, 2003). Advances in factor-analytic techniques allowed for greater clarification of intellectual abilities. Cattell (1941, 1957) introduced a two-factor theory of intelligence that included fluid intelligence (*Gf*) and crystallized intelligence (*Gc*). Horn (1985, 1988, 1991), expanded on Cattell's theories, and included the following factors: visual perception, short-term memory, long-term storage and retrieval, speed of processing, auditory processing ability, quantitative ability, reading, and writing ability.

Over the past 60 years debates have continued regarding the presence of an underlying, global aspect of intelligence that influences an individual's performance across cognitive domains (Prifitera et al., 2005; Wechsler, 2003). Despite the trend toward multiple, narrowly defined cognitive abilities, the most comprehensive factor-analytic study of cognitive ability measures to date (Carroll, 1993, 1997) demonstrated significant evidence that a general factor of intelligence exists. Factor analytic research has identified 8 to 10 broad domains of intelligence (Carroll, 1993, 1997; Horn & Noll, 1997). Current literature describes intelligence as having a hierarchical structure with

more specific abilities within several broad domains (Prifitera et al., 2005; Wechsler, 2003).

Early Wechsler Intelligence Scales

The original Wechsler-Bellevue Intelligence Scale (Wechsler, 1939) provided the foundation for future versions of Wechsler's intelligence tests. Wechsler conceptualized intelligence as a *global* entity characterizing the individual's whole behavior as well as *specific* entities that included distinct elements or abilities. The Wechsler-Bellevue computed verbal, performance, and overall composite scores using deviation IQ scores based on standard scores that compared the same distributional characteristics at all ages. Subtests on the Wechsler-Bellevue included: Information, Arithmetic, Similarities, Vocabulary, Digit Span, Comprehension, Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Coding. The Wechsler Intelligence Scale for Children (WISC; Wechsler, 1949) adapted subtests used in the Wechsler-Bellevue for use with children and added a new subtest, Mazes. Easier items were added to the beginning of subtests, making the test more appropriate for children, ages 5 to 15 years. The 12 subtests were grouped into Verbal and Performance scales, 6 subtests per scale, which yielded scores for Verbal IQ (VIQ), Performance IQ (PIQ), and Full Scale Score (FSIQ). The VIQ, PIQ, and FSIQ used deviation IQs obtained by comparing the examinee's scores with those earned by a representative sample of same age peers. The VIQ, PIQ, and FSIQ yielded standard IQ scores at each level, each with a mean of 100 and a standard deviation of 15. Scaled scores for each subtest had a mean of 10 and a standard deviation of 3.

Wechsler Intelligence Scale for Children-Revised (WISC-R)

The Wechsler Intelligence Scale for Children-Revised (WISC-R; Wechsler, 1974) was published 25 years after its predecessor. The WISC-R retained all 12 subtests from the WISC (Wechsler, 1949), including 72% of the items. Adjusted age ranges made the WISC-R appropriate for children 6 to 16 years old. The WISC-R continued to utilize VIQ, PIQ, and FSIQ scores and did not introduce any new subtests. The standardization sample included 2,200 American children. Unlike the WISC (Wechsler, 1949), which only included Caucasian children, the WISC-R standardization sample also included children of color. Reliability was outstanding and each of the IQ scales yielded an internal consistency reliability coefficient of .89 or above across all ages within the standardization sample. The Verbal Scale subtests typically generated the highest reliability coefficients with scores ranging from .77 to .86 (median = .80). Performance Scale subtests ranged from .70 to .85 (median = .72). Reliability coefficients were largely similar across the 11 age groups. The WISC-R provided stable IQs for each of the three scales with strong test-retest coefficients (FSIQ = .95, VIQ = .93, PIQ = .90). Practice effects, particularly on Performance subtests, accounted for increased scores in retest situations. Research studies yielded satisfactory concurrent validity with achievement and school grades (upper .30s to the low .80s).

Wechsler Intelligence Scale for Children-Third Edition (WISC-III)

Seventeen years after the publication of the WISC-R (Wechsler, 1974), came the release of the Wechsler Intelligence Scale for Children—Third Edition (WISC-III; Wechsler, 1991). The measure assessed children 6-0-0 to 16-11-30 years of age. The

standardization sample for the WISC-III included 2,220 children stratified by age, race/ethnicity, geographic region, and parent education. The WISC-III included all previous subtests and added a new supplementary subtest, Symbol Search, as a measure of processing speed. Approximately 73% of the WISC-R items were retained for the WISC-III in the original or slightly modified format. The WISC-III contained 13 subtests, 6 in the Verbal Scale and 7 in the Performance Scale. Five subtests in each scale were designated as standard subtests, including: Information, Similarities, Arithmetic, Vocabulary, and Comprehension subtests in the Verbal Scale and Picture Completion, Coding, Picture Arrangement, Block Design, and Object Assembly in the Performance Scale. The remaining three subtests—Digit Span in the Verbal Scale and Symbol Search and Mazes in the Performance Scale, served as supplementary subtests.

As the Wechsler tests progressed, they emphasized critical cognitive elements of intelligence. These included: verbal comprehension, abstract thinking, perceptual organization, quantitative reasoning, memory, and processing speed. Besides the continued use of the VIQ, PIQ, and FSIQ, the WISC-III (Wechsler, 1991) incorporated four new index scores, the Verbal Comprehension Index (VCI), the Perceptual Organization Index (POI), the Freedom from Distractibility Index (FDI), and the Processing Speed Index (PSI) that related to more specific cognitive functions. The addition of the Freedom from Distractibility Index (Arithmetic and Digit Span) and Processing Speed Index (Coding and Symbol Search) on the WISC-III veered from the two-branched approach initially used in Wechsler's intelligence measures. However, the inclusion of the FDI and PSI gave the WISC-III clearer interpretive value and greater

psychometric clarity than its predecessor the WISC-R (Kaufman, 1994). Performance on the subtests comprising the FDI appeared strongly influenced by attention and concentration as well as impaired by distractibility and anxiety. PSI also reflected as neuropsychological and clinical variables.

The WISC-III (Wechsler, 1991) showed excellent internal consistency reliabilities for the Verbal, Performance, and Full Scales (average r_{xx} of .95, .91, and .96 respectively). Subtest internal consistency reliabilities ranged from .69 to .87, and test-retest reliabilities ranged from .57 to .89. Reliabilities for the three index scales were higher than those for the individual subtests. Studies in the WISC-III manual indicated that the WISC-III demonstrated acceptable concurrent, criterion, and construct validity.

Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV)

The Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003) is the most current revision of the scale. Like its predecessors, the WISC-R (Wechsler, 1974) and WISC-III (Wechsler, 1991), the WISC-IV is one of the most widely used assessments of intellectual functioning of children (Gabel & Shaughnessy, 2006). The revision of the WISC-III to WISC-IV resulted in a number of changes. Modifications complied with more rigorous test standards (American Educational Research Association, 1999), adapted to the changing needs and regulations set forth by government regulations such as the Individuals with Disabilities Act (IDEA; U. S. Department of Education, 2002), and linked the WISC-IV with newer versions of achievement tests (e.g., Wechsler Individual Achievement Test-Second Edition, WIAT-II; Wechsler, 2002). Essential to any revision, the WISC-IV included updated