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RESEARCH INTO PRACTICE: CATTELL-HORN-CARROLL COGNITIVE ASSESSMENT IN PRACTICE: ELIGIBILITY AND PROGRAM DEVELOPMENT ISSUES

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In this article we explore the application of Cattell-Horn-Carroll (CHC)-based cognitive assessment to school psychology practice. We review the theoretical literature to address both identification practices, with a focus on learning disabilities and mental retardation eligibility, and program development, with a focus on linking assessment to intervention design. We present case studies that illustrate the application of CHC-based cognitive assessment to identification and intervention development. © 2005 Wiley Periodicals, Inc.

Underlying cognitive abilities, regardless of their determinants (i.e., heredity or environment), are associated with academic achievement in school. Most school psychologists and educators would probably agree that the way a student processes, stores, retrieves, and analyzes information influences how that student will perform in school. Within such a perspective, the assessment and interpretation of a student's cognitive abilities is warranted to gain a more substantial understanding of those effects on academic achievement. The Cattell-Horn-Carroll (CHC) theory of cognitive abilities is considered one of the most well-validated, comprehensive models of cognitive functioning (e.g., Evans, Floyd, McGrew, & Leforgee, 2002). We briefly review CHC theory and then discuss ways to incorporate the theory and empirical findings into everyday school psychology practice.

Within the CHC conceptual framework, cognitive functioning (g) is subdivided into specific broad and narrow abilities. Some of the main broad abilities (also referred to as stratum II abilities) include fluid intelligence or novel reasoning (Gf), crystallized intelligence or acquired knowledge (Gc), visual processing (Gv), auditory processing (Ga), short-term memory (Gsm), long-term retrieval (Glr), and processing speed (Gs). Each of the broad abilities is likewise subdivided into narrow abilities. For example, Ga includes the narrow ability of phonetic coding (PC), which describes the ability to process, analyze, and synthesize speech sounds within words.

Many practicing school psychologists place less emphasis on general ability and more on specific intellectual constructs because of the *belief* that subtest scores yield useful diagnostic and treatment validity (McGrew, Flanagan, Keith, & Vanderwood, 1997). For example, in a national survey, 89% of school psychologists indicated that they used index scores, subtest profile analysis, or both, in interpreting their clients' performance on the Wechsler Intelligence Scale for Children–Third Edition (WISC-III; Pfeiffer, Reddy, Kletzel, Schmelzer, & Boyer, 2000). Texts for clinical practitioners present methodologies for interpreting variation in test and subtest scores as measures of different underlying cognitive abilities (e.g., Kamphaus, 2001; Kaufman, 1994; McGrew & Flanagan, 1998; Sattler, 2001). In 1990, McDermott, Fantuzzo, and Glutting, in their "Just Say No" article, stated that to the extent that the ultimate purpose of any psychological measure rests on its ability to improve prediction, the observation that ipsative scores fail to exceed, match, or

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even approach conventional scores in predictive efficiency effectively eliminates any claim that ipsative assessment has relative merit. However, as McGrew and colleagues (1997) later point out,

> most of the anti-specific ability research in school psychology has been conducted with measures that are based on an outdated conceptualization of intelligence (viz., Wechsler batteries) and have used research methods that have placed primary emphasis on *prediction* with little attention to *explanation* and *theoretical understanding* of the relations between general and specific cognitive abilities and school achievement. (p. 191; italics in original)

In addition, the methodology used by McDermott and his colleagues (e.g., Glutting, McDermott, Konold, Snelbaker, & Watkins, 1998; Glutting, Youngstrom, Ward, Ward, & Hale, 1997; McDermott et al., 1990; Watkins, 2000) fails to take into account the multicollinearity of measures of cognitive functioning (e.g., see Hale, Fiorello, Kavanaugh, Hoeppner, & Gaither, 2001). Structural equation modeling (SEM), used in many of the studies presented here, provides a more accurate view of the contributions of *g* and multiple cognitive abilities to academic achievement.

In addition, we note that neither we nor other proponents of cross-battery assessment (XBA; e.g., see Flanagan & Ortiz, 2001) recommend using ipsative scores as defined by McDermott et al. (1990). Instead of subtracting subtest scores from the mean, and using these so-called ipsatized scores, we interpret cluster scores, which provide information about normative level of performance in addition to relative strengths and weaknesses.

New research studies have validated the effectiveness of the hierarchical CHC model as an organizing framework for making differential diagnoses and for guiding test selection. The majority of these studies have examined the relationship between theory-driven standardized measures of CHC cognitive abilities and standardized measures of achievement in reading, writing, and mathematics. Essentially, these studies were designed to reexamine the *g* versus specific abilities issue in a manner that reflects progress in theory, cognitive measurement, and research methodology (McGrew et al., 1997). McGrew and colleagues summarized the research findings to date on the relationship between both general and specific measures of *g* and academic achievement measures in reading and mathematics using an explanatory methodological framework. The results of these analyses suggest that certain specific abilities may be important for understanding the development of specific academic skills, above and beyond the understanding gained from general cognitive and achievement clusters (McGrew et al., 1997). In 2000, Flanagan found that a theoretically driven approach to Wechsler test interpretation (Wechsler-based CHC XBA) explained 25% more variance in reading achievement than the conventional, atheoretical Verbal Comprehension-Perceptual Organization-Freedom from Distractibility (VC-PO-FFD) Wechsler-based interpretation system. Another noteworthy finding of this study was that when assessments were organized around the CHC theoretical model, specific cognitive abilities, including Ga, Gs, and Gc, explained a significant portion of variance in reading achievement beyond that accounted for by *g*. Next, we review evidence linking specific CHC abilities to specific areas of academic achievement.

Reading

In 1999, the Center for the Improvement of Early Reading Achievement (CIERA; Konold, Juel, & McKinnon, 1999) at the University of Michigan conducted a study to investigate how children of varying reading abilities performed on measures that assess CHC constructs "fundamental to children's early literacy acquisition: auditory processing (Ga), crystallized ability (Gc), processing speed (Gs), and short-term memory (Gsm)" (p. 1). Specifically, each of these constructs is associated with an underlying function or component of literacy acquisition. Ga is associated with phonemic awareness or sound-letter correspondence recognition; Gc is associated with oral comprehension and lexical knowledge; Gs is associated with rate of processing or automaticity commonly assessed with rapid naming tasks; and Gsm (specifically auditory short-term memory) is associated with immediate storage of auditory information, the phonological loop.

Konold et al. (1999) assert that an integrative model of how these processes operate among emergent readers is necessitated because of the complexity of factors contributing to reading. They criticize previous literacy acquisition models for their focus on isolated "causative agents" including phonemic awareness, oral vocabulary, and listening comprehension (Adams, 1990; Juel, 1994; Snow, Burns, & Griffin, 1998; Wagner, Torgesen, & Rashotte, 1999). They developed an integrative model of early reading acquisition and evaluated emergent readers on these underlying constructs of early literacy development (i.e., Ga, Gc, Gs, and Gsm), identifying individual profile types among these emergent readers. Children within each of these profile types were subsequently compared on four literacy outcome measures to determine whether certain profiles were associated with later success in reading and whether others were associated with later difficulties in reading. Unsurprisingly, children with strengths in all four cognitive ability areas performed the best on all reading outcome measures whereas children with significant weaknesses in all four cognitive ability areas performed the worst on all reading outcome measures. More interesting results were obtained when comparing children with average to slightly below average abilities to children with flat average profiles with a normative strength in one ability area. Specifically, these researchers found that children with at least one secondary strength performed better than the flat average group. In addition, a strength in Ga predicted higher achievement than strengths in Gc and Gsm, which in turn predicted higher achievement than a strength in Gs.

In 2002, Evans and colleagues conducted a study to investigate predictive relationships between the various CHC cognitive abilities and reading achievement during childhood and adolescence. Using the nationally representative conormed standardization sample of the Woodcock-Johnson Tests of Cognitive Abilities (WJ-III COG) and Tests of Achievement (WJ-III ACH), multiple regression analyses were conducted in which WJ-III cognitive cluster scores constituted predictor variables and reading outcome clusters constituted criterion variables. In using these particular predictive constructs in their research design, the researchers were interested in circumventing the effects of specification error, when a model omits some potentially important variables, leading to biased results. In reading research, for example, different investigators have specified various models of reading, often focusing on one area and failing to include other important predictors. Fully identifying a model of reading should allow the selection of appropriate measures.

In 1998, the National Research Council's Committee on the Prevention of Reading Difficulties in Young Children amalgamated the extant literature on reading skill development, in which several cognitive and language abilities were identified as fundamental to successful literacy acquisition. These abilities consisted of "linguistic proficiency, verbal memory, lexical and syntactic skills, general language abilities, and phonological awareness" (Evans et al., 2002, p. 247). Thus, specification error would be curtailed by incorporating measurements of each of these known predictor variables into the design. Broadly speaking, these areas would fall under Gc, Gsm, Glr, and Ga.

However, to capture any additional cognitive variables from CHC theory that might be predictive of reading, Evans et al. (2002) used all seven CHC factor clusters and three clinical clusters derived from various tests on the WJ-III COG as predictor variables. The factor clusters of Gc, Glr, Gv, Ga, Gf, Gs, and Gsm were supplemented by the clinical clusters of Phonemic Awareness, Phonemic Awareness-3, and Working Memory, narrow abilities under Ga and Gsm, respectively. Two cluster scores derived from tests on the WJ-III ACH constituted the criterion variables: the Basic Reading Skills (BRS) cluster and the Reading Comprehension (RC) cluster. Five of the CHC constructs were significantly related to measures of reading achievement. Gc displayed moderate to strong relations with measures of reading achievement across childhood and adolescence, whereas Gsm displayed moderate relations during this same period. Ga, Glr, and Gs displayed moderate relations with reading achievement during childhood, though not in adolescence. The two phonemic awareness clinical clusters, PA and PA-3, demonstrated moderate to strong relations with both reading outcome clusters during the early elementary school years. The Working Memory cluster displayed moderate relations with BRS, and strong relations with RC early, dropping to moderate in older childhood and adolescence. These findings are consistent with the National Research Council's model of early reading acquisition, lending support to the CHC model.

In a diagnostic validity study of focused CHC XBA in predicting reading difficulty, four abilities (Ga, Gc, Gsm, and Gs) were selected based on previous empirical findings that established their significant and consistent relationship with reading achievement (Wexler & Fiorello, 2002). The XBA consisted of clusters from the Woodcock-Johnson Tests of Cognitive Abilities-Revised (WJ-R), and the Kaufman Assessment Battery for Children (K-ABC). The results of this study showed that concurrent prediction of a predefined reading difficulty group could be achieved at an 80% rate of accuracy using only five cognitive subtests. These researchers concluded that a selective, focused approach to cognitive assessment offers a valid alternative to full-battery assessment when testing students with purported reading problems.

Writing

Using a cross-sectional research design, McGrew and Knopik (1993) examined the relationship between the seven cognitive clusters (Gc, Glr, Gv, Ga, Gf, Gs, and Gsm) derived from the Woodcock-Johnson Tests of Cognitive Abilities-Revised (WJ-R COG) and the two written language achievement clusters—Basic Writing Skills (BWS) and Written Expression (WE)—derived from the Woodcock-Johnson Tests of Achievement-Revised (WJ-R ACH) for each of the 21 different age groups composing the standardization sample. The Gc cluster and the Gs cluster displayed the most consistent relationships with both written language achievement clusters across the lifespan. The relationship between the Gc cluster and both written language clusters systematically increased in magnitude across the lifespan beginning at age seven. The Gs cluster demonstrated relatively stronger relations with the BWS cluster during the school years after which point the relationship significantly decreased in magnitude. The relationship between the Gs cluster and the WE cluster, however, was consistently moderate in strength across the lifespan. Ga displayed a substantial role in both aspects of writing achievement during the elementary and intermediate grades, whereas Gf was primarily related to BWS during the elementary years but to WE across the lifespan.

The findings of the McGrew and Knopik (1993) study can be interpreted in terms of what we know about the writing process. According to Kay (n.d.), writing is highly complex and integrates skills across a wide range of cognitive and motor skills. Kay distinguishes between primary and secondary requirements for writing, with the primary being prerequisites for the secondary. The primary requirements include language and cognitive skills, in addition to motivational, emotional, and basic skills factors. The secondary factors include higher-level cognitive skills such as organization and flow. Considering the intricacy of written communication, it becomes apparent how the disturbance of diverse neuropsychological processes can disrupt and create difficulties in written expression. The four cognitive ability clusters (Gc, Gs, Ga, and Gf) that demonstrated at least moderate relations with measures of writing achievement across the lifespan can be associated with several of these primary and secondary writing requirements. For example, Gc can be associated with receptive and expressive language skills and syntactical knowledge; Gs can be associated with automatization and fluent motor skills; Ga can be associated with the encoding of sounds as symbols; and Gf can be associated with concepts of planning, organization, and flow.

The specific finding that Ga and Gs were predominantly influential during the primary and intermediate grades supports evidence that writing difficulties in the elementary grades are often a result of primary requirements such as handwriting, spelling, and orthographic coding (e.g., Berninger, 1998). Likewise, the specific finding that Gf and Gc were primarily significant in later life supports evidence that older students typically have more difficulty with the higher-order cognitive processing, both language generation and planning and organization (Berninger, 1998).

Math

In 1995, McGrew and Hessler investigated the relationship between the Woodcock-Johnson Tests of Cognitive Abilities-R (WJ-R COG) CHC clusters and mathematics achievement across the lifespan. Gs, Gc, and Gf were related consistently and significantly to performance on measures of basic mathematics skills (BMS) and mathematics reasoning (MR). Gsm exhibited a significant relationship with mathematical reasoning achievement during the elementary school years. Glr, Ga, and Gv were not consistently or substantially related to mathematics achievement across the lifespan.

The findings of a study of school-age children using the WJ-III (Floyd, Evans, & McGrew, 2003) are somewhat different from the findings of the McGrew and Hessler (1995) study. Gc displayed a moderate relation with the Math Calculation Skills (MCS) cluster in later school-age years, while it consistently exhibited a moderate to strong relation with the Math Reasoning (MR) cluster throughout the school years. Gf, Gsm, and Glr displayed moderate relations with both achievement clusters throughout the school-age years. Gs consistently displayed a moderate to strong relation with the MCS cluster while only displaying a moderate relation with the MR cluster during the early school years. Last, Ga exhibited a moderate relation with the MCS cluster, while Gv demonstrated insignificant relations with either mathematics achievement cluster throughout the school age years.

An up-to-date summary of the linkages between CHC abilities and reading and mathematics achievement is provided by Floyd, Shaver, and McGrew (2003). Broadly speaking, this information from the normative sample of the WJ-III is consistent with the results of prior studies. The most significant and consistent predictors of basic reading achievement are Gc, Ga (specifically Phonetic Coding), Glr, Gsm, Gs, and, for reading comprehension, Gc, Glr, Gs, with a slight contribution from Gf. The most significant and consistent predictors of math calculation are Gc, Gf, Gq (specifically Math Knowledge), Gsm, and, in the early grades, Glr and Gs. The most significant and consistent predictors of math reasoning are Gc, Gf, Gq (specifically Quantitative Reasoning), Gsm, and, in the early grades, Gs.

Collectively, these research findings establish the differential diagnostic validity of the CHC XBA and interpretation system in the identification of specific learning disabilities (SLD). In other words, the findings of divergent explanatory and/or predictive relations between specific CHC cognitive abilities and academic achievement in specific content areas strengthens the validity of the differential diagnostic detection techniques derived from this type of assessment and interpretation.

Although this literature demonstrates correlational links between the various cognitive abilities and specific achievement areas, those links do not automatically lead to interventions. Researchers have studied the links between specific assessment results and interventions using the Diagnostic-Prescriptive Model or an Aptitude-Treatment Interaction (ATI) approach. Much early ATI research, however, focused on identifying weaknesses in modality (e.g., visual or auditory) and attempts to remediate those weaknesses, without directly intervening with the academic difficulties. Unfortunately, attempts to remediate underlying weaknesses consistently failed to cause improvement in academic functioning (e.g., Kavale & Forness, 1999; Ysseldyke & Sabatino, 1973). Matching academic instruction to students' perceptual strengths has likewise been shown not to be effective (e.g., Braden & Kratochwill, 1997; Kavale & Forness, 1999). Likewise, the K-ABC was designed to facilitate interventions matched to simultaneous and sequential aptitudes but failed to demonstrate ATIs in later research (Ayres & Cooley, 1986; Fisher, Jenkins, Bancroft, & Kraft, 1988; Good, Vollmer, Creek, Katz, & Chowdhri, 1993). However, much early ATI research was plagued with methodological weaknesses, including poorly defined and measured constructs (Ysseldyke & Salvia, 1974) and poorly defined and implemented interventions (Reynolds, 1988). More recent research with better-defined aptitudes and treatments has identified some effective ATIs. Examples include individualized psycholinguistic training to improve students' language skills (summarized in Kavale & Forness, 1999), mediated learning for preschoolers with poor language development to develop general cognitive processes and direct instruction for preschoolers with higher language skills (Cole, Dale, Mills, & Jenkins, 1993) and a variety of effective ATIs for reading and math using the CAS (Das, Naglieri, & Kirby, 1994; Naglieri & Gottling, 1995, 1997; Naglieri & Johnson, 2000).

Future ATI research needs to focus on clearly delineating the cognitive processing model defining the aptitudes and ensuring that the measurement of those aptitudes is technically sound (e.g., Braden & Kratochwill, 1997; Deno, 1990; Reynolds, 1988; Speece, 1990). We feel that CHC theory provides the basis for a well-supported model that can be assessed in a technically sound way. The treatment side of the equation needs attention as well, including explicit assessment of treatment integrity. Interventions can be targeted at remediating deficits, strengthening weak areas explicitly linked to academic performance. We have good research validation for a number of interventions targeting specific academic weaknesses, but relatively few are validated for students with specific cognitive processing weaknesses. Often we rely on clinical judgment that a particular intervention is appropriate for a particular student (e.g., see Mather & Jaffe, 2002). Interventions can also be targeted at strengths, using them to address academic weaknesses. This method has theoretical support, but has not been adequately assessed (Reynolds, 1988). Because it is difficult to study ATIs at the group level, single-case or small-n studies using within-subject experimental methodology have been recommended (Braden & Kratochwill, 1997). We have described elsewhere a model for developing and evaluating individual interventions using this methodology, which we call Cognitive Hypothesis Testing (CHT; Hale & Fiorello, 2001; Hale & Fiorello, 2004).

Learning Disabilities

Learning disabilities are assumed to be a within-child problem; a processing disorder that causes a severe discrepancy between ability and achievement in one or more academic areas in a child that has had appropriate opportunities to learn. However, there is little agreement about what a processing disorder is and how to document it, how to define and measure ability, how to determine the presence of a severe discrepancy, and how to document that appropriate learning opportunities were present.

Several researchers have pointed out difficulties with the severe discrepancy model for identification of learning disabled (LD) children (e.g., Aaron, 1997; Siegel, 1989). One problem is that a number of studies have compared "garden variety poor readers" and reading disabled children and found remarkable similarities (Pennington, Gilger, Olson, & DeFries, 1992; Shaywitz, Fletcher, Holahan, & Shaywitz, 1992; Siegel, 1992). However, we also know that students identified as LD in schools may include children with a wide variety of subtypes of LD (Wong, 1996) and comorbid conditions, or may be children with other disabilities or no disability at all (MacMillan, Gresham, & Bocian, 1998). In addition, children thought to be "garden variety poor readers" may actually have undetected learning disabilities for various reasons, such as inappropriate test or score use in identification or referral bias.

Because of the professional movement to eliminate the discrepancy formula, many have called for the elimination of IQ testing from LD identification altogether (e.g., Pasternack, 2002; Stanovich, 1991). However, a great deal of research has identified cognitive processing deficits that are linked to learning disabilities (e.g., Tallal et al., 1996; Wolf, 2001), and if cognitive assessment can be used to identify cognitive processing strengths and weaknesses, elimination of testing would be a mistake.

Many researchers have delineated models for identifying learning disabilities that apply our knowledge of cognitive functioning to identifying consistencies or concordances between cognitive processing weaknesses and academic difficulties (e.g., Flanagan et al., 2002; Hoy, Gregg, Wisenbaker, Bonham, King, & Moreland, 1996; Hale & Fiorello, 2004; Naglieri & Reardon, 1993), rather than focusing on a severe discrepancy between ability and achievement. These models share a belief that empirical or theoretical evidence should link the cognitive deficit and achievement difficulties of a student to identify a learning disability.

We have used the above research findings linking CHC abilities to specific achievement areas to produce learning disability worksheets for reading, writing, and math. Because each worksheet contains the cognitive processes that have been empirically linked to that specific achievement area, the worksheets can be used to summarize cognitive testing results, ecological information about functioning, and achievement testing results, to identify concordances. As part of a comprehensive assessment for learning disabilities, these CHC linkages can document the ways that a student's processing deficits may be related to his or her academic weaknesses.

B, a student with an identified learning disability, was reevaluated at the middle school level because of concerns about her progress. Results of her assessment are summarized on the sample worksheet in Figure 1. Test results were all converted to comparable standard scores (M = 100, SD = 15), and observational and teacher interview results were summarized under "Ecological" information. The worksheet demonstrates that her cognitive weakness, working memory, has been empirically linked to basic reading skills. Associative memory, also empirically linked to basic reading skills, is also low average after a delay, which may contribute to B's difficulties. Though she functions in the low average range in basic reading skills with resource support, her reading fluency continues to be very poor with grade-level materials. Programming recommendations were derived from these cognitive processing findings, including additional drill on orthographic and phonological skills, because increasing the size of each "chunk" of information B would be able to recall would minimize the working memory load of reading. Accommodations for poor working memory were also recommended, such as allowing her to use a tape recorder during lectures and obtaining copies of the teacher's or a peer's notes. In addition, repeated readings, using books on tape together with the text, were recommended to increase rehearsal of information to solidify it in long-term memory. Of course, data would continue to be collected to verify the effectiveness of these recommendations.

Another way that research can be brought to bear on LD identification is in the area of the exclusionary clause. One major differential diagnosis question is whether a student's difficulty can be attributed to normal acquisition of a second language, or whether there is a learning disability. Flanagan and Ortiz (2001) have provided guidelines for considering cultural and linguistic loading during a CHC XBA. Although their classifications of the level of linguistic demand and cultural knowledge required were made by expert judgment rather than empirically derived, they provide a beginning heuristic for evaluating children from culturally or linguistically different backgrounds.

D was evaluated by one of our students after he moved to the United States from India. He had been exposed to English in the classroom but spoke primarily Punjabi in the home. He was evaluated with the WJ-III Cognitive and Achievement, and his scores were averaged and entered

BASIC READING

COGNITIVE PROCESSES

Source	Ability	Scores
Testing	Gc-LD Language Development	102
	Gc-VL Vocabulary Knowledge	
	Gc-K0 General Knowledge	
Ecological	Language	Good
	Prior Knowledge	Good
Testing	Ga-PC Phonetic Coding	110
Ecological	Phonemic Awareness	
	Letter-Sound Correspondence	Poor but remediated
	Systematic Phonics Instruction	Wilson
Testing	Glr-NA Rapid Automatic Naming (Symbols)	
	Glr-MA Associative Memory	101/86
Ecological	Long Term Memory Skills	Good
	Verbal Fluency	Good
Testing	Gsm-MS Auditory Memory Span	105
	Gsm-WM Auditory Working Memory	75
Ecological	Short Term Memory Skills	Very poor
Testing	Gs Processing Speed	97
Ecological	Speed	
	Fluency	
	Attention	
	Planning	

ACHIEVEMENT AREAS

Scores	Achievement	Source
	Grw-V Reading Vocabulary	Testing
	Grw-RD Word Reading	
87	Grw-RD Reading Decoding	
86	Grw-RD Pseudoword Decoding	
Poor	Basic Reading Skills	Ecological
69 WPM on grade level	Reading Fluency Oral	Testing
86	Grw-RS Reading Speed Silent	
Poor	Basic Reading Speed and Fluency	Ecological

FIGURE 1. Basic reading disability worksheet for Sample Case B, diagnosed with LD.

into a table based on the Flanagan and Ortiz (2001) scheme (Table 1). The effects of language and cultural difference can clearly be seen in the table, as D's scores drop as you move right and down toward tasks with greater demands for English language ability and American cultural knowledge. The most loaded subtests average 86, approximately one standard deviation below average, about

Table 1
Culture and Language Analysis for Sample Case D, LD Ruled Out

		Language Ability		
		Low	Medium	High
American cultural knowledge	Low	120	116	113
	Medium	123	100	110
	High			86

what would be expected from a nondisabled second-language learner (Anderson, n.d.). In addition, the WJ-III provides CALP (Cognitive-Academic Language Proficiency) scores, criterion-referenced scores reflecting abstract English ability required for classroom success. D's CALP scores ranged from 3–4 (Limited to Fluent) on oral language/Gc to 4 (Fluent) in reading and writing. Although reading and writing should be manageable at D's age level, oral language would range from difficult to manageable. His classroom difficulties are assumed a consequence of his second language acquisition, and a learning disability was ruled out. Programming recommendations included English as a second language (ESL) services in lieu of LD resource support, as well as methods to increase D's exposure to vocabulary and cultural knowledge.

Mental Retardation

The American Association on Mental Retardation (AAMR, 2002) defines mental retardation as "a disability characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills" (p. 1). The AAMR goes on to specify that valid assessment must take into account culture and language, as well as sensory, motor, language, and behavioral issues. In addition, they note that strengths and limitations can coexist, and that limitations should be assessed to define needed supports. CHC theory can guide the assessment of students to identify mental retardation within this framework and provide information about strengths and limitations to provide appropriate programming.

Research findings about the *g* loadings of different CHC abilities allow for analysis of a child's strengths and weaknesses for programming while still confirming the essential nature of mental retardation. A was seen in our psychoeducational clinic for a preschool evaluation. A's scores are presented in Table 2 organized around the *g* loading identified for the broad CHC abilities (McGrew et al., 1997). Although not all areas could be assessed, A's scores clearly reflect a child with mental retardation. His areas of lowest functioning were those loading highest on *g*. He showed a relative strength in rote short-term memory, a skill that will be used in programming for him. The results of prior drill, in his preschool setting and at home, are reflected in his readiness scores, currently in the average range.

Issues that are particularly important to take into account when assessing a child for possible mental retardation are linguistic or cultural difference, as well as the effects of a sensory, motor, or language disability on test results. The high language demands of the Wechsler scales make them particularly vulnerable to the effects of language difference or disability. Certainly, we are aware that language demands in the classroom are high and should be assessed. However, a child with a language difference or disability should not be labeled as having mental retardation if language is the primary source of the delay.

S was a child seen in our psychoeducational clinic. Her WISC-III scores alone would have raised the concern that she might have mental retardation: Verbal IQ 62, Performance IQ 75, Full

Table 2
CHC g Loading Chart for Sample Case A, Diagnosed With MR

	Factor	Description	Avg. Score	Level of Performance
More	Gf	Fluid reasoning	60	Significantly below average
g	Gq	Quantitative reasoning	63	Significantly below average
loading	Gc	Crystallized ability	70	Well below average
|	Gsm	Short-term memory	77	Well below average
|	Gv	Visual processing	71	Well below average
|	Ga	Auditory processing		
Less	Glr	Long-term storage & retrieval		
g	Gs	Processing speed		
loading	Grw	Reading & writing	95	Average

Scale IQ 66. We chose to complete her XBA using the Leiter-R because of concerns about her language ability. Here we present the average scores from her XBA, combining scores from both the WISC-III and the Leiter-R (Table 3). Clearly, S does well on high-*g* tasks, as long as language demands are minimized. Her Vineland adaptive behavior scores confirmed that she is a child with a language disorder, not a child with mental retardation: Communication 58, Daily Living 105, Socialization 105. Programming recommendations for S included full-time placement in a language support classroom with intensive speech and language therapy daily.

School psychology practice should occur in the context of research findings. This places a great burden on practitioners to stay current in the research literature. However, the burden also falls on researchers to ensure that our research addresses issues pertinent to practice in the real world. Based on our current state of knowledge, we recommend that practitioners use CHC theory when interpreting assessment findings. Although learning disabilities identification is in a state of flux, when using a clinical model for evaluation, research findings on the links between cognitive abilities and achievement should always be kept in mind. Evaluations serve two purposes, diagnosis/classification and recommendations for intervention. CHC-based assessments can provide information relevant for both identification and programming.

Table 3
CHC g Loading Chart for Sample Case S, MR Ruled Out

	Factor	Description	Avg. Score	Level of Performance
More	Gf	Fluid reasoning	92	Average
g	Gq	Quantitative reasoning	82	Below average
loading	Gc	Crystallized ability	74	Well below average
|	Gsm	Short-term memory	75	Well below average
|	Gv	Visual processing	93	Average
|	Ga	Auditory processing	72	Well below average
|	Glr	Long-term storage & retrieval	78	Well below average
Less	Gs	Processing speed	88	Low average
g	Grw	Reading	72	Well below average
loading		Writing	60	Significantly below average

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