

## **APPENDIX D**

### **Table of CHC Abilities, Measurements and Relation to Academic Achievement**

The following table provides a definition of the 7 Cattell-Horn-Carroll ability areas in alignment to the subtests that measure skills within those clusters. The table then provides information as to validity research on the relationship of the CHC abilities within the broad achievement areas of Reading, Mathematics, and Writing.

**Table 9. CHC Abilities, Measurements and Relation to Academic Achievement**

7 CHC Broad Abilities	CHC Narrow Abilities		(Basic) W-J III Cognitive Measurement	(Advanced) Cross-Battery Cognitive Measures	Relation Between Ability and Academic Achievement		
	Ability	Definition			Reading	Math	Writing
<b>Comprehension-Knowledge (Gc)</b>  <b>Definition:</b> <i>The breadth and depth of knowledge including verbal communication and information. Reasoning, when using previously learned procedures, is also included.</i>	<b>Language Development (LD)</b>  <i>*Significantly related to reading achievement</i>	General development or the understanding of words, sentences, and paragraphs (not requiring reading) in spoken native language skills.	<b>Test 1 Verbal Comprehension</b>  <i>Picture Vocabulary</i>  <i>Synonyms</i>  <i>Antonyms</i>  <i>Verbal Analogies</i>  Extended Battery: General Information	<b>K-ABC</b> <i>Expressive Vocabulary</i> <i>Verbal Knowledge</i> <i>Riddles</i>  <b>WISC-IV</b> <i>Vocabulary</i> <i>Information</i> <i>Similarities</i> <i>Comprehension</i> <i>Word Reasoning</i>  <b>WAIS-III</b> <i>Vocabulary</i> <i>Information</i> <i>Similarities</i> <i>Comprehension</i>  <b>WPPSI-III</b> <i>Vocabulary</i> <i>Information</i> <i>Similarities</i> <i>Comprehension</i> <i>Receptive Vocabulary</i> <i>Picture Naming</i> <i>Word Reasoning</i>	<b>Language development, lexical knowledge, and listening ability are important at all ages. These abilities become more important with age.</b>	<b>Language development, lexical knowledge, and listening ability are important at all ages. These abilities become more important with age.</b>	<b>AFTER AGE 7, language development, lexical knowledge, and general information are important. These abilities become increasingly more important with age.</b>
	<b>Lexical Knowledge (VL)</b>  <i>*Significantly related to reading achievement</i>	Extent of vocabulary that can be understood in terms of correct word meanings.					
	<b>General Verbal Information (KO)</b>	Range of general knowledge.					

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Broad Ability	Ability	Definition			Reading	Math	Writing
<p><b>Long-Term Retrieval (Glr)</b></p> <p><b>Definition:</b> The ability to store information efficiently and retrieve it later through association.</p>	<b>Associative Memory (MA)</b>	Ability to recall one part of a previously learned but unrelated pair of items when the other part is presented (i.e., paired associative learning).	Test 2: Visual-Auditory Associative Memory	<p><b>K-ABC</b></p> <p><i>Atlantis</i></p> <p><i>Rebus</i></p> <p><i>Atlantis</i></p> <p><i>Delayed</i></p> <p><i>Rebus Delayed</i></p>	<p><b>Naming facility (NA) or rapid automatic naming is very important during the elementary school years. Associative memory (MA).</b></p>		<p>Naming facility (NA) or rapid automatic naming has demonstrated relations with written expression, primarily the fluency aspect of writing.</p>
	<b>Ideational Fluency (FI)</b>	Ability to produce rapidly a series of ideas, words, or phrases related to a specific condition or object.	Test 10: Delayed Visual-Auditory Learning – Delayed				
	<b>Naming Facility (NA)</b>	Ability to produce rapidly names for concepts.	<i>Associative Memory</i>				
	<b>Meaningful Memory (MM)</b>	Ability to recall a set of items where there is a meaningful relation between items or the items comprise a meaningful story or connected discourse.	Extended Battery: Retrieval Fluency  <i>Ideational fluency</i>				

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	Ability	Definition			Reading	Math	Writing
<b>Visual-Spatial Thinking (Gv)</b>  <b>Definition:</b> Spatial orientation, the ability to analyze and synthesize visual stimuli, and the ability to hold and manipulate mental images.	<b>Visualization (VZ)</b>	Ability to mentally manipulate objects or visual patterns and to see, in the "mind's eye", how they would appear under altered conditions.	Test 3: Spatial Relations  <i>Visualization</i>  <i>Spatial Relations</i>	<b>K-ABC</b> Face Recognition Triangles Gestalt Closure Rover Block Counting Conceptual Thinking	Orthographic procession	May be important primarily for higher level or advanced mathematics (e.g., geometry, calculus.)	
	<b>Spatial Relations (SR)</b>	Ability to perceive and manipulate visual patterns or to maintain orientation with respect to objects in space.	<b>Extended Battery:</b>	<b>WISC-IV</b> Block Design Picture Completion			
	<b>Visual Memory (MV)</b>	Ability to form and store a mental representation or image of a visual stimulus and then recognize or recall it later.	Test 13: Picture Recognition  <i>Visual Memory</i>	<b>WAIS-III</b> Block Design Object Assembly Picture Arrangement Picture Completion			
	<b>Spatial Scanning (SS)</b>	Ability to survey a spatial field or pattern accurately and identify a path through the visual field or pattern.	Test 19: Planning  <i>Spatial scanning</i>  <i>General sequential reasoning</i>	<b>WPPSI-III</b> Block Design Object Assembly Picture Completion			

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Broad Ability	Ability	Definition			Reading	Math	Writing
<b>Auditory Processing (Ga)</b>  <b>Definition:</b> The ability to discriminate, analyze, and synthesize auditory stimuli. Also related to phonological awareness.	<b>Phonetic Coding (PC)</b>  <i>*Significantly related to reading achievement</i>	Ability to process speech sounds, as in identifying, isolating, and blending sounds-phonological awareness.	Test 4: Sound Blending  <i>Phonetic Coding: Synthesis</i>  Test 8 Incomplete Words  <i>Phonetic Coding: Analysis</i>	<b>K-ABC</b>  <b>WISC-IV</b>  <b>WAIS-III</b>  <b>WPPSI-III</b>	<b>Phonological coding (PC) or phonological awareness is very important during the elementary school years.</b>		Phonological coding (PC) or phonological awareness or processing are very important during the elementary school years for both basic writing skills and written expression (primarily before age 11).
	<b>Resistance to Auditory Stimulus Distortion (UR)</b>	Ability to understand speech that has been distorted or masked in one or more ways.	<b>Extended Battery:</b>  Test 14 Auditory Attention				
	<b>Speech-Sound Discrimination (US)</b>	Ability to discriminate particular phonemes or speech sounds.	<i>Speech-sound discrimination</i>  <i>Resistance to auditory stimulus distortion</i>				

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	Broad Ability	Ability			Definition	Reading	Math
<b>Fluid Reasoning (Gf)</b>  <b>Definition:</b> The ability to reason and solve problems that often involve unfamiliar information or procedures. Manifested in the reorganization, transformation, and extrapolation of information.	<b>General Sequential Reasoning (RG)</b>  <i>*Significantly related to math achievement</i>	Ability to start with stated rules, premises, or conditions and to engage in one or more steps to reach a solution to a problem.	<b>Extended Battery:</b> Analysis-Synthesis  <i>Sequential reasoning</i>  <i>Test 19: Planning</i>  <i>Spatial scanning</i>  <i>General sequential reasoning</i>	<b>K-ABC</b> Pattern Reasoning Story Comprehension  <b>WISC-IV</b> Matrix Reasoning Picture Concepts  <b>WAIS-III</b> Matrix Reasoning	Inductive (I) and general sequential reasoning (RG) abilities play a moderate role in reading comprehension.	<b>Inductive (I) and general sequential reasoning (RG) abilities are consistently very important at all ages.</b>	Inductive (I) and general sequential reasoning (RG) abilities are related to basic writing skills primarily during the elementary school years (e.g., 6 – 13) and consistently related to written expression at all ages.
	<b>Induction (I)</b>  <i>*Significantly related to math achievement</i>	Ability to discover the underlying characteristic (e.g., rule, concept, process, trend, class membership) that governs a problem or a set of materials.	Test 5: Concept Formation  <i>Induction</i>	<b>WPPSI-III</b> Matrix Reasoning Picture Concepts			

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	Broad Ability	Ability			Definition	Reading	Math
<b>Processing Speed (Gs)</b>  <b>Definition:</b> Speed and efficiency in performing automatic or very simple cognitive tasks.	<b>Perceptual Speed (P)</b>  <i>*Significantly related to reading, math, and writing achievement</i>	Ability to search for and compare rapidly visual symbols presented side by side or separated in a visual field.	<b>Test 6: Visual Matching</b>  <i>Perceptual speed</i> Test 16: Decision Speed	<b>K-ABC-II</b>  <b>WISC-IV</b> Symbol Search Coding Cancellation	<b>Perceptual speed (P) is very important during all school years, particularly the elementary school years.</b>	<b>Perceptual speed (P) is very important during all school years, particularly the elementary school years.</b>	<b>Perceptual speed (P) is very important during all school years, for basic writing and related to all ages for written expression.</b>
	<b>Semantic Processing Speed (RA)</b>	Speeded performance requiring encoding and mental manipulation of content.	<i>Semantic processing speed</i>	<b>WAIS-III</b> Symbol Search Digit Symbol Coding			
	<b>Attention/ Concentration (AC)</b>	Identified as a possible ability in some studies, may be related to personality characteristics such as carefulness or impulsivity, and/or cognitive abilities in the domain of processing speed.	<b>Test 18: Rapid Picture Naming</b>  <i>Naming facility</i> <b>Extended Battery:</b>  <b>Test 20: Pair Cancellation</b>  <i>Attention &amp; concentration</i>	<b>WPPSI-III</b> Coding Symbol Search			

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	Broad Ability	Ability			Definition	Reading	Math
<b>Short-Term Memory (Gsm)</b>  <b>Definition:</b> The ability to hold information in immediate awareness and then use it within a few seconds, also related to working memory.	<b>Memory Span (MS)</b>  *Significant relationship to writing and to working memory in reading, math and advanced writing skills.	Ability to attend to and immediately recall temporally ordered elements in the correct order after a single presentation.	Extended Battery:  Test 17: Memory for Words  <i>Memory span</i>	<b>K-ABC-II</b> Number Recall Word Order Hand Movements  <b>WISC-IV</b> Digit Span Letter-Number Sequencing	Memory span (MS) is important especially when evaluated <b>within the context of working memory.</b>	Memory span (MS) is important especially when evaluated <b>within the context of working memory.</b>	<b>Memory span (MS) is important to writing, especially spelling skills whereas working memory has shown relations with advanced writing skills (e.g., written expression).</b>
	<b>Working Memory (MW)</b>	Ability to hold information in mind for a short time while performing some operation upon it.	Test 7: Numbers Reversed  <i>Working memory</i>  Test 9: Auditory Working Memory	<b>WAIS-III</b> Symbol Search Digit Symbol Coding  <b>WPPSI-III</b> Coding Symbol Search			

Table summarizes information from Table 5-4. Definitions of Seven CHC Broad Abilities Measured by the WJ III Cog (p. 76) ; Table 5 – 5. Broad and Narrow Abilities Measured by the WJ III Cog (p. 76); Table 5-6. Definitions of Narrow Abilities Measured by the WJ-III Cog; Mather and Woodcock, 2001 Examiner’s Manual Woodcock-Johnson III Tests of Cognitive Abilities, Riverside Publishing and Table 2/14. Summary of Findings on Relations between CHC Abilities and Academic Achievement (p. 45), Flanagan, et al. (2006) The Achievement Test Desk Reference: A Guide to Learning Disability Identification, John Wiley & Sons, New Jersey. Flanagan, Ortiz, Alfonso (2007) Essentials of Cross-Battery Assessment: 2<sup>nd</sup> Edition. John Wiley and Sons. Hoboken, New Jersey.



