The Utility of the CHC Taxonomy and Cross-Battery Assessment for SLD Identification

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Conflict of Interest Disclosure

I am a co-founder of the *Comprehensive Assessment for Intervention* (CAI) website, which operates under Cross-Battery Assessment LLC, a for-profit company.

Objectives-Part 1

To describe 2-3 important developments in the evolution of CHC theory

To identify 5-7 CHC constructs measured by current tests

To describe at least one debate issue among scholars in the field who have published on CHC theories

Content-Part 1

Progress in psychometric theories of intelligence

- From *g* to CHC
- Definitions of key broad and narrow abilities that make up CHC theory and that are measured most frequently on ability tests

Progress in the development and structure of cognitive tests

- Evolution of the Wechsler Scales
- Summary of other comprehensive cognitive batteries

Progress in approaches to cognitive test interpretation

- Overall *g*
- Clinical profile analysis
- Psychometric profile analysis (shared abilities; intelligent testing)
- Application of theory (*g* v. specific abilities)
- Application of and refinements to theory and CHC-based research and interpretation

Evolution and Impact of Psychometric Theories on the Structure of Cognitive Tests and Cognitive Test Interpretation

Theories

General Ability (*g*) → **Two-Factor Models** → **Early Multiple Factor Models** → **Current Multiple Factor Models**

Spearman

Original *Gf-Gc* Simultaneous-Successive

Thurstone's Primary Mental Abilities
Planning, Attention, Simultaneous, and Successive (PASS)

Cattell-Horn *Gf-Gc* Theory
Carroll Three-Stratum Theory
Cattell-Horn-Carroll (CHC)

Cognitive Tests

Stanford-Binet LM

W-B
WISC
WAIS
WPPSI

WISC-R
WAIS-R
WPPSI-R

WJ

K-ABC
KAIT

SB-IV

SB5

WJ-R

WJ III

WISC-III/WISC-IV
WAIS-III/WAIS-IV
WPPSI-III

CAS
DAS

CAS2
KABC-II

DAS-II

WISC-V

WJ IV

Cross-Battery Assessment (XBA) applied to all batteries and used in hypothesis-testing approaches

Interpretive Approaches

Clinical Profile Analysis (Second Wave)

- Interpretation of Verbal/Performance differences
- Interpretation of the shape of the subtest profile
- Interpretation of both subtest scores and item responses
- Subtest profiles believed to reveal diagnostic information
- Rapaport et al.'s (1945/1946) work had significant impact

Psychometric Profile Analysis (Third Wave)

- Application of psychometric information to interpretation
- Interpretation of empirically based factors
- Incorporation of subtest specificity in interpretation
- Deemphasis on subtest interpretation
- Validity of profile analysis questioned
- Cohen's (1959) work had significant impact
- Kaufman's (1979) "intelligent" testing approach
- Bannatyne's (1974) recategorization of subtests

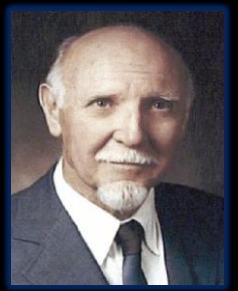
Application of Theory to Interpretation (Fourth Wave)

- Theoretical grouping of subtests
- Interpretation based on Gf-Gc, PASS, and CHC theories
- Kamphaus (1993) confirmatory approach
- Kaufman (1994) "intelligent testing" approach
- McGrew and Flanagan (1998) and Flanagan and Ortiz (2001) cross-battery approach

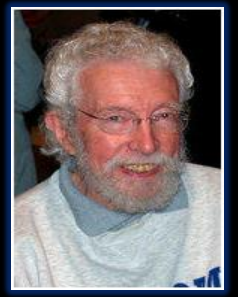
Application of Refinements to Theory and CHC-based Research to Psychological Test Interpretation (Fifth Wave)

- Refinements to CHC theory (e.g., McGrew, 2009; Schneider & McGrew, 2012, 2018)
- Refinements and extensions to the cross-battery approach (e.g., Flanagan et al., 2007, 2012, 2013, 2015, 2017, 2018)
- More attention paid to CHC-based academic outcomes research (e.g., Hajovsky, Niileksela, Flanagan, Alfonso, & Schneider, 2022; McGrew & Wendling, 2010)
- More attention paid to Cross-Battery-CFA in construct validation research (e.g., Caemmerer, Keith, & Reynolds, 2020; Keith & Reynolds, 2012; Reynolds, Keith, Flanagan, & Alfonso, 2012)
- Integration of CHC and neuropsychological theory for cognitive test interpretation (e.g., Flanagan, Alfonso, Ortiz, & Dynda, 2010; Hale & Fiorello, 2004; Miller et al., 2022)

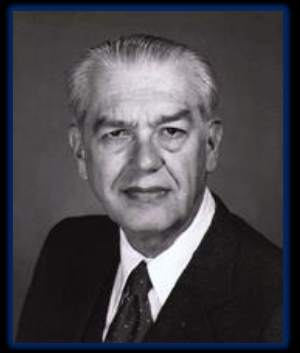
Several Decades of Revisions and Refinements to Gf-Gc/CHC Theory



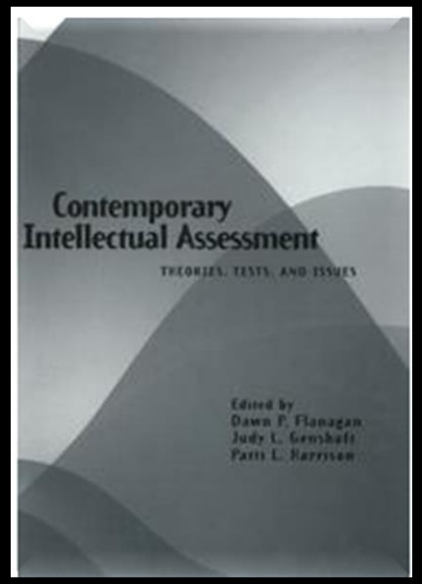
Raymond Cattell Introduced Gf-Gc Theory in 1941



John Horn and colleagues' work (1960s – 1990s) led to expanded 10-factor Gf-Gc theory

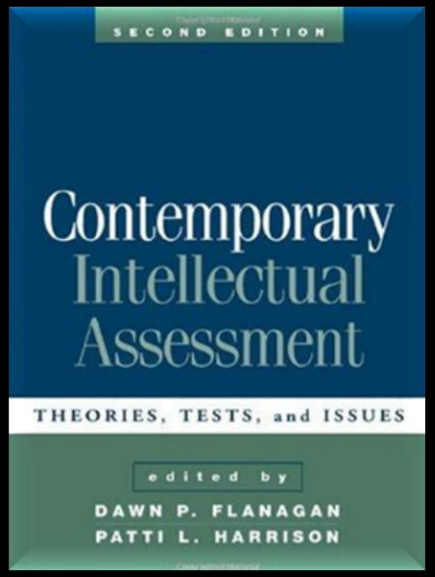


John Carroll reanalyzed the world's literature of human cognitive abilities – Proposed Three-Stratum Theory (1993)



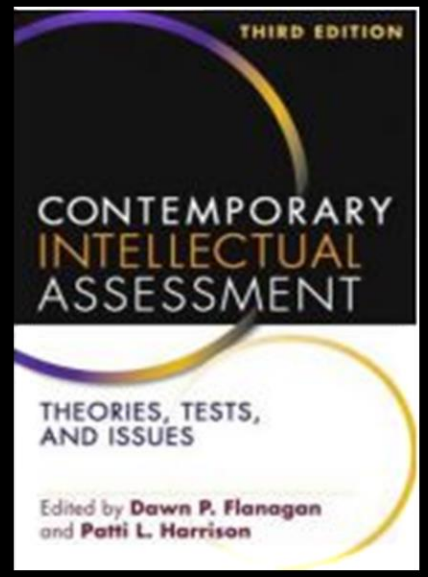
1997

Chapter by **McGrew**: First attempt at Integrating Cattell-Horn Gf-Gc Theory and John Carroll's Three-Stratum Theory



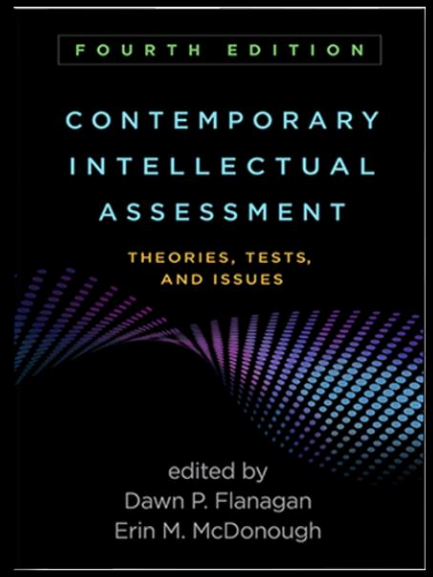
2005

Chapter by **McGrew**: Documentation of how the integrated model presented in 1997 and again in 2000 became known as CHC theory



2012

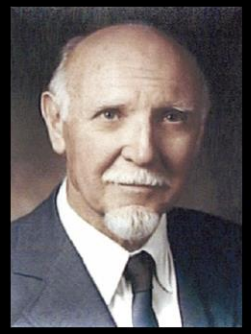
Chapter by **Schneider and McGrew**: Careful review of the literature led to some substantial modifications



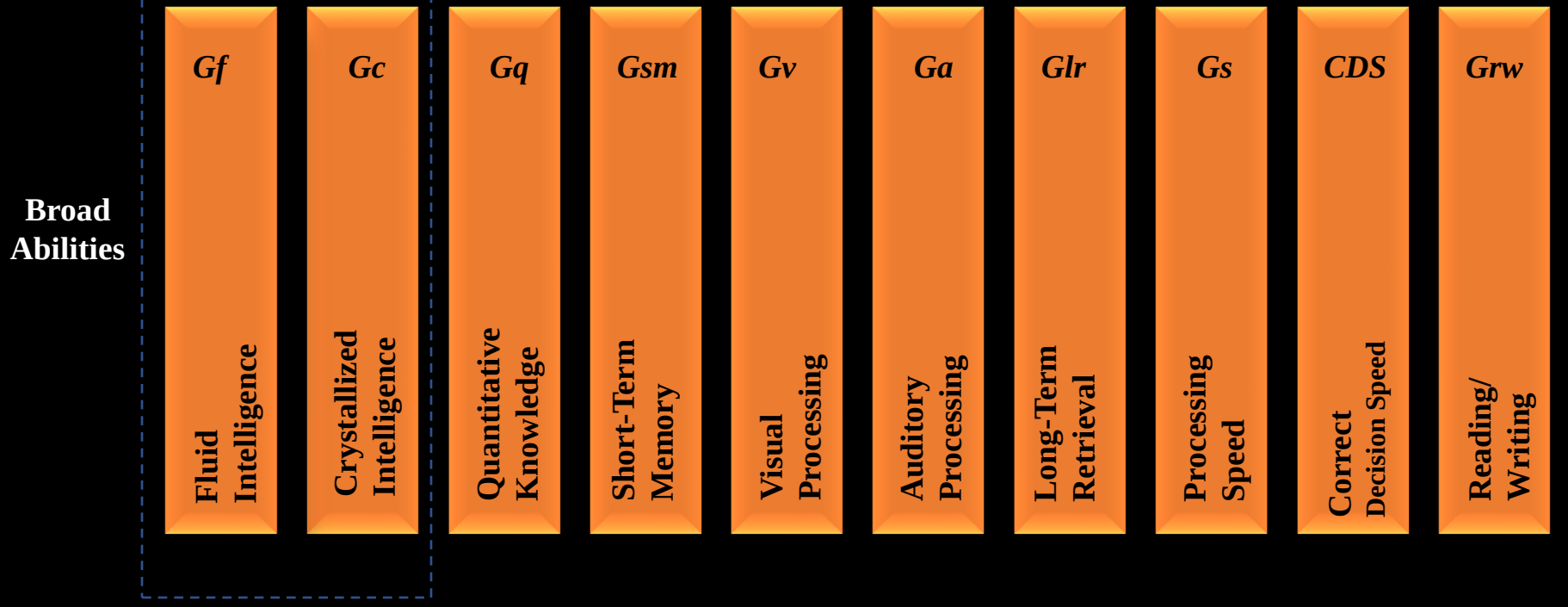
2018

Chapter by **Schneider and McGrew**: Most significant revisions to CHC theory to date and criteria for revisions to the CHC taxonomy

Cattell-Horn *Gf-Gc* Theory



Gf-Gc theory originally proposed by Raymond Cattell in 1941

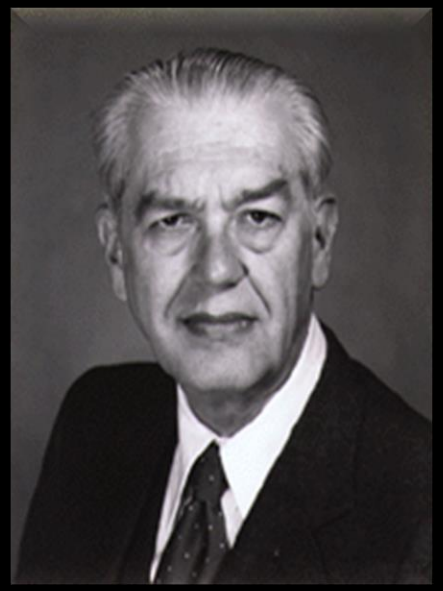


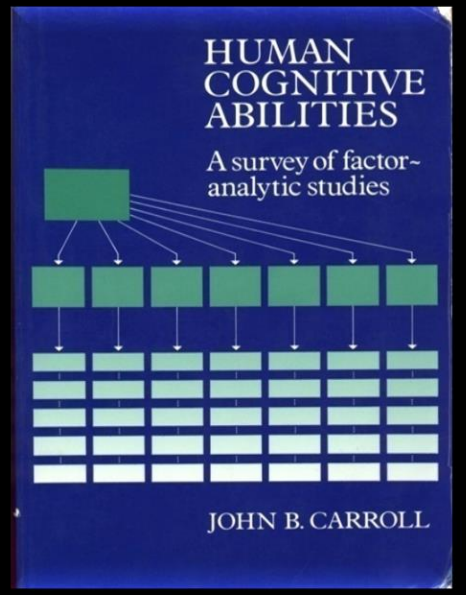
Gf-Gc theory expanded through Horn and colleagues' systematic research

Flanagan, McGrew, & Ortiz (2000); Flanagan, Ortiz, and Alfonso (2013); McGrew and Flanagan (1998); Woodcock (1994)

Progress in Psychometric Theories of Intelligence: From *g* to CHC

Carroll, J. B. (1993). ***Human cognitive abilities: A survey of factor-analytic studies***. New York: Cambridge University Press





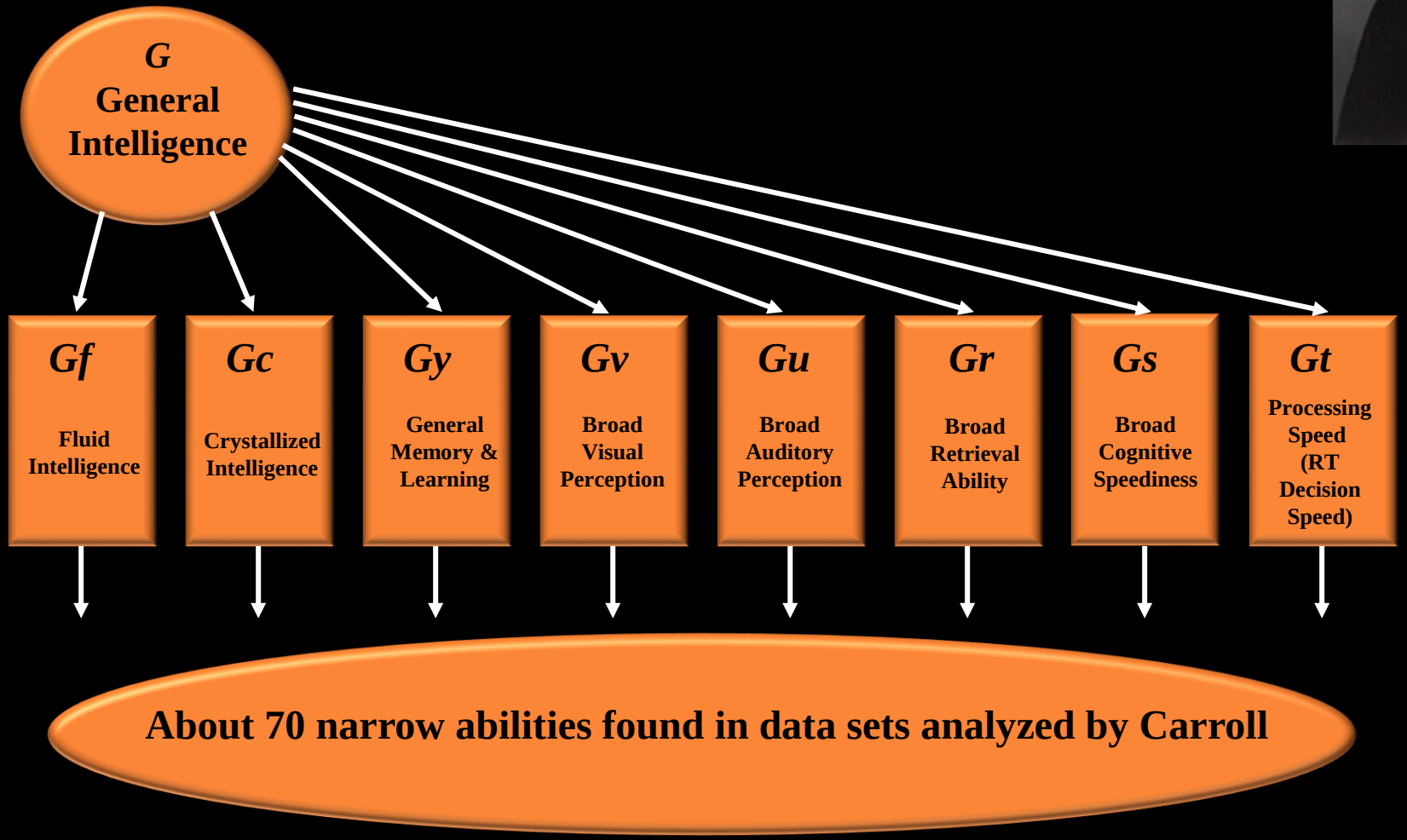
A Landmark Event in Understanding the Structure of Intelligence

Carroll's (1993) Three-Stratum Theory of Cognitive Abilities

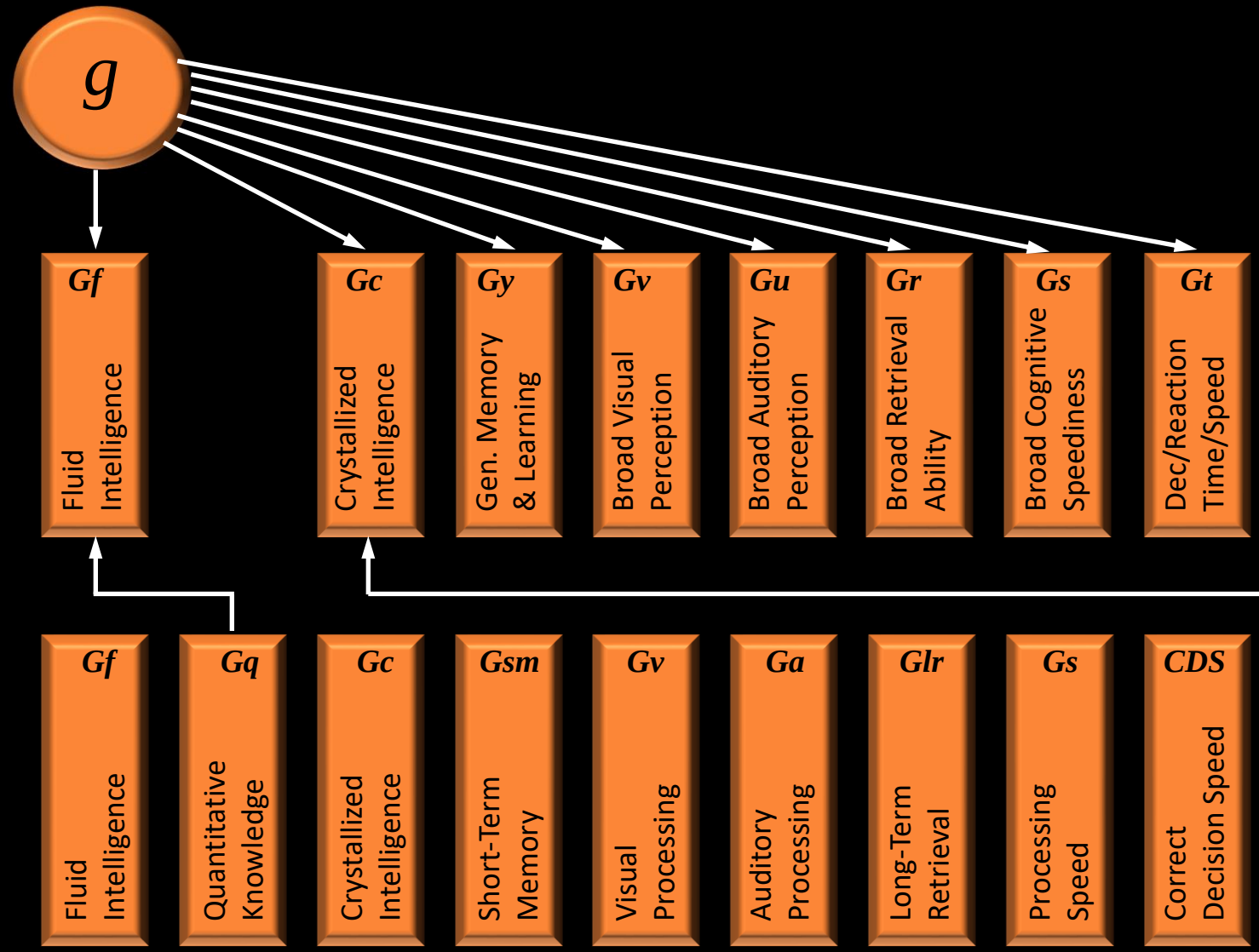
General (Stratum III) Ability

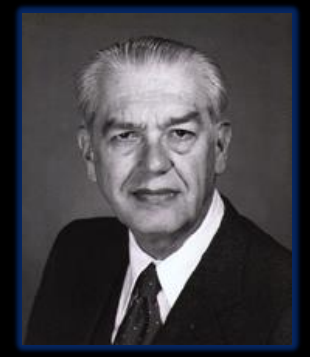
Broad (Stratum II) Abilities

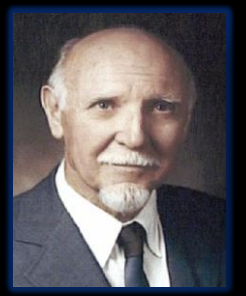
Narrow (Stratum I) Abilities



A Comparison of Cattell-Horn Gf-Gc Theory and Carroll's Three-Stratum Theory







Flanagan, McGrew, & Ortiz (2000); Flanagan, Ortiz, and Alfonso (2013); McGrew and Flanagan (1998); Woodcock (1994)

Four Structural Differences Between the Cattell-Horn and Carroll Models

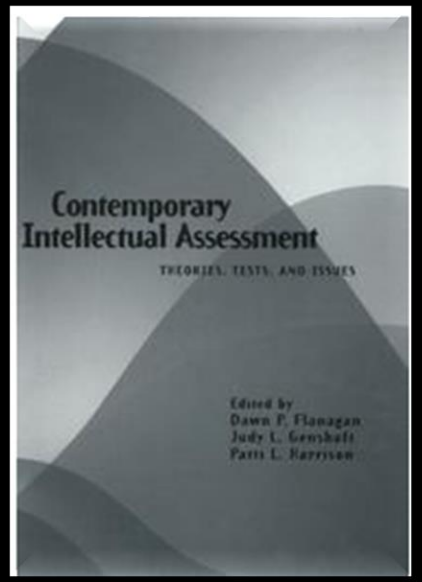
1. Carroll's theory includes a general ability factor (stratum III) whereas the Cattell-Horn theory does not, as Horn and Carroll differed in their beliefs about the existence of this elusive construct
2. The Cattell-Horn theory includes quantitative reasoning as a distinct broad ability (i.e., *Gq*) whereas Carroll's theory includes quantitative reasoning as a narrow ability subsumed by *Gf*.
3. The Cattell-Horn theory includes a distinct broad reading and writing (*Grw*) factor. Carroll's theory includes reading and writing as narrow abilities subsumed by *Gc*.
4. Carroll's theory includes short-term memory with other memory abilities, such as associative memory, meaningful memory, and free-recall memory, under *Gy* whereas the Cattell-Horn theory separates short-term memory (*Gsm*) from associative memory, meaningful memory, and free-recall memory, because the latter abilities are purported to measure long-term retrieval.

Despite these differences, Carroll (1993) concluded that the Cattell-Horn *Gf-Gc* theory represented the most comprehensive and reasonable approach to understanding the structure of cognitive abilities.

Progress in Psychometric Theories of Intelligence: From *g* to CHC

An Integration of the *Gf-Gc* and Three-Stratum Theories of Cognitive Abilities

Based largely on McGrew's analyses in 1997-1999



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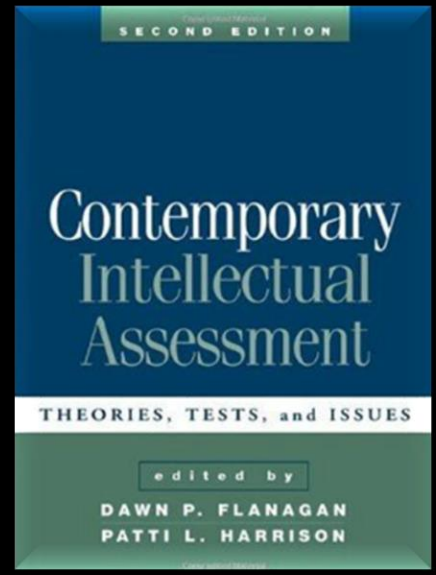

2005

Chapter by McGrew: Documentation of how the integrated model presented in 1997 and again in 2000 became known as CHC theory

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Intelligence

Volume 37, Issue 1, January–February 2009, Pages 1-10

Editorial

CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research

Kevin S. McGrew

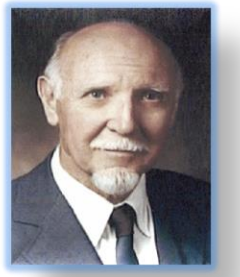
Abstract

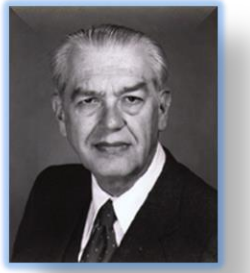
During the past decade the Cattell–Horn Gf–Gc and Carroll Three-Stratum models have emerged as the consensus psychometric-based models for understanding the structure of human intelligence. Although the two models differ in a number of ways, the strong correspondence between the two models has resulted in the increased use of a broad umbrella term for a synthesis of the two models (Cattell–Horn–Carroll theory of cognitive abilities—CHC theory).

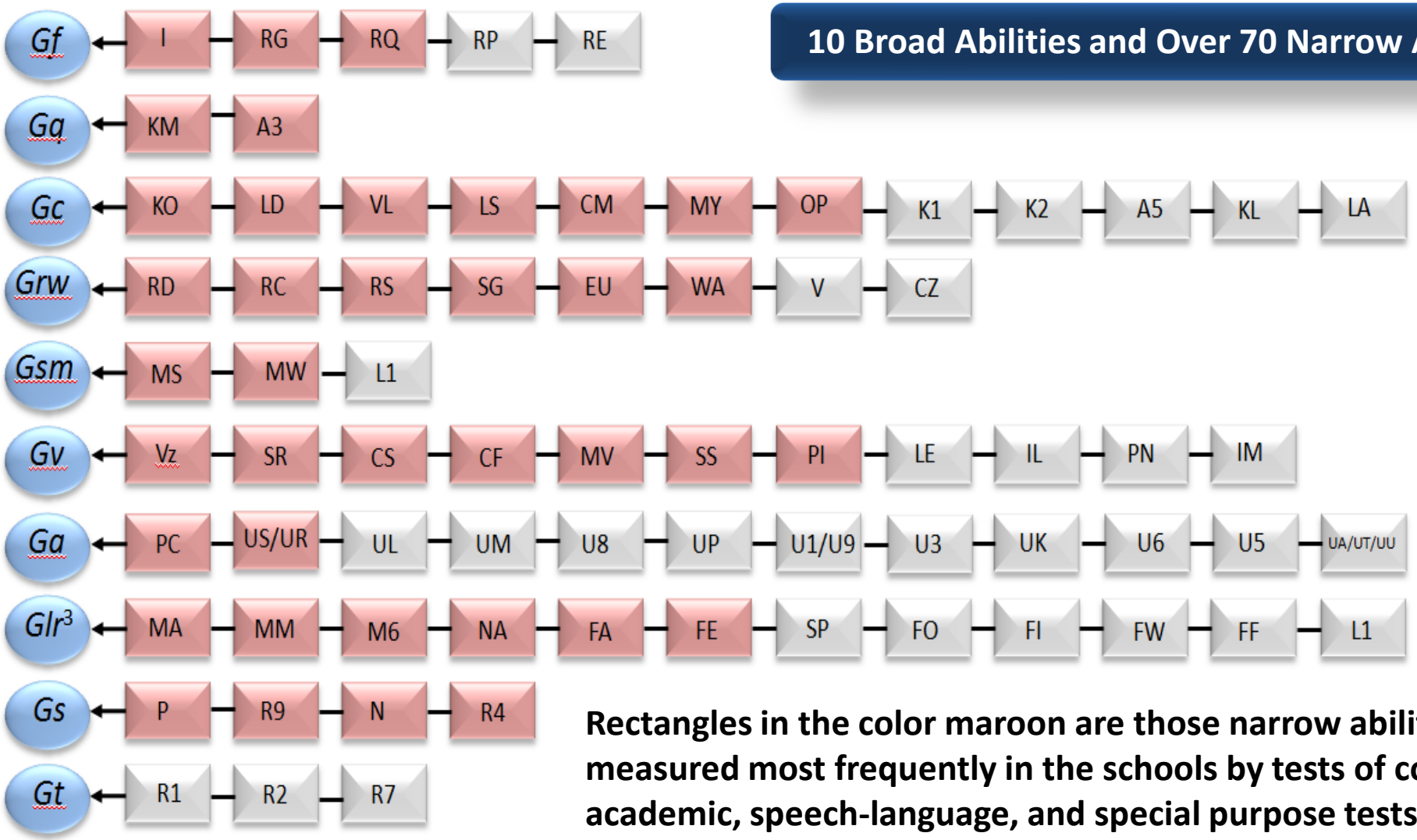
The purpose of this editorial is three-fold. First, I will describe the CHC framework and recommend that intelligence researchers begin using the CHC taxonomy as a common nomenclature for describing research findings and a theoretical framework from which to test hypotheses regarding various aspects of human cognitive abilities. Second, I argue that the emergence of the CHC framework should not be viewed as the capstone to the psychometric era of factor analytic research. Rather, I recommend the CHC framework serve as the stepping stone to reinvigorate the investigation of the structure of human intelligence.

Finally, the Woodcock-Muñoz Foundation Human Cognitive Abilities (HCA) project, which is an evolving, free, on-line electronic archive of the majority of datasets analyzed in Carroll's (1993) seminal treatise on factor analysis of human cognitive abilities, is introduced and described. Intelligence scholars are urged to access the Carroll HCA datasets to test and evaluate structural models of human intelligence with contemporary methods (confirmatory factor analysis). In addition, suggestions are offered for linking the analysis of contemporary data sets with the seminal work of Carroll. The emergence of a consensus CHC taxonomy and access to the original datasets analyzed by Carroll provides an unprecedented opportunity to extend and refine our understanding of human intelligence.

The Cattell-Horn-Carroll (CHC) Model of Cognitive Abilities that Guided Intelligence Test Development from 2000-2012





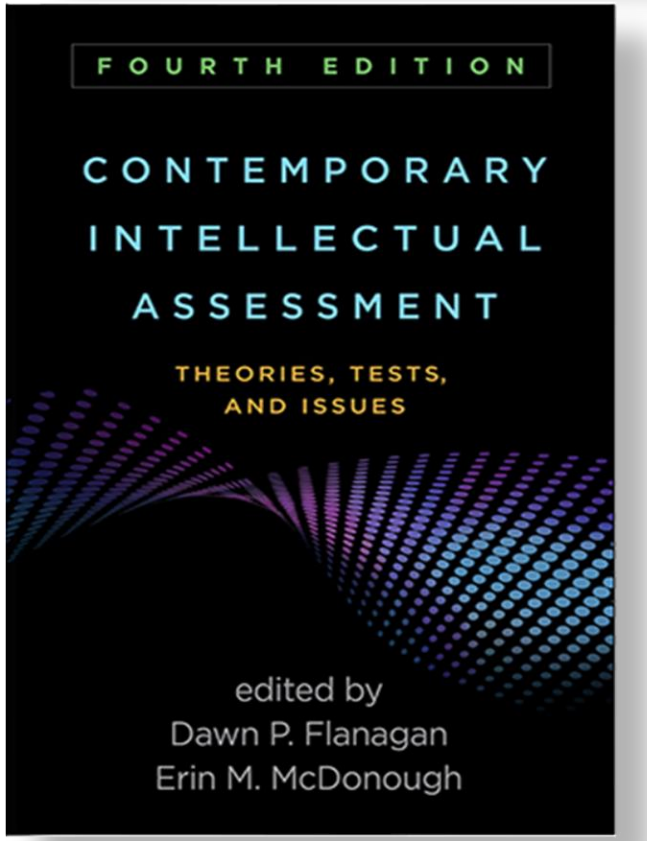


10 Broad Abilities and Over 70 Narrow Abilities

Rectangles in the color maroon are those narrow abilities measured most frequently in the schools by tests of cognitive, academic, speech-language, and special purpose tests (e.g., memory batteries, neuropsychological tests)

Refinements and Extensions to CHC Theory

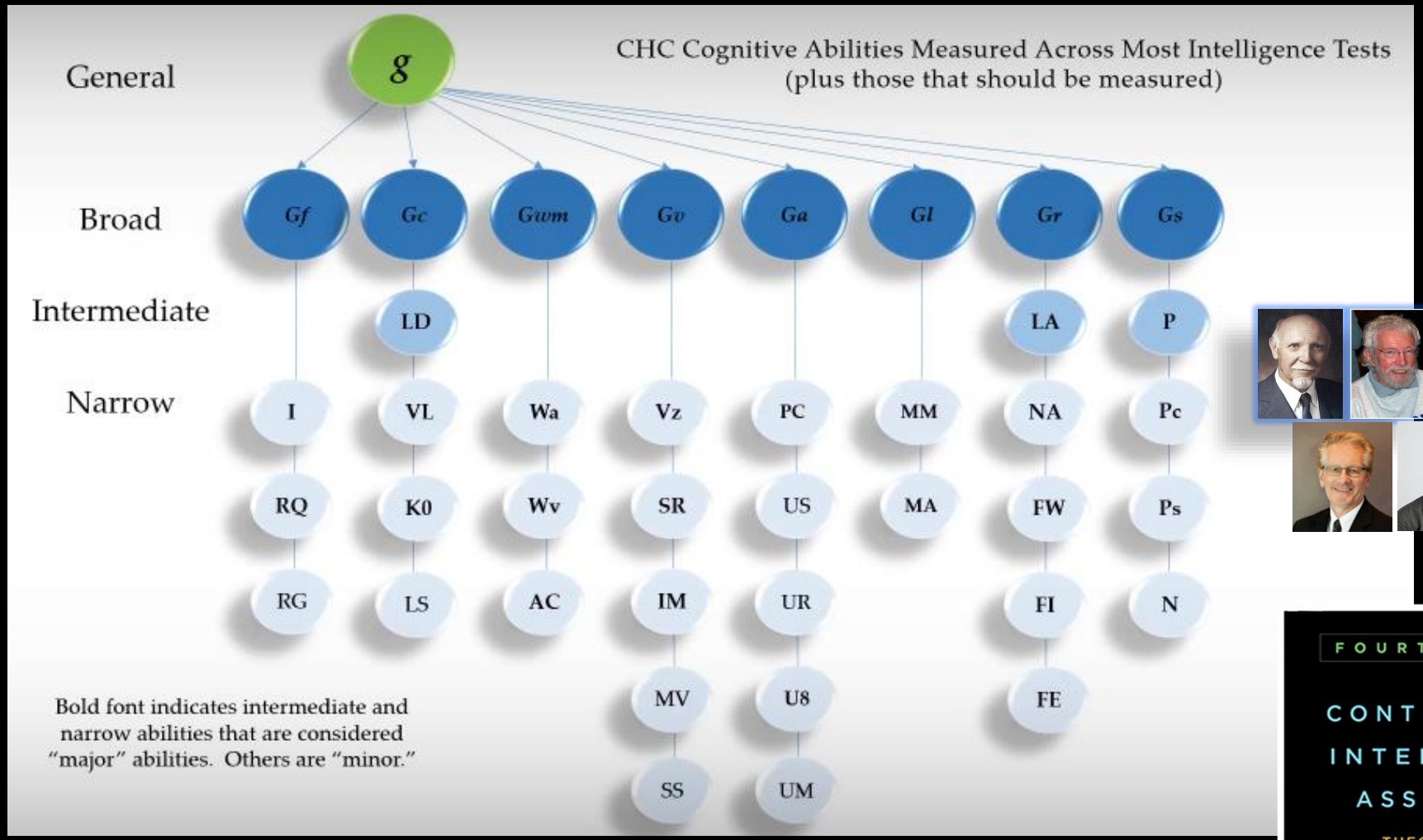
Schneider and McGrew's 2018 Revision of CHC Theory

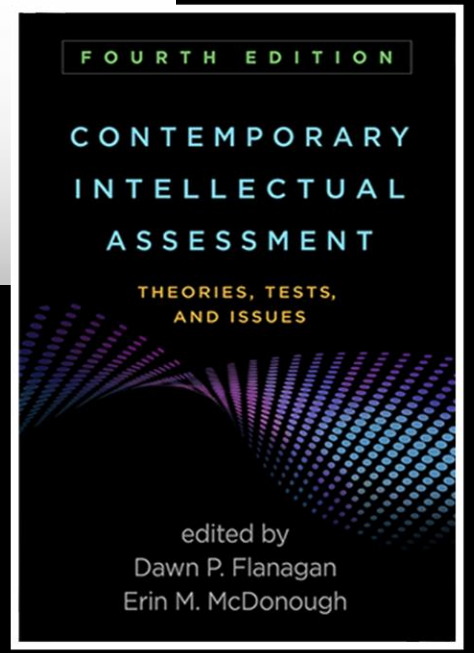


2018

Chapter by
Schneider and McGrew: Most significant revisions to CHC theory to date, including criteria for revisions to the CHC taxonomy

- Intermediate factors were added
- Facets were added
- New broad and narrow ability codes were introduced
- New narrow abilities were added





CHC Theory Revised: A Visual Graphic Summary of **Schneider and McGrew's** 2018 Chapter in Flanagan & McDonough's (Eds.) ***Contemporary Intellectual Assessment***, fourth edition. NY: Guilford. Posted on McGrew's MindHub May 11, 2018

2012-2018 Expanded Cattell-Horn-Carroll (CHC) Model of Cognitive Abilities

Reasoning	*Gf*	I	RG	RQ										
Acquired Knowledge	*Gc*	KO	LD	VL	LS	CM	MY	OP[1]						
	Gkn	KL	KF	LP	A5	K1	MK	BC						
	Gq	KM	A3											
	Grw	RD	RC	RS	SG	EU	WA	WS						
Memory and Efficiency	*Gsm*	MS	MW											
	Glr[3]	MA	MM	M6	NA	FA	FE	SP	FO	FI	FW	FF		
Sensory	*Gv*	Vz	SR	CS	CF	MV	SS	PI	LE	IL	PN	IM		
	Ga	PC	US	UR	UM	U8	UP	U1 U9	UL					
	Go	OM												
	Gh													
Motor	*Gp*	P3	P6	P2	P1	P7	P8	A1	P4					
	Gk													
Speed and Efficiency	*Gs*	P	R9	N	RS	WS								
	Gt	R1	R2	R4	R7	IT								
	Gps	R3	WS	PT	MT									

Sixteen broad and approximately 80 narrow abilities; approximately 9 broad and 35 narrow abilities represented on current batteries

Research on CHC Theory

Tests from Five Different Batteries (39 subtests) were included in a Cross-Battery CFA

Findings:
CHC-based test classifications from theory and prior research were accurate thus supporting CHC theory and its use as a taxonomy for test development, assessment, and interpretation

The factorial composition of almost all subtests was described successfully by the CHC taxonomy, regardless of whether they were designed to tap into CHC abilities

The invariant CHC broad ability factors provide additional support for the CHC-based cross-battery assessment approach, particularly with regard to its guidelines for combining subtests from different batteries to create CHC composites

Contents lists available at SciVerse ScienceDirect

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A cross-battery, reference variable, confirmatory factor analytic investigation of the CHC taxonomy ☆

Matthew R. Reynolds [a,*], Timothy Z. Keith [b], Dawn P. Flanagan [c], Vincent C. Alfonso [d]

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Fluid intelligence
General intelligence
Flynn effect

ABSTRACT

The Cattell–Horn–Carroll (CHC) taxonomy has been used to classify and describe human cognitive abilities. The ability factors derived from the CHC taxonomy are often assumed to be invariant across multiple populations and intelligence batteries, which is an important assumption for research and assessment. In this study, data from five different test batteries that were collected during separate Kaufman Assessment Battery for Children—Second Edition (KABC-II; Kaufman & Kaufman, 2004) concurrent validity studies were factor-analyzed jointly. Because the KABC-II was administered to everyone in the validity studies, it was used as a reference battery to link the separate test batteries in a "cross-battery" confirmatory factor analysis. Some findings from this analysis were that CHC-based test classifications based on theory and prior research were straightforward and accurate, a first-order Fluid/Novel Reasoning (Gf) factor was equivalent to a second-order *g* factor, and sample heterogeneity related to SES and sex influenced factor loadings. It was also shown that a reference variable approach, used in studies that incorporate planned missingness into data collection, may be used successfully to analyze data from several test batteries and studies. One implication from these findings is that CHC theory should continue to serve as a useful guide that can be used for intelligence research, assessment, and test development.

The Largest and Most Comprehensive CHC Investigation to Date

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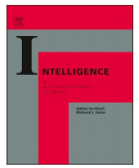

Beyond individual intelligence tests: Application of Cattell-Horn-Carroll Theory

Jacqueline M. Caemmerer[a,*], Timothy Z. Keith[b], Matthew R. Reynolds[c]

[a] Howard University, United States of America
[b] University of Texas at Austin, United States of America
[c] University of Kansas, United States of America

10. Summary

An adequately fitting cross-battery CHC cognitive model that combines six tests consisting of 66 subtests and seven samples of nearly 4000 youth aged 6 to 18 provides validity evidence for CHC theory. The findings applied to tests and subtests developed from a variety of theoretical orientations, not just those derived from CHC theory. These findings support the applicability of CHC theory to the development and interpretation of modern intelligence tests. Results suggest the CHC classification system is useful even if there are other possible theories that may explain intelligence as well or better. Thus, across applied and theoretical fields CHC terminology can be used as a common language to classify these different cognitive tasks according to overarching broad cognitive abilities.

Support for CHC theory, CHC test classifications, and the Cross-battery assessment (XBA) approach

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Beyond individual intelligence tests: Application of Cattell-Horn-Carroll Theory

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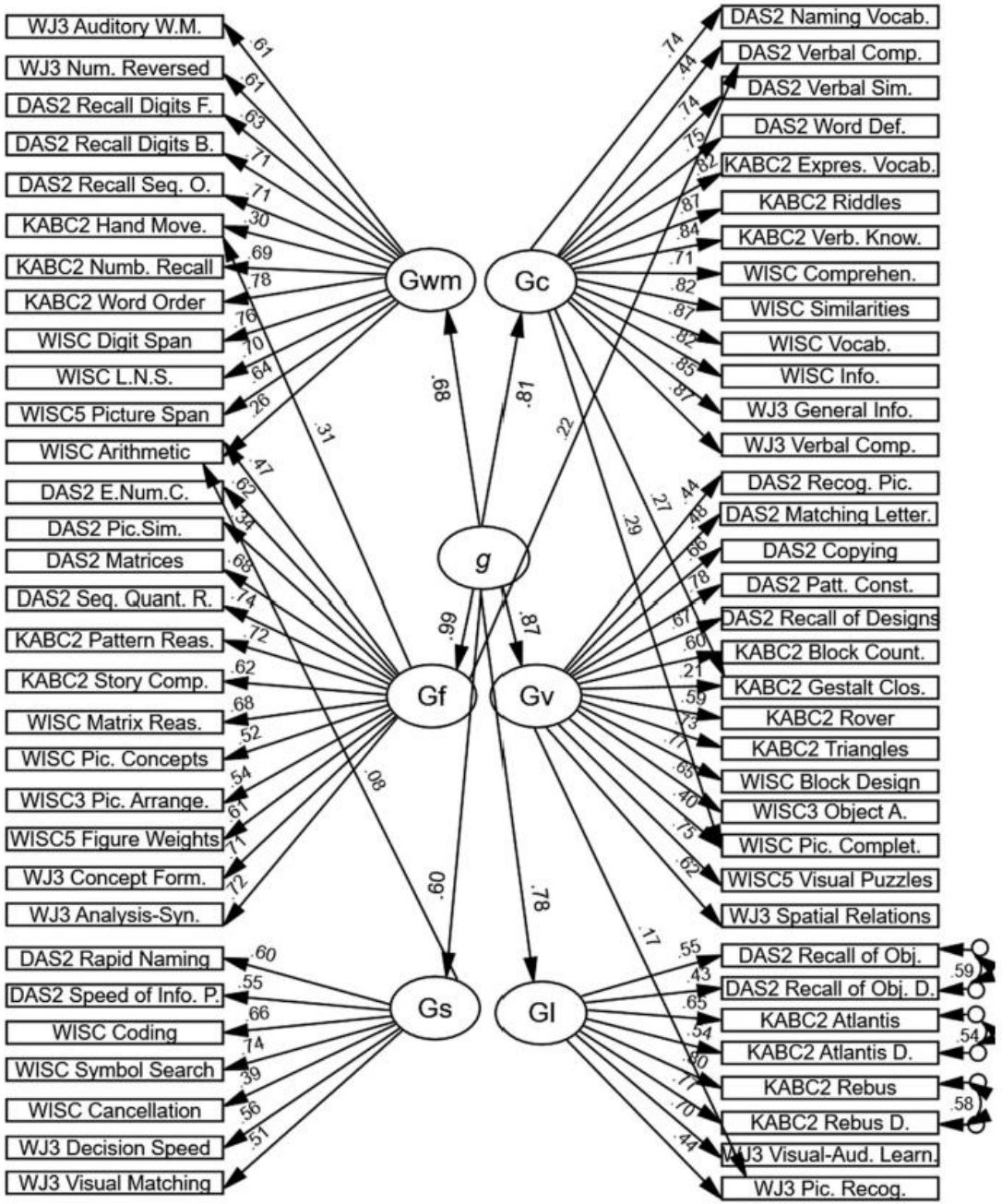

Fig. 1. CB-CFA second-order model standardized coefficients.

Journal of *Intelligence*

MDPI

Article

Carroll's Three-Stratum (3S) Cognitive Ability Theory at 30 Years: Impact, 3S-CHC Theory Clarification, Structural Replication, and Cognitive–Achievement Psychometric Network Analysis Extension

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Abstract: Carroll's treatise on the structure of human cognitive abilities is a milestone in psychometric intelligence research. Thirty years later, Carroll's work continues to influence research on intelligence theories and the development and interpretation of intelligence tests. A historical review of the relations between the 3S and CHC theories necessitates the recommendation that the theories of Cattell, Horn, and Carroll be reframed as a family of obliquely correlated CHC theories—not a single CHC theory. Next, a previously unpublished Carroll exploratory factor analysis of 46 cognitive and achievement tests is presented. A complimentary bifactor analysis is presented that reinforces Carroll's conclusion that his 3S model more accurately represents the structure of human intelligence than two prominent alternative models. Finally, a Carroll-recommended higher-stratum psychometric network analysis (PNA) of CHC cognitive, reading, and math variables is presented. The PNA results demonstrate how PNA can complement factor analysis and serve as a framework for identifying and empirically evaluating cognitive–achievement causal relations and mechanisms (e.g., developmental cascade and investment theories), with an eye toward improved cognitive–achievement intervention research. It is believed that Carroll, given his long-standing interest in school learning, would welcome the integration of theory-driven factor and PNA research.

Keywords: intelligence; Carroll; Horn; Cattell; three-stratum theory; CHC theory; Gf-Gc; factor analysis; psychometric network analysis

Citation: McGrew, Kevin S. 2023.

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MDPI

Article

A Psychometric Network Analysis of CHC Intelligence Measures: Implications for Research, Theory, and Interpretation of Broad CHC Scores "Beyond *g*"

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Abstract: For over a century, the structure of intelligence has been dominated by factor analytic methods that presume tests are indicators of latent entities (e.g., general intelligence or *g*). Recently, psychometric network methods and theories (e.g., process overlap theory; dynamic mutualism) have provided alternatives to *g*-centric factor models. However, few studies have investigated contemporary cognitive measures using network methods. We apply a Gaussian graphical network model to the age 9–19 standardization sample of the Woodcock–Johnson Tests of Cognitive Ability—Fourth Edition. Results support the primary broad abilities from the Cattell–Horn–Carroll (CHC) theory and suggest that the working memory–attentional control complex may be central to understanding a CHC network model of intelligence. Supplementary multidimensional scaling analyses indicate the existence of possible higher-order dimensions (PPIK; triadic theory; System I-II cognitive processing) as well as separate learning and retrieval aspects of long-term memory. Overall, the network approach offers a viable alternative to factor models with a *g*-centric bias (i.e., bifactor models) that have led to erroneous conclusions regarding the utility of broad CHC scores in test interpretation beyond the full-scale IQ, *g*.

Citation: McGrew, Kevin S., W. Joel Schneider, Scott L. Decker, and Okan

Learning and Individual Differences
Volume 102, February 2023, 102271

Beyond individual tests: Youth's cognitive abilities on their math and writing skills ☆

Jacqueline M. Caemmerer [a], Matthew R. Reynolds [b], Timothy Z. Keith [c]

https://doi.org/10.1016/j.lindif.2023.102271

Abstract

A cross-battery study of cognitive-achievement relations, which simultaneously analyzes several intelligence and achievement test scores, allows for the analysis of more broadly defined constructs that transcend test batteries. That was the approach taken in this study. Six intelligence tests, represented by 66 subtests, and three achievement tests, represented by 10 subtests, were analyzed. Our sample included 3927 youth aged 6 to 18. Youth's general intelligence (*g*), verbal comprehension-knowledge, and working memory significantly explained their broad math and broad writing skills. Other broad cognitive abilities influenced only one of the academic skills. Learning efficiency and processing influenced youth's broad writing and visual processing and fluid reasoning influenced their broad math skills. The influence of *g* and fluid reasoning were difficult to separate statistically. Most of the cognitive-achievement relations were consistent across age.

Effects of cognitive abilities on child and youth academic achievement: Evidence from the WISC-V and WIAT-III.

Database: APA PsycInfo Journal Article

Caemmerer, Jacqueline M. Maddocks, Danika L. S. Keith, Timothy Z. Reynolds, Matthew R.

Citation

Caemmerer, J. M., Maddocks, D. L. S., Keith, T. Z., & Reynolds, M. R. (2018). Effects of cognitive abilities on child and youth academic achievement: Evidence from the WISC-V and WIAT-III. *Intelligence, 68*, 6–20. https://doi.org/10.1016/j.intell.2018.02.005

Abstract

The relations between children and adolescents' cognitive abilities and their reading, writing, and math achievement were examined using the Wechsler Intelligence Scale for Children, Fifth Edition and Wechsler Individual Achievement Test, Third Edition co-norming sample. We tested and compared models that included effects from the Cattell-Horn-Carroll broad cognitive abilities and models that focused on the effects of *g* only. Developmental differences in the patterns of cognitive-achievement effects were tested for statistical significance using interaction terms. Comprehension-knowledge exerted direct effects on all reading and most writing skills, fluid reasoning exerted direct effects on essay writing and math skills, and processing speed exerted direct effects on reading fluency, math fluency, and math calculation skills. Working memory significantly influenced most of the achievement skills and was particularly important for younger children. The effect of g on all achievement skills was strong, but indirect through the broad abilities and often overlapped with the effect of fluid reasoning. Results from this study suggest that children and adolescent's reading, math, and writing are differentially influenced by their cognitive abilities, and some of these effects vary by age. (PsycInfo Database Record (c) 2020 APA, all rights reserved)

A meta-analysis of mathematics and working memory: Moderating effects of working memory domain, type of mathematics skill, and sample characteristics.
P Peng, J Namkung, M Barnes, C Sun
Journal of Educational Psychology

A meta-analysis on the relation between reading and working memory
P Peng, M Barnes, CC Wang, W Wang, S Li, L Swanson, W Dardick, ...
Psychological Bulletin

The relation between mathematics anxiety and mathematics performance among school-aged students: A meta-analysis
J Namkung, P Peng, X Lin
Review of Educational Research

A meta-analysis of working memory deficits in children with learning difficulties: Is there a difference between verbal domain and numerical domain?
P Peng, D Fuchs
Journal of Learning Disabilities, 0022219414521667

The development of academic achievement and cognitive abilities: A bidirectional perspective
P Peng, R Kievit
Child Development Perspectives

A meta-analysis on the relation between fluid intelligence and reading/mathematics: Effects of tasks, age, and social economics status
P Peng, T Wang, C Wang, X Lin
Psychological Bulletin

A meta-analytic review of the relations between motivation and reading achievement for K-12 students
J Toste, L Didion, P Peng, M Filderman, A McClelland
Review of Educational Research

The relation between family socioeconomic status and academic achievement in China: A meta-analysis
J Liu, P Peng, L Luo
Educational Psychology Review 32, 49-76

Examining the mutual relations between language and mathematics: A meta-analysis
P Peng, X Lin, ZE Ünal, K Lee, J Namkung, J Chow, A Sales
Psychological Bulletin 146 (7), 595-643

Phonological storage and executive function deficits in children with mathematics difficulties
P Peng, C Sun, B Li, S Tao
Journal of Experimental Child Psychology

A randomized control trial of working memory training with and without strategy instruction: Effects on young children's working memory and comprehension
P Peng, D Fuchs
Journal of Learning Disabilities

The other side of the coin:

- The Cattell-Horn and Carroll models should not have been integrated
- Practical application of CHC theory is not recommended
- Little, if any, support for the interpretation of CHC broad abilities
- ***Note: Entirely different conclusions are reached depending on the type of factor analysis used***

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2019, VOL. 32, NO. 3, 232–248
https://doi.org/10.1080/08957347.2019.1619562

Challenges to the Cattell-Horn-Carroll Theory: Empirical, Clinical, and Policy Implications

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[a]Psychology, Eastern Illinois University; [b]Psychology and Neuroscience, University of North Carolina at Chapel Hill

ABSTRACT

The Cattell-Horn-Carroll (CHC) taxonomy of cognitive abilities married John Horn and Raymond Cattell's Extended Gf-Gc theory with John Carroll's Three-Stratum Theory. While there are some similarities in arrangements or classifications of tasks (observed variables) within similar broad or narrow dimensions, other salient theoretical features and statistical methods used for examining and supporting them are in direct opposition. In this article, the theoretical disagreements between Carroll and Cattell-Horn and theoretical incongruencies between their models are delineated, which raises substantive challenges to CHC. Additionally, there are practical and substantial measurement obstacles that further threaten *practical* application of CHC. We conclude that the problems are due to some fundamental differences that likely will not change, so call for an annulment of this arranged but unhappy marriage.

Reviews

Critically Reflecting on the Origins, Evolution, and Impact of the Cattell-Horn-Carroll (CHC) Model

Ryan J. McGill & Stefan C. Dombrowski

ABSTRACT

The Cattell-Horn-Carroll (CHC) model presently serves as a blueprint for both test development and a taxonomy for clinical interpretation of modern tests of cognitive ability. Accordingly, the trend among test publishers has been toward creating tests that provide users with an ever-increasing array of scores that comport with CHC. However, an accumulating body of independent research on modern intelligence tests has questioned many instruments' alignment with the CHC model. To shed potential insight on these discrepancies, we review the developmental history of CHC and its numerous modifications from 1997 to the present. Next, we identify and discuss several potential limitations in the CHC literature that may be responsible for this discrepancy. Finally, we encourage clinicians to consider the extant evidence currently available for engaging in CHC-inspired assessment applications (e.g., XBA, PSW).

	Broad Ability	Definition
Reasoning	**Fluid Reasoning (Gf)**	The use of deliberate and controlled procedures (often requiring focused attention) to solve novel, "on-the-spot" problems that cannot be solved by using previously learned habits, schemas, and scripts.
Acquired Knowledge	**Comprehension-Knowledge (Gc)**	The ability to comprehend and communicate culturally valued knowledge.
	Domain-Specific Knowledge (Gkn) *	The depth, breadth and mastery of specialized declarative and procedural knowledge (knowledge not all members of society are expected to have).
	Quantitative Knowledge (Gq)	The depth and breadth of declarative and procedural knowledge related to mathematics.
	Reading and Writing (Grw)	The depth and breadth of declarative and procedural knowledge and skills related to written language.
Memory	**Working Memory Capacity (Gwm)**	The ability to maintain and manipulate information in active attention.
	Learning Efficiency (Gl)	The ability to learn, store, and consolidate new information over periods of time measured in minutes, hours, days, and years.
	Retrieval Fluency (Gr)	The rate and fluency with which individuals can produce and selectively and strategically retrieval verbal and nonverbal information and ideas stored in long-term memory.
Sensory	**Visual Processing (Gv)**	The ability to perceive complex patterns and mentally simulate how they might look when transformed.
	Auditory Processing (Ga)	The ability to discriminate, remember, reason, and work creatively (on) auditory stimuli, which may consist of tones, environmental sounds, and speech units.
	Olfactory Abilities (Go) *	The abilities to detect and process meaningful information in odors.
	Tactile Abilities (Gh) *	The abilities to detect and process meaningful information in haptic (touch) sensations.
Motor	**Psychomotor Abilities (Gp) ***	The abilities to perform physical body motor movements (e.g., movement of fingers, hands, legs) with precision, coordination, or strength.
	Kinesthetic Abilities (Gk) *	The abilities to detect and process meaningful information in proprioceptive sensations.
Speed and Efficiency	**Processing Speed (Gs)**	The ability to control attention to automatically, quickly, and fluently perform relatively simple repetitive cognitive tasks.
	Reaction and Decision Speed (Gt) *	The speed of making very simple decisions or judgments when items are presented one at a time.
	Psychomotor Speed (Gps) *	The speed and fluidity with which physical body movements can be made.

***These broad abilities appear infrequently or not at all on cognitive and neuropsychological batteries**

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DOI: 10.1002/pits.22298

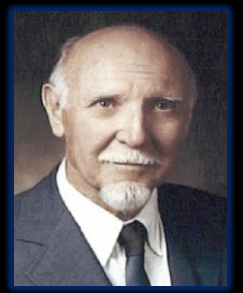
WILEY

RESEARCH ARTICLE

The cognitive assessment course: Two decades later

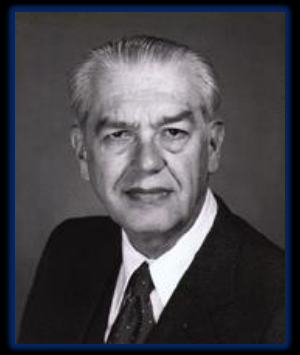
Adam B. Lockwood[1] | Ryan L. Farmer[2]

Overall Interpretation Framework	Percentage of Instructors Teaching
Cattell-Horn-Carroll	92.9
Patterns of Strengths & Weaknesses, General	68.5
Cross-Battery Assessment	60.6
Intelligent Testing	38.6
Dual Discrepancy/Consistency	23.6
General intelligence only	21.3
Cognitive Hypothesis Testing	16.5
Concordance Disconcordance Model	11.8
School Neuropsychology	11.8

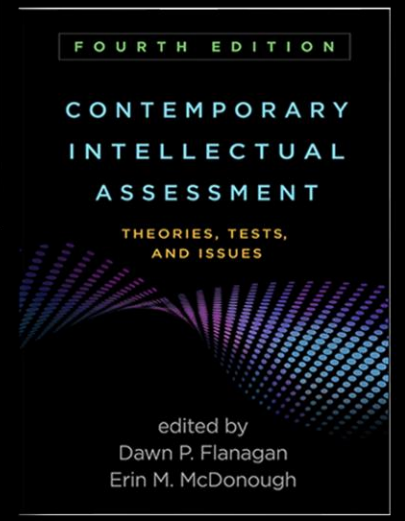


Raymond Cattell Introduced Gf-Gc Theory in 1941

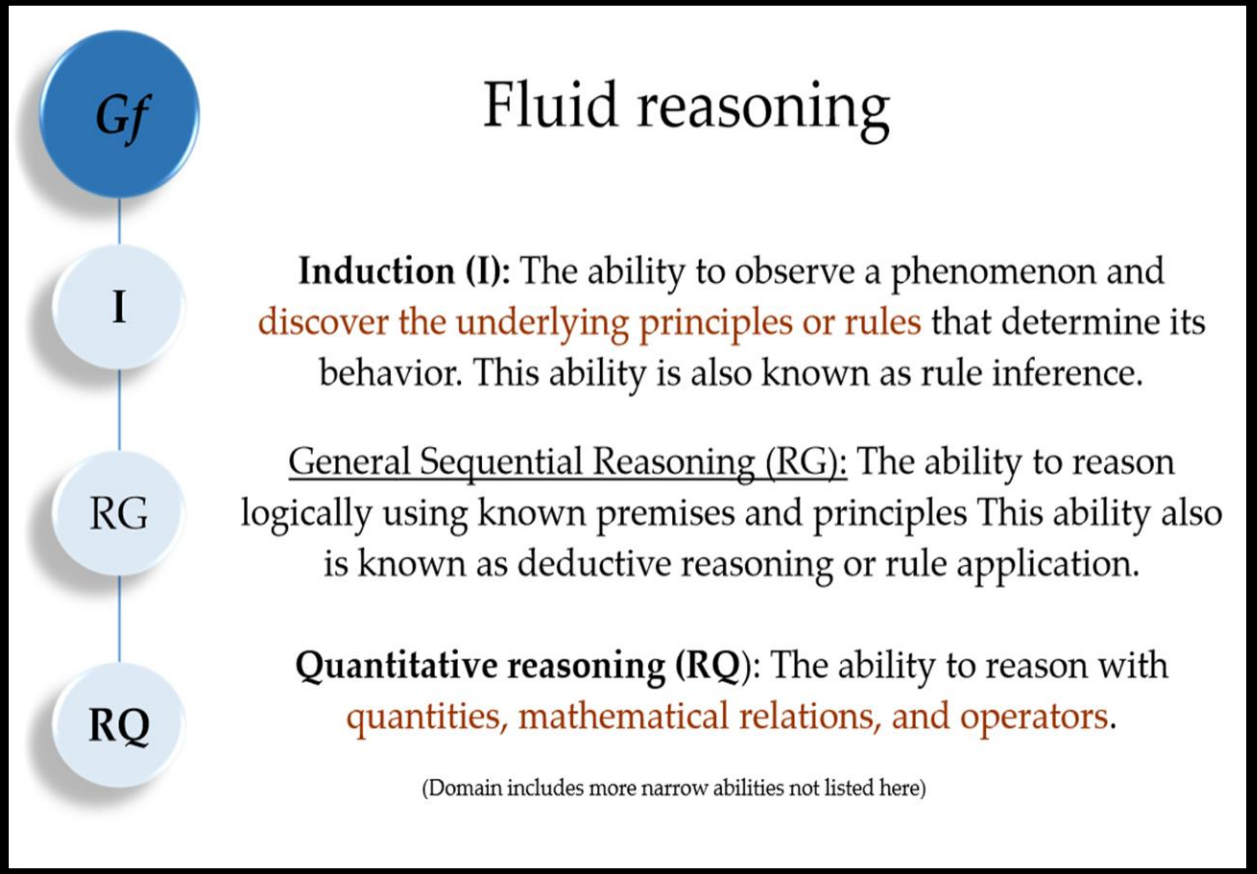
John Horn and colleagues' work (1960s – 1990s) led to expanded 10-factor Gf-Gc theory

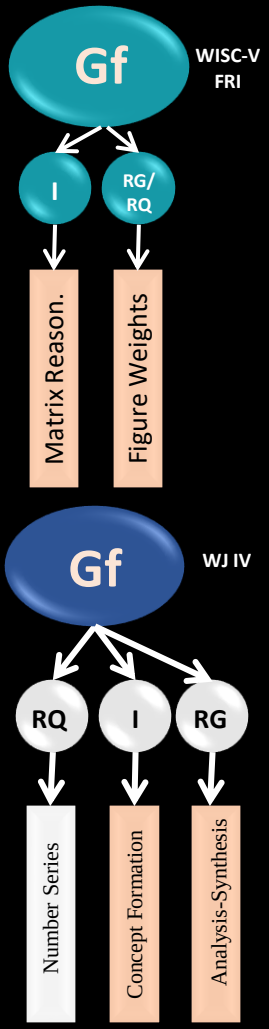


John Carroll reanalyzed the world's literature of human cognitive abilities – Proposed Three-Stratum Theory (1993)



Fluid Reasoning (Gf). Gf refers to a type of thinking or reasoning that individuals use when faced with a relatively new or novel task that cannot be performed automatically.





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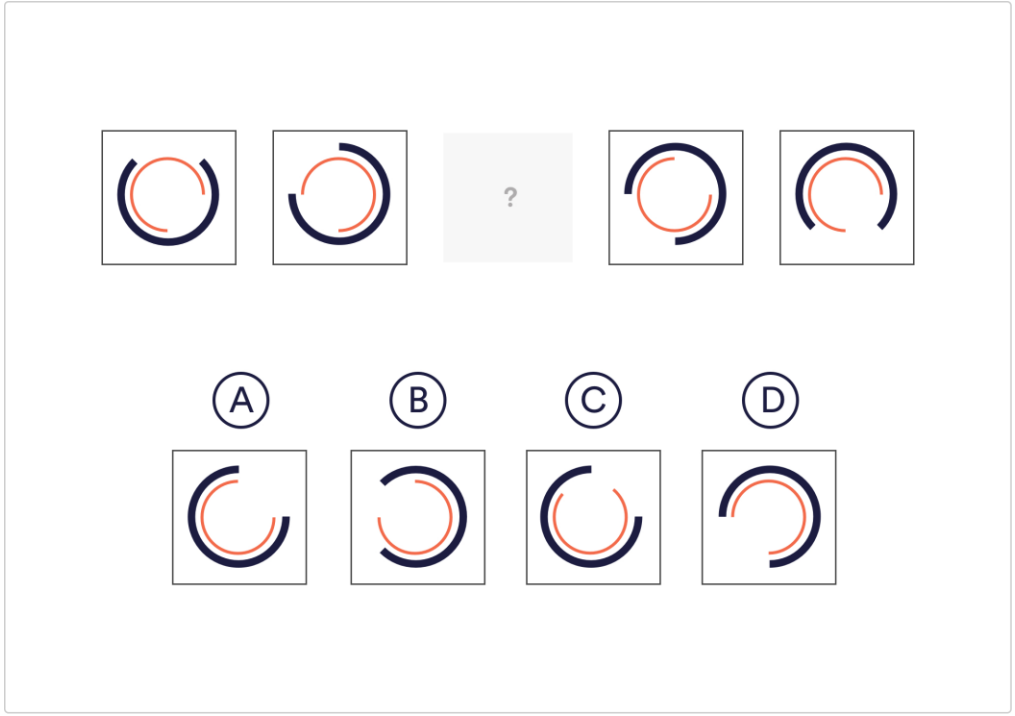
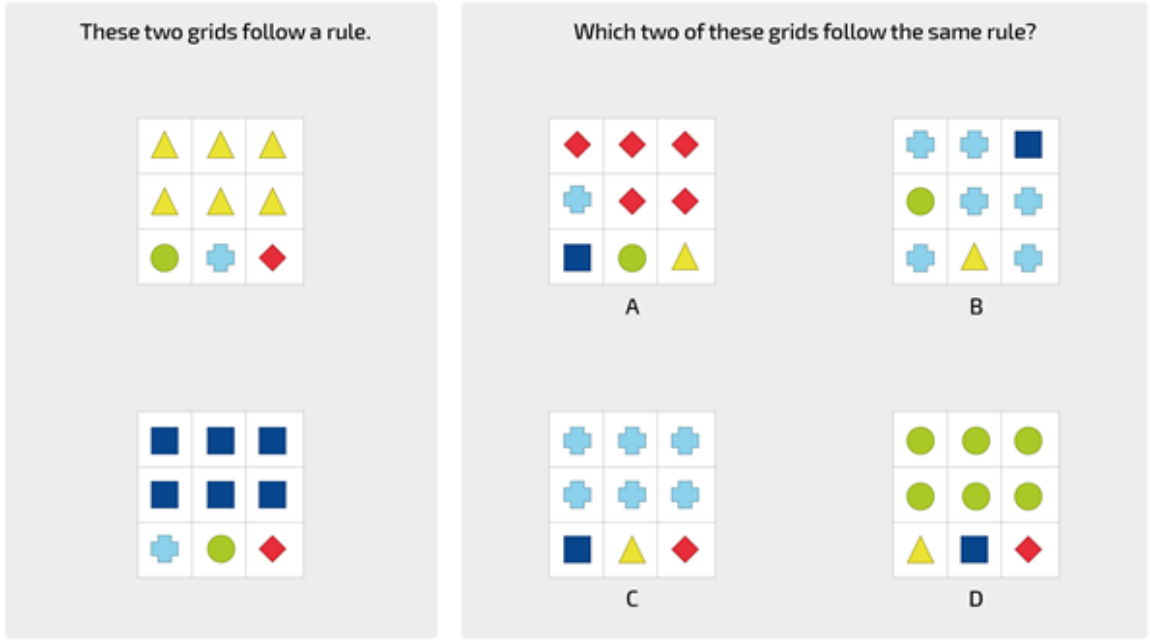
- **Gf – Induction**

Task Example: An examinee is presented with a certain pattern of related stimuli and must select one of several stimuli that would complete or continue the pattern.



- **Gf – General Sequential (Deductive) Reasoning**

Task Example: An examinee is presented with an incomplete logic puzzle and must deduce the missing components following careful analysis of the presented stimuli.



- **Gf – Quantitative Reasoning**

Task Example: An examinee is presented with an incomplete series of related numbers and must select the number(s) that best complete the series.

2, 4, 12, 48, 240, 1440, ___ ___

Describe the Pattern:

2, 6, 12, 20, 30, 42, 56, ___ ___

Describe the Pattern:

1, 8, 27, 64, 125, 216, 343, ___

Describe the Pattern:

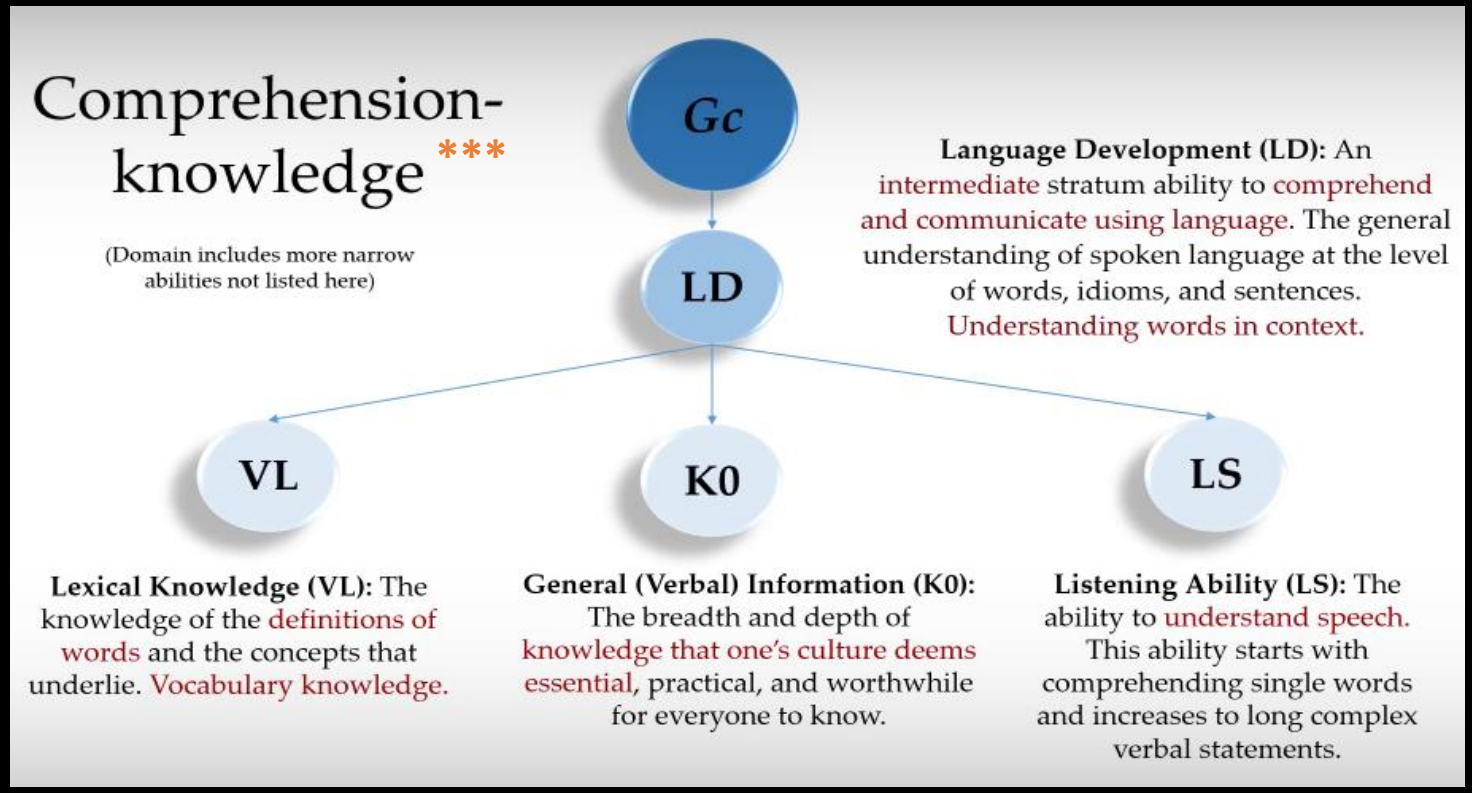
0, 3, 8, 15, 24, 35, 48, ___ ___

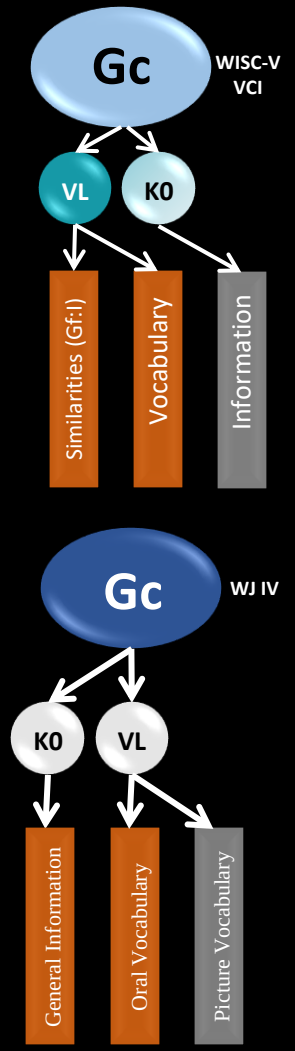
Describe the Pattern:

Revised CHC Theory Introduced

Intermediate Factors

Comprehension-Knowledge (Gc). **Gc is the breadth and depth of knowledge and skills (e.g., words, general information) that are acquired as a result of exposure to language, culture, general life experiences, and formal schooling. The ability to comprehend and communicate culturally-valued knowledge.**





******Omitted from this figure are Communication Abilities (CM), and Grammatical Sensitivity (MY)***

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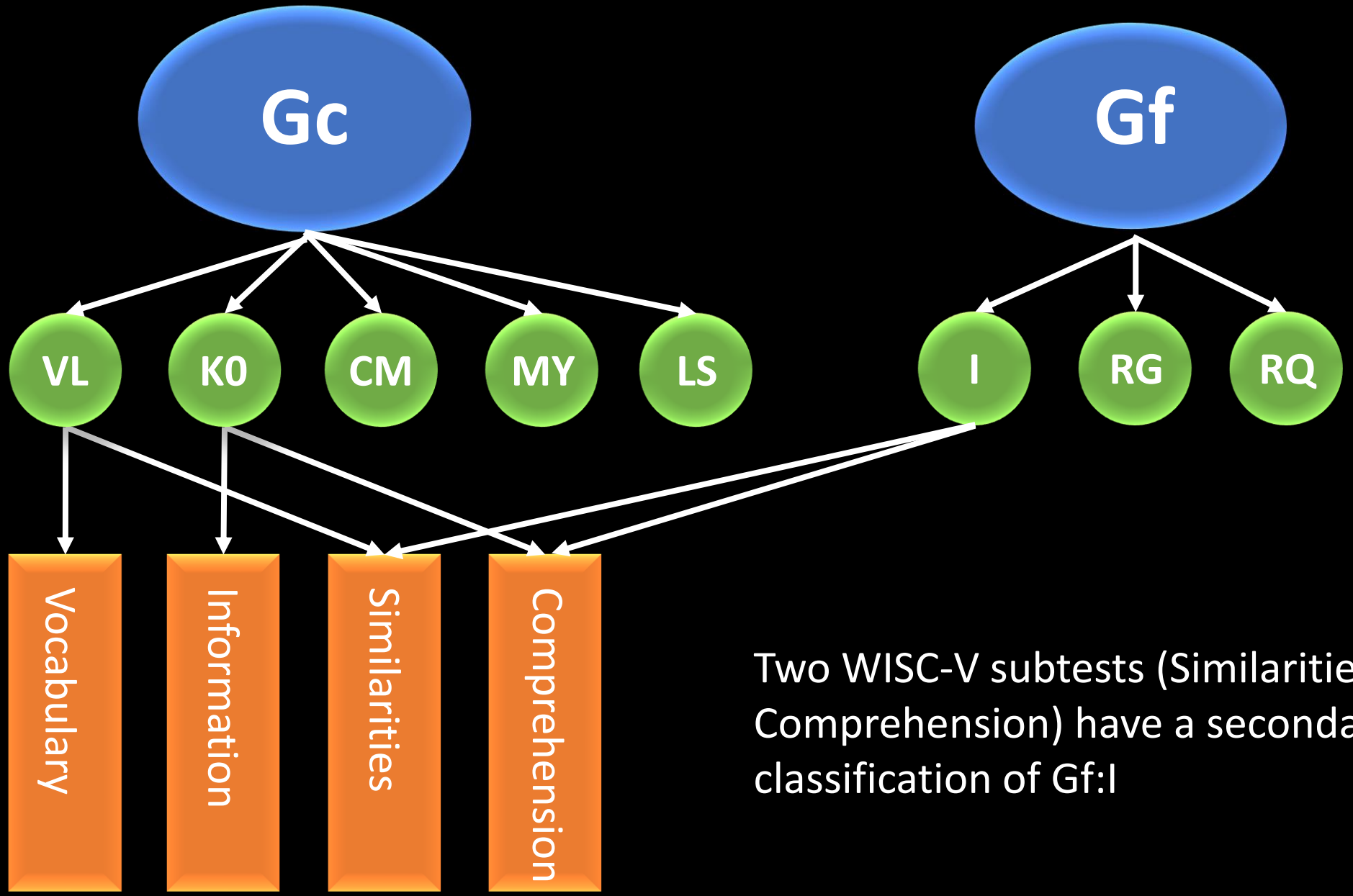
WISC-V Gc Subtests



Two WISC-V subtests (Similarities and Comprehension) have a secondary classification of Gf:I

Gc – General Information

Task Example: An examinee must provide specific responses to questions of general information.

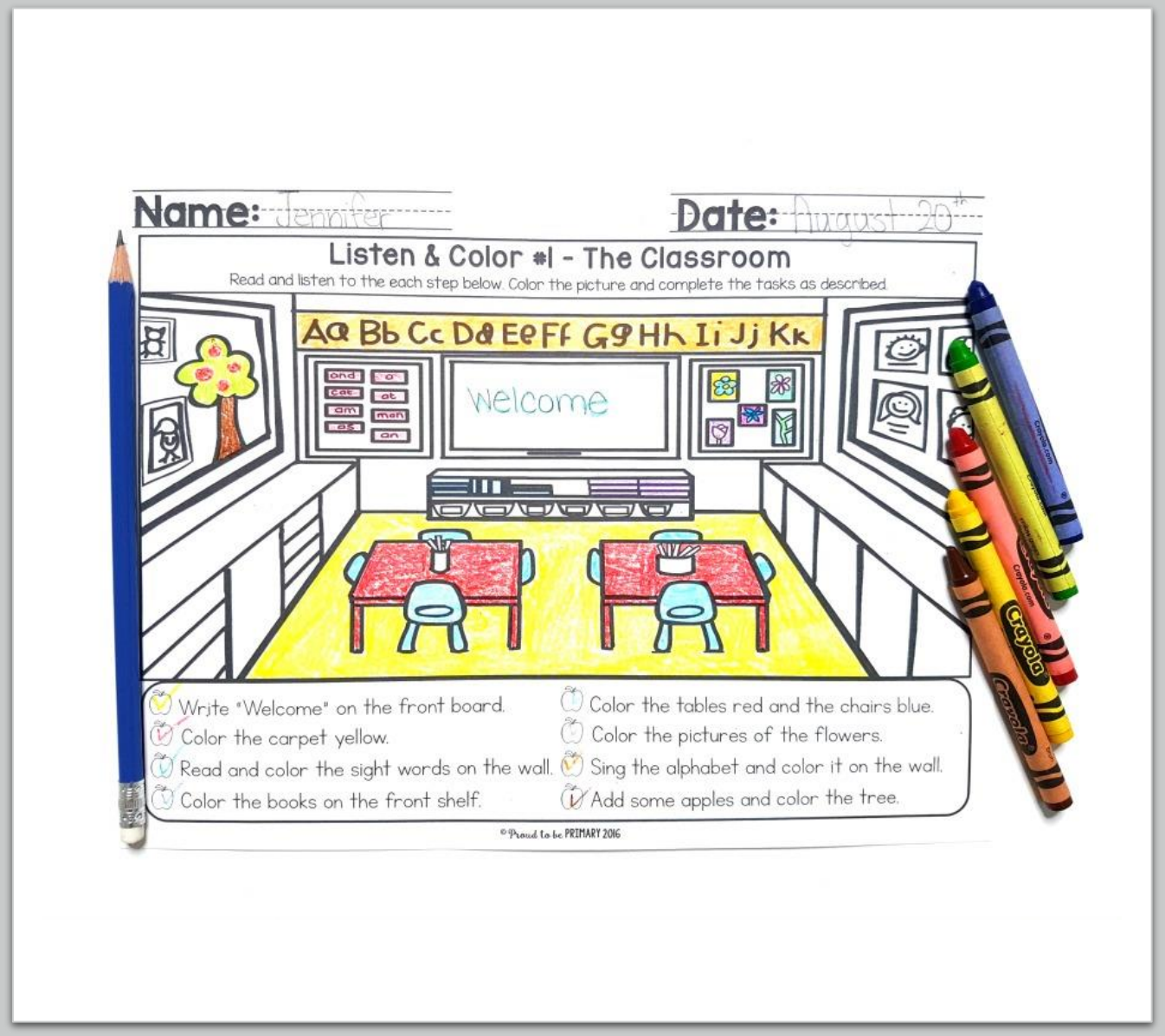
Gc – Lexical Knowledge
Task Example: An examinee must provide oral definitions for words of increasing difficulty.

500 English Vocabulary Words

Words	Synonyms	Words	Synonyms
superb	magnificent	impetuous	reckless
sunrise	dawn	imperfect	faulty
sundown	sunset	imperative	vital
suggest	propose	imperative	crucial
sufficient	ample	impediment	obstacle
successful	prosperous	impatient	eager
substantially	considerably	impassive	emotionless
stupid	silly	impasse	deadlock
stupid	dense	impartial	neutral

Gc – Listening Ability

Task Example: The examinee is presented with a picture and a set of instructions.



Gc – Communication Ability

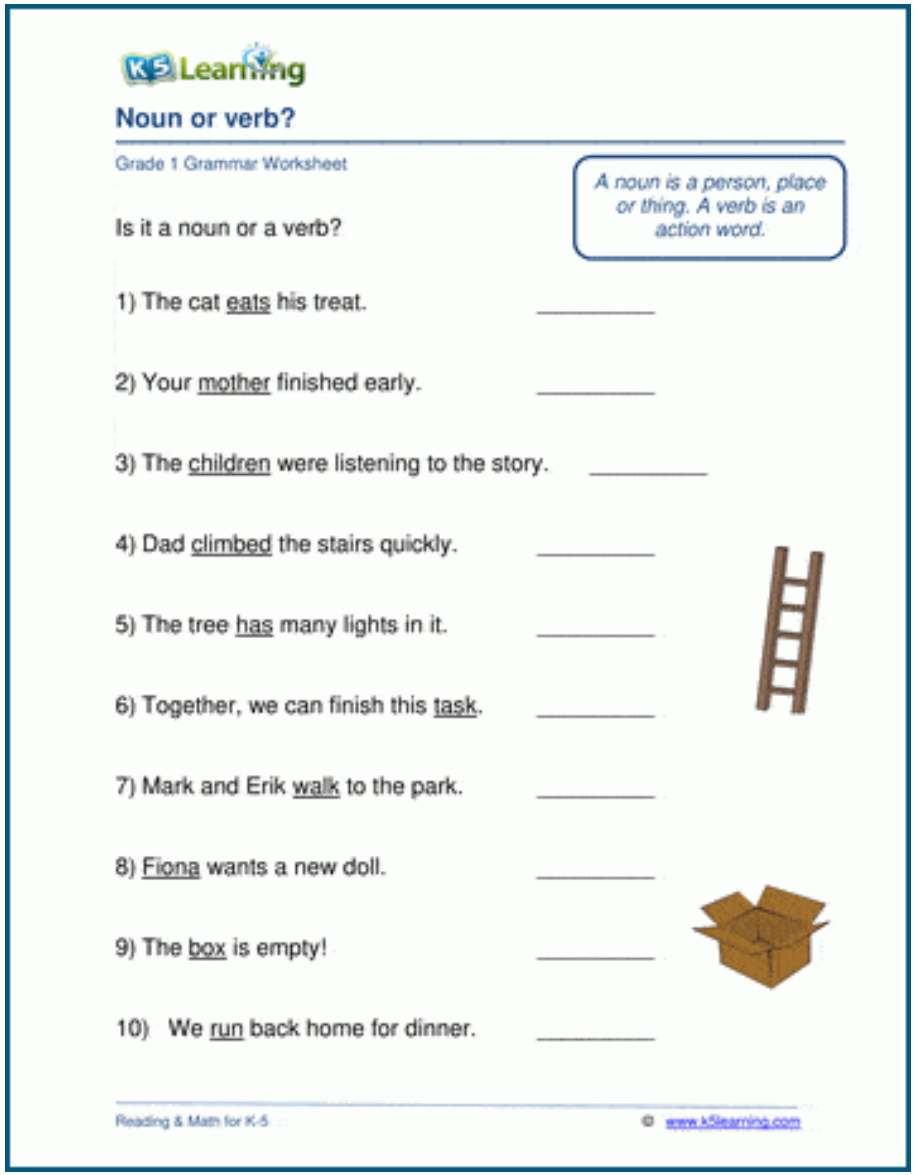
Task Example: An examinee is presented with a picture stimulus and asked to describe it in detail.

Look at this picture and tell me what you see.

Gc – Grammatical Sensitivity

Task Example: An examinee must correctly label the parts of speech contained in a sentence and/or correct those parts of speech that are used incorrectly.

The narrow Gc abilities of Listening Ability (LS), Communication Ability (CM), and Grammatical Sensitivity (MY) are measured primarily by *speech-language batteries (and to a lesser extent, achievement batteries)*



K5 Learning

Noun or verb?

Grade 1 Grammar Worksheet

A noun is a person, place or thing. A verb is an action word.

Is it a noun or a verb?

1) The cat eats his treat. _____

2) Your mother finished early. _____

3) The children were listening to the story. _____

4) Dad climbed the stairs quickly. _____

5) The tree has many lights in it. _____

6) Together, we can finish this task. _____

7) Mark and Erik walk to the park. _____

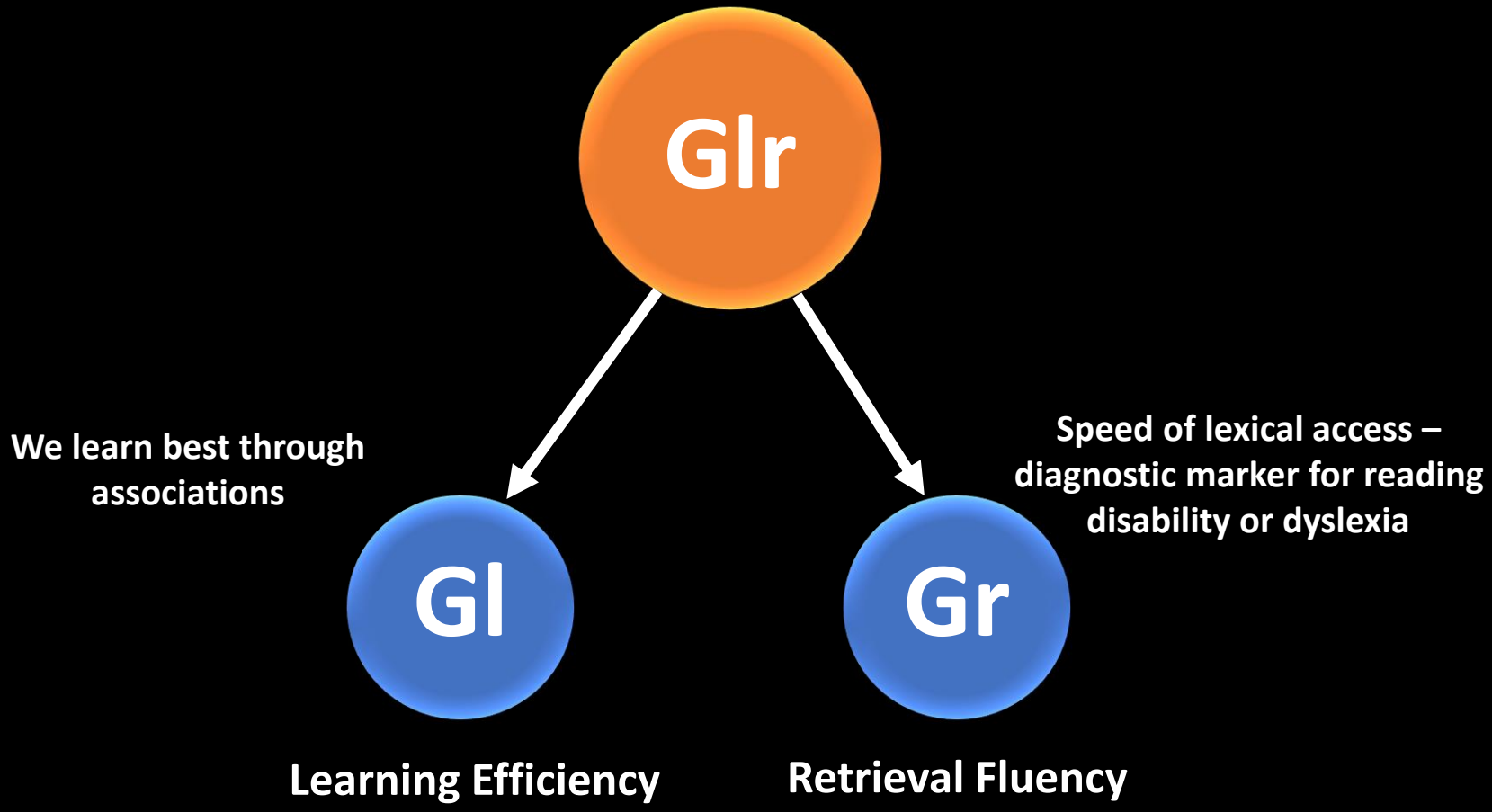
8) Fiona wants a new doll. _____

9) The box is empty! _____

10) We run back home for dinner. _____

Reading & Math for K-5 © www.k5learning.com

Long-term Storage and Retrieval Has Been Separated Because it has been Shown that it Encompasses Two Relatively Distinct Abilities



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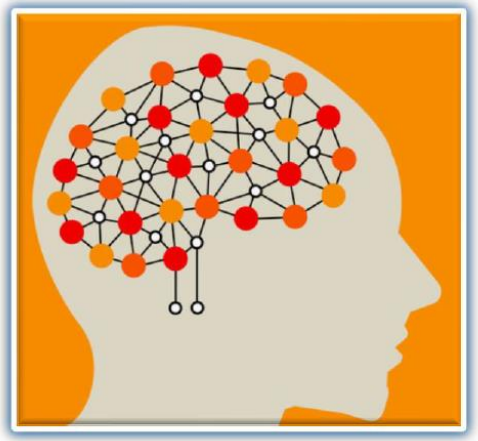
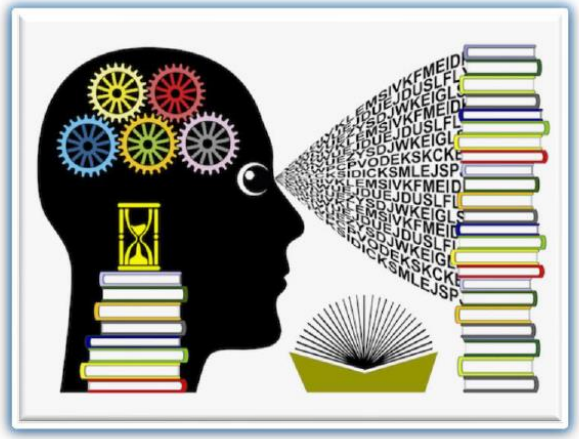
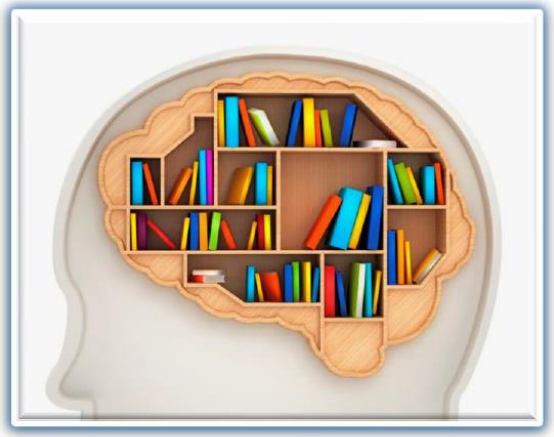
Learning efficiency

Gl

The ability to learn, store, and consolidate new information over periods of time measured in minutes, hours, days, and years.







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Learning efficiency

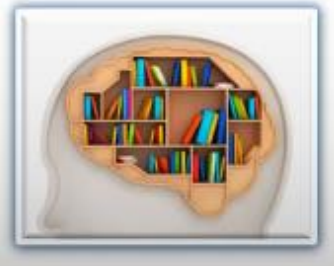
Gl

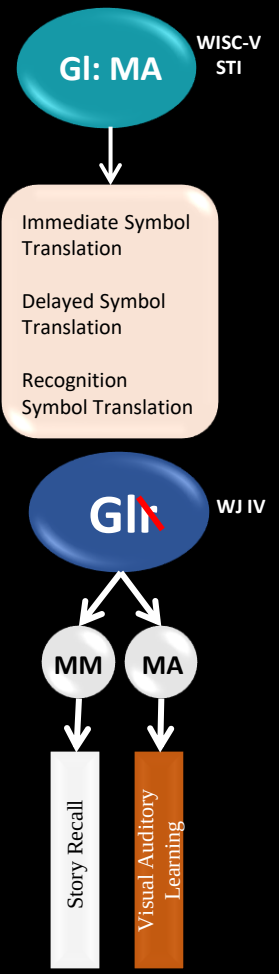
MA

MM

Associative memory (MA): The ability to form a link between two previously unrelated stimuli such that the subsequent presentation of one of the stimuli serves to activate the recall of the other stimuli.

Meaningful memory (MM): The ability to remember narratives and other forms of semantically related information.





***Free Recall Memory (M6)** is a third Gl narrow ability that is not measured by the WISC-V or WJ IV

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GI – Associative Memory – Task Example: An examinee is presented with a set of visual stimuli paired with nonsense words and must correctly identify the nonsense word that had been presented with a certain visual stimulus.

You will see pictures of
fish, plants, and shells,
Each one has a name.

This is KOH.

Point to KOH.

Point to KOH.

GI – Meaningful Memory Task Example: An examinee is presented with a short story and must retell the story as accurately as possible immediately following a single presentation.

The Lion And The Boar

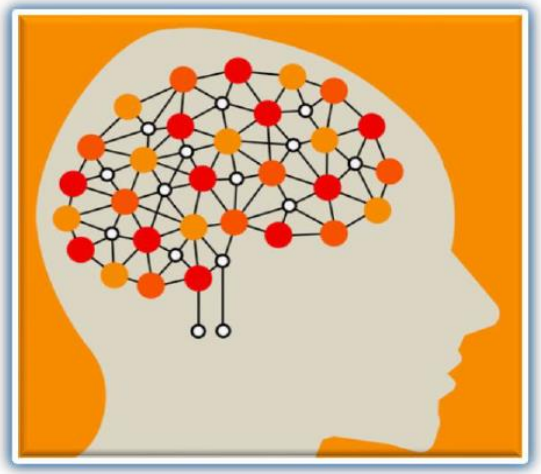
It was a hot summer day. A lion and a boar reach a small water body for a drink. They begin arguing and fighting about who should drink first. After a while, they are tired and stop for breath, when they notice vultures above. Soon they realize that the vultures are waiting for one or both of them to fall, to feast on them. The lion and the boar then decide that it was best to make up and be friends than fight and become food for vultures. They drink the water together and go their ways after.

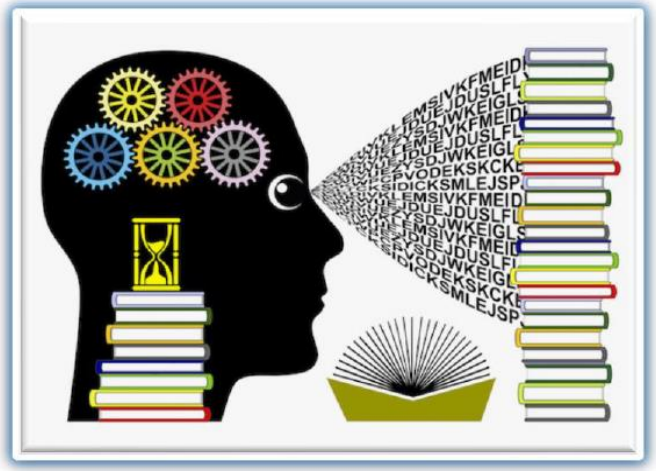
Gl – Free Recall Memory Task Example: An examinee is presented with a series of words and, after they are removed, must recall as many of the words as possible in any order.

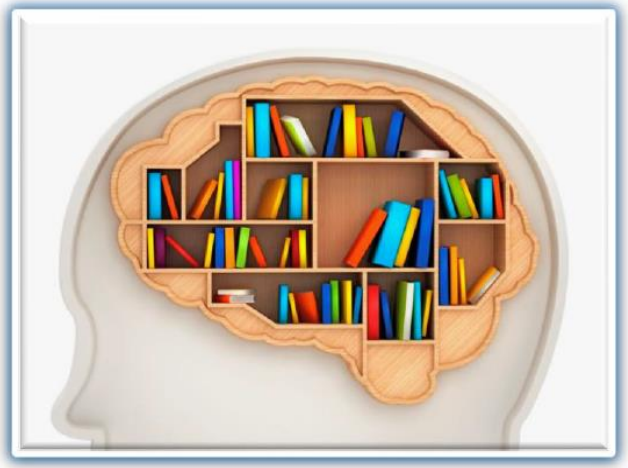
Gr

Retrieval fluency

The rate and fluency at which individuals can access information stored in long-term memory.







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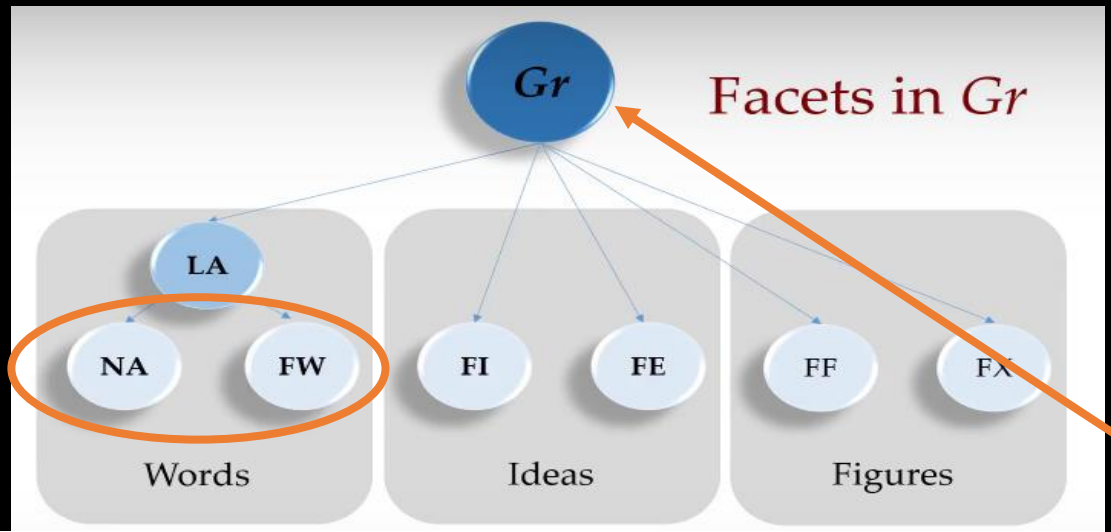
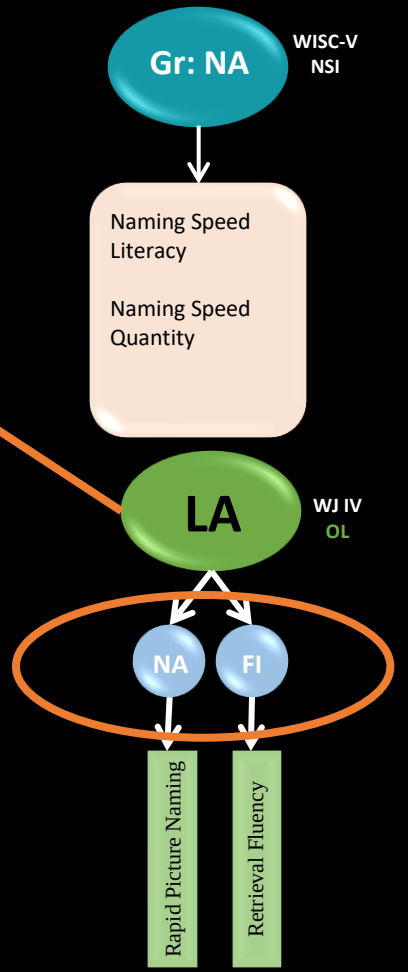
Revised CHC Theory Introduced Facets

Speed of lexical access (LA): The ability to rapidly retrieve words from an individual's lexicon. Verbal efficiency or automaticity of lexical access. An intermediate stratum level ability.





Naming facility (NA): The ability to rapidly call objects by their names.

Word fluency (FW): The ability to rapidly produce words that share a phonological (e.g., fluency of retrieval of words via a phonological cue) or semantic feature (e.g., fluency of retrieval of words via a meaning-based representation).

Ideational fluency (FI): The ability to rapidly produce a series of ideas, words, or phrases related to a specific condition or object.

Expressional fluency (FE): The ability to rapidly think of different ways of expressing an idea.

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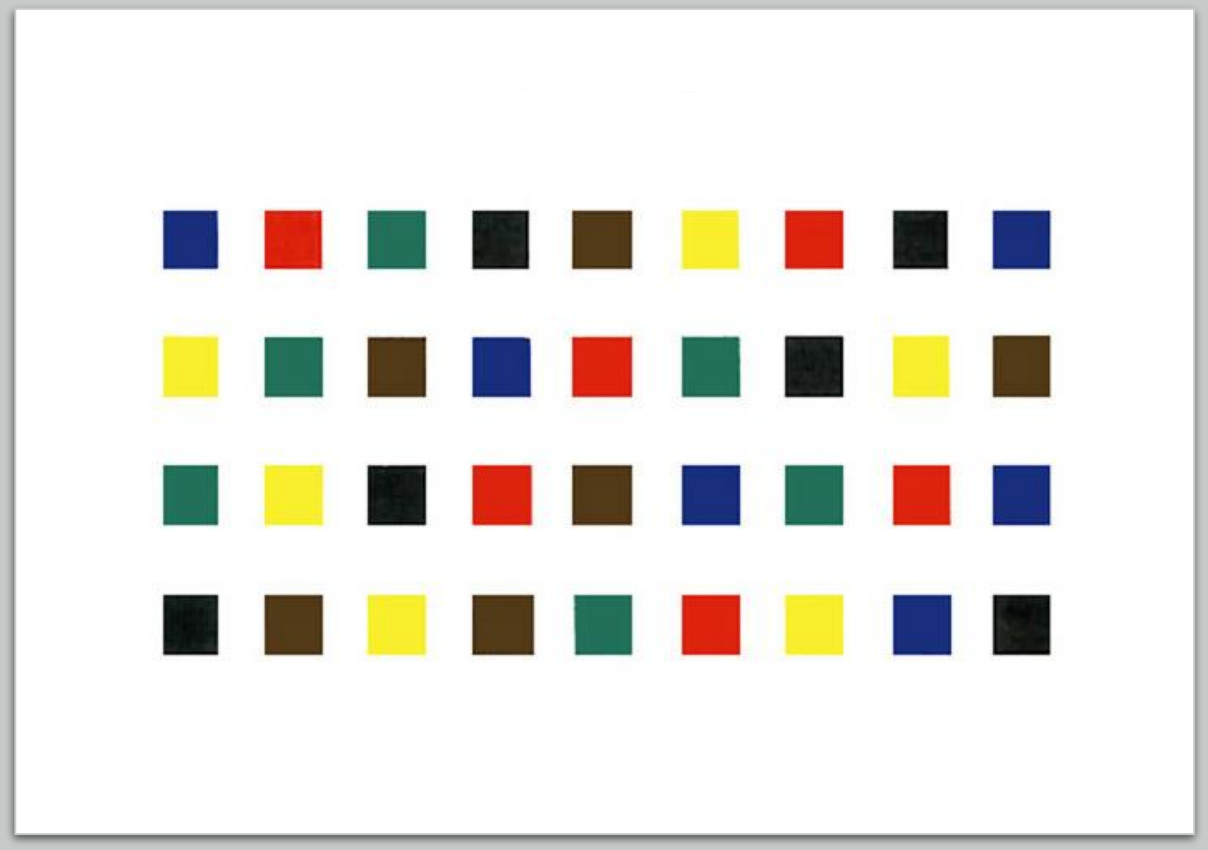
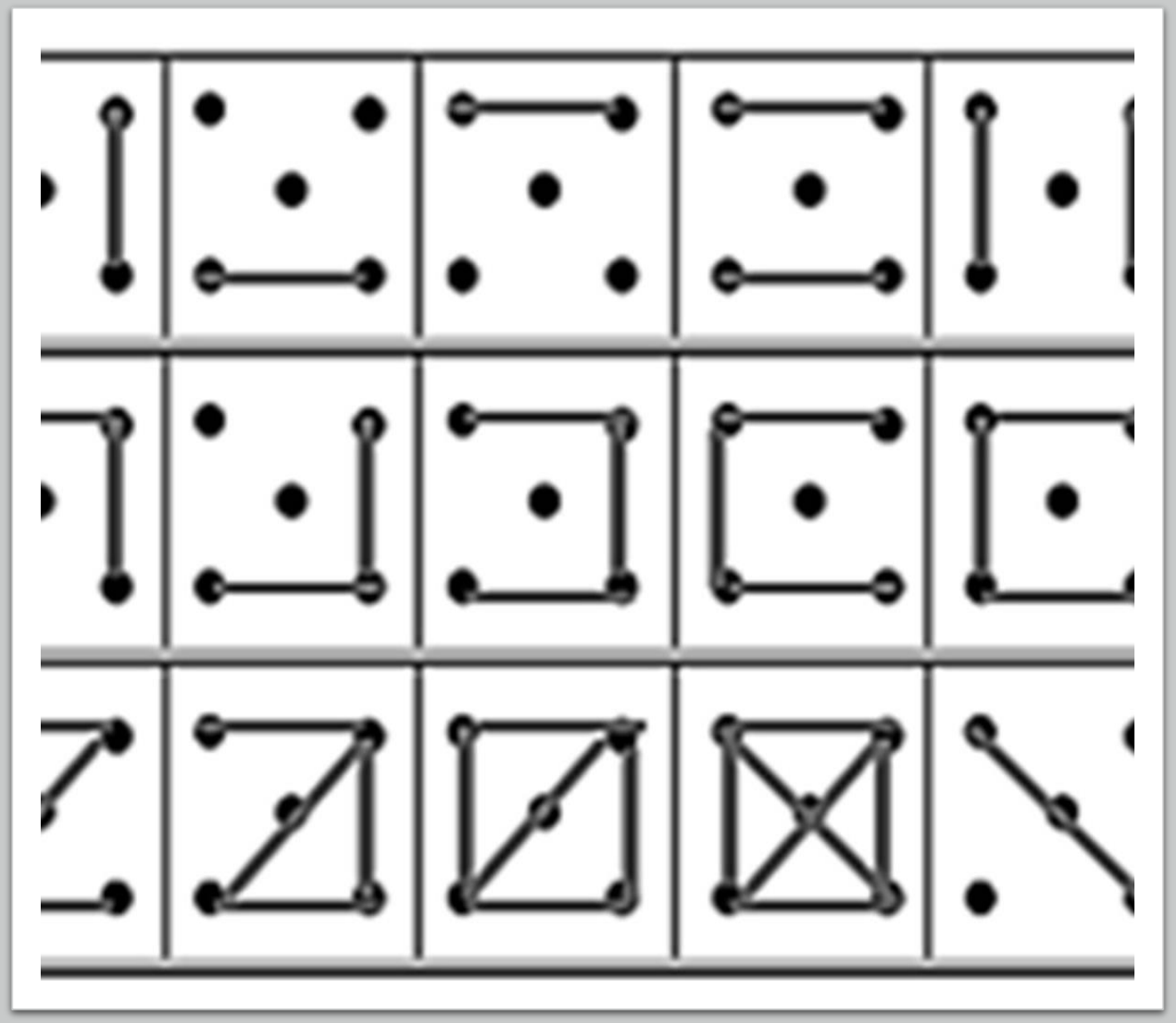
Gr (Words Facet) – Naming Facility – Task Examples: Rapid Naming of Letters; Rapid Naming of Colors



Gr (Ideas Facet) – Ideational Fluency Task Examples: An examinee must rapidly name as many kitchen utensils/appliances as they can think of within a specified time limit.

Gr (Figures Facet) – Figure Fluency

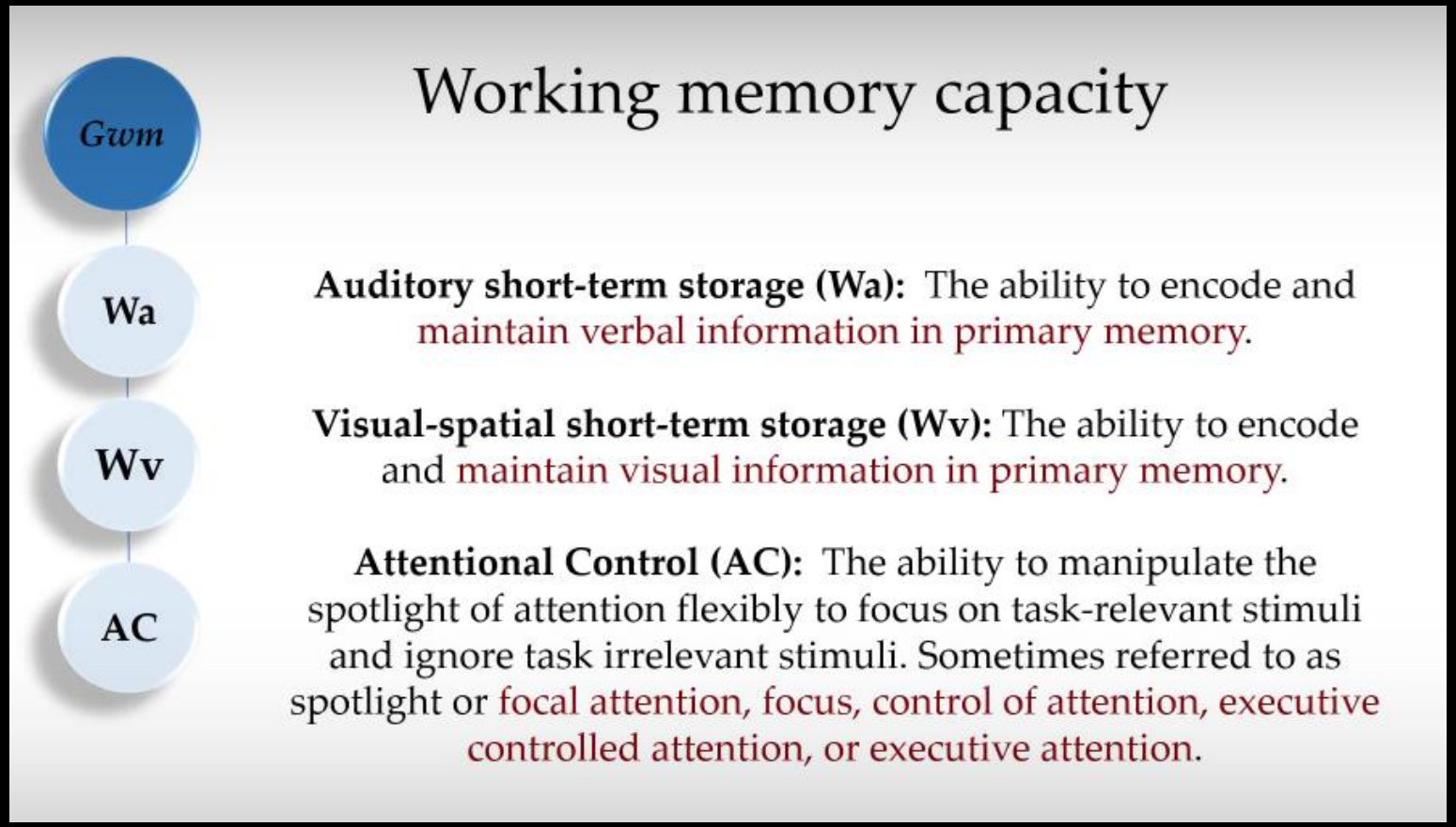
Task Example: The examinee is required to quickly connect dots to make as many different designs as possible.



Revised CHC Theory Introduced

New Narrow Ability Codes

Working Memory Capacity (Gwm). The ability to encode and maintain verbal or visual information in immediate awareness and then manipulate or transform it in some way within a few seconds, which is dependent in part on focus of attention. It also includes the ability to focus attention on task-relevant stimuli and ignore task irrelevant stimuli.



Working Memory Capacity (Wc)
The ability to **MANIPULATE** information in primary memory

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Gwm Narrow Abilities

Auditory short-term storage (Wa)	**the ability to encode and maintain verbal information in primary memory**
Visual-spatial short-term storage (Wv)	**the ability to encode and maintain visual information in primary memory**
Attentional control (AC)	**the ability to manipulate the spotlight of attention flexibly to focus on task-relevant stimuli and ignore task-irrelevant stimuli (sometimes referred to as spotlight or focal attention, focus, control of attention, executive controlled attention, or executive attention)**
Working memory capacity (Wc) ***not technically a narrow ability**	**the ability to manipulate information in primary memory**

Previously "Memory Span" (MS) – high demand on storage/maintenance

Previously inherent in the broad Gwm definition – high demand on deliberate processing

Previously "Working Memory" (MW) – moderate demands on maintenance and deliberate processing

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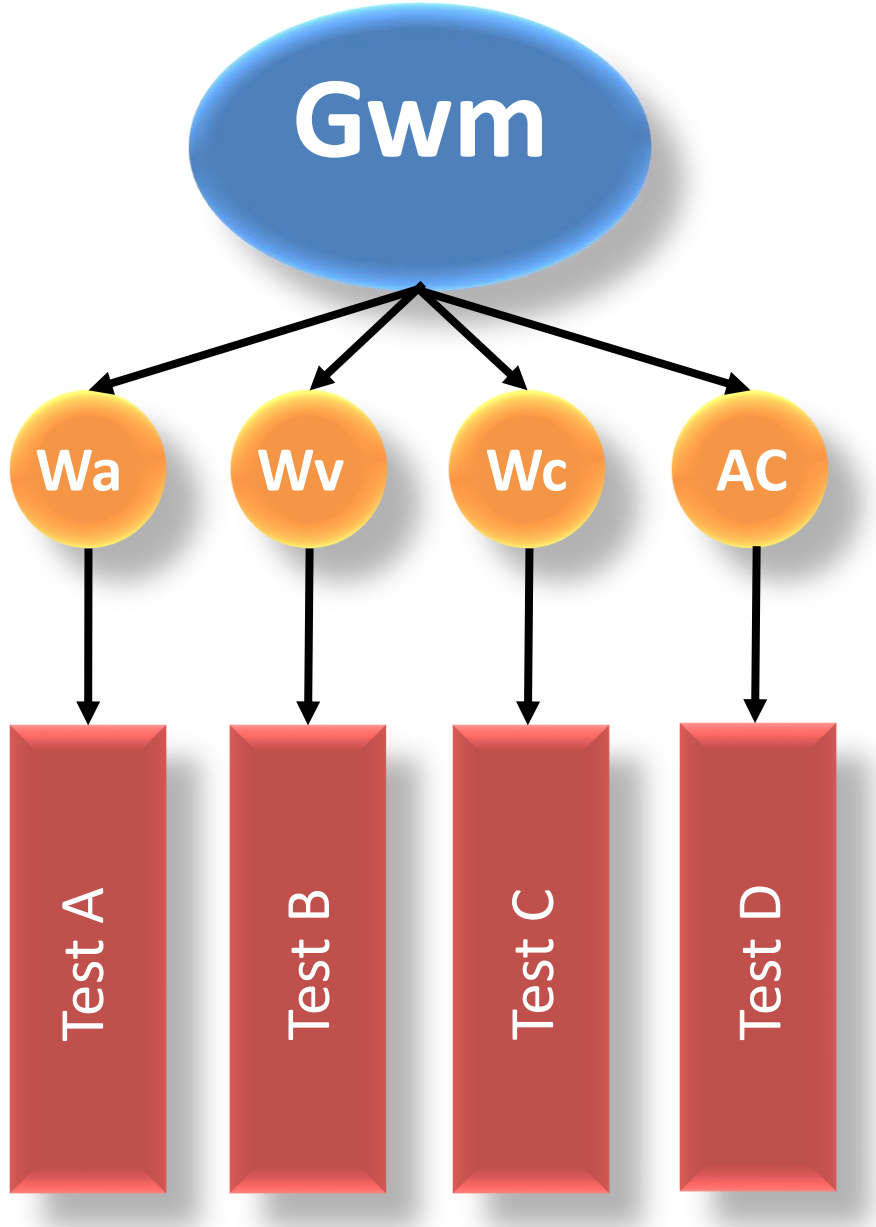
Slight Variation in Gwm for Clarity

- **Change name of Broad Ability** from "Working Memory Capacity" to "Short-term Storage and Working Memory" to avoid redundancy in terms and to capture maintenance and deliberate processing

- **Four Narrow Abilities**
  - Short-term Auditory Storage (Wa)
  - Short-term Visual Spatial Storage (Wv)
  - Working Memory Capacity (Wc)
  - Attentional Control (AC)



How Will Gwm Tests Be Reclassified?

- All tests previously classified as Memory Span (MS) will be reclassified as either:
  - Auditory Short-term Storage (Wa) – for example, Memory for Words; or
  - Visual-spatial Short-term Storage (Wv) – for example, Picture Span

All tests previously classified as Working Memory (WM) will be reclassified as:

- Working Memory Capacity (Wc) (regardless of whether the task stimuli are visual or auditory)
  - Example: Letter-Number Sequencing will be coded as Wc
  - **Note that Attentional Control (AC) is inherent in the definition of Wc and therefore Wc does not require a secondary code of AC**
  - Note that when a subtest has subcomponents, such as Digit Span – which has three subcomponents: *Forward, Backward, and Sequencing* – and one component is a short-term storage task and another is a working memory task, then two narrow ability codes will be used to classify the subtest.
    - Digit Span Forward = Wa
    - Digit Span Backward and Sequencing = Wc
    - **Digit Span will be coded as "Gwm: Wa, Wc"**

Is Attentional Control Constrained to Gwm?

- **Attentional Control (AC)** is related primarily to Gwm and Gs tasks; however, AC is also involved in tasks in other domains (e.g., Gf, Gv), but to a lesser extent

- Proposed AC "classification rules"

1. Working Memory Capacity (Wc) subtests are classified as Gwm:Wc. **AC is inherent in the definition of Wc.**

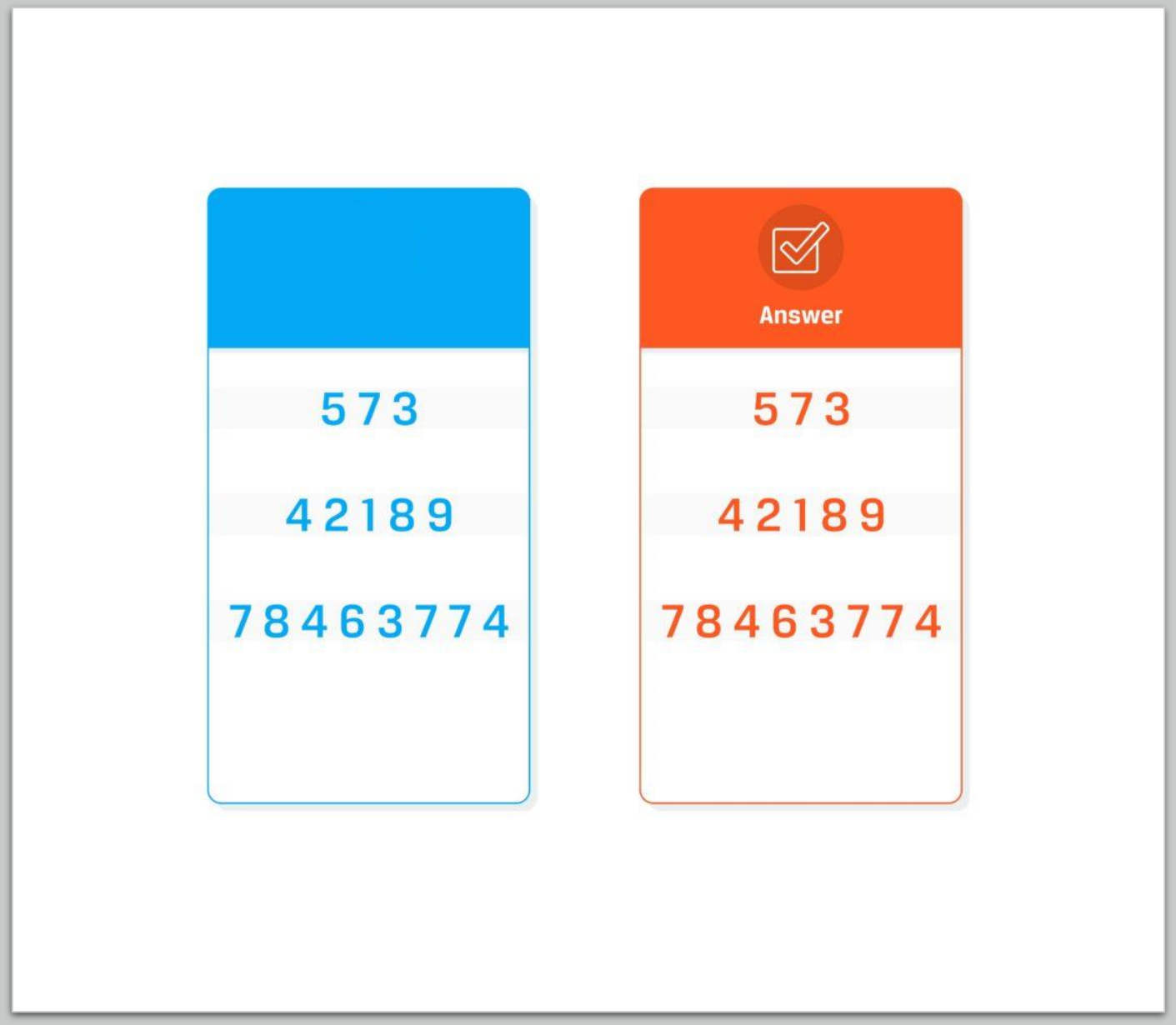
2. AC is a secondary classification for Gwm subtests that have subcomponents where either Wa or Wv is involved but a distinct subcomponent involves Wc. These subtests may be classified as "Gwm:Wa, AC" or "Gwm:Wv, AC".

Example: The blue browned the red. Who browned the red? Answer: the blue. This task does not require manipulating information, but it requires more deliberate processing than a typical Wa task and therefore has a secondary code of AC (i.e., Gwm:Wa, AC)

3. If AC is an appropriate classification for a task outside of the Gwm domain (e.g., Gf, Gv, Gs), then "Gwm" should be dropped, and "AC" should be used as the sole classification or as a classification that is secondary to the primary narrow ability classification.

Gwm – Auditory Short-term Storage (Wa)

Task Example: An examinee is presented with a series of numbers orally and must repeat the numbers verbatim.



- **Gwm – Visual Short-term Storage (Wv)**

Task Example: *An examinee is presented with a series of pictures for 5 seconds* and then must point to the pictures in order when they are displayed on a page with several other pictures.

- **Gwm – Visual Short-term Storage (Wv)**

Task Example: An examinee is presented with a series of pictures for 5 seconds *and then must point to the pictures in order when they are displayed on a page with several other pictures*.

Gwm – Working Memory Capacity (Wc)

Task Example: An examinee is presented with a series of letters and numbers in a mixed-up order and is required to reorder them by stating the numbers in ascending order followed by the letters in alphabetical order.

Item

9 – L – 7 – C – 2 – R

Response

2 – 7 – 9 – C – L – R

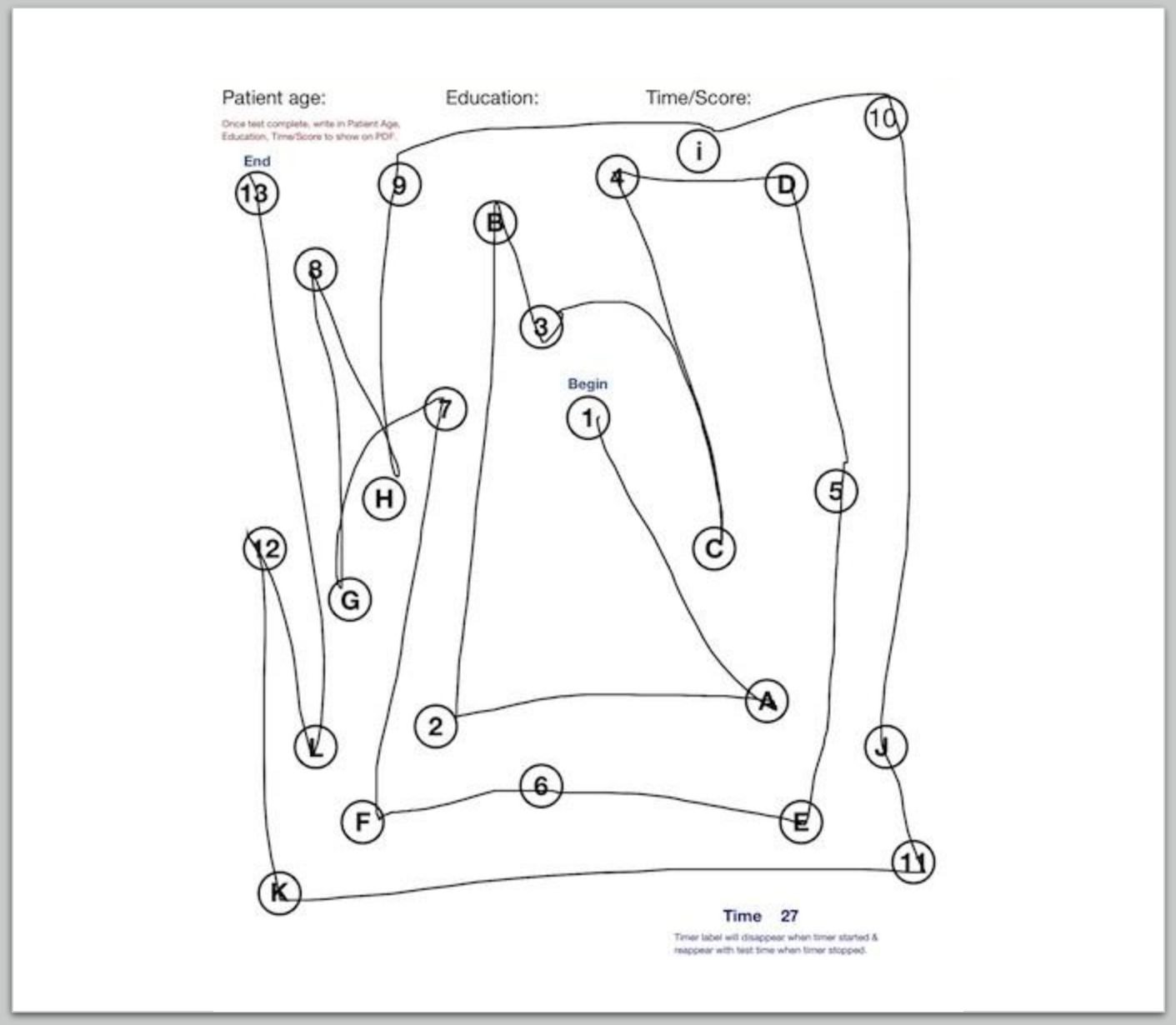
AC is required on many tests commonly thought of as tests of Executive Functions (e.g., tests that involve cognitive flexibility, inhibition, switching, set shifting)

- **Example of proposed AC rule #3**:

The examinee is required to draw a line connecting, in alternating sequence, the numbers 1 through 13 and the letters A through L, starting with 1 and drawing a line to A, then 2, then B, and so on until he or she has connected all numbers and letters.

Classification: Gs:Ps; AC

Trails (Gs:Ps; AC)

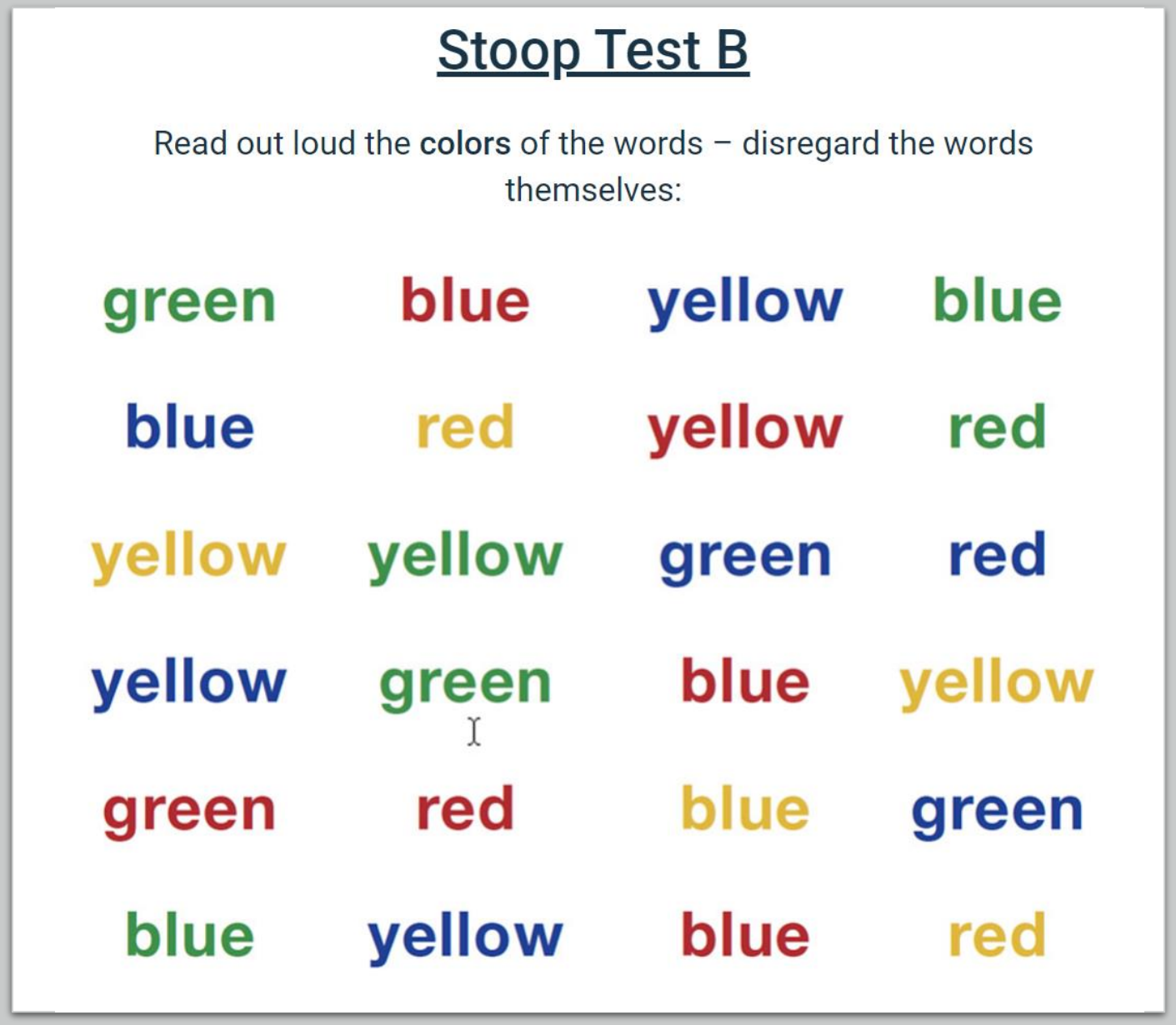


AC is required on many tests commonly thought of as tests of Executive Functions (e.g., tests that involve cognitive flexibility, inhibition, switching, set shifting)

- **Another example of AC rule #3**: An examinee is required to quickly say the color a word is printed in rather than read the word.

Classification: AC

Stroop (AC)



The degree of ***Attentional Control*** needed increases as reasoning tasks become more complex and when time constraints are imposed

Attentional Control is important; a high level may be needed to perform more complex working memory tests, particularly those involving resequencing or transforming information in some way

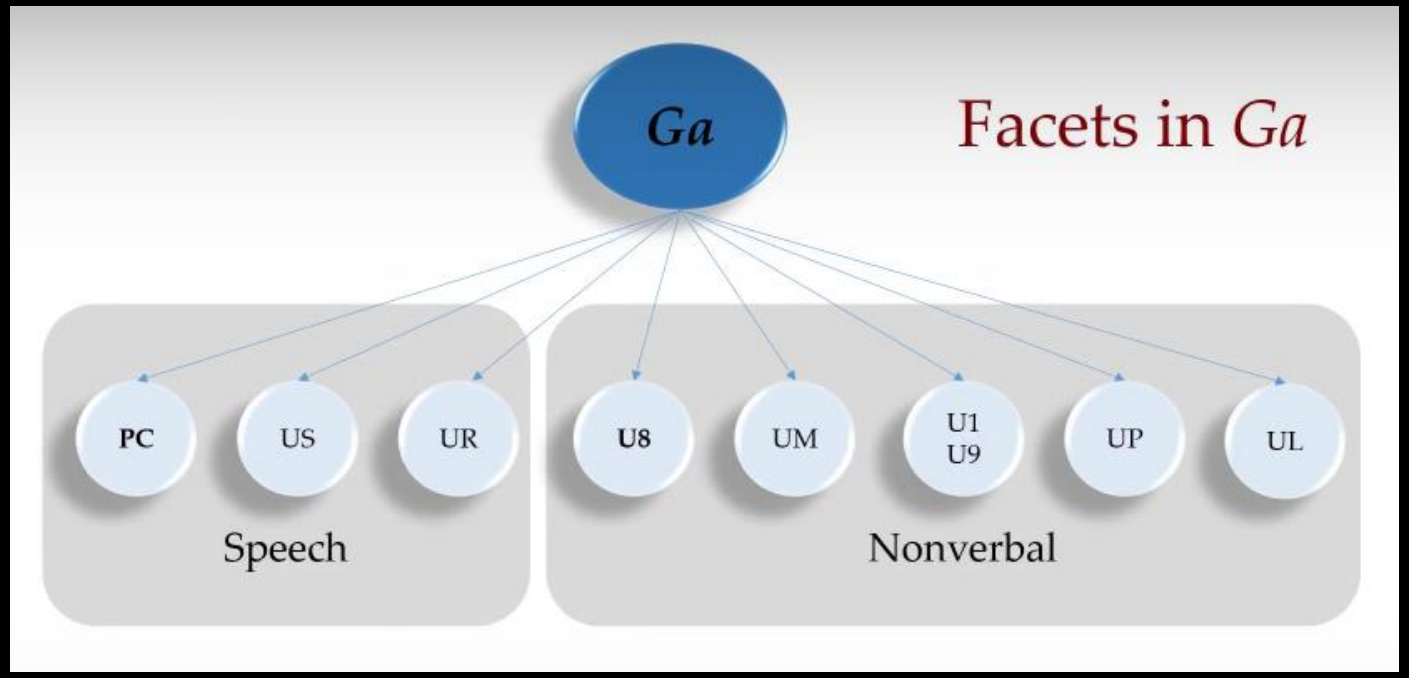
Attentional Control is important; a high level may be needed to perform speeded tasks that require inhibition, switching, and cognitive set shifting

Reasoning	*Gf*	**I**	**RG**	**RQ**								
Acquired Knowledge	*Gc*	**K0**	**VL**	**LS**	**CM**	**MY**						
	Gkn	KL	KF	LP	K1	K2	MK	BC				
	Gq	**KM**	**A3**									
	Grw	**RD**	**RS**	**RC**	**SG**	**WA**	**EU**	**WS**				
Memory	*Gwm*	**Wa**	**Wv**	**Wc**	**AC**							
	Gl	**MA**	**MM**	**M6**								
	Gr	**NA**	**FI**	FW	FA	FE	SP	FO	LA	FF	FX	
Sensory	*Gv*	**Vz**	**MV**	IM	CF	SR	CS	SS	PI	LE	IL	PN
	Ga	**PC**	UM	UR	US	U8	UP	U1 U9	UL			
	Go	OM										
	Gh											
Motor	*Gp*	**P1**	P2	P3	P4	P6	P7	P8	AI			
	Gk											
Speed and Efficiency	*Gs*	**Pc**	**Ps**	**N**	**RS**	**WS**						
	Gt	R1	R2	R4	R7	IT						
	Gps	**WS**	RS	PT	MT							

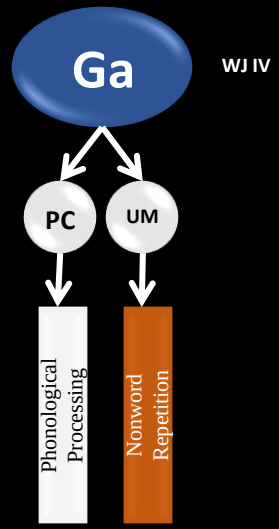
The Current CHC Taxonomy Incudes 17 Broad Abilities and 80 Narrow Abilities (Schneider & McGrew, 2018)

Auditory Processing (Ga)

The ability to analyze, manipulate, discriminate, comprehend, and synthesize sounds (e.g., speech units). It involves the ability to hear phonemes distinctly, blend and segment words, and retain speech sounds on a short-term basis



Supplement WISC-V with Ga tests from another battery (e.g., CTOPP-2; FAR; WJ IV OL)



PC — **Phonetic coding (PC):** The ability to distinctly hear phonemes, blend sounds into words, and segment words into parts, sounds, or phonemes.

US — Speech sound discrimination (US): The ability to detect and discriminate differences in speech sounds (other than phonemes) under conditions of little or no distraction or distortion.

UR — Resistance to auditory stimulus distortion (UR): The ability to hear words or extended speech passages correctly under conditions of distortion or background noise.

U8 — **Maintaining and judging rhythm (U8):** The ability to recognize and maintain a musical beat

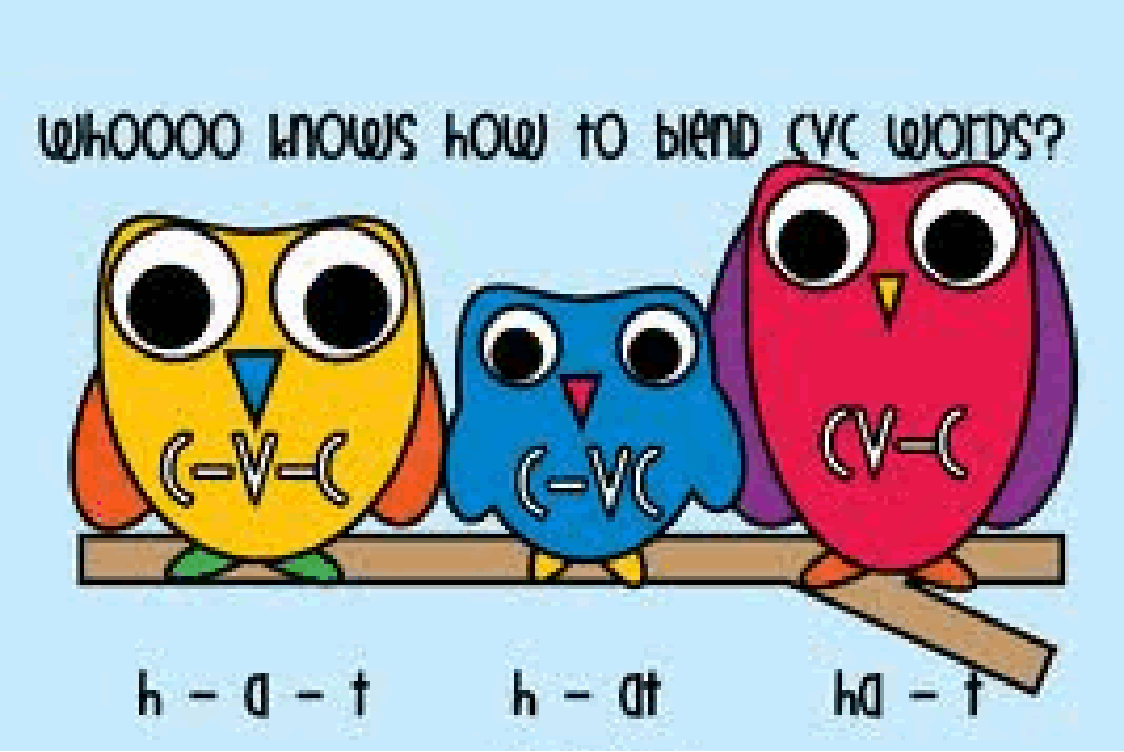
UM — Memory for sound patterns (UM): The ability to retain (on a short-term basis) auditory codes such as tones, tonal patterns, or speech sounds.

Also called Phonological Memory

- **Ga – Phonetic Coding**

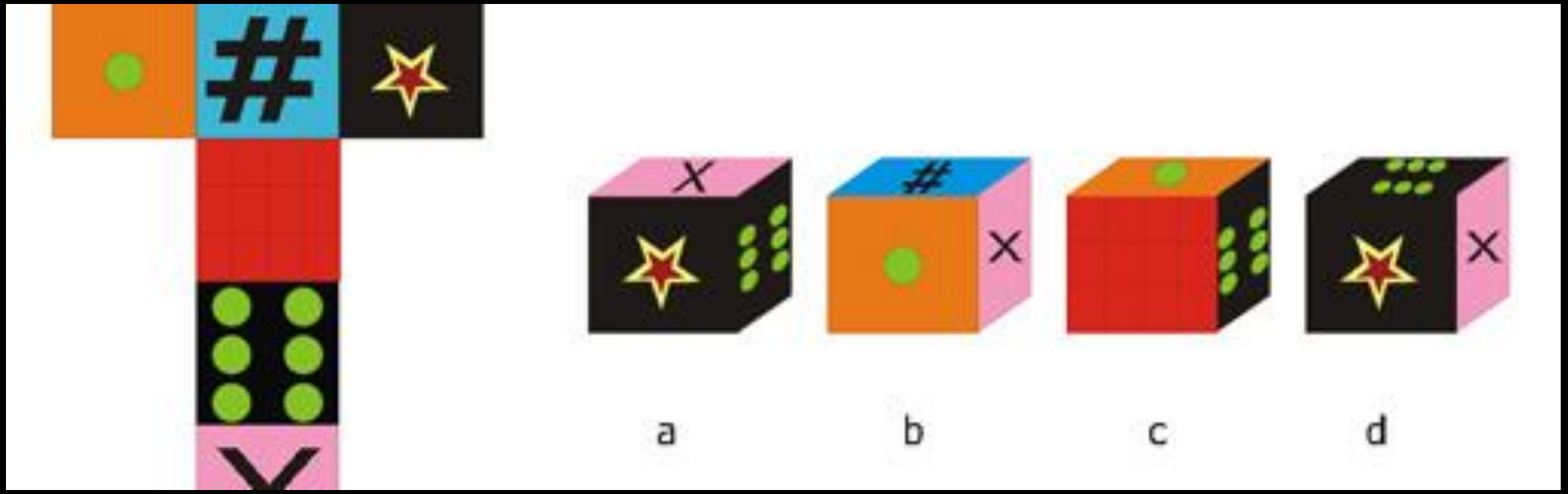
Task Example: An examinee blends sounds together fluently to form words.

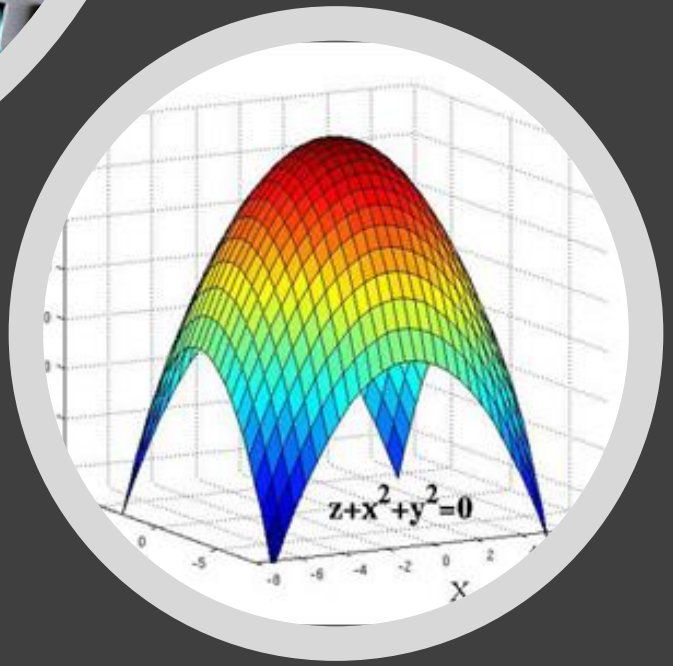
Phonemic Awareness tests are found on cognitive, achievement, speech-language, and special purpose tests



Visual Processing (Gv)

- Visual processing (Gv) is an individual's ability to think about visual patterns (e.g., what is the shortest route from your house to school?) and visual images (e.g., what would this shape look like if I turned it upside down?).



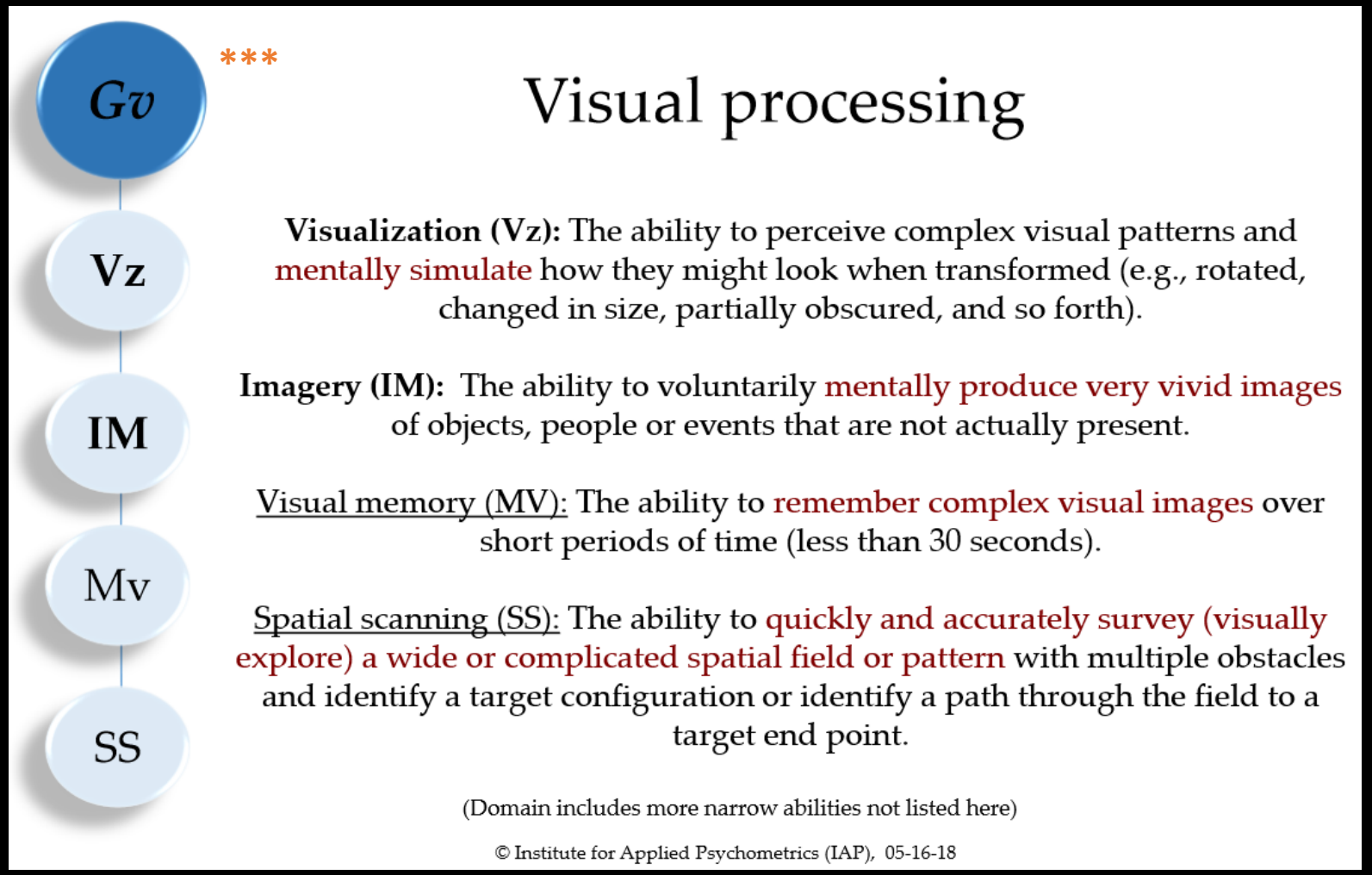


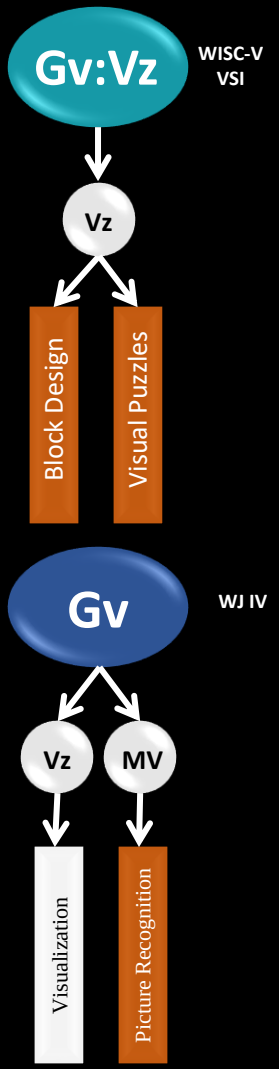
Visual Processing (Gv)

- This type of ability also involves generating, perceiving, and analyzing visual patterns and visual information.
  - putting puzzles together
  - completing a maze
  - Interpreting charts, graphs, and figures
- Important when doing advanced math

  (e.g., geometry and calculus).

Visual Processing (Gv). The ability to generate visual images and perceive and analyze visual patterns and visual information. It also involves the ability to mentally simulate how complex visual patterns might look when transformed in some way (e.g., rotated).





Eight Gv abilities are not listed in this figure: Speeded Rotation (SR), Closure Speed (CS), Serial Perceptual Integration (PI), Length Estimation (LE), Perceptual Illusions (IL), Perceptual Alternations (PN), and Perceptual Speed (P)

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- **Gv – Visualization**

Task Example: An examinee is required to assemble blocks to match a picture or standing model.

- **Gv – Visual Memory**

Task Example: After being exposed to an image for five seconds, the examinee must identify the image when it is part of a larger and more complex image.

- **Gv – Visual Memory**

Task Example: After being exposed to an image for five seconds, the examinee must identify the image when it is part of a larger and more complex image.

A

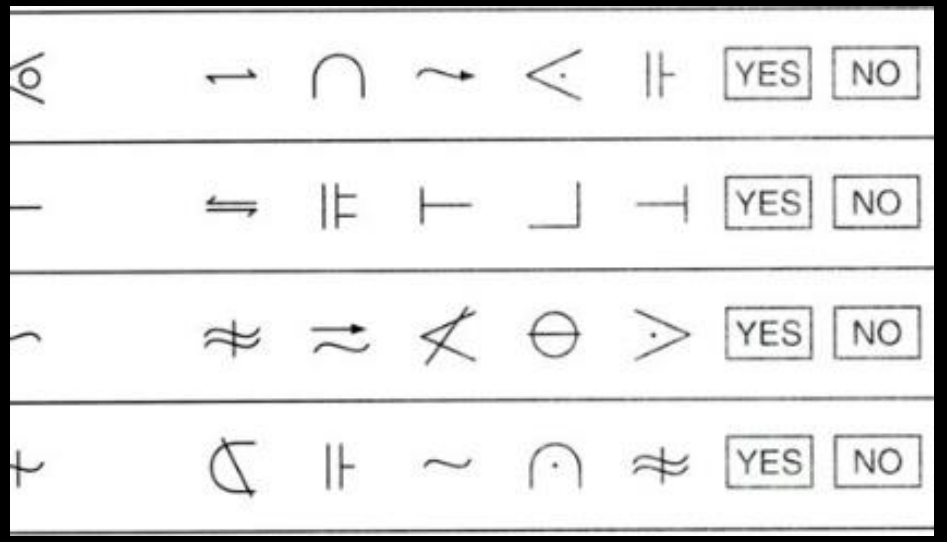
B

C

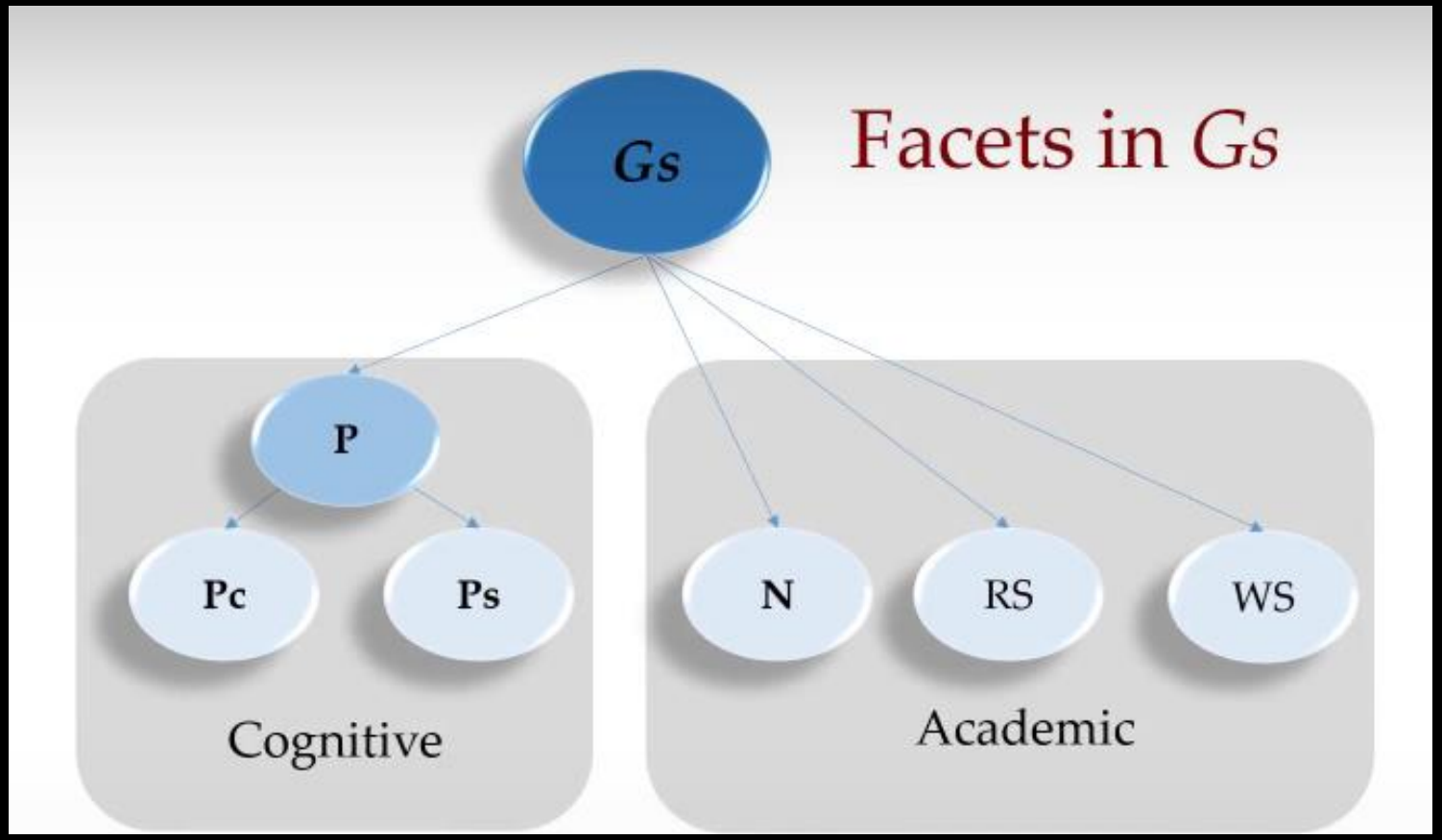
D

Answer: C

Processing Speed (Gs)



- The ability to control attention to automatically perform simple and repetitive clerical-type tasks quickly. It may be thought of as mental speed or the fluency with which simple, over-learned tasks are performed.



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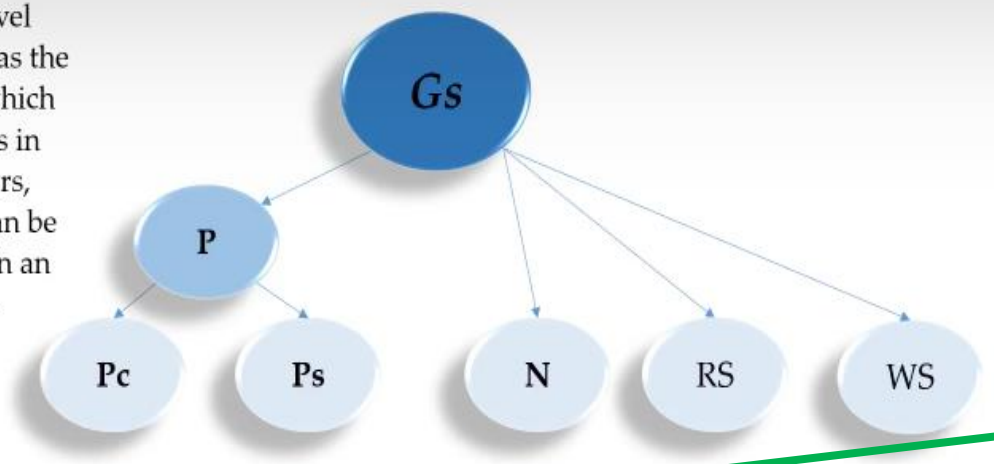
New to Gs

Intermediate Factor, Narrow Ability Codes, Facets

Rate of Test Taking (R9) was dropped

Perceptual speed (P): An intermediate stratum level ability that can be defined as the speed and fluency with which similarities or differences in visual stimuli (e.g., letters, numbers, patterns, etc.) can be searched and compared in an extended visual field.



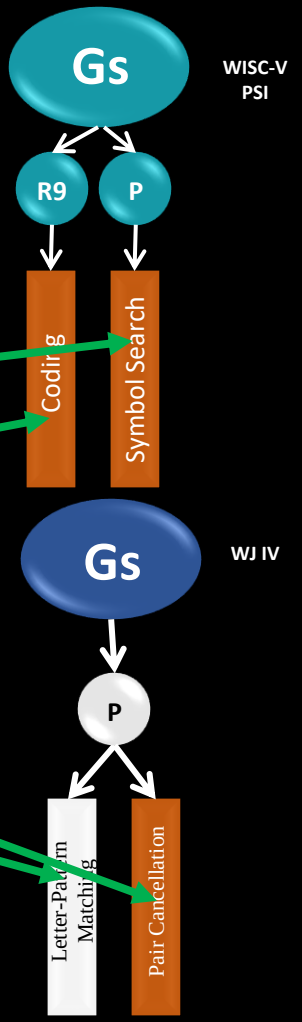
Perceptual speed-search (Ps): The speed and fluency of searching or scanning an extended visual field to locate one or more simple visual patterns.

Perceptual speed-compare (Pc): The speed and fluency of looking up and comparing visual stimuli that are side-by-side or more widely separated in an extended visual field.

Number facility (N): The speed, fluency and accuracy in manipulating numbers, comparing number patterns, or completing basic arithmetic.

Reading speed (fluency) (RS): The speed and fluency of reading text with full comprehension. Also listed under *Grw*.

Writing speed (fluency) (WS): The speed and fluency of generating or copying words or sentences. Also listed under *Grw* and *Gps*.



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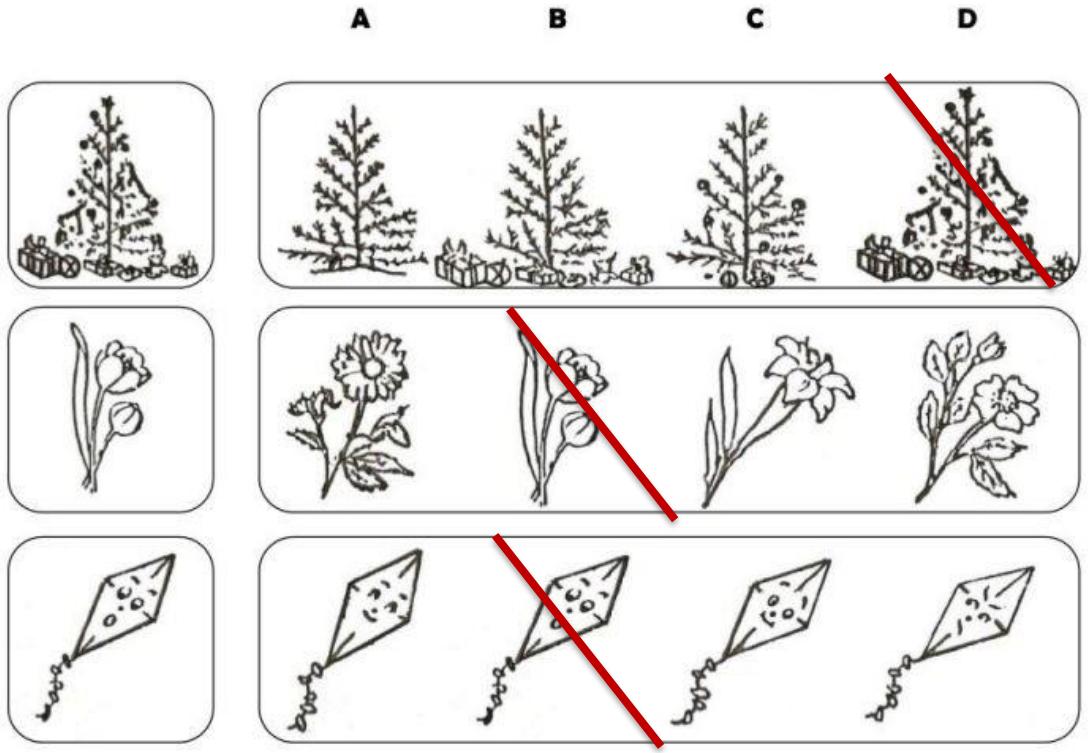
Cognitive Facet

- **Gs – Perceptual Speed Search (Ps)**

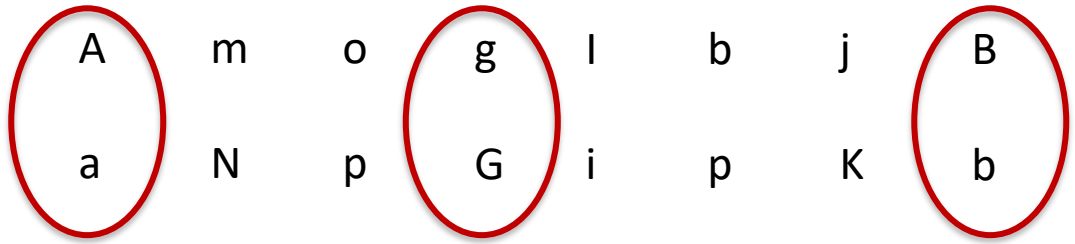
Task Example: The examinee must identify from a series of pictures the one that matches the target picture as quickly as possible.



Cognitive Facet

- **Gs – Perceptual Speed Compare (Pc)**

Task Example: The examinee is required to circle the pairs of letters with the same name as quickly as possible.

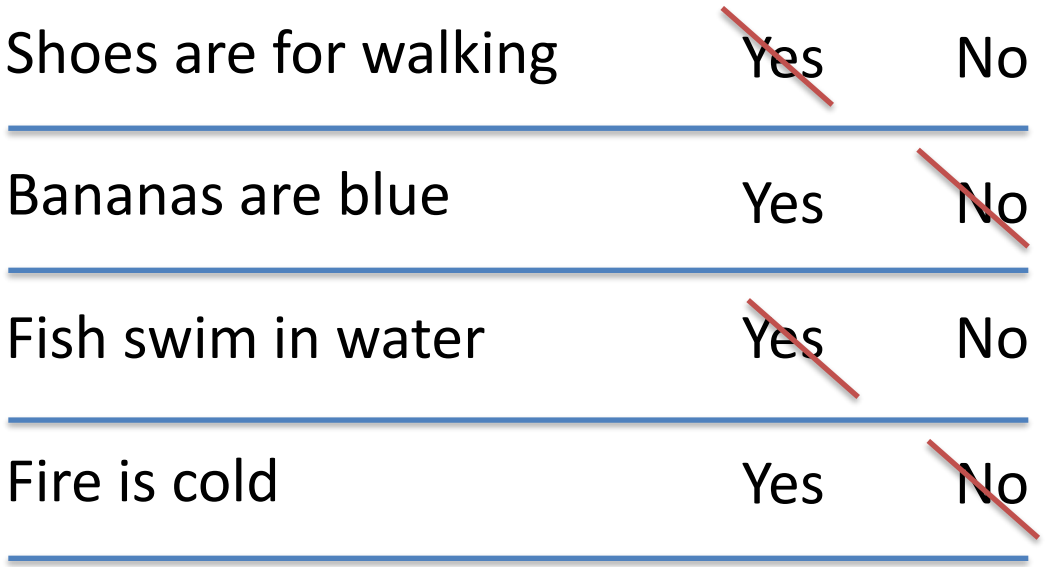


Academic Facet (Cross Listed in Grw)

- **Gs:RS – Reading Speed (Fluency)**

Task Example: The examinee is required to read simple sentences and determine whether they are accurate

Note: This definition includes comprehension



Proposal: RS should be restricted to *reading connected text fluently and accurately*, separate from comprehension. This suggested change would mean that reading speed tests would parallel writing speed and math speed tests. RS, WS, and MS tasks should answer the question: Has the individual developed automaticity in reading/writing/math?

Fiction Passage 7

The Yak

Name: _____

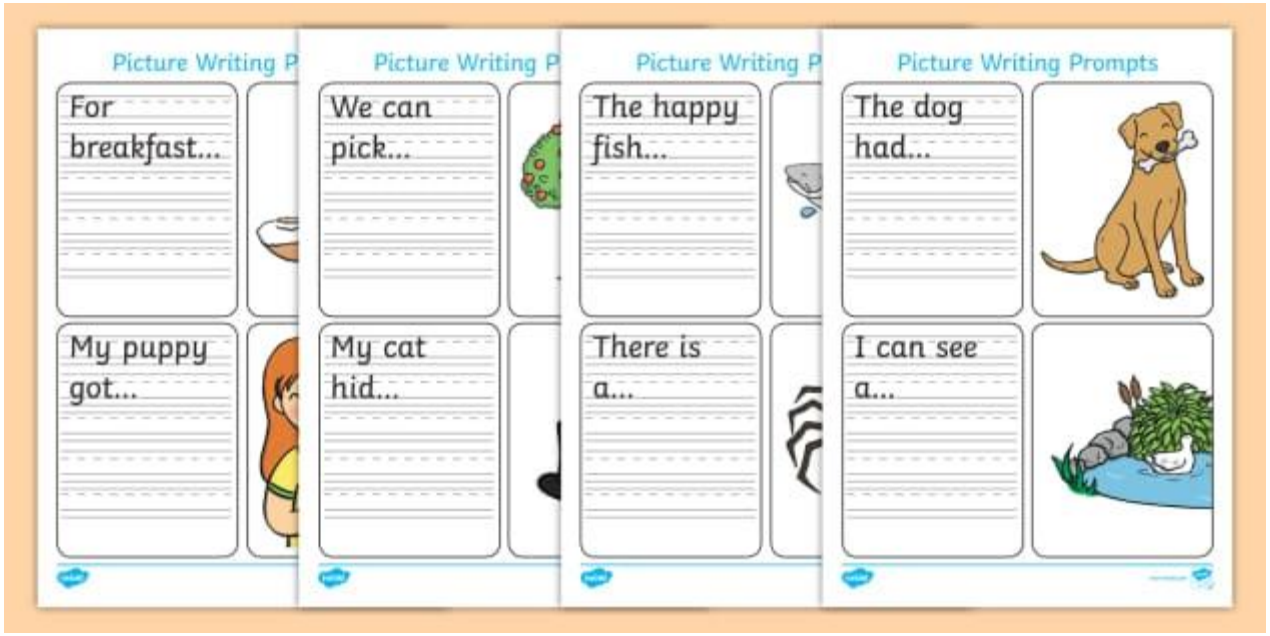
"Look at my hair," the yak said.	7
His hair was a mess. He did not	15
like it this long. The yak could	22
barely see because of his long	28
hair. He needed to find someone	34
that would cut it. He walked	40
through the plains looking. He	45
found a monkey pal. The monkey	51
said he could help him out.	57

	Words Per Minute
1st Read	
2nd Read	
Last Read	

Academic Facet (Cross Listed in Grw)

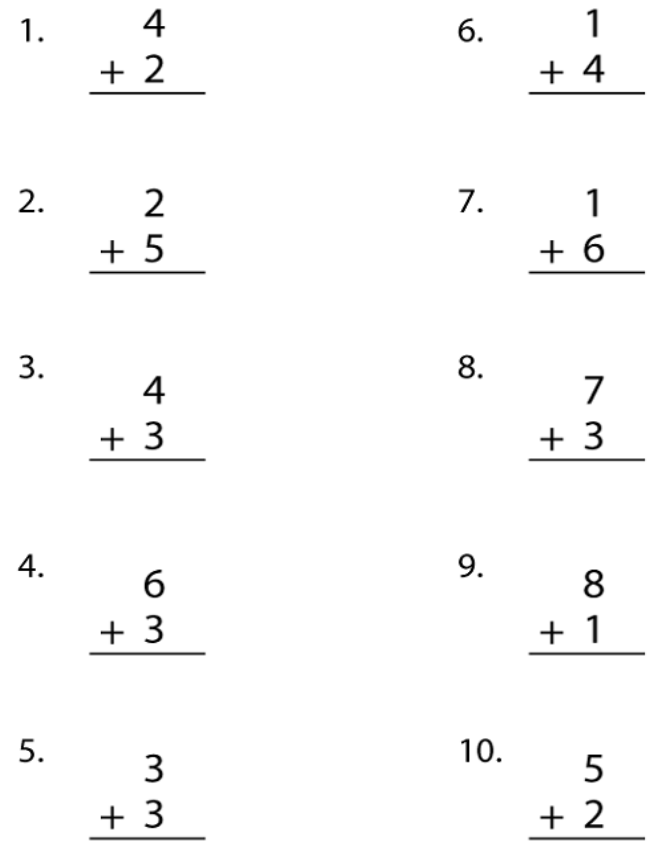
- **Gs:WS – Writing Speed (Fluency)**

Task Example: The examinee is required to complete sentences using picture prompts as quickly as possible.



Academic Facet (Cross Listed in Gq)

- **Gs:MS – Proposed Math Speed (Fluency)**: The examinee is required to solve simple addition problems as quickly as possible



Perceptual speed-search (Ps)	the speed and fluency of searching or scanning an extended visual field to located one or more simple visual patterns
Perceptual speed-compare (Pc)	the speed and fluency of looking up and comparing visual stimuli that are side by side or more widely separated in an extended visual field

Gs Cognitive Facet

Number facility (N)	the speed, fluency, and accuracy in manipulating numbers, comparing number patterns, or completing basic arithmetic operations
Reading speed (fluency) (RS)	the speed and fluency of reading text with full comprehension
Writing speed (fluency) (WS)	the speed and fluency of generating or copying words or sentences

Gs Achievement Facet

Math speed (MS)	the speed and fluency of completing basic arithmetic operations
Reading speed (fluency) (RS)	the speed of reading connected text fluently and accurately
Writing speed (fluency) (WS)	the speed and fluency of generating or copying words or sentences

Gs Achievement Facet **Modified**

Quantitative knowledge (Gq)	the depth and breadth of declarative and procedural knowledge related to mathematics
Mathematical knowledge (KM)	range of general knowledge about mathematics, not the performance of mathematical operations or the solving of math problems
Mathematical achievement (A3)	measured (tested) mathematics achievement
Number sense (N)	the basic processing of numerical information, including number representation (quantifying sets without counting) and number comparison (estimating the relative magnitude of sets)

Gq **Modified**

Gs:MS (Math Speed)
Gq:N (Number Sense)

- Recommendation: Use “N” for tests of number sense or basic processing of numerical information (e.g., estimating the relative magnitude of sets, estimating quantity, number comparisons, number representation), which is not currently its own narrow ability.
- Number Sense is nonsymbolic and intuitive (distinct from A3 and KM)
- Math Speed parallels RS and WS in the Gs domain (each of these narrow abilities is consistent with fluency or automaticity in basic skills that have been taught via formal instruction).
- Like RS and WS, MS should be cross listed under Gq
- Gq: N (Number Sense), A3 (Mathematical Achievement), MS (Math Speed), and KM (Math Knowledge)

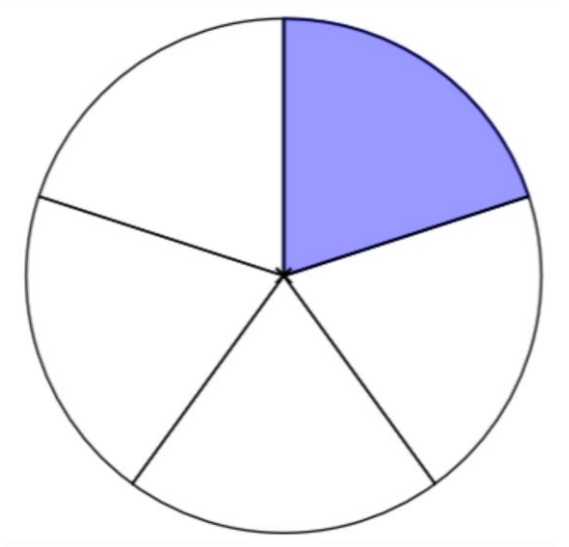
How are Gs tests classified?

- **Recommendations**: Since reading, writing, and math fluency are in the *achievement* facet of Gs and these tasks are intended to measure fluency in *skills that have been taught,* which is why they are mostly found on achievement tests, the classifications should reflect the broad achievement domain as primary
  - Grw:RS, Grw:WS, Gq:MS
  - Also, cross listed in Gs

Quantitative Knowledge (Gq)

- **Math Knowledge (KM)**

Task Example: The examinee is required to select the fraction that goes with the picture

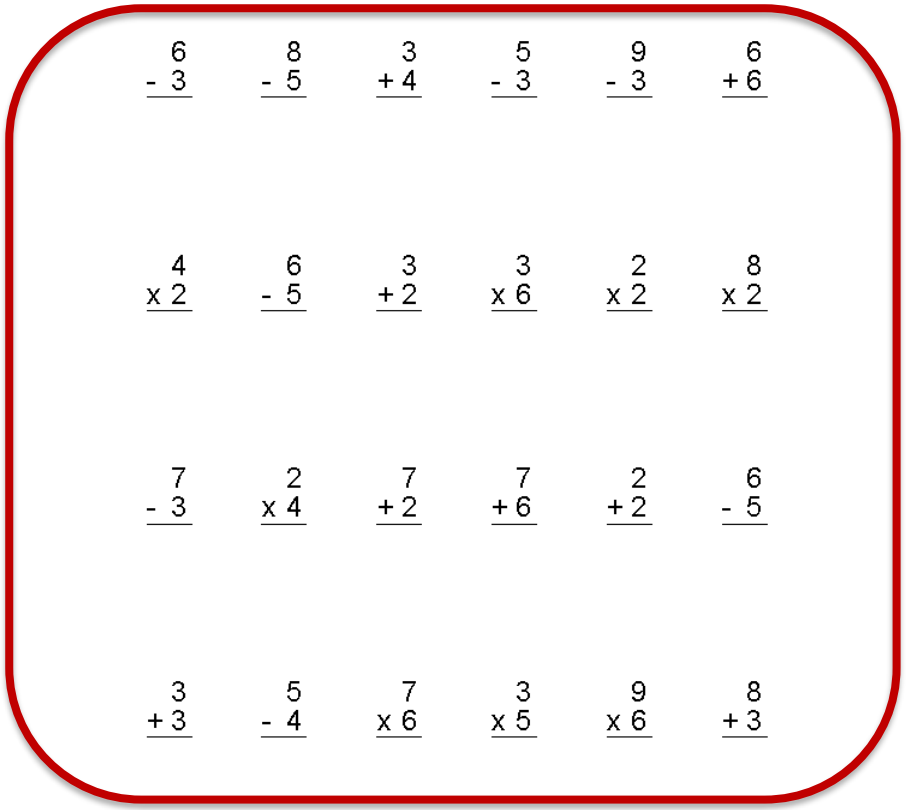


1/2 2/3 1/5 2/5

Quantitative Knowledge (Gq)

- **Math Achievement (A3)**

Task Example: The examinee is required to complete as many problems as possible in a specified time frame.



Broad Reading and Writing (Grw)

- **Grw – R (Reading)**

Reading comprehension (RC)	the ability to understand written discourse
Reading decoding (RD)	the ability to identify words from text
Reading speed (RS)	the rate at which a person can read connected discourse with full comprehension

Broad Reading and Writing (Grw)

- **Grw – W (Writing)**

Writing Speed (WS)	the ability to copy or generate text quickly
English Usage (EU)	knowledge of the mechanics of writing (e.g., capitalization, punctuation, and word usage)
Spelling (SG)	the ability to spell words
Writing Ability (WA)	the ability to use text to communicate ideas clearly

CHC Abilities Measured by Cognitive, Academic, and Special Purpose Tests

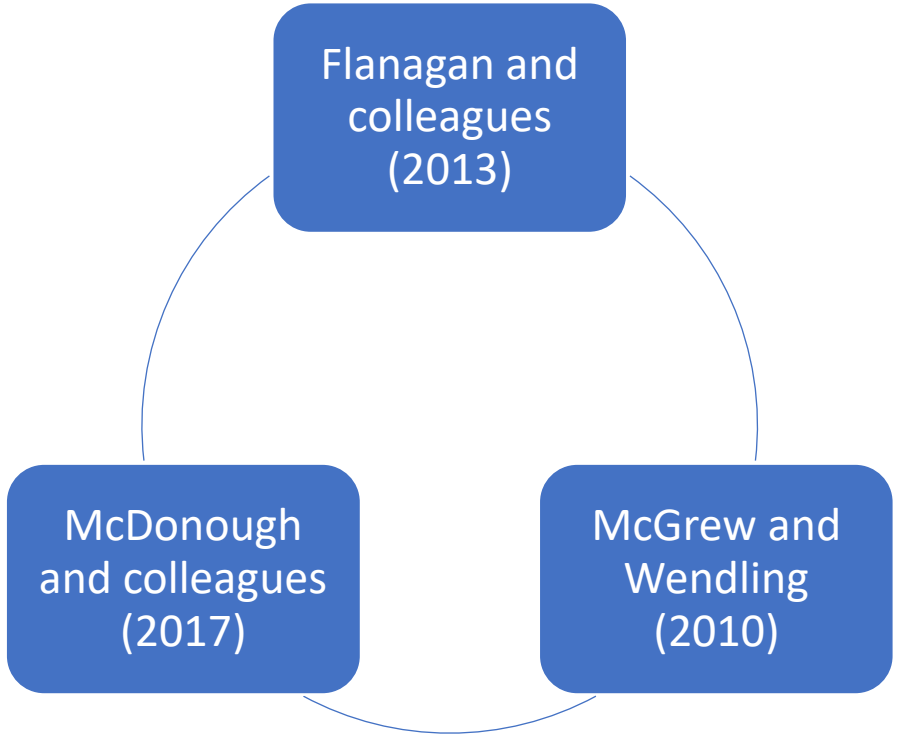
BROAD ABILITIES	2022 (pre Re-classification)	2015	2014	Change 2015	Change 2014
TOTALS					
Gc	303	242	185	61	118
Grw	216	154	109	62	107
Gv	140	108	89	32	51
Glr	138	98	81	40	57
Gsm	123	89	64	34	59
Gq	92	59	35	31	55
Ga	87	67	55	20	32
Gs	70	58	36	12	34
Gf	69	61	43	8	26
Gkn	9	7	3	2	6
Gp	4	-----	14	-----	-10
Gh	-----	-----	4	0	-----
Gps	1	-----	1	-----	0

Zinkiewicz, C., Alfonso, V. C., & Flanagan, D. P. (2022, May). *CHC broad & narrow abilities measured: 2014-2022*. Poster presented at the annual meeting of the Association for Psychological Science, Chicago, Il.

Cognitive-Achievement Relations

Research Underlying DD/C

(consistency component)



A Consensus Model of Cognitive-Achievement Relations Using Meta-SEM

- Daniel Hajovsky, Ph.D. – Texas A&M University
- Chis Niileksela, Ph.D. – University of Kansas
- Dawn Flanagan, Ph.D. – St. John's University
- Vincent C. Alfonso, Ph.D. – Gonzaga University
- Joel Schneider, Ph.D. – Temple University
- Craig Zinkiewicz, Ph.D. – Scottsdale Unified School District

See also: Hajovsky, D. B., Villeneuve, E. F., Schneider, W. J., & Caemmerer, J. M. (2020). An alternative approach to cognitive and achievement relations research: An introduction to quantile regression. *Journal of Pediatric Neuropsychology*, *6*, 83–95.

A Consensus Model of Cognitive-Achievement Relations Using Meta-SEM

Hajovsky, Niileksela, et al.

The aim of this study is to add empirical evidence to the literature on Cattell-Horn-Carroll (CHC) cognitive-achievement relations by analyzing multiple tests simultaneously using meta-structural equation modeling (meta-SEM; Jak et al., 2021). Meta-SEM is a useful method for analyzing correlation matrices across specific test batteries. This method results in an increased sampling of cognitive and academic skills measured by various batteries to better inform the validity of construct relations. We will use the normative and special validity samples of multiple standardized cognitive and achievement tests. Our primary results will demonstrate the construct relations between general intelligence (g), broad abilities, and academic skills across batteries and whether results are moderated by test battery, type of sample (e.g., standardization vs. validity), and age.

Presented at APA 2022

Toward a Consensus Model of Cognitive-Achievement Relations Using Meta-SEM

Daniel B. Hajovsky, Christopher R. Niileksela, Dawn P. Flanagan, Vincent C. Alfonso, W. Joel Schneider, & Craig J. Zinkiewicz

Method

The subtest correlations from the technical manuals of the WJ77, WJ-R, WJ III, WJ IV, WISC-III, WISC-IV, WISC-V, WAIS-III, WAIS-IV, WPPSI-III, WPPSI-IV, KABC-II, KABC-II NU, DAS-II, SB5, WIAT-II, WIAT-III, WIAT-4, OWLS-II, CASL-2, CELF-4, PPV4, KTEA-II, and KTEA-III along with the cross-battery correlations from all validity studies listed in the manuals were included in the data set. Where possible, correlations and sample sizes were listed separately by age. At the time of writing, 45,597 correlation coefficients were analyzed with a combined sample size of over 33,000 participants.

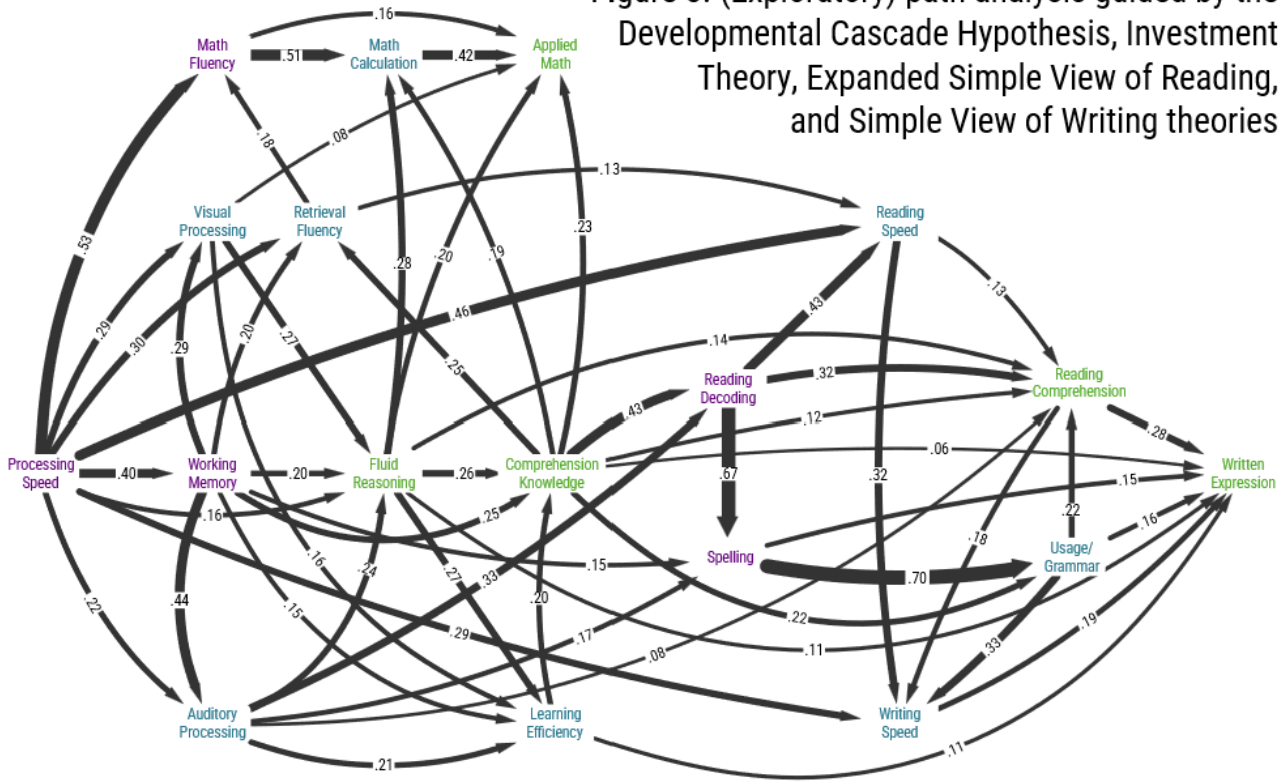
There were 219 unique subtests across the 23 test batteries/editions. For each subtest, the primary Cattell-Horn-Carroll (Schneider & McGrew, 2018) ability constructs were assigned according to their classifications in the X-BASS software (Flanagan, Ortiz, & Alfonzo, 2017). For this study, secondary classifications were ignored. For academic abilities, we distinguished between basic skills (reading decoding, spelling, grammar/punctuation, and calculation), skill fluency (reading fluency, writing fluency, and calculation fluency), and higher-level applied skills (reading comprehension, written expression, and math applied problem solving).

The exploratory analyses we conducted were guided and inspired by Fry and Hale's Developmental Cascade Hypothesis (Fry & Hale, 1996; Kail, 2007), Cattell's Investment Theory (Cattell, 1987, p. 139), Ackerman's PPIK Theory (2018), Juel's expansion of Gough and Tunmer's Simple View of Reading, and Berninger's Simple View of Writing theories. That is, some basic abilities are assumed to be fundamental precursors to more complex abilities and learned abilities. Processing speed is assumed to underly working memory, which is a primary ingredient of fluid reasoning, which facilitates verbal comprehension, which is the foundation of academic skill acquisition, which is essential for applied academic work.

Key Findings

1. Ability constructs can be viewed as densely interconnected network of skills
2. It is theoretically and empirically plausible that simple skills underlie more complex ones
3. Ability associations are likely more complex than what is displayed here

Figure 3. (Exploratory) path analysis guided by the Developmental Cascade Hypothesis, Investment Theory, Expanded Simple View of Reading, and Simple View of Writing theories



Progress in the Development and Structure of Cognitive Tests

Evolution of the Wechsler Scales

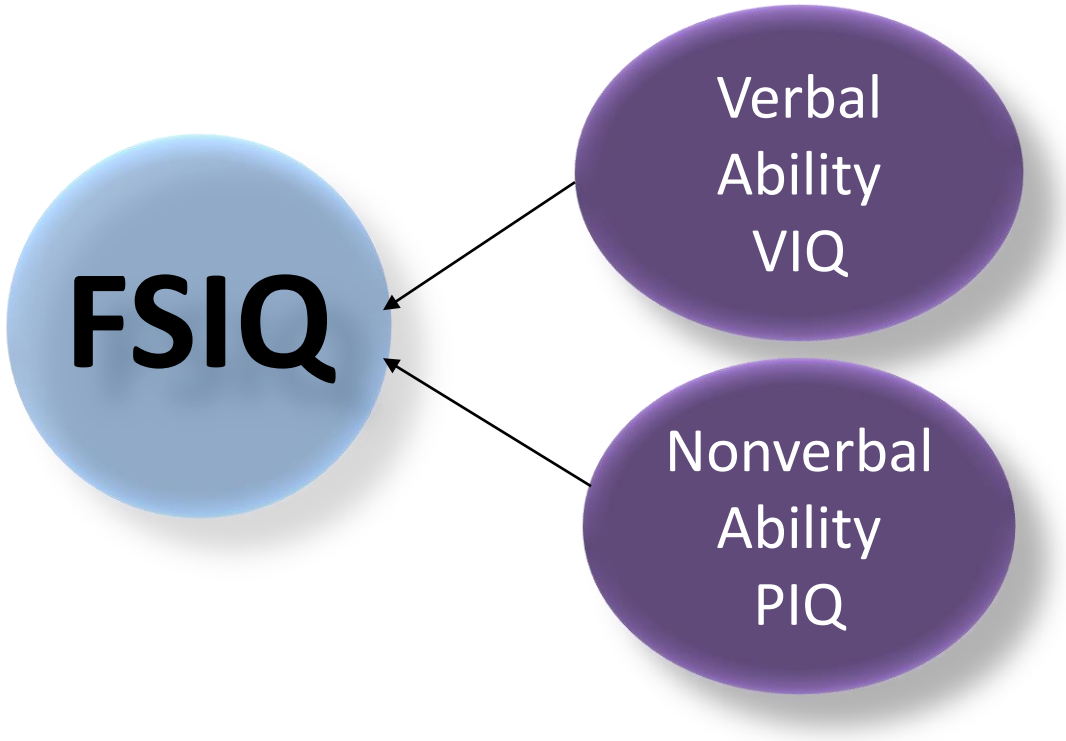
Summary of Other Comprehensive Cognitive Batteries

What Intelligence Test Was Published in 1939?

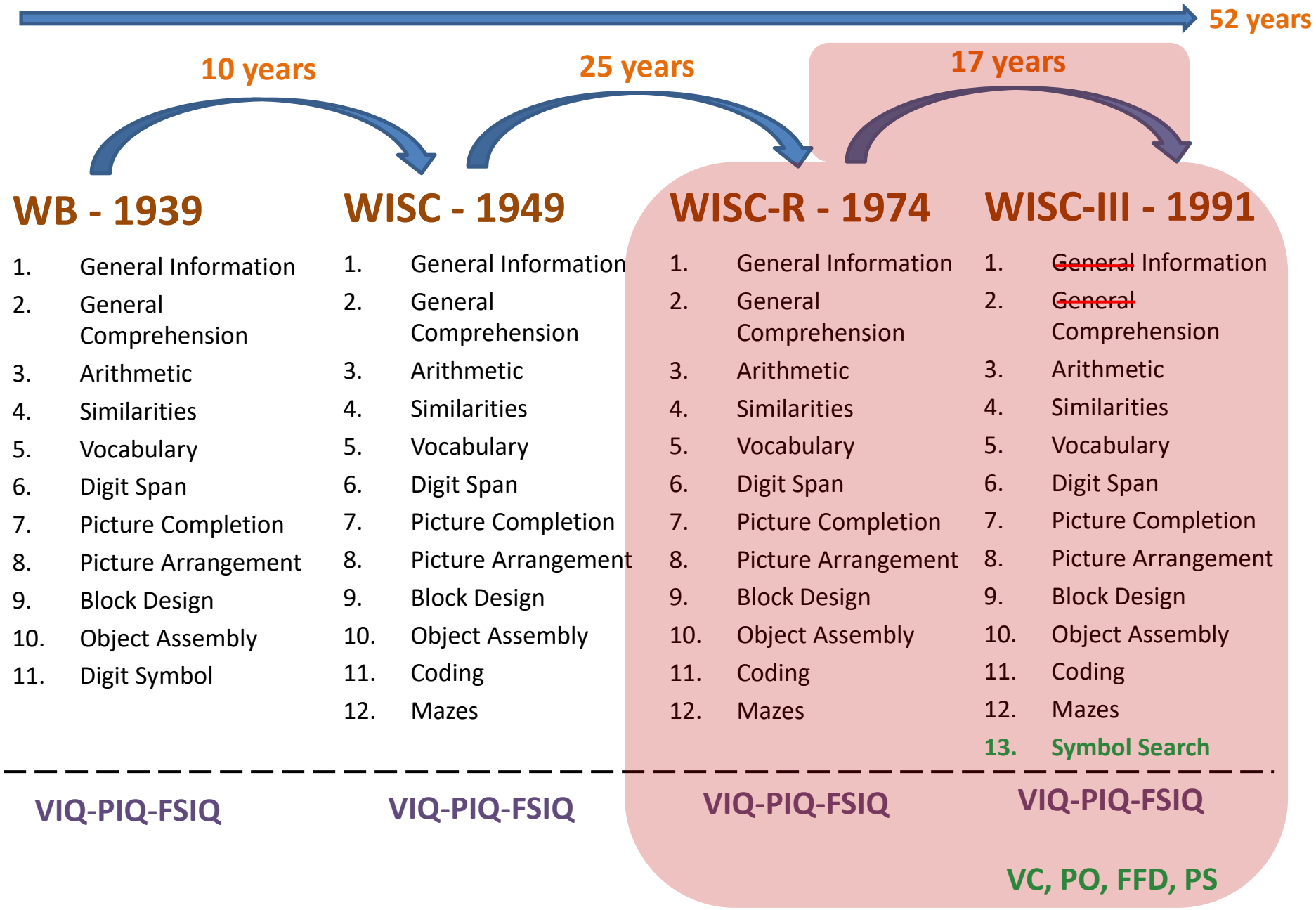
WISC, WPPSI, and WAIS roots can all be traced to The 1939 Wechsler-Bellevue

Traditional Wechsler Structure

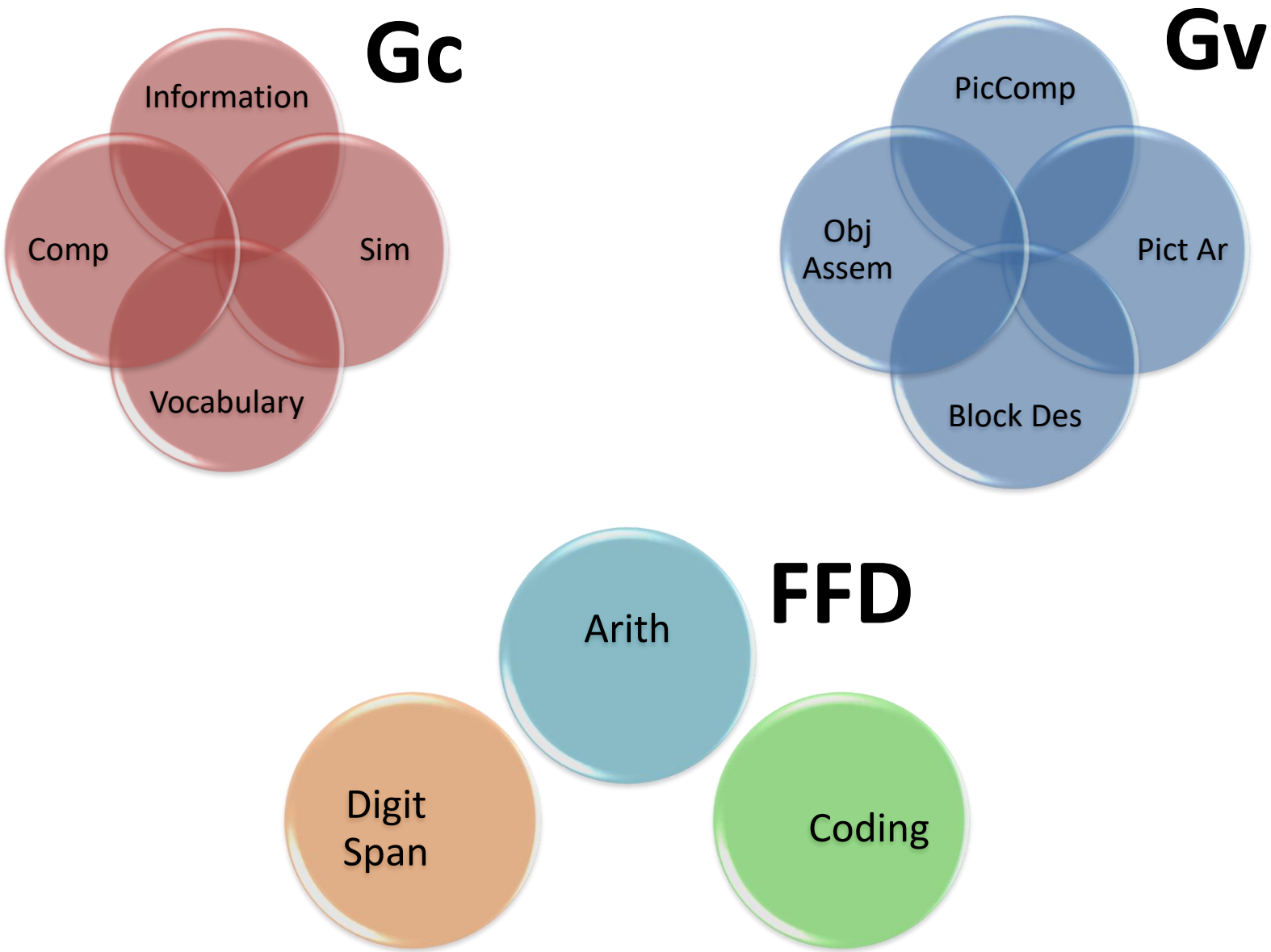
Traditional Cognitive Assessment



1939 - 1991


52 years
10 years
25 years
17 years
WB - 1939
1. General Information
2. General Comprehension
3. Arithmetic
4. Similarities
5. Vocabulary
6. Digit Span
7. Picture Completion
8. Picture Arrangement
9. Block Design
10. Object Assembly
11. Digit Symbol
WISC - 1949
1. General Information
2. General Comprehension
3. Arithmetic
4. Similarities
5. Vocabulary
6. Digit Span
7. Picture Completion
8. Picture Arrangement
9. Block Design
10. Object Assembly
11. Coding
12. Mazes
WISC-R - 1974
1. General Information
2. General Comprehension
3. Arithmetic
4. Similarities
5. Vocabulary
6. Digit Span
7. Picture Completion
8. Picture Arrangement
9. Block Design
10. Object Assembly
11. Coding
12. Mazes
WISC-III - 1991
1. General Information
2. General Comprehension
3. Arithmetic
4. Similarities
5. Vocabulary
6. Digit Span
7. Picture Completion
8. Picture Arrangement
9. Block Design
10. Object Assembly
11. Coding
12. Mazes
13. Symbol Search
VIQ-PIQ-FSIQ
VIQ-PIQ-FSIQ
VIQ-PIQ-FSIQ
VIQ-PIQ-FSIQ
VC, PO, FFD, PS

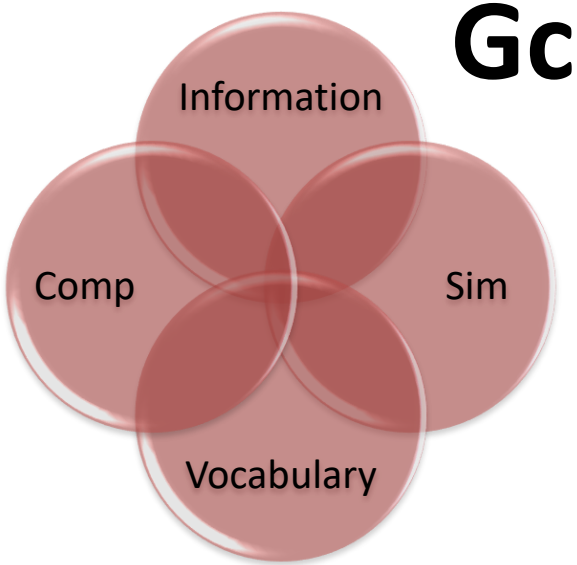
THE 1974 WISC-R Factor Structure



WISC-R -> WISC-III: WHAT DID WE WAIT 17 YEARS FOR?

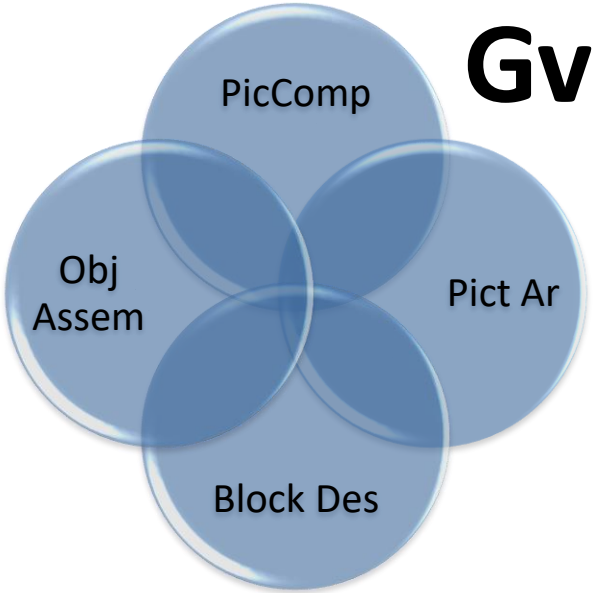
WISC-III Factor Structure (1991): 17 YEARS LATER

Gc

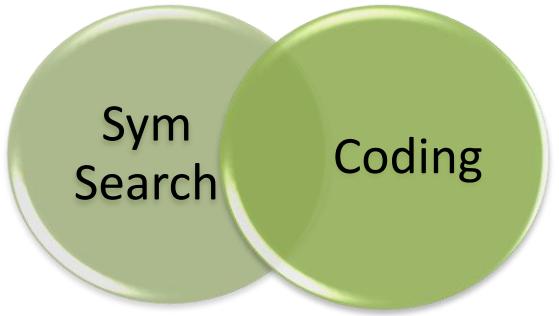


FFD

Gv



Gs



WISC-R (1974) -> WISC-III (1991)

17 years

- ***What happened in Medicine during that time period?***
  - **1974**: Liposuction
  - **1976**: First commercial PET scanner (picture to left)
  - **1980**: First commercial MRI scanner (picture above)
  - **1981**: First human heart-lung combined transplant
  - **1985**: Automated DNA sequencer;
    DNA Fingerprinting; Surgical Robot
  - **1987**: Tissue engineering
  - **1988**: Intravascular stent; Laser cataract surgery
  - **1990**: Gamow bag
    (used to treat extreme altitude sickness)

17 years

WISC-R - 1974 WISC-III - 1991

Major advances in the PET Scanner in 17 years, but no change in the WISC

17 years

WISC-R - 1974 **WISC-III - 1991**

Major advances in the MRI Scanner in 17 years, but no change in the WISC

17 years

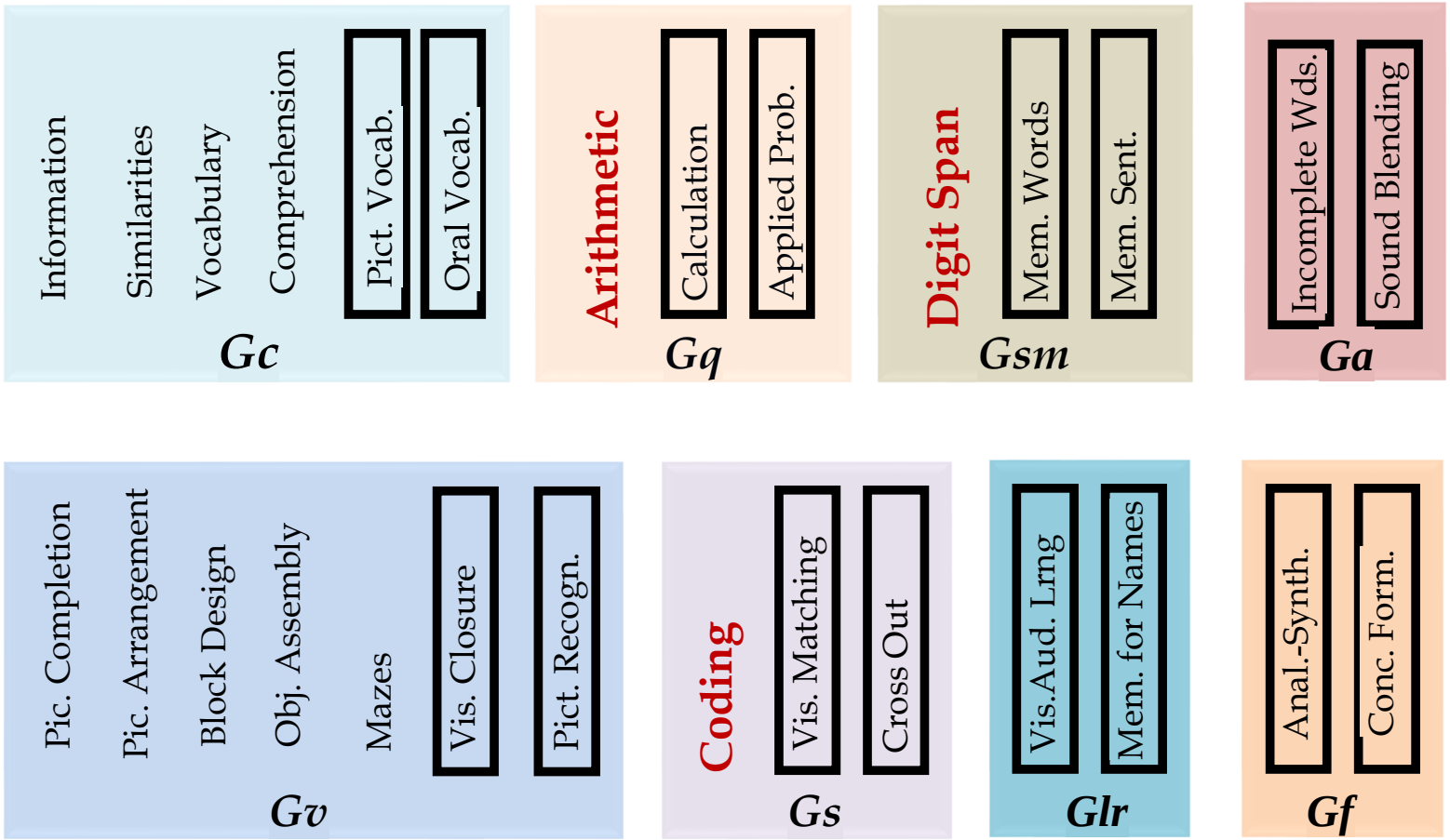
WISC-R - 1974 WISC-III - 1991

- ***20th Century Innovations***
  - 1974: Post-it Notes; Rubik's Cube
  - 1976: **Personal Computer**
  - 1978: Dyson Vacuum Cleaner
  - 1979: Trivial Pursuit
  - 1983: **Mobile Phone**
  - 1986: The Club
  - 1991: **World Wide Web**

  (first web page was created)

1974 WISC-R Was Used Until 1992

From *g* to CHC: Confirmatory Cross-Battery (or Joint) Factor Analysis of WISC-III and WJ-R

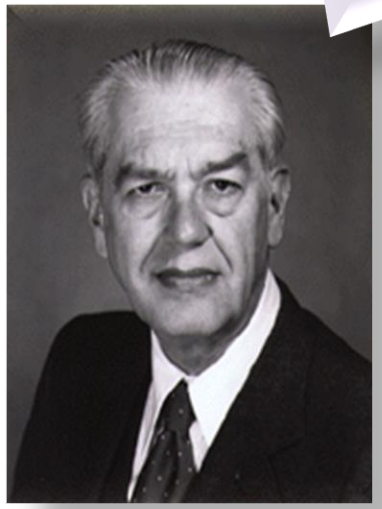


Note: WJ-R tests are indicated by bold rectangles

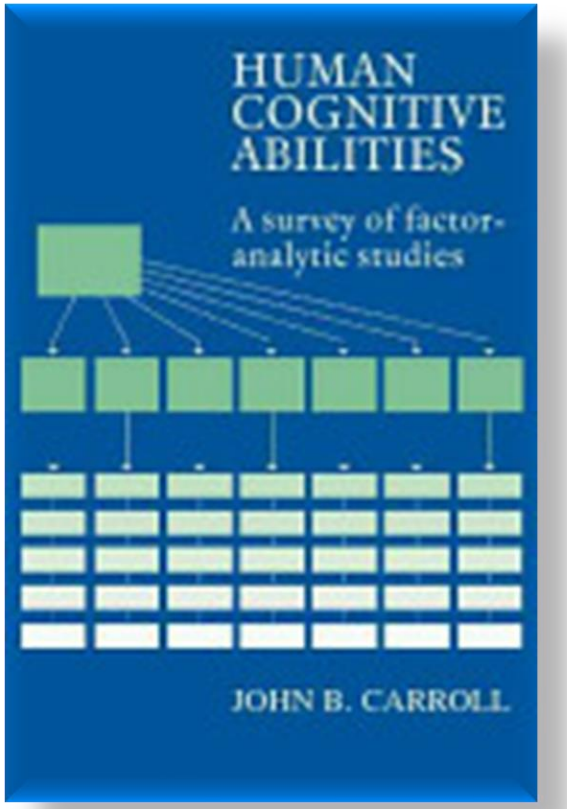
McGrew and Flanagan (1998); Flanagan, McGrew, & Ortiz (2000); Woodcock (1990)

Freedom From Distractibility Factor

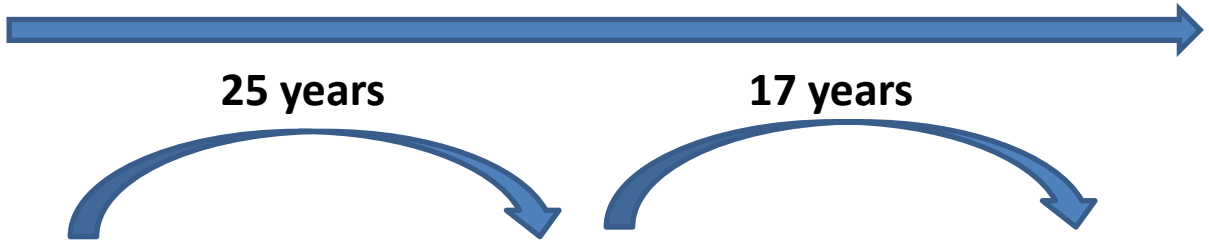
"Kaufman's "freedom from distractibility" factor is....an artifact of the factor analysis of a severely limited battery of tests, and is not to be considered as a basic primary factor in mental organization"



Carroll (1993)



The WISC had the same 12 subtests for 42 years



WISC - 1949	WISC-R - 1974	WISC-III - 1991
1. General Information	1. General Information	1. ~~General~~ Information
2. General Comprehension	2. General Comprehension	2. ~~General~~ Comprehension
3. Arithmetic	3. Arithmetic	3. Arithmetic
4. Similarities	4. Similarities	4. Similarities
5. Vocabulary	5. Vocabulary	5. Vocabulary
6. Digit Span	6. Digit Span	6. Digit Span
7. Picture Completion	7. Picture Completion	7. Picture Completion
8. Picture Arrangement	8. Picture Arrangement	8. Picture Arrangement
9. Block Design	9. Block Design	9. Block Design
10. Object Assembly	10. Object Assembly	10. Object Assembly
11. Coding	11. Coding	11. Coding
12. Mazes	12. Mazes	12. Mazes
		13. Symbol Search
VIQ-PIQ-FSIQ	**VIQ-PIQ-FSIQ**	**VIQ-PIQ-FSIQ**
		VC, PO, FFD, PS

The WISC-III was Published 10 Years After David Wechsler Died

(1896 – 1981)

The Wechsler scales introduced many novel concepts and breakthroughs to the intelligence testing movement.

25 years

17 years

12 years

WISC - 1949

1. General Information
2. General Comprehension
3. Arithmetic
4. Similarities
5. Vocabulary
6. Digit Span
7. Picture Completion
8. Picture Arrangement
9. Block Design
10. Object Assembly
11. Coding
12. Mazes

VIQ-PIQ-FSIQ

WISC-R - 1974

1. General Information
2. General Comprehension
3. Arithmetic
4. Similarities
5. Vocabulary
6. Digit Span
7. Picture Completion
8. Picture Arrangement
9. Block Design
10. Object Assembly
11. Coding
12. Mazes

VIQ-PIQ-FSIQ

WISC-III - 1991

1. ~~General~~ Information
2. ~~General~~ Comprehension
3. Arithmetic
4. Similarities
5. Vocabulary
6. Digit Span
7. Picture Completion
8. Picture Arrangement
9. Block Design
10. Object Assembly
11. Coding
12. Mazes
13. **Symbol Search**

VIQ-PIQ-FSIQ

VC, PO, FFD, PS

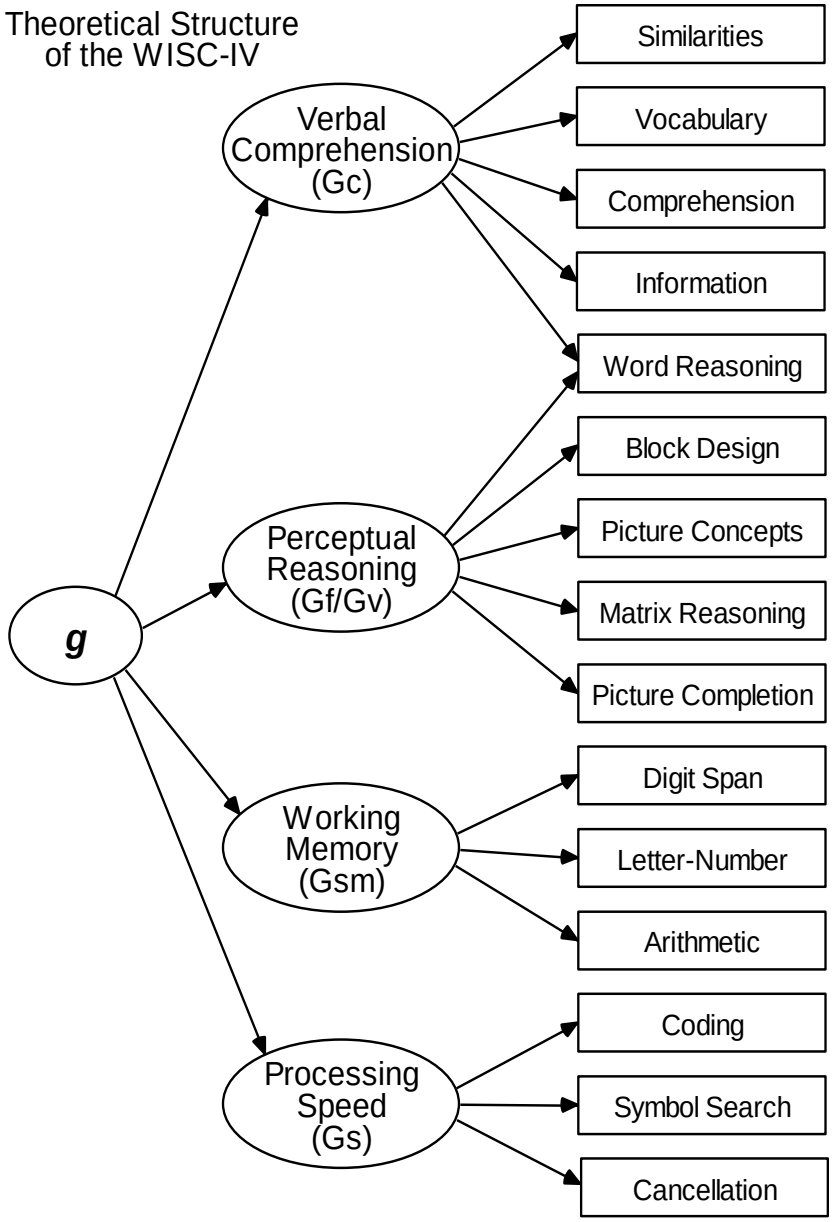
WISC-IV - 2003

1. ~~General~~ Information
2. ~~General~~ Comprehension
3. Arithmetic
4. Similarities
5. Vocabulary
6. Digit Span
7. Picture Completion
8. ~~Picture Arrangement~~
9. Block Design
10. ~~Object Assembly~~
11. Coding
12. ~~Mazes~~
13. Symbol Search
14. **Word Reasoning**
15. **Letter-Number Seq.**
16. **Picture Concepts**
17. **Matrix Reasoning**
18. **Cancellation**

~~VIQ-PIQ-FSIQ~~

VCI, PRI, WMI, PSI

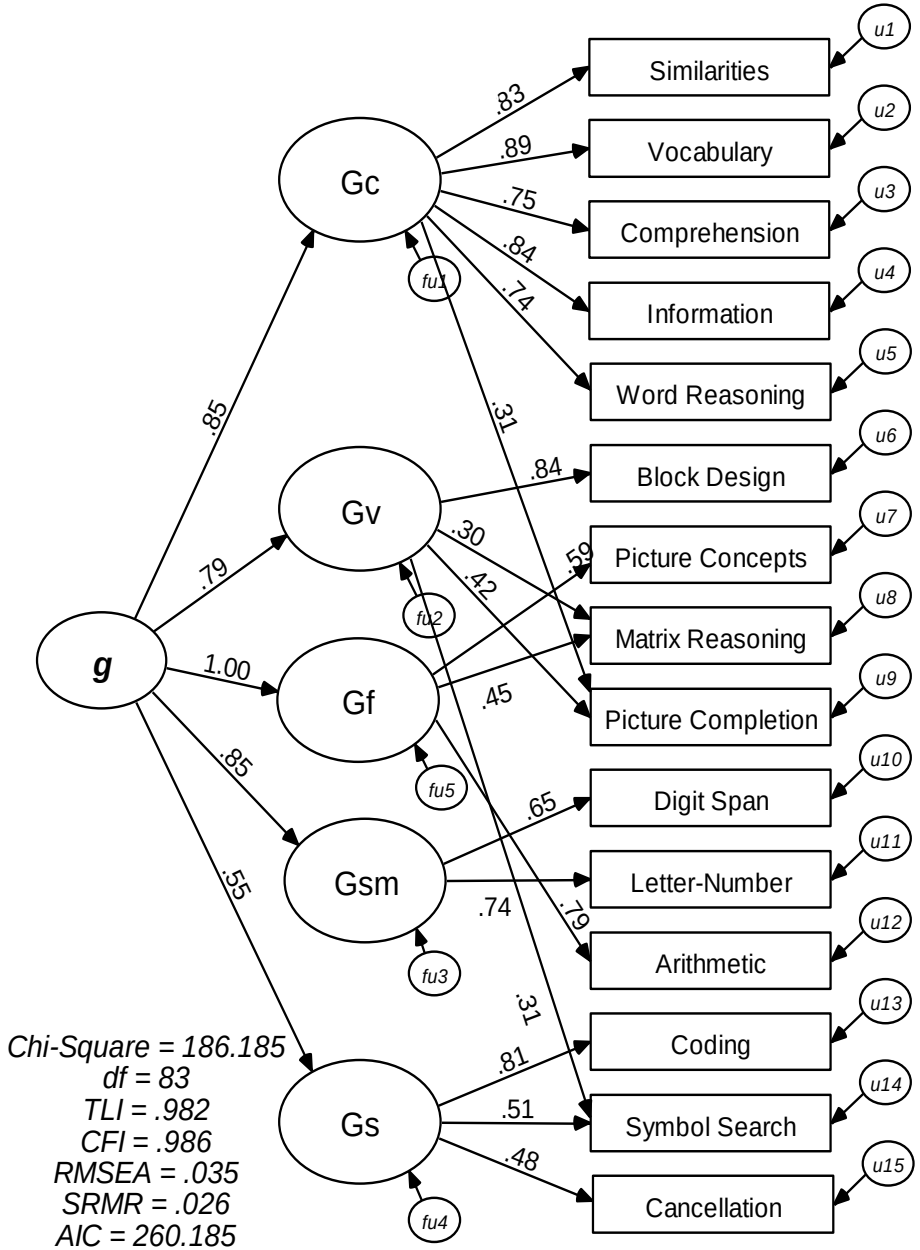
From g to CHC: Structure of the WISC-IV (Wechsler, 2003)



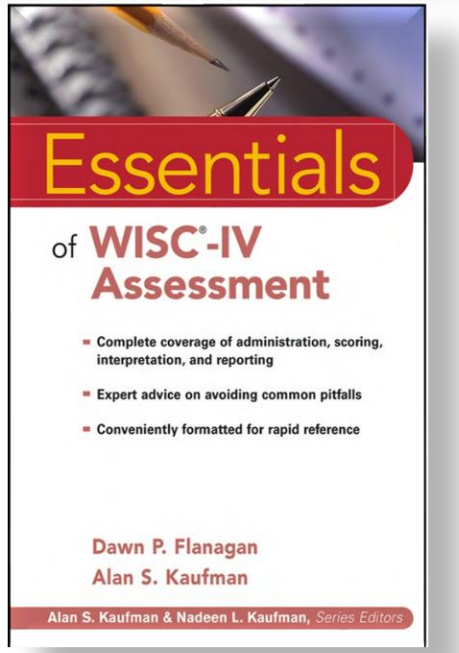
No obvious Impact of CHC theory on the WISC-IV

Keith, T. Z., Fine, J. G., Reynolds, M. R., Taub, G. E., & Kranzler, J. H. (2006). Hierarchical, multi-sample, confirmatory factor analysis of the Wechsler Intelligence Scale for Children-Fourth edition: What does it measure? *School Psychology Review. 35,* 108-127.

From *g* to CHC: Theory-based Structure of the WISC-IV (Keith et al., 2006)

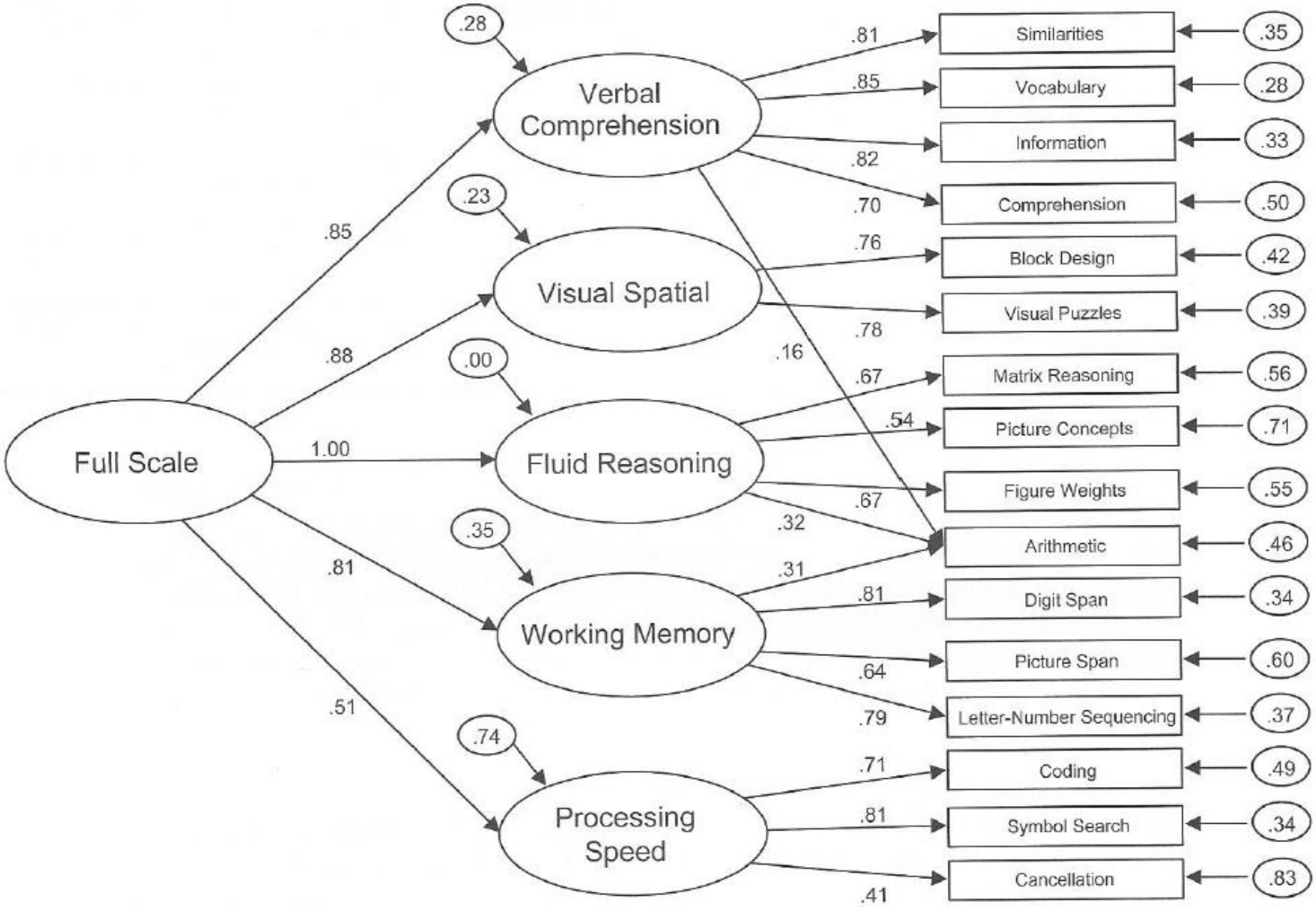


WISC-IV Indexes did not correspond to results of CHC-driven hierarchical CFA



Keith, T. Z., Fine, J. G., Reynolds, M. R., Taub, G. E., & Kranzler, J. H. (2006). Hierarchical, multi-sample, confirmatory factor analysis of the Wechsler Intelligence Scale for Children-Fourth edition: What does it measure? *School Psychology Review. 35,* 108-127.

Figure 5.1. Five-Factor Hierarchical Model for the Primary and Secondary Subtests, Ages 6-16 (p. 83 of WISC-V Technical and Interpretive Manual)



Obvious Impact of CHC theory on the WISC-V

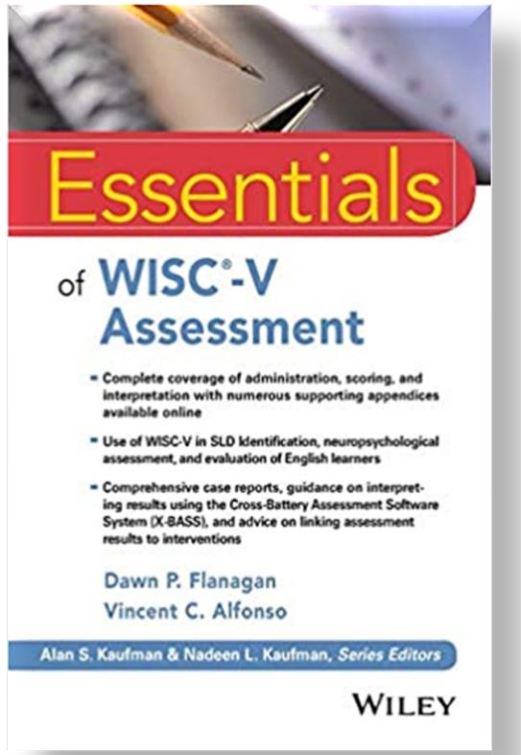
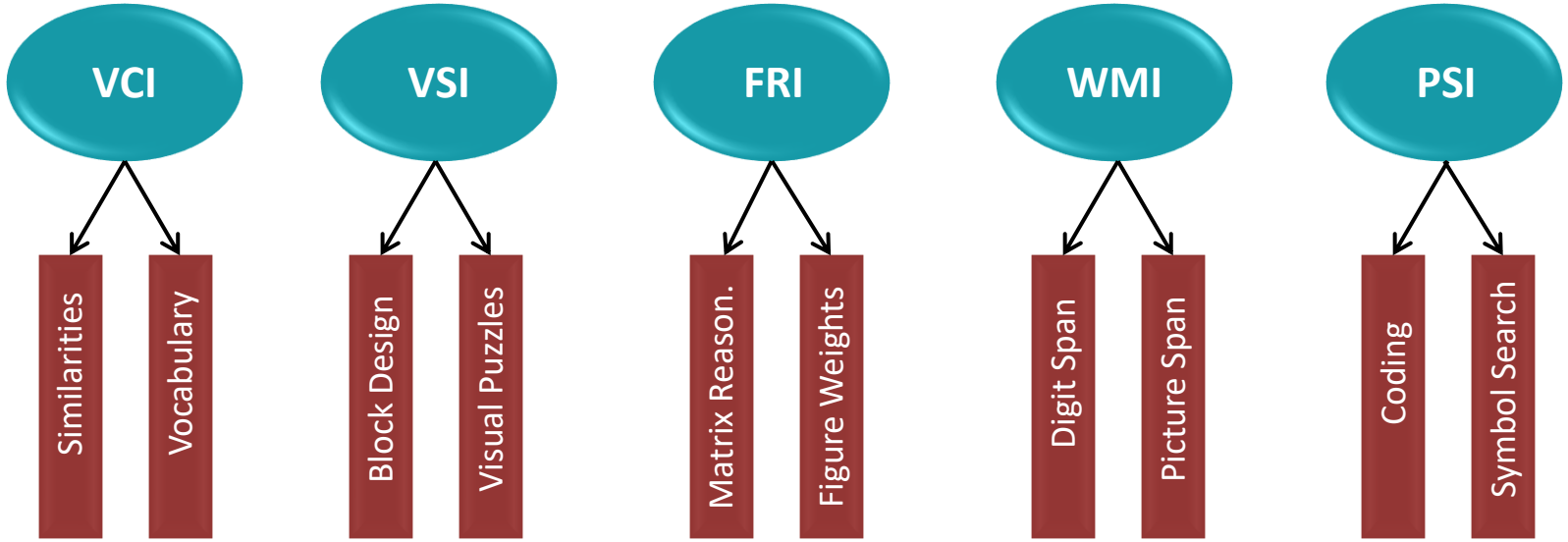


Figure 1.2. WISC-V Primary Index Scales

Based on 5-factor hierarchical Confirmatory Factor Analysis of primary and secondary subtests (*WISC-V Technical and Interpretive Manual*; Wechsler, 2014)



No Substitutions are Permitted

Primary abilities measured by subtests based on construct validation literature; Extant factor analyses; CHC classifications (see Rapid Reference 1.2 for a more comprehensive list of CHC classifications)

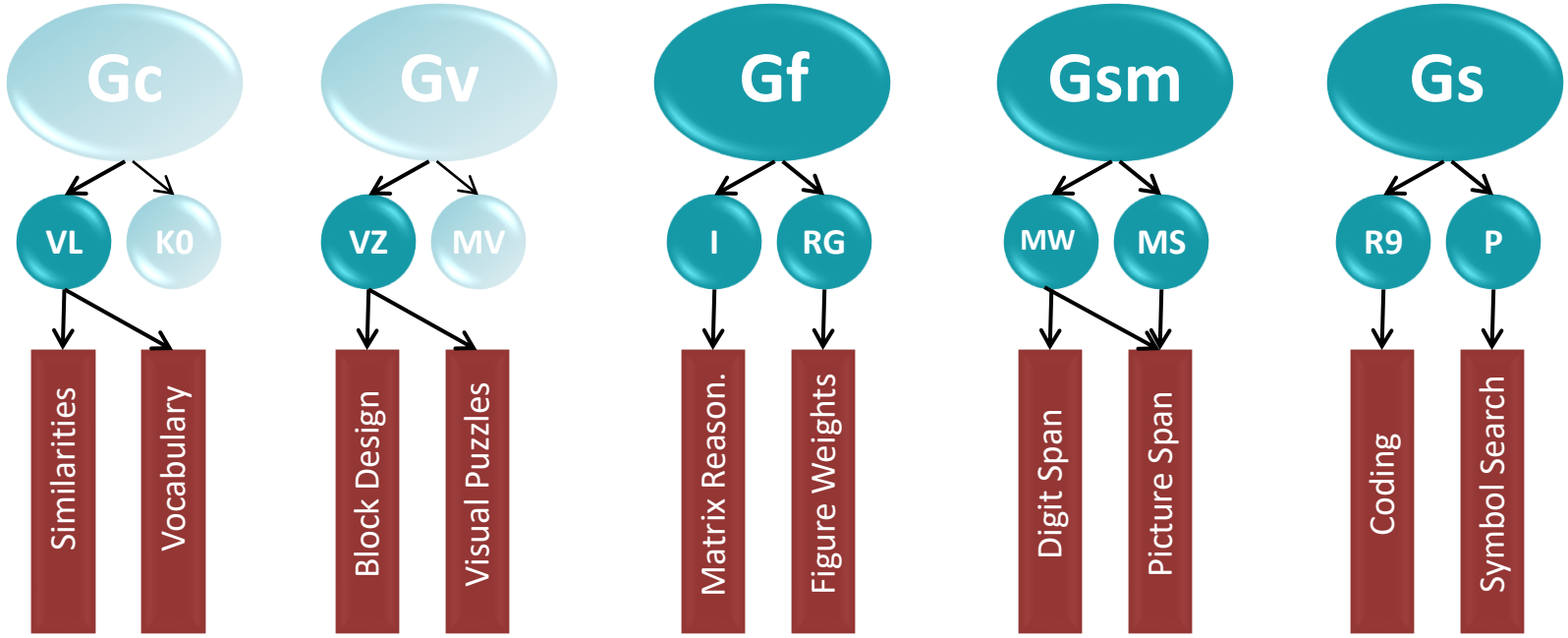
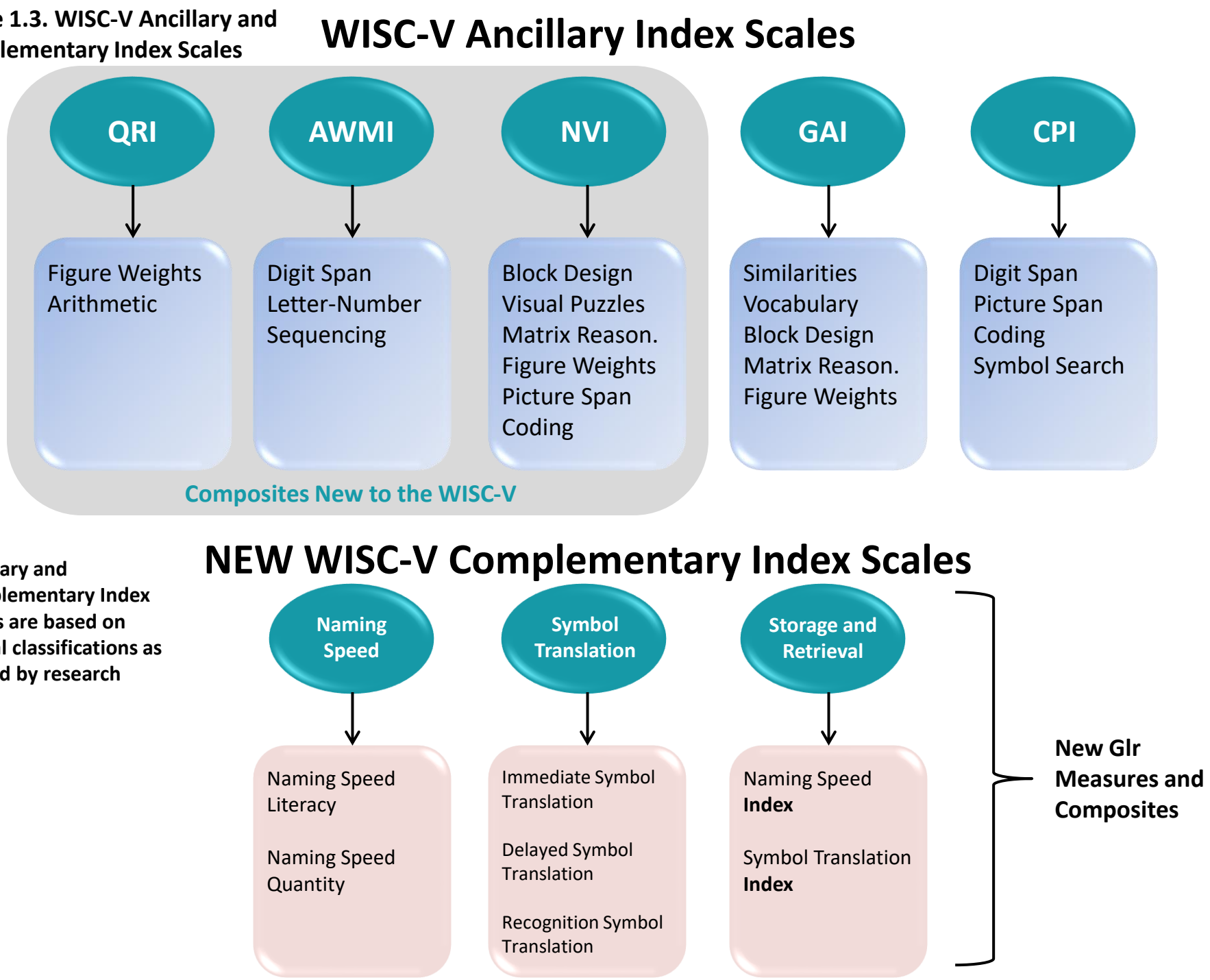


Figure 1.3. WISC-V Ancillary and Complementary Index Scales



Research Shows that the WISC-V May be Interpreted in the Manner in Which it was Intended

ELSEVIER

Intelligence

Volume 62, May 2017, Pages 31-47

Multi-group and hierarchical confirmatory factor analysis of the Wechsler Intelligence Scale for Children—Fifth Edition: What does it measure? ☆

Matthew R. Reynolds [a], Timothy Z. Keith [b]

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https://doi.org/10.1016/j.intell.2017.02.005

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Highlights

- WISC-V constructs are measured similarly across the 6–16-year age range.
- *g* and five broad ability factors account for subtest covariances.
- Our CFA findings diverged from EFA research.
- *g* is measured strongly in the new 7 subtest FSIQ.

Intelligence 77 (2019) 101403

Contents lists available at ScienceDirect

Intelligence

journal homepage: www.elsevier.com/locate/intell

Enduring the tests of age and time: Wechsler constructs across versions and revisions

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ARTICLE INFO

Keywords:
Wechsler
Factorial invariance
WPPSI
WISC
WAIS

ABSTRACT

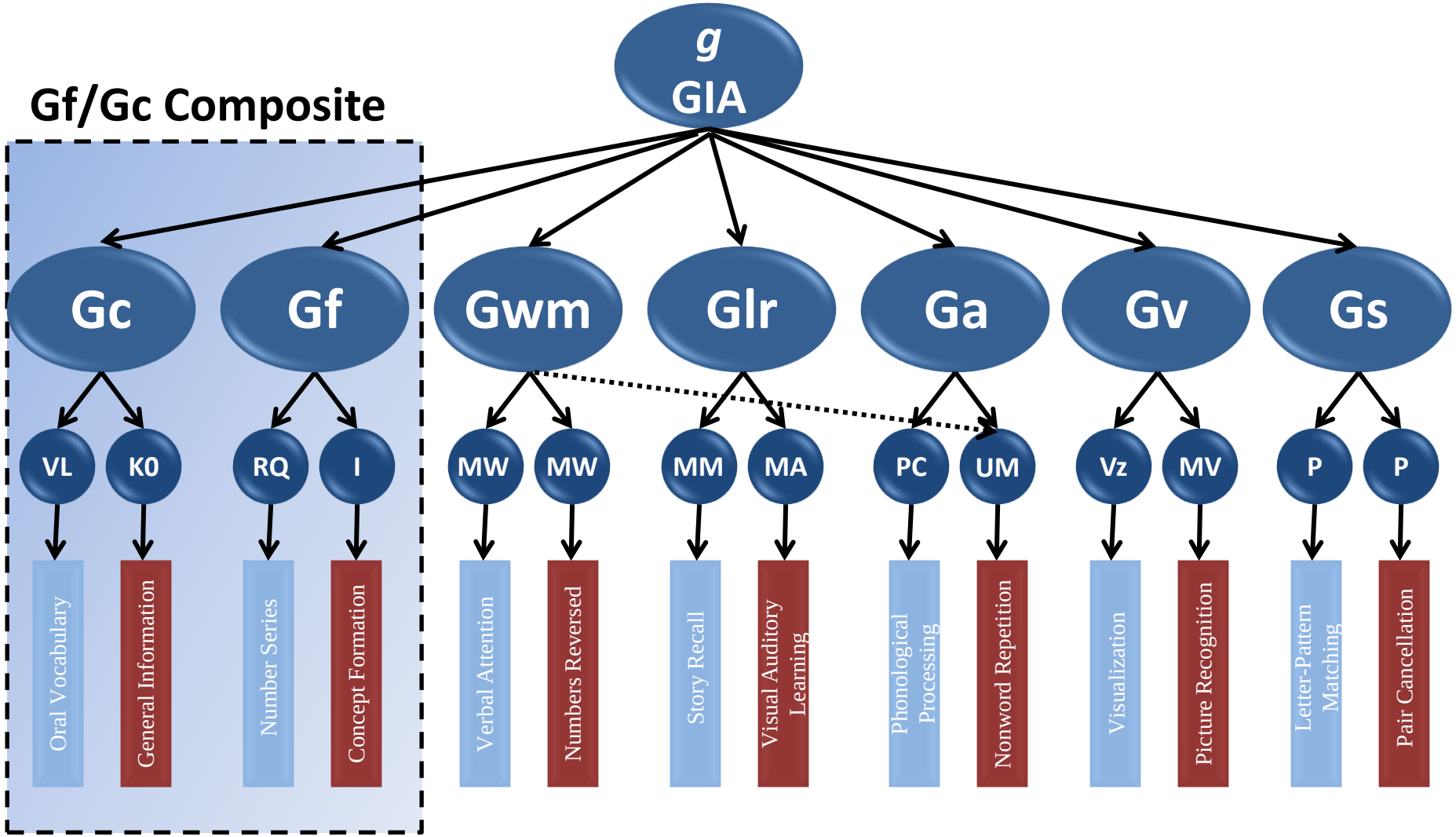
The Wechsler scales are some of the most commonly used intelligence tests in research and practice. It is unknown whether different versions (i.e., WPPSI, WISC, and WAIS) or revisions (e.g., WISC-IV and WISC-V) of the Wechsler scales measure the same constructs. We tested the factorial invariance across six Wechsler scales (WPPSI-III, WPPSI-IV, WISC-IV, WISC-V, WAIS-III, and WAIS-IV) to investigate whether the constructs measured across these scales are the same. Factorial invariance was tested using four- and five-factor measurement and higher-order models. Results suggested that the constructs measured by the Wechsler scales are generally the same and remarkably consistent across different versions and revisions. Most instances of non-invariance were due to subtest unique variances. The constructs measured by different Wechsler batteries can likely be interpreted similarly.

The WJ III

(Woodcock, McGrew, & Mather, 2001)

The first in a flurry of test revisions that represented advances unprecedented in assessment fields (e.g., based on CHC)

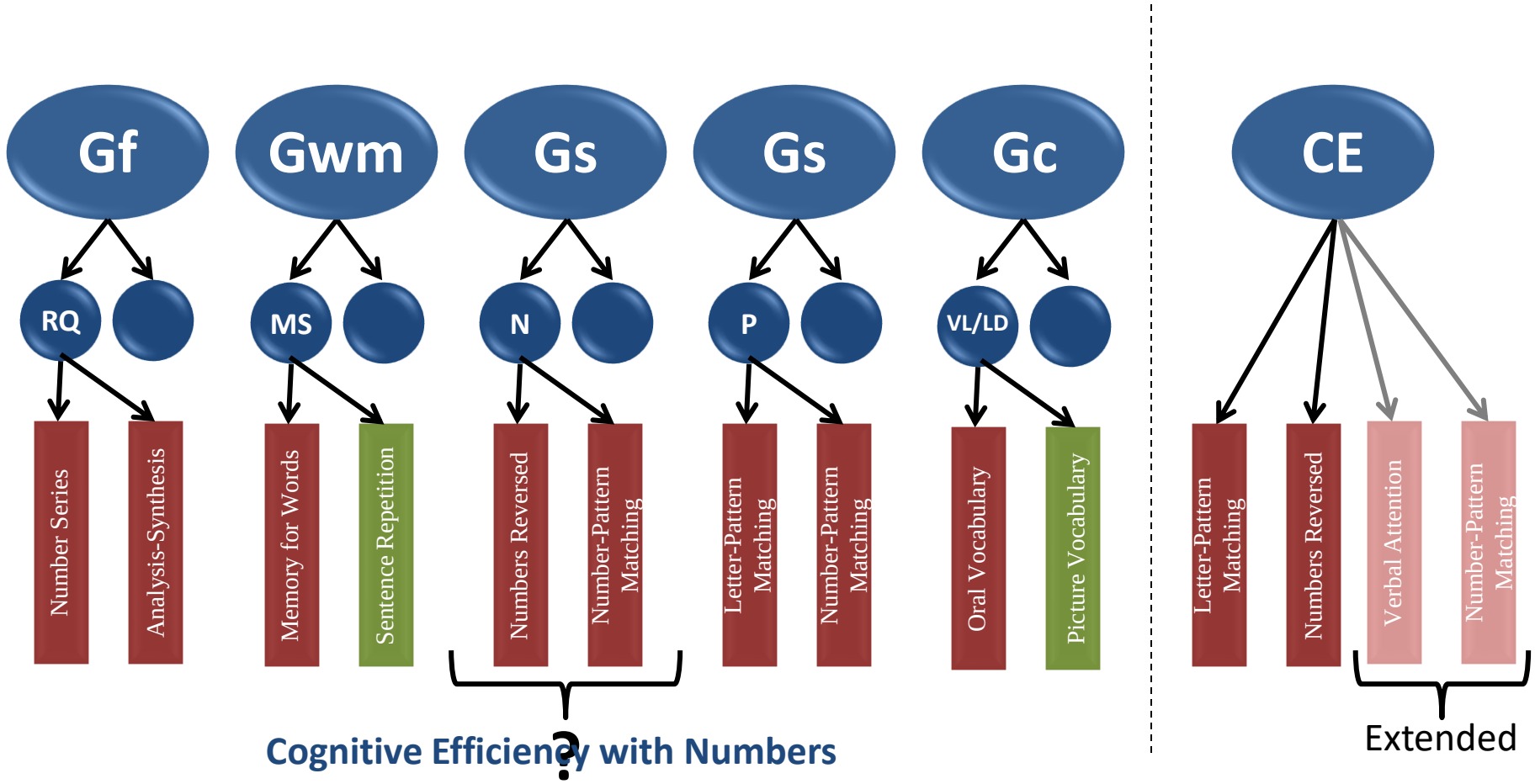
CHC Factors on the WJ IV COG



= Contribute to GIA

WJ IV COG includes 18 Tests; 14 comprise seven CHC factors

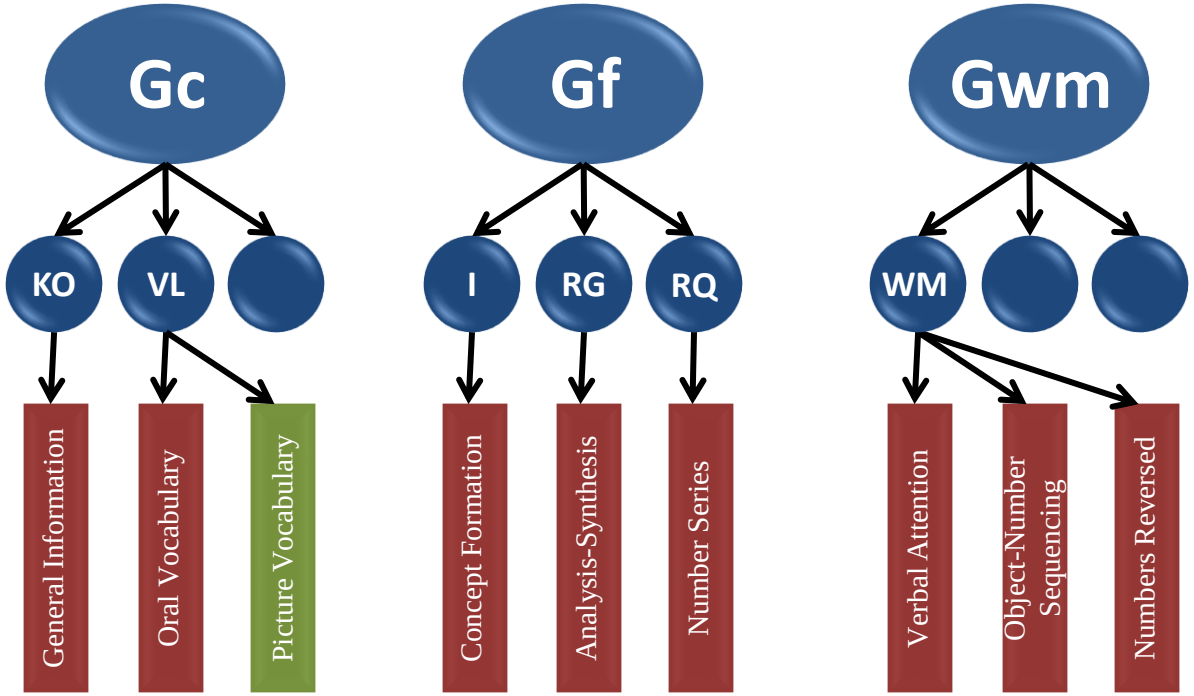
Narrow Ability an Other Clinical Clusters on the WJ IV COG



Number Facility (Gs:N) – The speed at which basic arithmetic operations are performed accurately

= Test from WJ IV OL

CHC Extended Factors on the WJ IV COG



= Test from WJ IV OL

CHC, Neuropsych, and Integrated Batteries

- SB5 (2003) – Based on CHC theory
- KABC-II (2004) – Based on CHC theory and Luria
- NEPSY-II (2007) – Based on Neuropsych theory
- DAS-II (2007) – Based on CHC theory
- CAS2 (2014) – Based on PASS theory

Batteries not based on a particular theoretical model

- **WISC-IV** (2003) – Some CHC terminology (e.g., Fluid Reasoning, Working Memory) and independent CHC approach to interpretation (Flanagan & Kaufman, 2004, 2009)

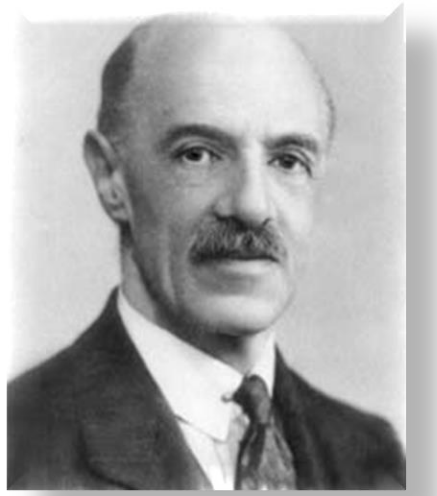
- **WAIS-IV** (2008) – Some CHC terminology and independent interpretive approach with reference to CHC constructs measured by the battery (Kaufman & Lichtenberger, 2009)

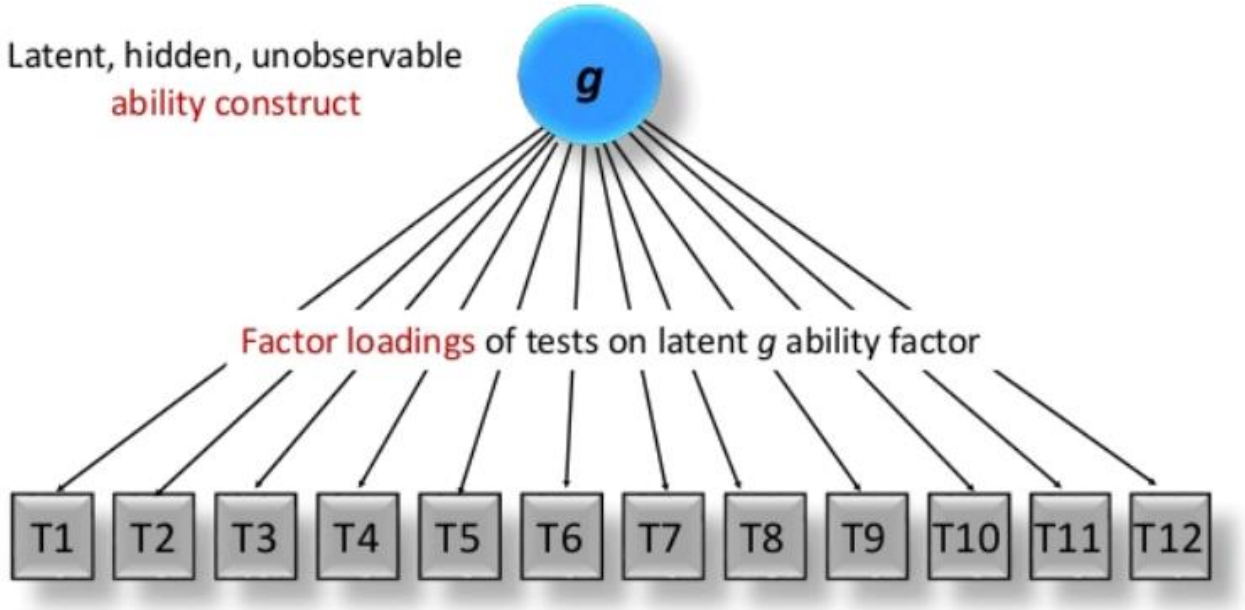
Progress in Approaches to Cognitive Test Interpretation

- Overall *g*
- Clinical profile analysis
- Psychometric profile analysis (shared abilities; intelligent testing)
- Application of and refinements to theory and CHC-based research and interpretation
- Application of theory (*g* v. specific abilities)

Progress in Approaches to **Interpreting** Cognitive Test Performance

- First wave of interpretation – Overall *g*





Spearman's general factor model; T# = different tests
Figure from: Institute of Applied Psychometrics (IAP) Dr. Kevin McGrew © 4-11-14

Kamphaus et al. (2012). A History of Intelligence Test Interpretation. In D.P. Flanagan and P.L. Harrison (Eds.), Contemporary Intellectual Assessment: Theories, Tests and Issues, 3rd edition. New York: Guilford.

Progress in Approaches to **Interpreting** Cognitive Test Performance

Clinical Profile Analysis (Second Wave)	Psychometric Profile Analysis (Third Wave)	Application of Theory to Interpretation (Fourth Wave)	Application of Refinements to Theory and CHC-based Research to Psychological Test Interpretation (Fifth Wave)

TABLE 2.4. Wechsler's Case Example for "Adolescent Psychopaths"

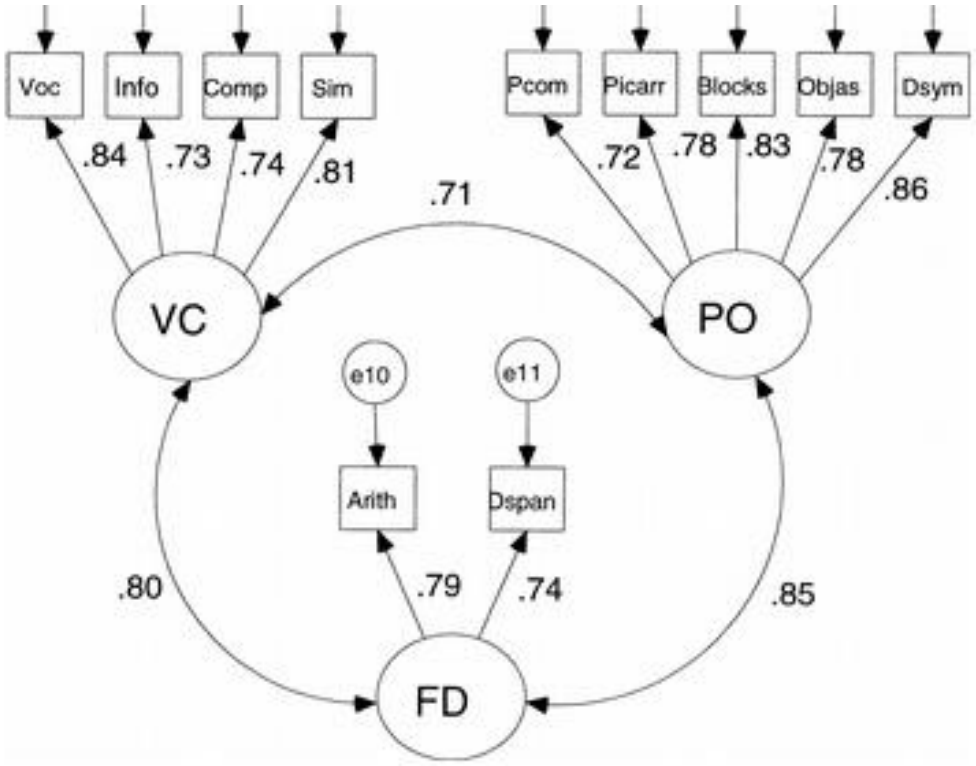
Subtest	Standard score
Comprehension	11
Arithmetic	6
Information	10
Digits	6
Similarities	5
Picture Arrangement	12
Picture Completion	10
Block Design	15
Object Assembly	16
Digit Symbol	12
Verbal IQ (VIQ)	90
Performance IQ (PIQ)	123

Table from Kamphaus et al. (2012). A History of Intelligence Test Interpretation. In D.P. Flanagan and P.L. Harrison (Eds.), Contemporary Intellectual Assessment: Theories, Tests and Issues, 3rd edition. New York: Guilford.

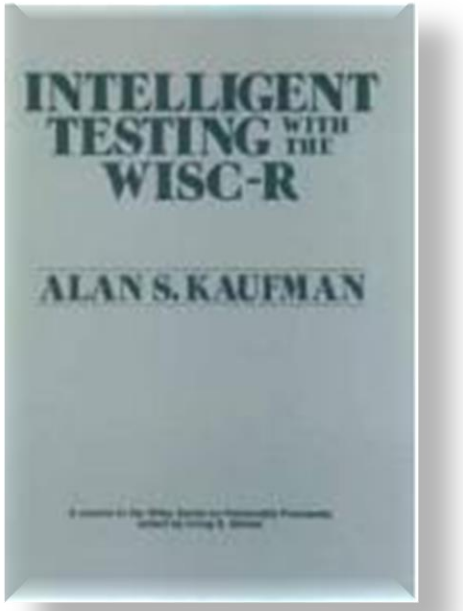
Progress in Approaches to **Interpreting** Cognitive Test Performance

Clinical Profile Analysis (Second Wave)	**Psychometric Profile Analysis (Third Wave)**	Application of Theory to Interpretation (Fourth Wave)	Application of Refinements to Theory and CHC-based Research to Psychological Test Interpretation (Fifth Wave)

Factor Analysis – Cohen's Three-factor solution of the WISC



Kaufman's Psychometric Approach – Profile analysis; shared abilities, and intelligent testing



Kaufman's Intelligent Testing Philosophy

A WISC-III detective strives to use ingenuity, clinical sense, a thorough grounding in psychological theory and research, and a willingness to administer supplementary cognitive tests to reveal the dynamics of a child's scaled-score profile

(Kaufman, 1994)

Kaufman's Intelligent Testing Philosophy

- Clinical tests of intelligence are administered individually—**they must also be interpreted individually**

- Cognitive, developmental, and neuropsychological theories are invaluable for interpreting test profiles, identifying processing disorders, and informing interventions

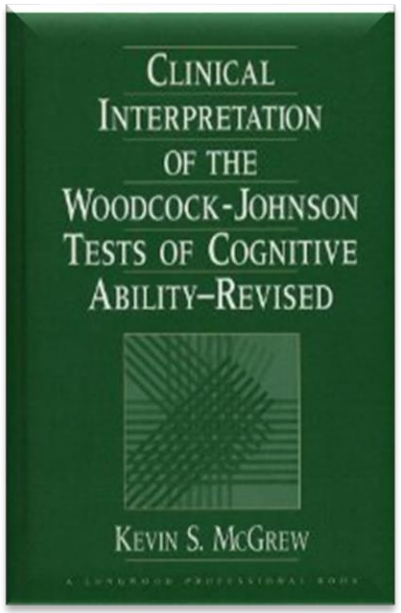
Progress in Approaches to Interpreting Cognitive Test Performance – **Mainly Gf-Gc and CHC-based**

Clinical Profile Analysis (Second Wave)	Psychometric Profile Analysis (Third Wave)	Application of Theory to Interpretation (Fourth Wave)	Application of Refinements to Theory and CHC-based Research to Psychological Test Interpretation (Fifth Wave)

KABC

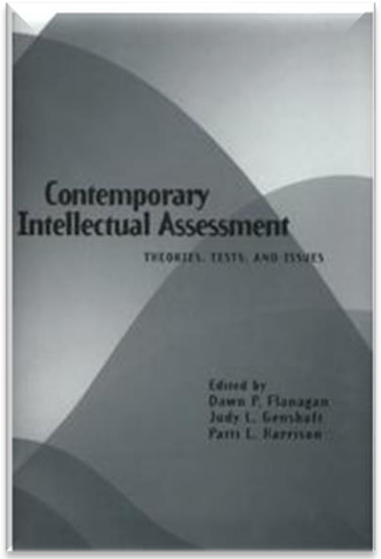
1983

WJ-R



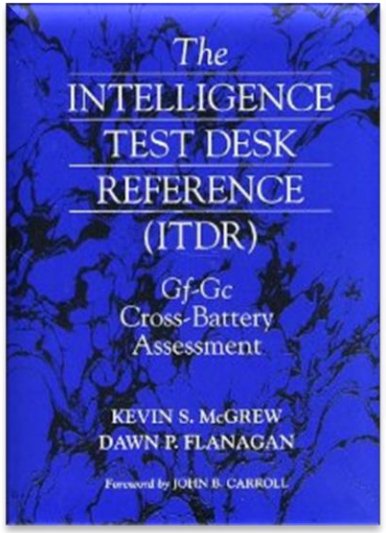
1989-1994

Brought Gf-Gc and Three-stratum Theories to School Psychology



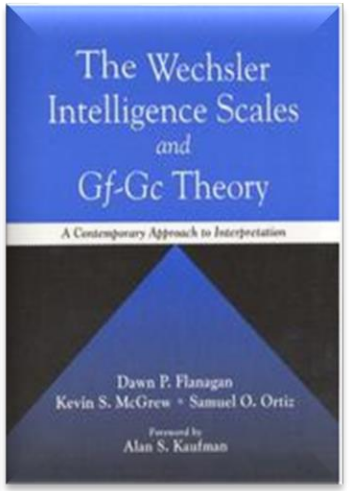
1997

Cross-Battery



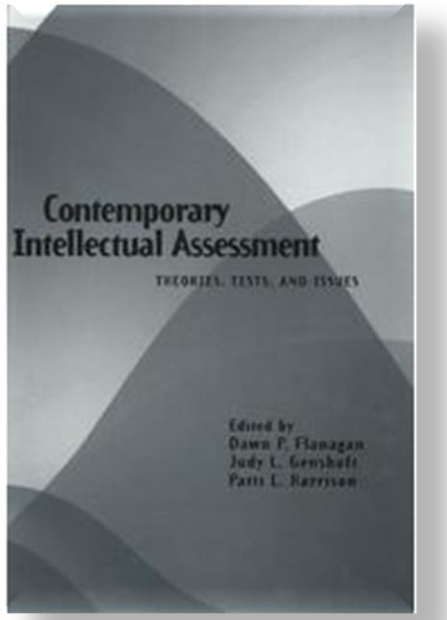
1998

Gf-Gc/CHC applied to Wechsler Scales



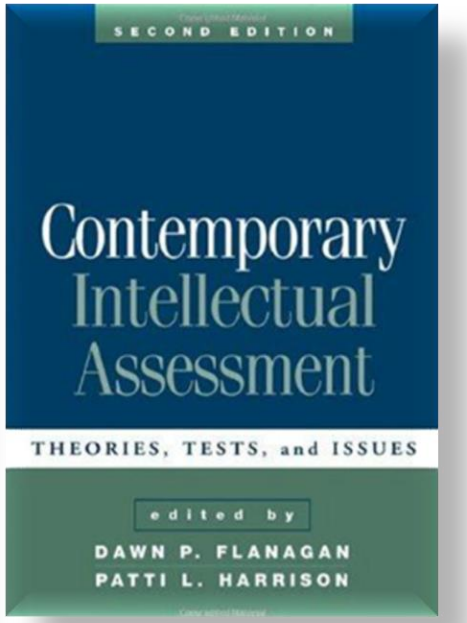
2000

Over Two Decades of Revisions and Refinements to Gf-Gc/CHC Theory



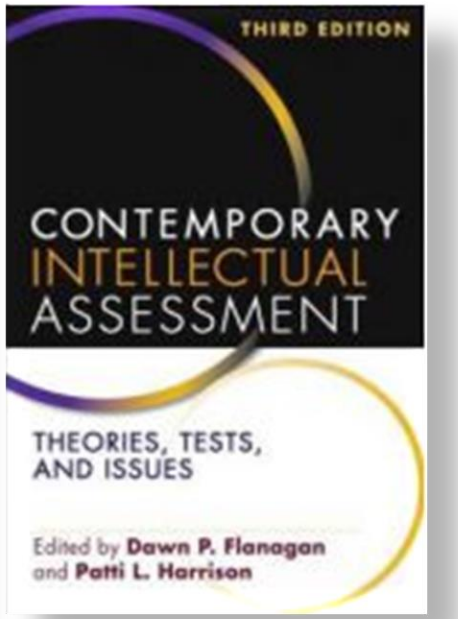
1997

Chapter by **McGrew**: First attempt at Integrating Cattell-Horn Gf-Gc Theory and John Carroll's Three-Stratum Theory



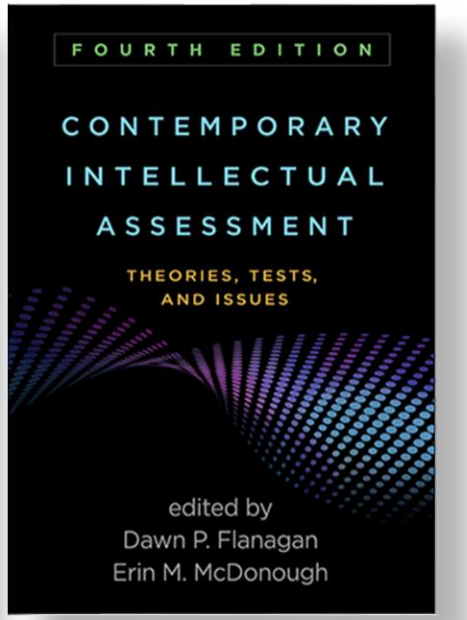
2005

Chapter by **McGrew**: Documentation of how the integrated model presented in 1997 and again in 2000 became known as CHC theory



2012

Chapter by **Schneider and McGrew**: Careful review of the literature led to some substantial modifications

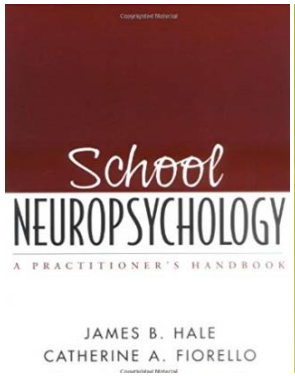


2018

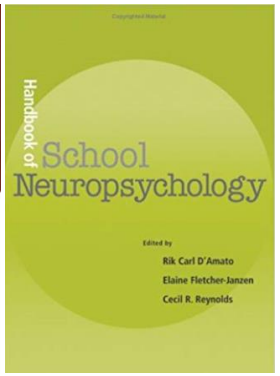
Chapter by **Schneider and McGrew**: Most significant revisions to CHC theory to date and criteria for revisions to the CHC taxonomy

Progress in Approaches to Interpreting Cognitive Test Performance from a **School Neuropsychological Perspective**

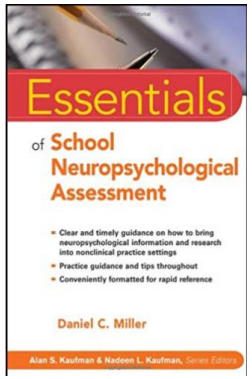
Clinical Profile Analysis (Second Wave)	Psychometric Profile Analysis (Third Wave)	Application of Theory to Interpretation (Fourth Wave)	Application of Refinements to Theory and CHC-based Research to Psychological Test Interpretation (Fifth Wave)



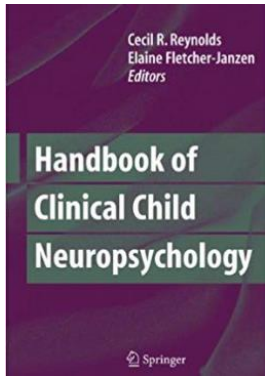
2004



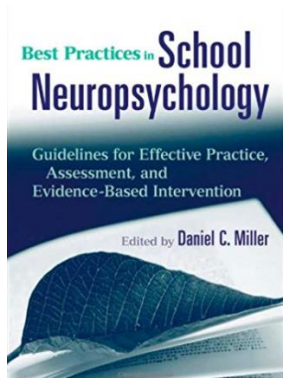
2005



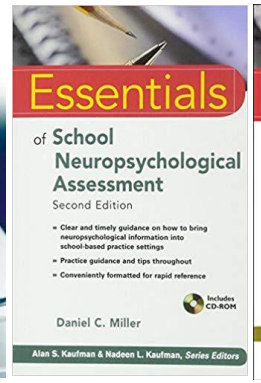
2007



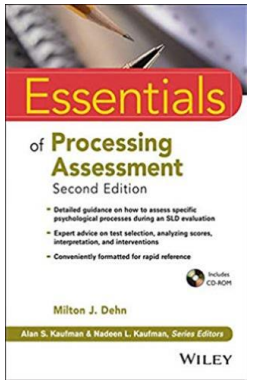
2008



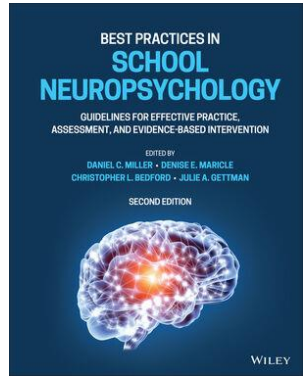
2010



2013



2013



2022

Progress in Approaches to **Interpreting** Cognitive Test Performance

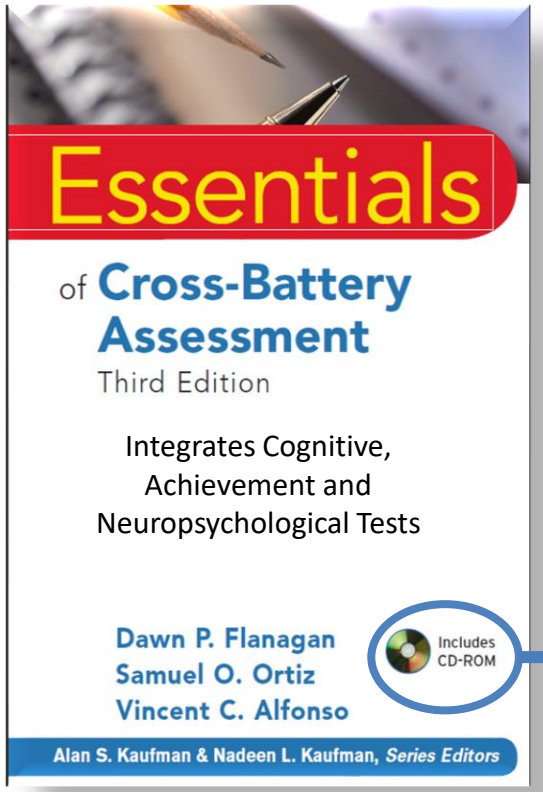
Clinical Profile Analysis (Second Wave)	Psychometric Profile Analysis (Third Wave)	Application of Theory to Interpretation (Fourth Wave)	Application of Refinements to Theory and CHC-based Research to Psychological Test Interpretation (Fifth Wave)

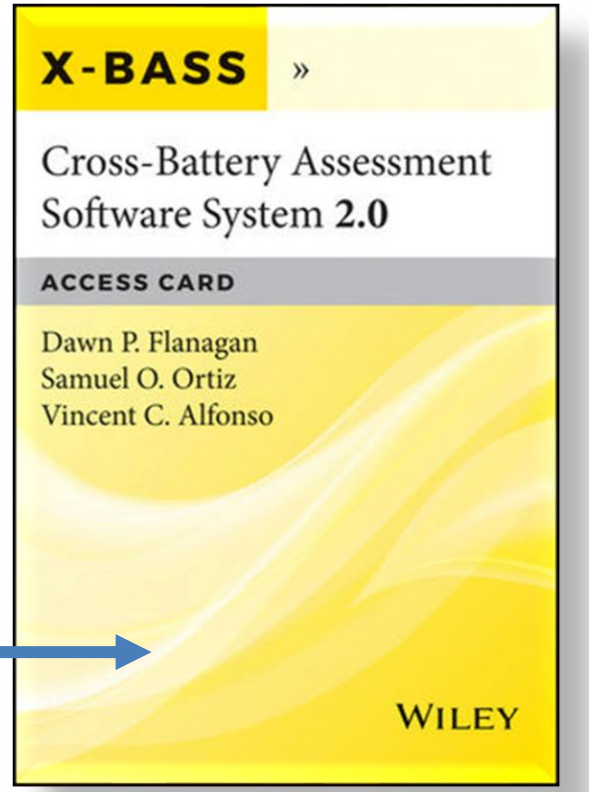
Refinements and Extensions to the Cross-Battery Approach

Cross-Battery Assessment

Significantly improved evidence base

Significantly improved and expanded software programs

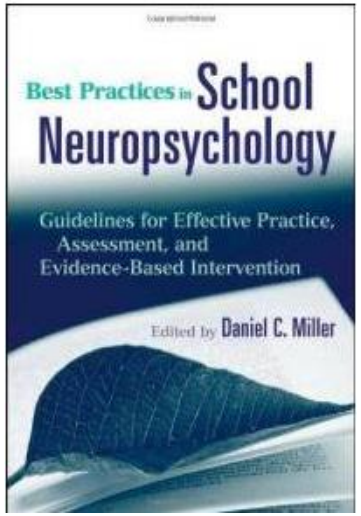


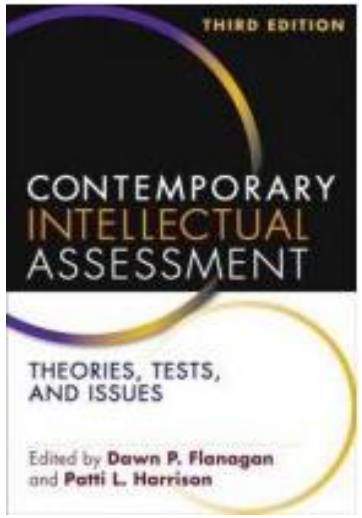


Progress in Approaches to Interpreting Cognitive Test Performance – **Integrated Models**

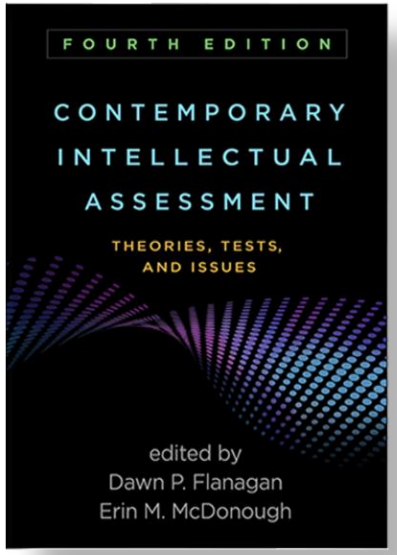
Clinical Profile Analysis (Second Wave)	Psychometric Profile Analysis (Third Wave)	Application of Theory to Interpretation (Fourth Wave)	Application of Refinements to Theory and CHC-based Research to Psychological Test Interpretation (Fifth Wave)

Integration of CHC and neuropsychological theory for cognitive test interpretation and identification/diagnosis of SLD





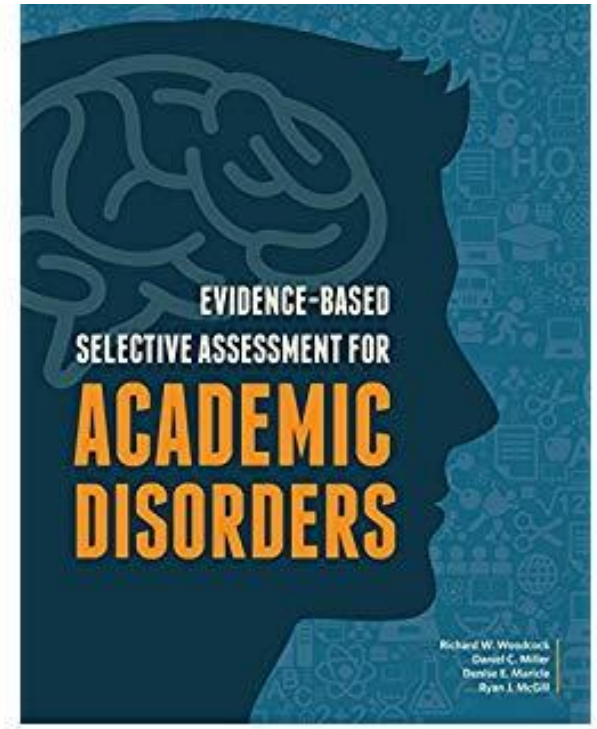
- Dan Miller
- Scott Decker
- Brad Hale
- Cyndi Riccio
- George McCloskey
- Denise Maricle



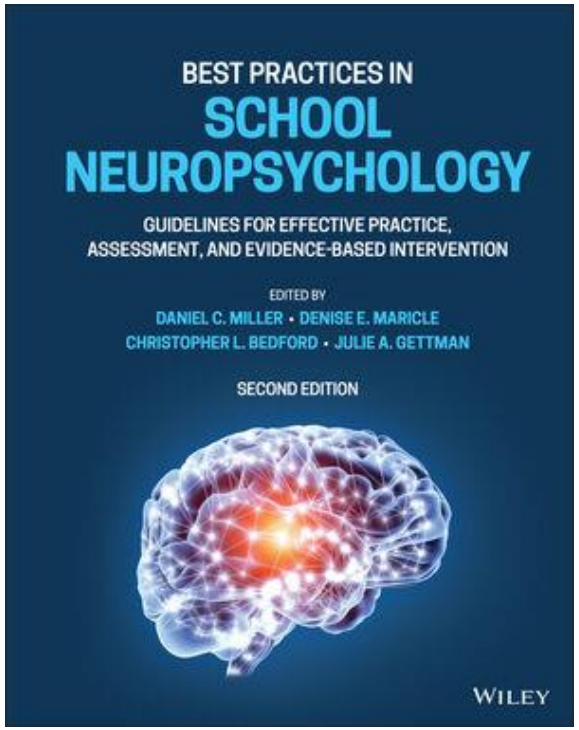
More than 1/3 of this book contains chapters that reference or directly address neuropsychological theory, including chapters that integrate CHC and neuropsychological theory

Progress in Approaches to Interpreting Cognitive Test Performance from a **School Neuropsychological Perspective**

Clinical Profile Analysis (Second Wave)	Psychometric Profile Analysis (Third Wave)	Application of Theory to Interpretation (Fourth Wave)	Application of Refinements to Theory and CHC-based Research to Psychological Test Interpretation (Fifth Wave)



Woodcock et al., 2017



Miller et al., 2022

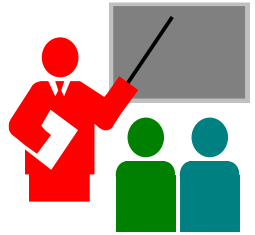
Current Cognitive Assessment

- Tests based on theory (a narrowing of the theory-practice gap)
- Integration of CHC and neuropsychological theories provide greater flexibility for interpretation
- Tests measure a wider range of cognitive abilities and processes than their predecessors

Summary and Conclusions -Part 1

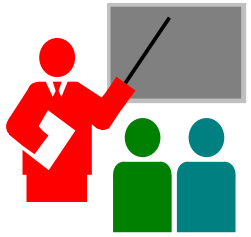
- Several salient revisions and refinements to CHC theories were highlighted
- Broad CHC cognitive abilities and processes were defined and there is a large research base supporting their importance for academic success
- Additional large-scale research on the relations between cognitive abilities and processes and academic functioning is underway
- CHC theories continue to evolve and inform assessment, test score interpretation, and intervention

Objectives-Part 2



- To understand when and how to use X-BASS to support assessment and interpretation
- To understand the purpose of the individual test tabs available in X-BASS
- To be able to use X-BASS features appropriately when given a set of data to enter
- To be able to interpret X-BASS output and make decisions regarding next steps in assessment and interpretation based on the output
- To be able to understand and use the XBA and Test Composite Analyzer tab

Content-Part 2

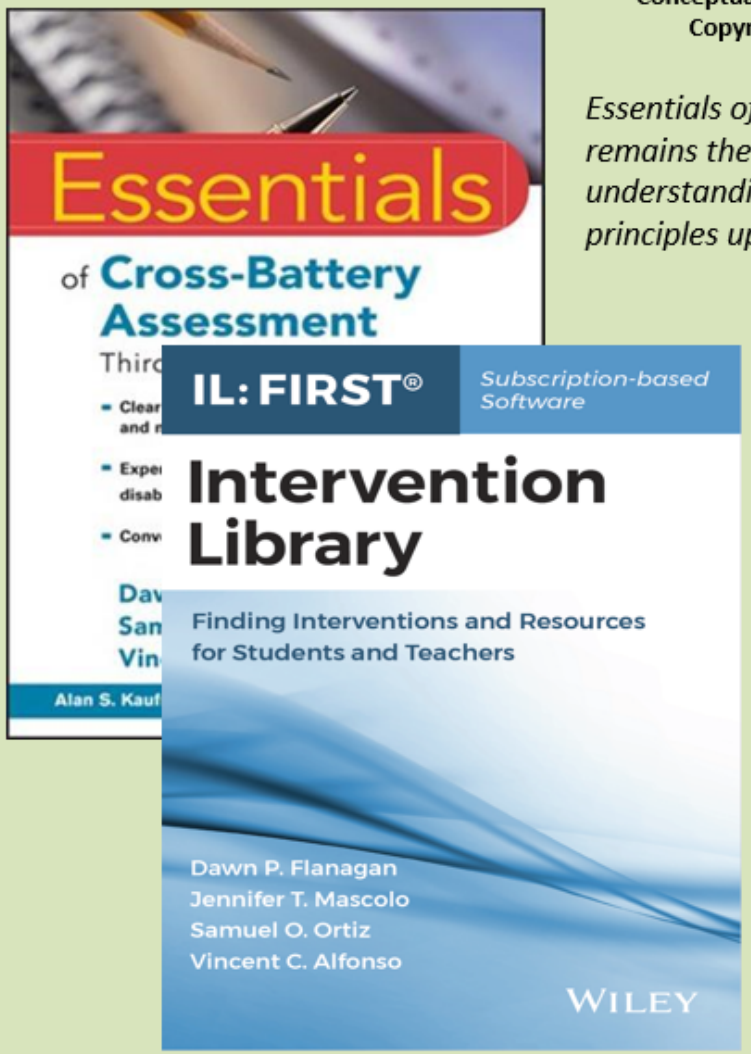


- Introduction to and use of the individual test tabs available in X-BASS
  - Cohesion of test composites
  - Need for follow-up assessment
  - Data transfer to XBA Analyzer and Data Organizer
  - Graphing
- Examples of entering scores and interpreting
- Examples of WJ IV and WISC-V data analysis
- Examples of XBA data analysis using the XBA Analyzer Tab
- How XBA composites are calculated on the XBA Analyzer tab
- Interpretation of XBA composites
- Evaluation of cohesion for composites from batteries that do not have their own test tab in X-BASS (e.g., CTOPP2)
- Introduction to and use of the Data Organizer
  - i. Data transfer from cognitive and achievement test tabs
  - ii. Principles for selecting best composites or subtests for transfer
  - iii. Principles for selecting composites for later use in PSW-A

Cross-Battery Assessment Software System (X-BASS® v2.4)

Conceptualization by D.P. Flanagan, S.O. Ortiz, V.C. Alfonso; Programming by S.O. Ortiz and A.M. Dynda

Release: 2.4



Essentials of Cross-Battery Assessment, 3rd Edition remains the reference document necessary for understanding Cross-Battery Assessment (XBA) and the principles upon which the X-BASS is based.

NEW: *We are proud to announce the release of an independent, companion program to X-BASS called "Intervention Library: Finding Interventions and Resources for Students and Teachers (IL:FIRST v1.0)." IL:FIRST is a stand alone program designed to assist practitioners in being able to find, evaluate, and explore a variety of interventions that can be tailored to specific cognitive and academic strengths and weaknesses commonly found in students with learning difficulties as may be informed via use of X-BASS. For more information, go to Wiley.com and search for "Intervention Library."*

Click here to find out more about new features in X-BASS. **What's New**

New Users:

If you are new to XBA or X-BASS, click the "Start Here" button and follow the prompts for step-by-step guidance. This option is strongly recommended for first time and inexperienced users of X-BASS. New users should also read and review the User Guide for basic info.

Start Here **Guide** **Help**

Experienced Users:

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User Mode
- Beginner
- Intermediate
- Advanced

Start **Index**

PSW-Quick Analysis:

If you have a set of scores for which you would like to conduct a quick PSW analysis for SLD evlauation, click here for guidance on using the PSW-QA.

PSW-QA

Scroll down page to see all notes

What's New in X-BASS v2.4?

This version is primarily a maintenance release that includes the new WIAT-IV along with some small fixes as well as a revision to the structure that reduces the size significantly and improves performance notably.

Release Notes History - Version 2.4

1. Added the WIAT-4 to the test database and constructed a core test tab that replaces the older WIAT-III. However, all WIAT-III classifications remain in the test database and the WIAT-III core test tab is still available for use.

2. Fixed a minor error that was preventing some subtests from appearing in the Culture-Language Test Reference.

3. Fixed the missing subtest highlighting that designates the appropriate subtests for a particular cluster for a given age/grade on the WJ IV, KABC-II, and other tabs.

4. Streamlined the code to increase overall speed and performance while decreasing file size by 1/3.

5. Modified the import-export feature to function more easily by requiring use of the same folder in which the program is being used for the PC-Windows version. The Mac version will be updated to use a special folder that is necessary due to the MacOs sandbox security requirements.

6. Changed the way information regarding update notifications are handled so that only a link to information on the web is provided rather than downloading a file to check, which could trigger warnings from security and antivirus programs.

7. Added values to the bars to the graphs on the C-LIM to assist with interpretation of the impact of cultural/linguistic variables on test performance.

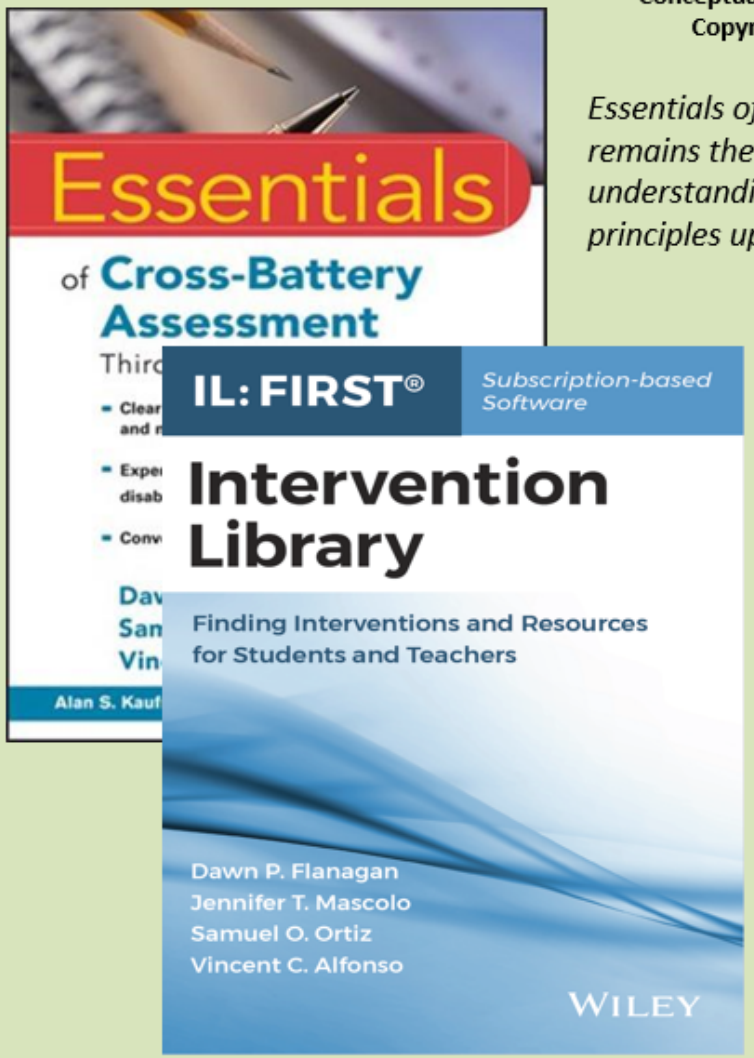
8. Modified interpretive wording for follow up rules on the core test tabs so that any combination of two or three scores that all fall within the average range or higher will no longer result in a recommendation to follow up on the lowest score.

9. Corrected some missing subtest entries in the test database for a few tests, notably the NEPSY-II and CELF-V.

Beginners Start Here

Cross-Battery Assessment Software System (X-BASS® v2.4)

Release: 2.4



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PSW-QA

More Experienced Users Go to Intermediate or Advanced

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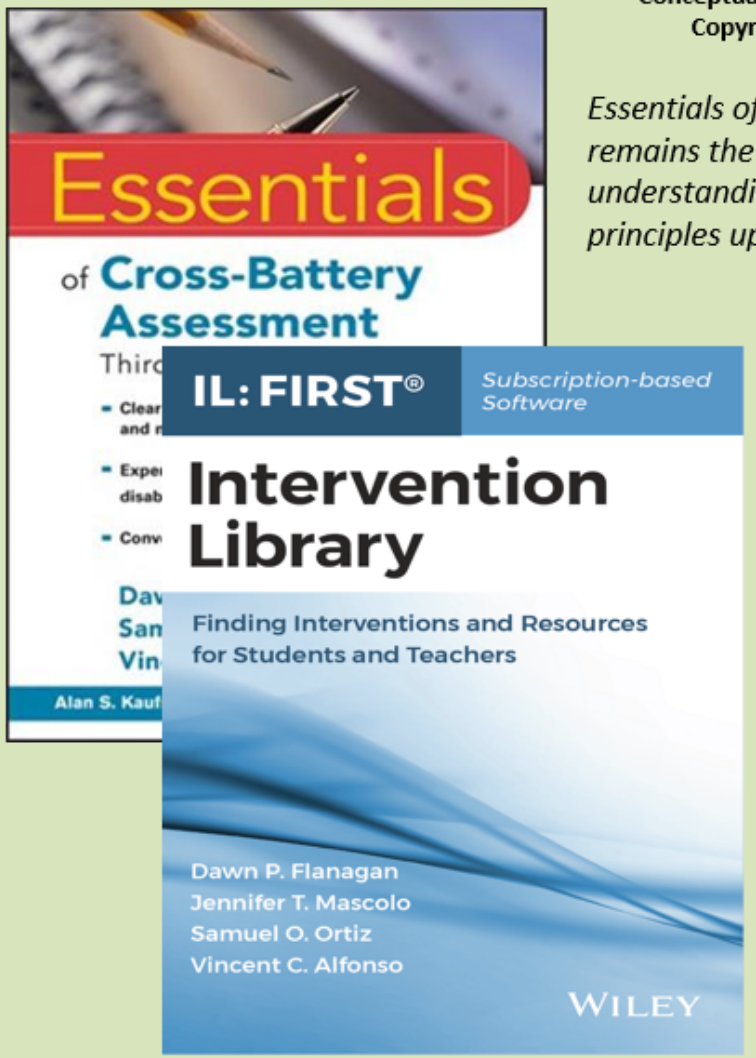
Release: 2.4

Conceptualization by D.P. Flanagan, S.O. Ortiz, V.C. Alfonso; Programming by S.O. Ortiz and A.M. Dynda



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PSW-QA

Click “Start”

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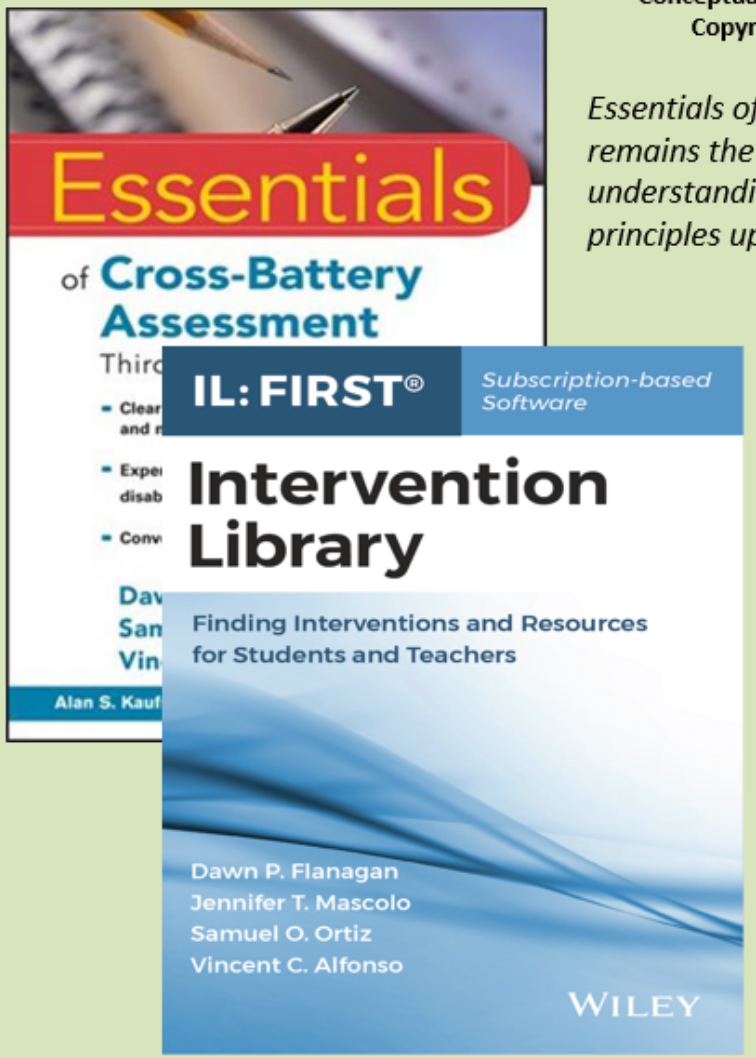

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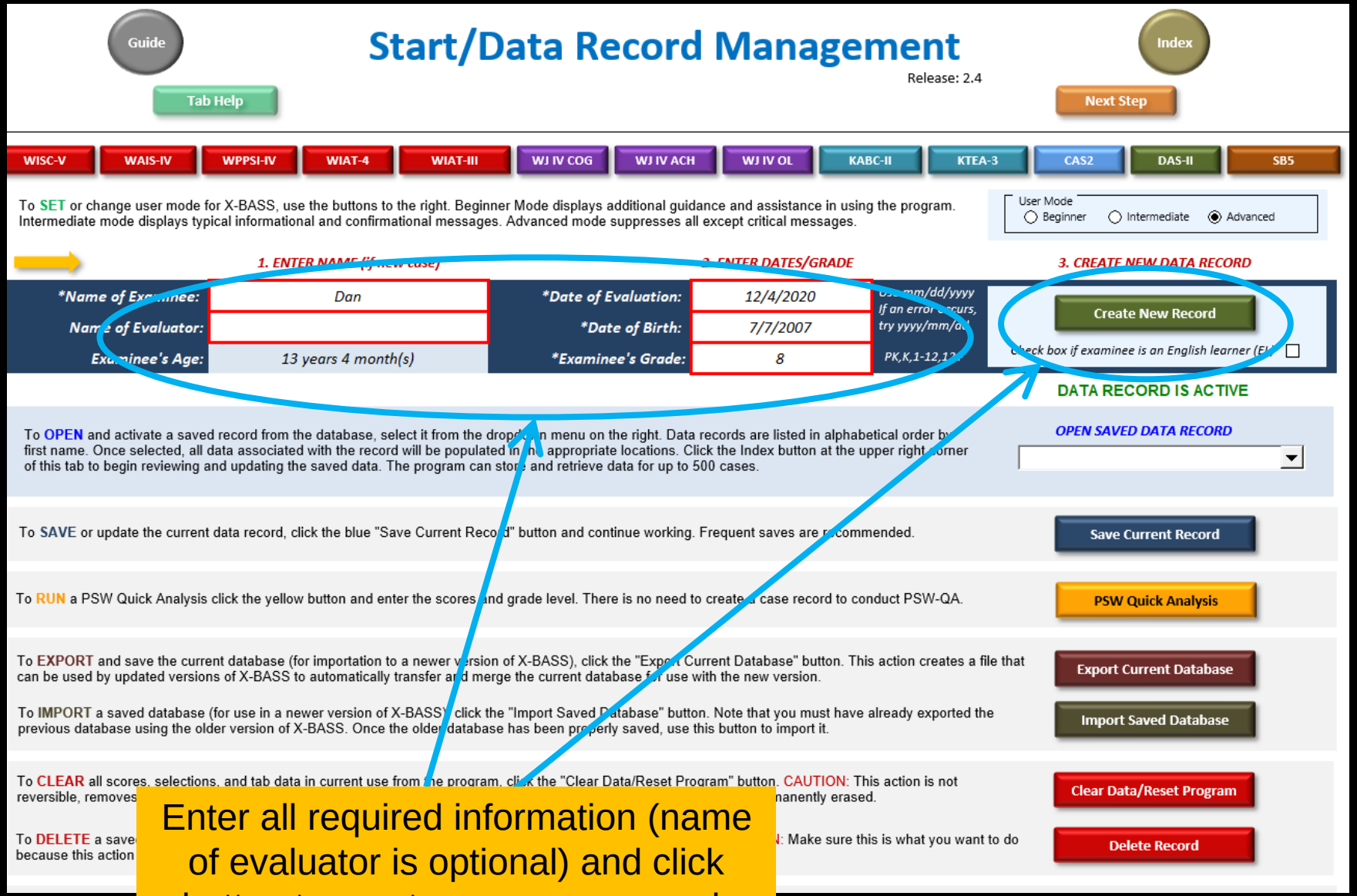
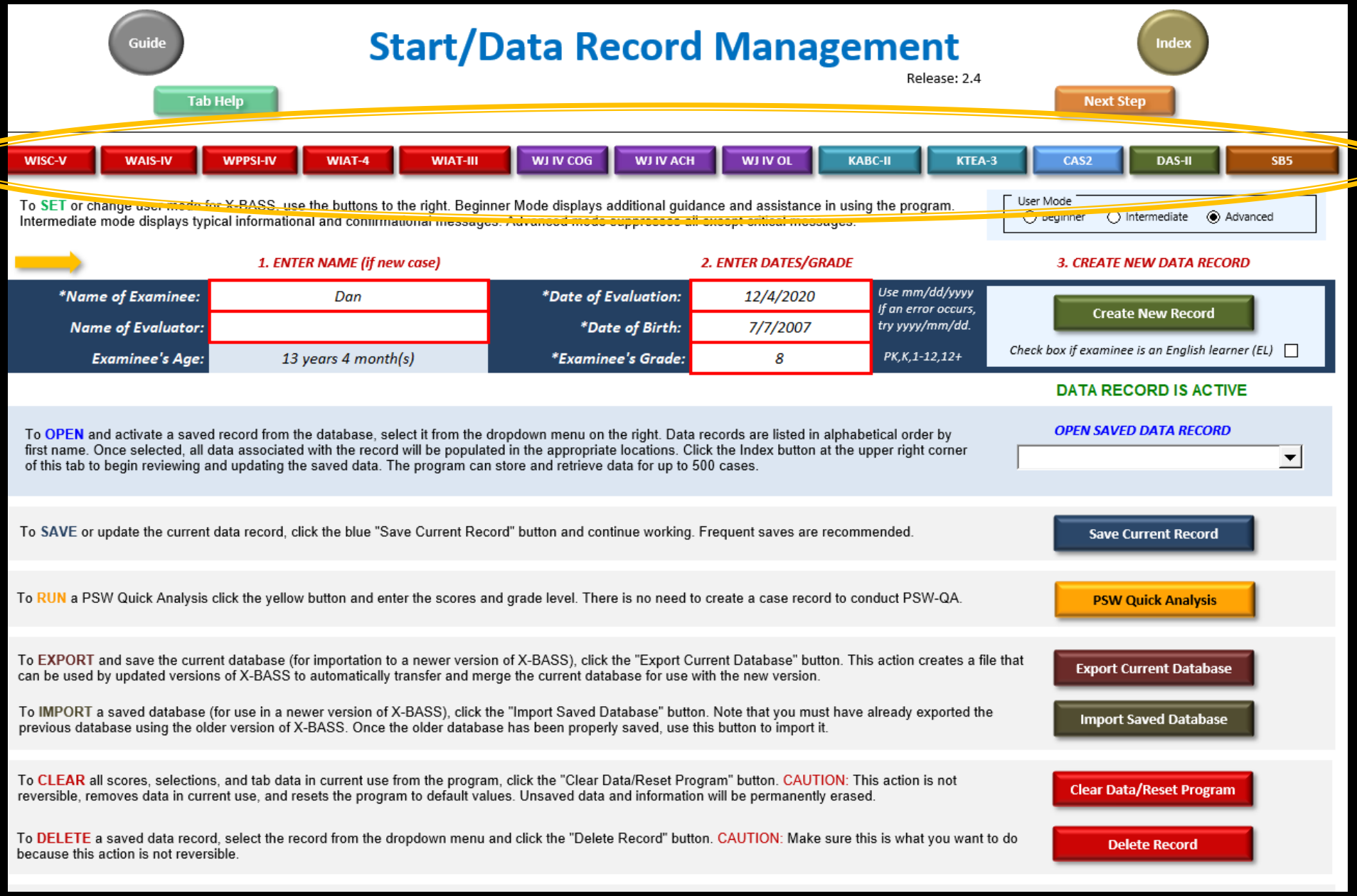
PSW-QA

Enter Student/Client Name, DOE, DOB, and Grade



Enter all required information (name of evaluator is optional) and click button to create new case record.

X-BASS Has 13 Individual Test Tabs



X-BASS Has 152 Tests/Batteries and Over 1250 Subtests

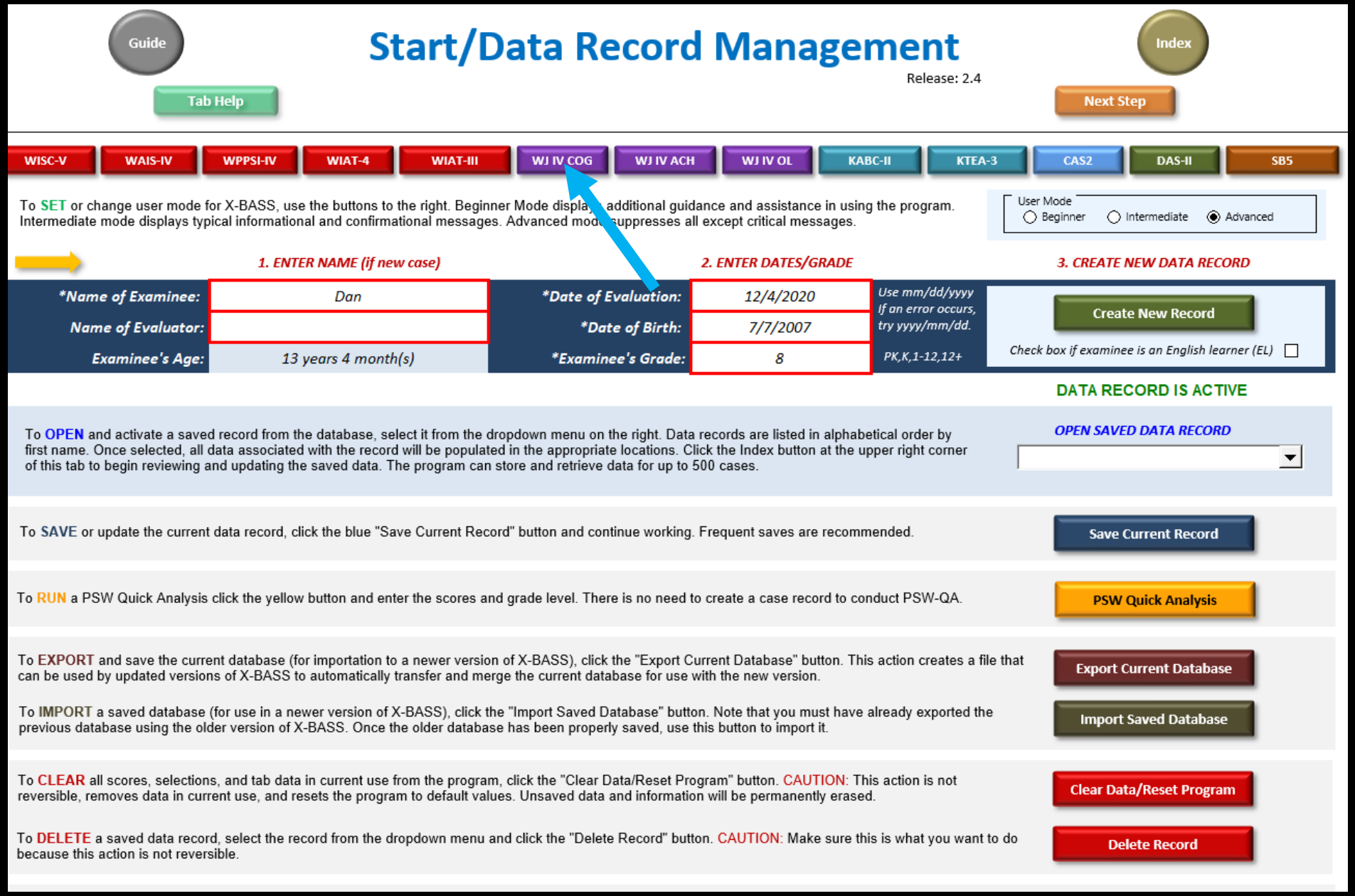
Only 13 of the 152 Batteries Have Their Own Tabs

How Do I Find All Other Batteries?

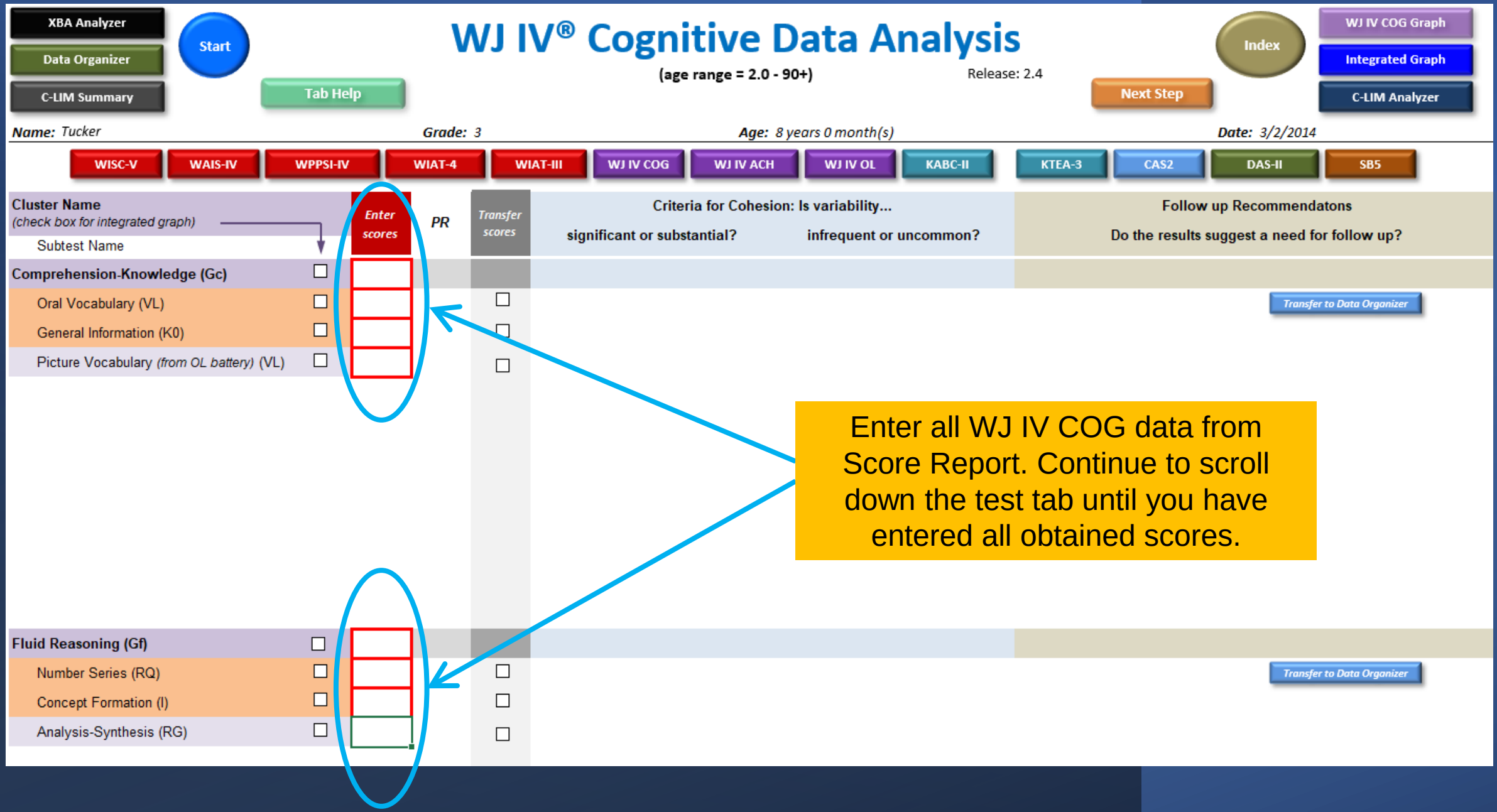
- Test List Quick Reference button (accessed from Index tab)
- Top Row of All Domains on XBA and Test Composite Analyzer tab
- XBA-CHC Classifications button (accessed from Index tab)

Let's First Look at the Individual Test Tabs

After Entering Student/Client Identifying Information, Select Core Battery Used in Assessment



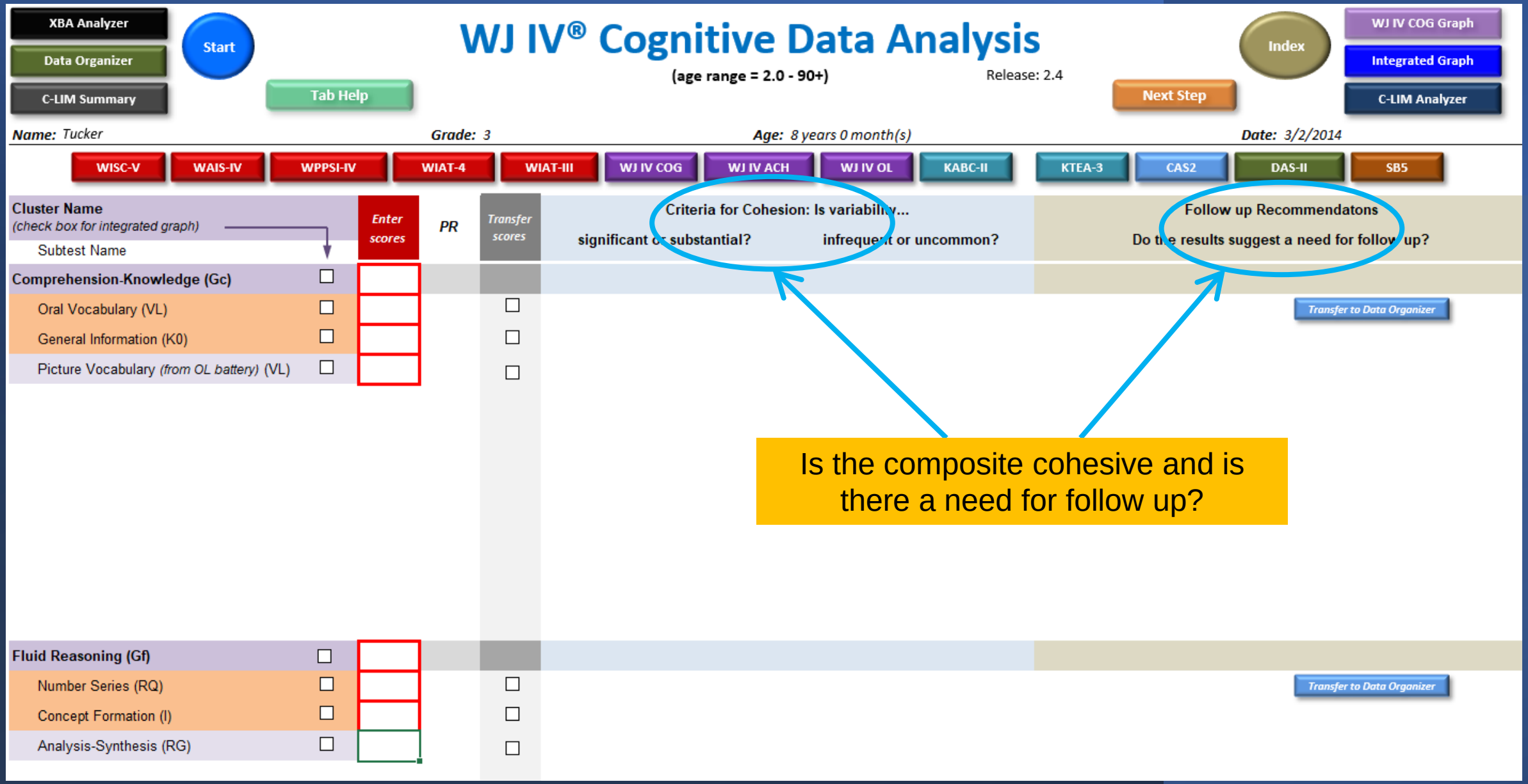
Begin Data Entry



For All Composites Entered Into X-BASS Individual Test Tabs

- **X-BASS Answers these Questions**:
  - *Is the Composite Cohesive?*
  - *Is there a Need for Follow-up Assessment?*

- Examples of Composites:
  - **WISC-V**
    - Verbal Comprehension Index
    - Visual Spatial Index
    - Fluid Reasoning Index
  - **WJ IV**
    - *Gc* Factor
    - *Gf* Factor
    - *Glr* Factor
  - **KABC-II**
    - Sequential/*Gsm* Scale
    - Simultaneous/*Gv* Scale


XBA Analyzer
Data Organizer
C-LIM Summary
Start
Tab Help
WJ IV® Cognitive Data Analysis
(age range = 2.0 - 90+)
Release: 2.4
Index
Next Step
WJ IV COG Graph
Integrated Graph
C-LIM Analyzer
Name: Tucker
Grade: 3
Age: 8 years 0 month(s)
Date: 3/2/2014
WISC-V
WAIS-IV
WPPSI-IV
WIAT-4
WIAT-III
WJ IV COG
WJ IV ACH
WJ IV OL
KABC-II
KTEA-3
CAS2
DAS-II
SB5
Cluster Name
(check box for integrated graph)
Subtest Name
Enter scores
PR
Transfer scores
Criteria for Cohesion: Is variability...
significant or substantial?
infrequent or uncommon?
Follow up Recommendatons
Do the results suggest a need for follow up?
Comprehension-Knowledge (Gc)
Oral Vocabulary (VL)
General Information (K0)
Picture Vocabulary (from OL battery) (VL)
Transfer to Data Organizer
Fluid Reasoning (Gf)
Number Series (RQ)
Concept Formation (I)
Analysis-Synthesis (RG)
Transfer to Data Organizer
Is the composite cohesive and is there a need for follow up?

What is Cohesion?

- Cohesion is related to how well the scores in a composite "hang" together
- Construct validation research indicates that individuals who score in the Average range on one aspect of a construct ought to score within the Average range on all aspects of the construct. For example, if an individual does well on tests of inductive reasoning, then they ought to do well on tests of deductive reasoning because both are related to the same construct – Fluid Reasoning (Gf)
- When the composite is ***cohesive***, it is a good summary of the theoretically related abilities it is intended to represent

Rules for Cohesion for Two-Subtest Composites on Individual Test Tabs in X-BASS (Determined Based on the Psychometric Properties of the Test)

Table from Essentials of Cross-Battery Assessment 3e	
Finding	**Interpretation**
Outcome 1 **The difference between scores is not significant or uncommon**	The difference between the scores that comprise the composite is not significant and occurs in more than 10% of the general population and, therefore, is common. The composite is **cohesive** and, therefore, provides a good summary of the theoretically related abilities it was intended to represent.
Outcome 2 **The difference between scores is significant but not uncommon**	Although the difference between the scores that comprise the composite is significant, the magnitude of the difference occurs in at least 10% of the general population and, therefore, is common. **Clinical judgment** is needed to determine whether the composite is cohesive and, therefore considered an adequate summary of the theoretically related abilities it was intended to represent.
Outcome 3 **The difference between scores is significant and uncommon**	The difference between the scores that comprise the composite is significant and occurs in ≤ 10% of the general population and, therefore, is uncommon. The composite is **not cohesive**, meaning that it *likely is not a good summary* of the theoretically related abilities it was intended to represent. Clinical judgement should be used to determine the extent to which interpretation should be tempered or whether follow up assessment is warranted. Although the meaning of a noncohesive composite may be difficult to determine, it is reliable and valid. Nevertheless, ***noncohesive composites often obscure important information about an individual's strengths and weaknesses***.

WJ IV COG Tab

Cohesion Analysis Outcomes

Cluster Name / Subtest Name (check box for integrated graph)	Enter scores	PR	Transfer scores
Comprehension-Knowledge (Gc)	101	53rd	
Oral Vocabulary (VL)	99	47th	
General Information (K0)	102	55th	
Picture Vocabulary *(from OL battery)* (VL)			

Criteria for Cohesion: Is variability...

significant or substantial?	infrequent or uncommon?
No	No

COHESIVE

Follow up Recommendatons

Do the results suggest a need for follow up?

No, not considered necessary

Gc = 101 Transfer to Data Organizer

Because the difference between the scores that comprise the composite is not substantial (less than 2/3 SD) and both scores are at least average, follow up is not considered necessary.

The WJ IV COG Comprehension-Knowledge (Gc) is primarily a measure of Comprehension and Knowledge. Gc refers to an individual's knowledge base (or general fund of information) that develops as a result of exposure to language, culture, general life experiences, and formal schooling. The difference between the scores that comprise the WJ IV COG Comprehension-Knowledge (Gc) is not statistically significant and a difference of this size occurs in at least 10% of the general population which means the difference is relatively common. This means that the WJ IV COG Comprehension-Knowledge (Gc) is a good psychometric summary of Comprehension and Knowledge. Additionally, information regarding where the subtest scores fall relative to each other and relative to most people is unlikely to add clinically relevant information above and beyond the WJ IV COG Comprehension-Knowledge (Gc), although clinical judgement is always necessary when making this determination. The individual's score on the WJ IV COG Comprehension-Knowledge (Gc) of 101 (96 - 106) is classified as Average/Within Normal Limits and is ranked at the 53rd percentile, indicating performance as good as or better than 53% of same age peers from the general population.

Outcome 1

Fluid Reasoning (Gf)	87	19th	
Number Series (RQ)	100	50th	
Concept Formation (I)	80	9th	
Analysis-Synthesis (RG)			

Yes	No

CLINICAL JUDGMENT NEEDED

Yes, recommended for lowest score

Gf = 87 Transfer to Data Organizer

Because the difference between the scores that comprise the composite is at least 1SD, and the lower score is indicative of a weakness or deficit, follow up on the lower score is considered necessary to determine if it is an accurate and valid representation of ability.

The WJ IV COG Fluid Reasoning (Gf) is primarily a measure of Fluid Reasoning. Gf refers to a type of thinking that an individual may use when faced with a relatively new or novel task that cannot be performed automatically. Although the difference between the scores that comprise the WJ IV COG Fluid Reasoning (Gf) is statistically significant, a difference of this size occurs in at least 10% of the general population which means the difference is relatively common. This means that although the composite is likely a psychometrically sound estimate of Fluid Reasoning, it may not be a good clinical summary because it may obscure an important and meaningful difference within this domain, which often occurs when one score is below average, and the other score is at least average relative to most people. The individual's score on the WJ IV COG Fluid Reasoning (Gf) of 87 (82 - 92) is classified as Low Average/Within Normal Limits and is ranked at the 19th percentile, indicating performance as good as or better than 19% of same age peers from the general population.

Outcome 2

Short-Term Working Memory (Gsm:MW)	83	13th	
Verbal Attention (MW)	70	2nd	
Numbers Reversed (MW)	109	73rd	
Object-Number Sequencing (MW)			

The WJ IV code for this ability domain is "Gwm," however, for the purposes of X-BASS, the traditional "Gsm:MW" designation is used instead.

Yes	Yes

NOT COHESIVE

Yes, recommended for lowest score

Gsm:MW = 83 Transfer to Data Organizer

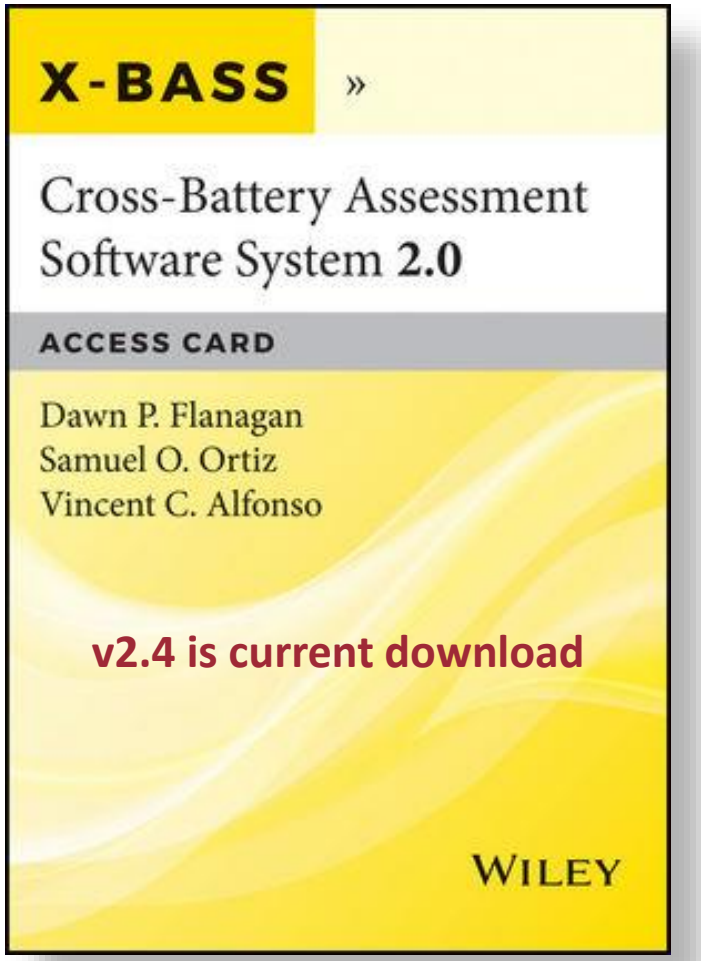
Because one score in the composite is indicative of average or better performance and the other score is indicative of a deficit, follow up on the lower score is considered necessary to determine if it is an accurate and valid representation of ability.

The WJ IV COG Short-Term Working Memory (Gsm:MW) is primarily a measure of Short-Term Memory. Gsm refers to the ability to hold information in immediate awareness and then manipulate or transform it in some way within a few seconds. The difference between the scores that comprise the WJ IV COG Short-Term Working Memory (Gsm:MW) is statistically significant and a difference of this size occurs in less than 10% of the general population which means the difference is relatively uncommon. This means that although the composite is likely a psychometrically sound estimate of Short-Term Memory, it may not be a good clinical summary because it may obscure an important and meaningful difference within this domain, which often occurs when one score is below average and the other score is at least average relative to most people.

Outcome 3

UPDATE

v2.2 - 2.4 include expanded interpretive statements



XBA Analyzer | Data Organizer | C-LIM Summary | Start | Tab Help

Cross-Battery Assessment Software System (X-BASS® v2.1)

WJ IV® Cognitive Data Analysis

(age range = 2.0 - 90+)

Next Step | Index | WJ IV COG Graph | Integrated Graph | C-LIM Analyzer

Name: *Amanda Farris* ***Grade:*** *2* ***Age:*** *8 years 3 month(s)* ***Date:*** *1/4/2016*

WISC-V | WAIS-IV | WPPSI-IV | WIAT-III | WJ IV COG | WJ IV ACH | WJ IV OL | KABC-II | KTEA-3 | CAS2 | DAS-II | SB5

Cluster Name (check box for integrated graph) / Subtest Name		Enter scores	PR	Transfer scores
Comprehension-Knowledge (Gc)	☐	83	13	
Oral Vocabulary (VL)	☐	89	23	☐
General Information (K0)	☐	103	58	☐
Picture Vocabulary *(from OL battery)* (VL)	☐			☐

Criteria for Cohesion: Is variability...

significant or substantial? **No** **infrequent or uncommon?** **No**

COHESIVE

The difference between the scores that comprise the composite is not significant and a difference of this size occurs in more than 10% of the general population which makes it relatively common. The composite is, therefore, cohesive and should be interpreted because it provides a good summary of the theoretically related abilities it was intended to represent.

Follow up Recommendatons

Do the results suggest a need for follow up?

Maybe for lowest score

Gc = 83 Transfer to Data Organizer

The difference between the scores that comprise the composite is considered substantial (i.e., at least 2/3 SD). Therefore, to gain a better understanding of the individual's performance in this ability domain, it may be helpful to follow up on the lower score and consider the differences that specific task demands and characteristics may have had on performance.

XBA Analyzer | Data Organizer | C-LIM Summary | Start | Tab Help

WJ IV® Cognitive Data Analysis

(age range = 2.0 - 90+)

Release: 2.4

Next Step | Index | WJ IV COG Graph | Integrated Graph | C-LIM Analyzer

Name: *Danny* ***Grade:*** *3* ***Age:*** *8 years 1 month(s)* ***Date:*** *1/3/2019*

WISC-V | WAIS-IV | WPPSI-IV | WIAT-III | WJ IV COG | WJ IV ACH | WJ IV OL | KABC-II | KTEA-3 | CAS2 | DAS-II | SB5

Cluster Name (check box for integrated graph) / Subtest Name		Enter scores	PR	Transfer scores
Comprehension-Knowledge (Gc)	☐	83	13th	
Oral Vocabulary (VL)	☐	89	23rd	☐
General Information (K0)	☐	103	58th	☐
Picture Vocabulary *(from OL battery)* (VL)	☐			☐

Criteria for Cohesion: Is variability...

significant or substantial? **No** **infrequent or uncommon?** **No**

COHESIVE

The WJ IV COG Comprehension-Knowledge (Gc) is primarily a measure of Comprehension and Knowledge. Gc refers to an individual's knowledge base (or general fund of information) that develops as a result of exposure to language, culture, general life experiences, and formal schooling. The difference between the scores that comprise the WJ IV COG Comprehension-Knowledge (Gc) is not statistically significant and a difference of this size occurs in at least 10% of the general population which means the difference is relatively common. This means that the WJ IV COG Comprehension-Knowledge (Gc) is a good psychometric summary of Comprehension and Knowledge. Additionally, information regarding where the subtest scores fall relative to each other and relative to most people is unlikely to add clinically relevant information above and beyond the WJ IV COG Comprehension-Knowledge (Gc), although clinical judgement is always necessary when making this determination. The individual's score on the WJ IV COG Comprehension-Knowledge (Gc) of 83 (78 - 88) is classified as Below Average/Normative Weakness and is ranked at the 13th percentile, indicating performance as good as or better than 13% of same age peers from the general population.

Follow up Recommendatons

Do the results suggest a need for follow up?

Maybe for lowest score

Gc = 83 Transfer to Data Organizer

The difference between the scores that comprise the composite is considered substantial (i.e., at least 2/3 SD). Therefore, to gain a better understanding of the individual's performance in this ability domain, it may be helpful to follow up on the lower score and consider the differences that specific task demands and characteristics may have had on performance.

Composite Analysis

- Composite Analysis involves consideration of three factors

1. What the composite measures from a theoretical standpoint (Gf, Gc, Gv, Gl, etc.)
2. Whether the composite is cohesive or otherwise considered a good summary of the theoretically related abilities it was intended to represent
3. Whether follow up is necessary (irrespective of cohesion)

What is Meant by Follow Up?

X-BASS provides guidance on whether follow up may be warranted based on the configuration of scores in a composite, specifically

How far apart the scores are from one another	Where the scores fall relative to most people (e.g., Average range, Below Average range, etc.)

Most of the time, when a composite is cohesive there is not a need for follow up

Examples of what is Meant by *Follow-up* in the XBA Approach

Additional Data Collection	Review of Existing Data
Investigation of narrow ability performance via administration of standardized, norm-referenced tests	Evaluation of existing data to determine if it corroborates current test performance (e.g., classroom work samples reveal manifestations of current cognitive ability weakness or deficit)
Informal assessment of the manifestations of an ability weakness or deficit (e.g., curriculum-based measures, state/local exams)	Outside evaluation corroborates current findings
Formal and informal testing of hypotheses regarding variation in task characteristics and task demands	Professional, teacher, parent, and/or student report corroborates current findings
Outside evaluation of disorder or condition that may adversely affect test performance (e.g., neuropsychological evaluation of ADHD; psychological evaluation of emotional or personality functioning; functional behavioral assessment)	Error analysis explains inconsistencies in current data or reasons for weak or deficient performance
Consultation with parents, teachers or other professionals	Demand analysis explains inconsistencies in current data or reasons for weak or deficient performance
Classroom observations in areas of concerns	Review attempted interventions

WJ IV COG Tab

Examples of Follow up Analysis

WISC-V | WAIS-IV | WPPSI-IV | WIAT-4 | WIAT-III | WJ IV COG | WJ IV ACH | WJ IV OL | KABC-II | KTEA-3 | CAS2 | DAS-II | SB5

Cluster Name (box for integrated graph) (check) / Subtest Name	Enter scores	PR	Transfer scores
Comprehension-Knowledge (Gc)	101	53rd	
Oral Vocabulary (VL)	99	47th	
General Information (K0)	102	55th	
Picture Vocabulary *(from OL battery)* (VL)			

No

Criteria for Cohesion: Is variability... significant or substantial?	infrequent or uncommon?
No	No

COHESIVE

The WJ IV COG Comprehension-Knowledge (Gc) is primarily a measure of Comprehension and Knowledge. Gc refers to an individual's knowledge base (or general fund of information) that develops as a result of exposure to language, culture, general life experiences, and formal schooling. The difference between the scores that comprise the WJ IV COG Comprehension-Knowledge (Gc) is not statistically significant and a difference of this size occurs in at least 10% of the general population which means the difference is relatively common. This means that the WJ IV COG Comprehension-Knowledge (Gc) is a good psychometric summary of Comprehension and Knowledge. Additionally, information regarding where the subtest scores fall relative to each other and relative to most people is unlikely to add clinically relevant information above and beyond the WJ IV COG Comprehension-Knowledge (Gc), although clinical judgement is always necessary when making this determination. The individual's score on the WJ IV COG Comprehension-Knowledge (Gc) of 101 (96 - 106) is classified as Average/Within Normal Limits and is ranked at the 53rd percentile, indicating performance as good as or better than 53% of same age peers from the general population.

Follow up Recommendatons

Do the results suggest a need for follow up?

No, not considered necessary

Gc = 101 Transfer to Data Organizer

Because the difference between the scores that comprise the composite is not substantial (less than 2/3 SD) and both scores are at least average, follow up is not considered necessary.

Fluid Reasoning (Gf)	87	19th	
Number Series (RQ)	100	50th	
Concept Formation (I)	80	9th	
Analysis-Synthesis (RG)			

Yes

Yes	No

CLINICAL JUDGMENT NEEDED

The WJ IV COG Fluid Reasoning (Gf) is primarily a measure of Fluid Reasoning. Gf refers to a type of thinking that an individual may use when faced with a relatively new or novel task that cannot be performed automatically. Although the difference between the scores that comprise the WJ IV COG Fluid Reasoning (Gf) is statistically significant, a difference of this size occurs in at least 10% of the general population which means the difference is relatively common. This means that although the composite is likely a psychometrically sound estimate of Fluid Reasoning, it may not be a good clinical summary because it may obscure an important and meaningful difference within this domain, which often occurs when one score is below average, and the other score is at least average relative to most people. The individual's score on the WJ IV COG Fluid Reasoning (Gf) of 87 (82 - 92) is classified as Low Average/Within Normal Limits and is ranked at the 19th percentile, indicating performance as good as or better than 19% of same age peers from the general population.

Yes, recommended for lowest score

Gf = 87 Transfer to Data Organizer

Because the difference between the scores that comprise the composite is at least 1SD, and the lower score is indicative of a weakness or deficit, follow up on the lower score is considered necessary to determine if it is an accurate and valid representation of ability.

Short-Term Working Memory (Gsm:MW)	83	13th	
Verbal Attention (MW)	70	2nd	
Numbers Reversed (MW)	109	73rd	
Object-Number Sequencing (MW)			

The WJ IV code for this ability domain is "Gwm," however, for the purposes of X-BASS, the traditional "Gsm:MW" designation is used instead.

Yes

Yes	Yes

NOT COHESIVE

The WJ IV COG Short-Term Working Memory (Gsm:MW) is primarily a measure of Short-Term Memory. Gsm refers to the ability to hold information in immediate awareness and then manipulate or transform it in some way within a few seconds. The difference between the scores that comprise the WJ IV COG Short-Term Working Memory (Gsm:MW) is statistically significant and a difference of this size occurs in less than 10% of the general population which means the difference is relatively uncommon. This means that although the composite is likely a psychometrically sound estimate of Short-Term Memory, it may not be a good clinical summary because it may obscure an important and meaningful difference within this domain, which often occurs when one score is below average and the other score is at least average relative to most people. The individual's score on the WJ IV COG Short-Term Working Memory (Gsm:MW) of 83 (78

Yes, recommended for lowest score

Gsm:MW = 83 Transfer to Data Organizer

Because one score in the composite is indicative of average or better performance and the other score is indicative of a deficit, follow up on the lower score is considered necessary to determine if it is an accurate and valid representation of ability.

There is Not a One-to-One Correspondence Between "Cohesion" and "Follow Up"

- When a composite is cohesive, X-BASS has three possible follow up outcomes:
  1. Both scores are at least Average (≥ 90): *No, follow up not considered necessary*
  2. One score is at least Average, and the other score is Below Average or lower and the difference between them is at least 2/3rd of a standard deviation: *Maybe follow up on lower score*
  3. One score is at least Average, and the other score is in the deficient range (<80): *Yes, follow up on lower score*

There is Not a One-to-One Correspondence Between "Cohesion" and "Follow Up"

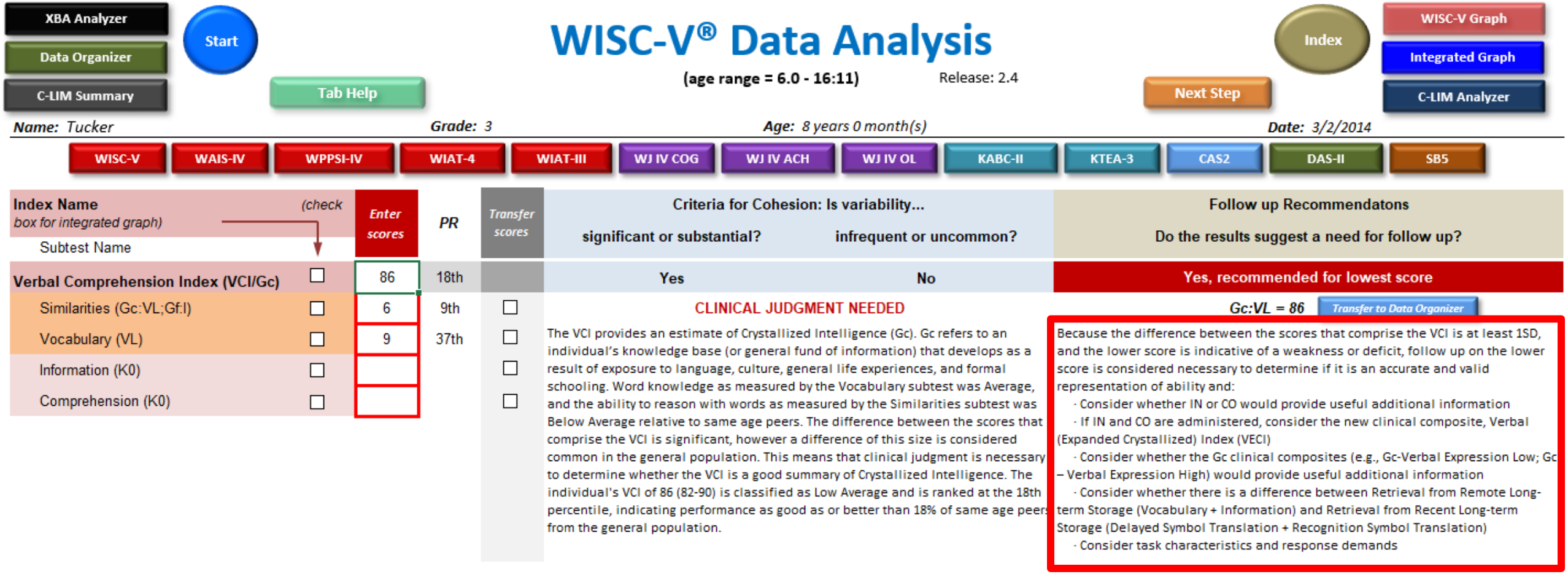
- When determination of cohesion requires *clinical judgment*, X-BASS has two possible follow up outcomes:
  1. Both scores are at least Average (≥ 90; ≥ 8): *No, follow up not considered necessary*
  2. One score is Average, and the other score is Below Average or lower (< 80; < 6): *Yes, follow up on lower score*

There is Not a One-to-One Correspondence Between "Cohesion" and "Follow Up"

- When a composite is not cohesive, X-BASS has three possible follow up outcomes:
  1. Both scores are at least Average (≥ 90; ≥ 8): *No, follow up not considered necessary*
  2. *Both scores are Below Average or lower* (< 80; < 6) *and differ by at least 1SD: Maybe, follow up on lower score*
  3. One score is at least Average, and the other score is Below Average or lower: *Yes, follow up on lower score*

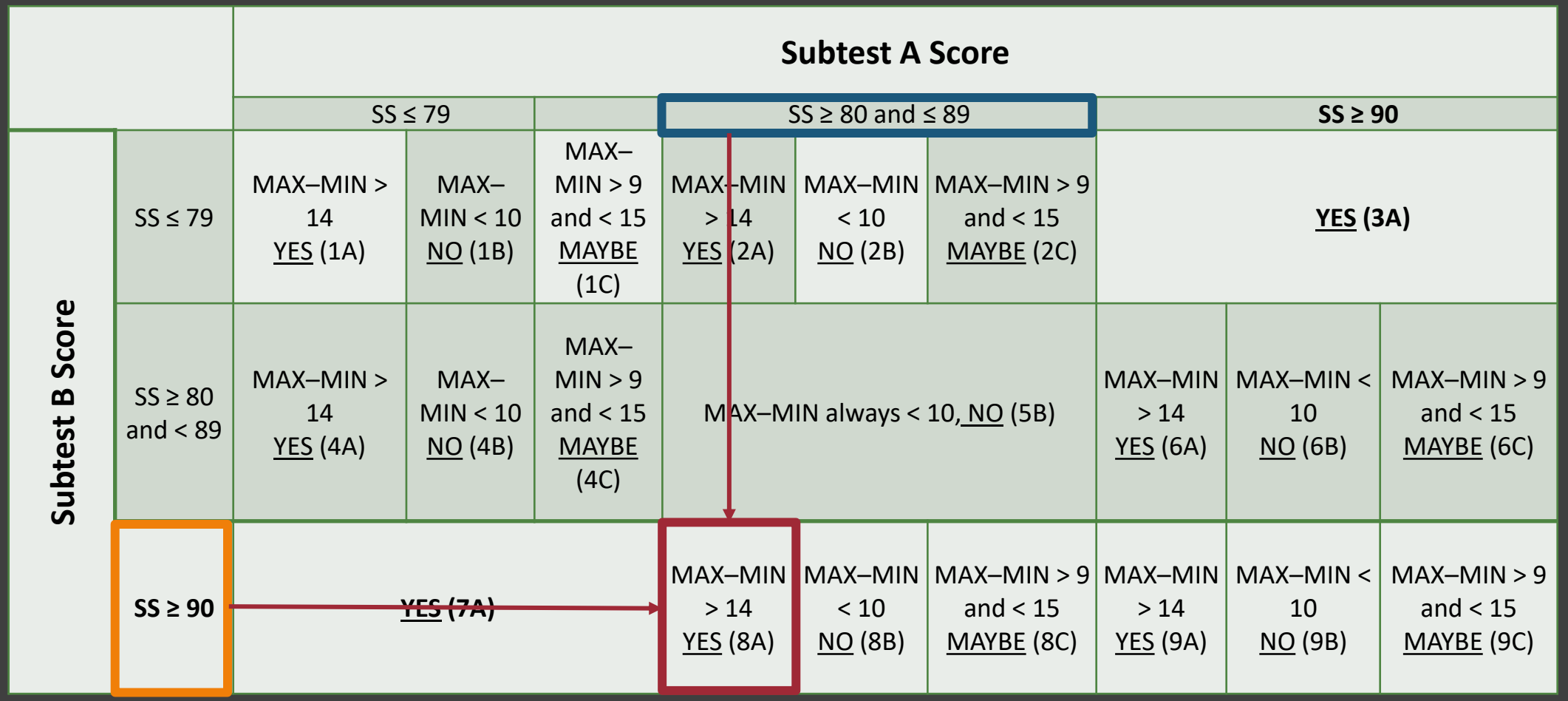
WISC-V Tab

- Expanded Follow Up Statements
- Guidance offered



X-BASS Individual Test Tabs: Follow Up

How are the test tabs programmed to determine follow up?



WJ IV Fluid Reasoning = 99

Subtest A: Number Series = 84

Subtest B: Concept Formation = 113

Criteria Used in X-BASS for Follow-up on Lower Score in a Two-Subtest Composite when Subtest scores are on a Scale Having a Mean of 100 and Standard Deviation of 15

Number-Letter Codes (e.g., 1A, 1B, 1C) are linked to Interpretive Statements in Chapter 3 of Essentials of Cross-Battery Assessment, 3e (see Rapid Reference 3.5)

How are the test tabs programmed to determine follow up?

MAX–MIN
> 14
YES (8A)

6A (and 8A). YES. Because the difference between the scores that comprise the composite is ≥ 1*SD*, and the lower score is indicative of a weakness or deficit, follow up on the lower score is considered necessary to determine if it is an accurate and valid representation of ability.

Fluid Reasoning (Gf)	☐	99	47th		**Yes**	**Yes**	**Yes, recommended for lowest score**
Number Series (RQ)	☐	84	14th	☐	NOT COHESIVE		*Gf = 99* Transfer to Data Organizer
Concept Formation (I)	☐	113	81st	☐	The WJ IV COG Fluid Reasoning (Gf) is primarily a measure of Fluid Reasoning. Gf refers to a type of thinking that an individual may use when faced with a relatively new or novel task that cannot be performed automatically. The difference between the scores that comprise the WJ IV COG Fluid Reasoning (Gf) is statistically significant and a difference of this size occurs in less than 10% of the general population which means the difference is relatively uncommon. This means that although the composite is likely a psychometrically sound estimate of Fluid Reasoning, it may not be a good clinical summary because it may obscure an important and meaningful difference within this domain, which often occurs when one score is below average and the other score is at least average relative to most people. The individual's score on the WJ IV COG Fluid Reasoning (Gf) of 99 (94 - 104) is classified as Average/Within Normal Limits and is ranked at the 47th percentile, indicating performance as good as or better than 47% of same age peers from the general population.		Because the difference between the scores that comprise the composite is at least 1SD, and the lower score is indicative of a weakness or deficit, follow up on the lower score is considered necessary to determine if it is an accurate and valid representation of ability.
Analysis-Synthesis (RG)	☐			☐			

		Subtest A Score								
		SS ≤ 5			SS ≥ 6 and ≤ 7			SS ≥ 8		
Subtest B Score	SS ≤ 5	MAX-MIN > 2 ***YES*** (1A)	MAX -MIN < 2 ***NO*** (1B)	MAX -MIN = 2 ***MAYBE*** (1C)	MAX -MIN > 2 ***YES*** (2A)	MAX -MIN < 2 ***NO*** (2B)	MAX -MIN = 2 ***MAYBE*** (2C)	MAX -MIN is always > 2 ***YES*** (3A)		
	SS ≥ 6 and SS ≤ 7	MAX -MIN > 2 ***YES*** (4A)	MAX -MIN < 2 ***NO*** (4B)	MAX -MIN = 2 ***MAYBE*** (4C)	MAX -MIN is always < 2 ***NO*** (5B)			MAX -MIN > 2 ***YES*** (6A)	MAX -MIN < 2 ***NO*** (6B) *(see Rapid Reference 3.5)*	MAX -MIN = 2 ***MAYBE*** (6C)
	SS ≥ 8	MAX – MIN is always > 2 ***YES*** (7A)			MAX -MIN > 2 ***YES*** (8A)	MAX -MIN < 2 ***NO*** (8B)	MAX -MIN = 2 ***MAYBE*** (8C)	MAX -MIN > 2 ***YES*** (9A)	MAX -MIN < 2 ***NO*** (9B)	MAX -MIN = 2 ***MAYBE*** (9C)

Note: MIN = lowest score in the composite; MAX = highest score in the composite. Number and letter combinations in parentheses within each cell correspond to the interpretive statements listed in Rapid Reference 3.5.

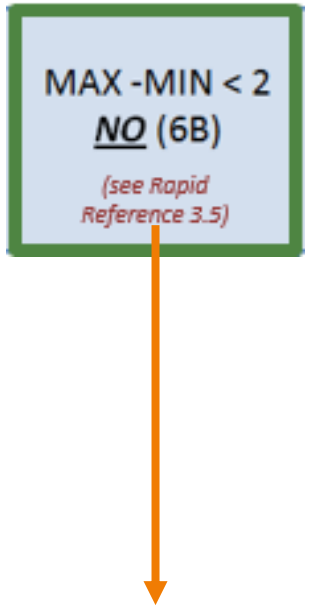
KABC-II Planning/Gf Scale = 85

Story Completion = 8

Pattern Reasoning = 7

Criteria Used in X-BASS for Follow-up on Lower Score in a Two-Subtest Composite when Subtest scores are on a Scale Having a Mean of 10 and Standard Deviation of 3

Number-Letter Codes (e.g., 1A, 1B, 1C) are linked to Interpretive Statements in Chapter 3 of Essentials of Cross-Battery Assessment, 3e (see Rapid Reference 3.5)



X-BASS Follow up Statement: Because the difference between the scores that comprise the composite is not substantial (i.e., less than $^{2}/_{3}$ *SD*, indicating similar subtest performances, *follow-up is not considered necessary.*

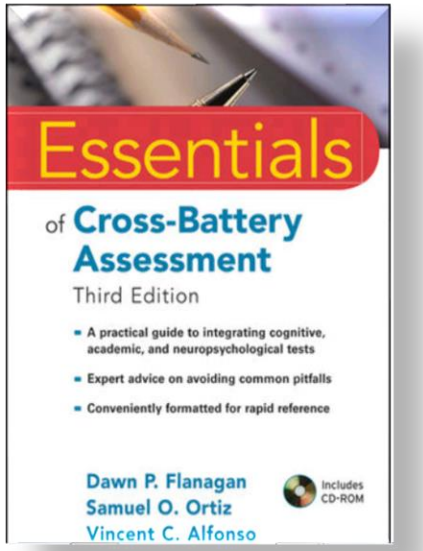
KABC-II Planning/Gf Scale = 85
Story Completion = 8
Pattern Reasoning = 7

RR 3.5. Following the recommendation of X-BASS, the practitioner did not follow up. Practitioner's general conclusion:

*Sian's performance on tasks that measured Fluid Reasoning (*Gf *) was Below Average but within the normal limits of functioning relative to same-age peers. The difference between her performance on a task that required her to reason inductively (Pattern Reasoning) and her performance on a task that required her to reason deductively (Story Completion) was not statistically significant, indicating that she performed about the same on both tasks. Overall, this finding indicates that, compared to her peers, Sian may have difficulty solving novel problems that cannot be performed automatically. It is likely that explicit strategy instruction will be necessary to assist Sian in solving problems, drawing inferences, extrapolating, and reorganizing or transferring information.*

MAX -MIN < 2
NO (6B)
(see Rapid Reference 3.5)

For Every Possible Outcome There is an Example of How Practitioners' Followed Up and What Their Conclusions Were After Following Up (Chapter 3, Rapid Reference 3.5)



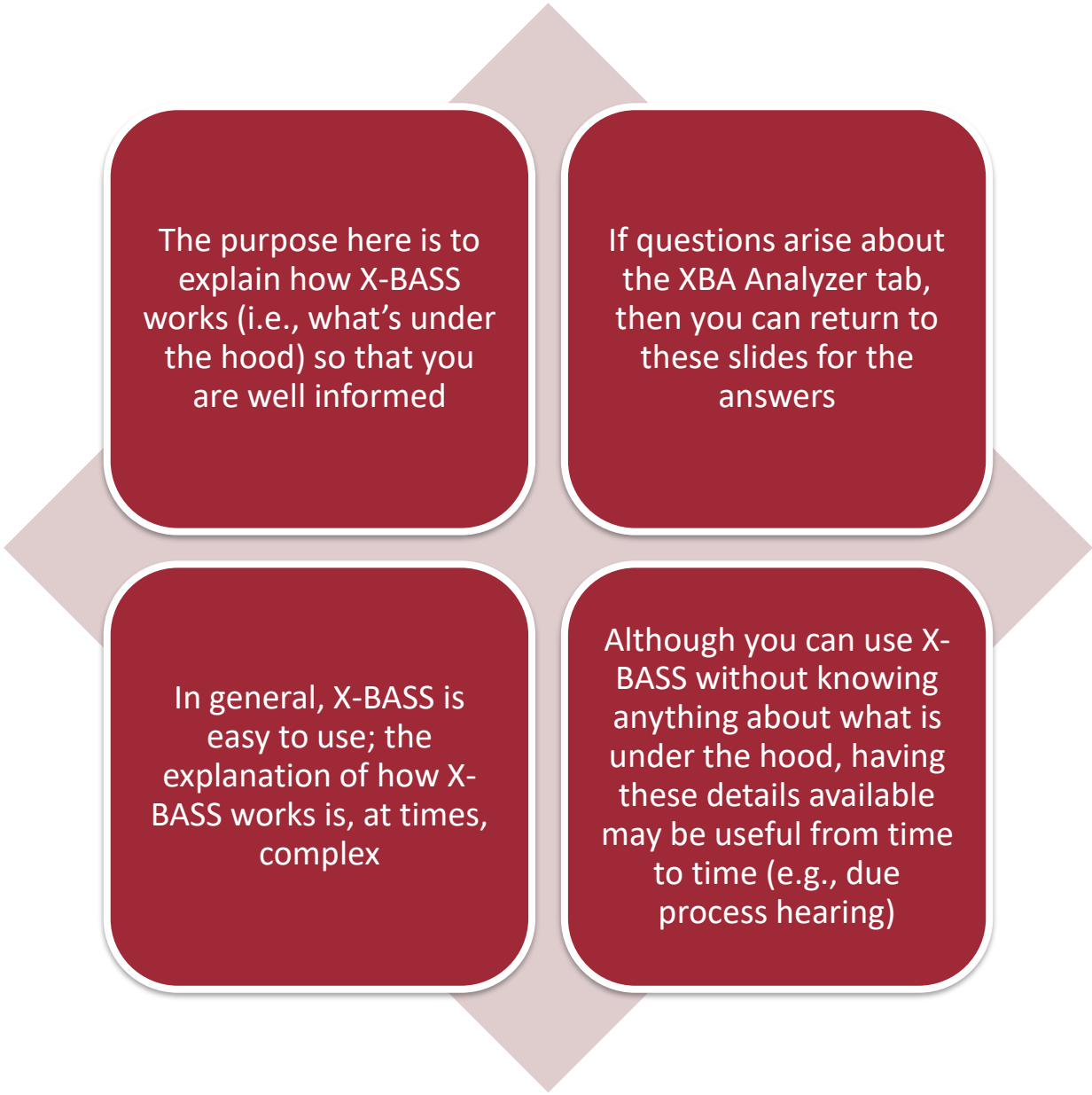
RR 3.5. Following the recommendation of X-BASS, the practitioner did not follow up. Practitioner's general conclusion:

*Sian's performance on tasks that measured Fluid Reasoning (*Gf *) was Below Average but within the normal limits of functioning relative to same-age peers. The difference between her performance on a task that required her to reason inductively (Pattern Reasoning) and her performance on a task that required her to reason deductively (Story Completion) was not statistically significant, indicating that she performed about the same on both tasks. Overall, this finding indicates that, compared to her peers, Sian may have difficulty solving novel problems that cannot be performed automatically. It is likely that explicit strategy instruction will be necessary to assist Sian in solving problems, drawing inferences, extrapolating, and reorganizing or transferring information.*

Different Cohesion and Follow Up Examples – Practitioner May Disagree with X-BASS Output Given Myriad Variables Involved in Each Case

Scores and Results of Cohesion Analysis for WISC-V FRI	Sian	Marie	Antonio	Alex
Matrix Reasoning (MR)	10	11	8	5
Figure Weights (FW)	9	16	6	2
FRI	**97**	**121**	**82**	**64**
Results of Cohesion Analysis	Difference is not significant; *Cohesive*	Difference is significant and rare; *Not Cohesive*	Difference is not significant; *Cohesive*	Difference is significant but not rare; *Clinical Judgment Needed*
Results of follow up	No, not considered necessary	Maybe follow up on lower score	Maybe follow up on lower score	Yes, recommended for lower score
Agree with X-BASS recommendation?	Yes	Given that both scores are at least average, in most cases follow up would not be necessary	Yes, would follow up and would consider task demands and task characteristics	Unless more information about what this individual *can do* is needed, would not follow up (b/c it is clear that Gf is a deficit)

Sidebar: *There is No Need to Memorize All of the Ways in Which X-BASS Analyzes Data*



Cohesion

- **Three (or more)-subtest composites on individual test tabs**
  - Base rate data used to determine whether the size of the difference between highest and lowest scores is *infrequent or uncommon* in the general population (i.e., about 10% or less).

Interpreting Three (or more)-Subtest Composites on the Individual Test Tabs of X-BASS

Finding	Interpretation
The magnitude of the difference between the highest and lowest score in the composite is uncommon in the general population	The difference between the scores that comprise the composite occurs in ≤ 10% of the general population and, therefore, is uncommon. The composite is **not cohesive**, meaning that it ***may not be a good summary*** of the theoretically related abilities it was intended to represent. ***Clinical judgement should be used to determine whether interpretation should be tempered or whether follow up assessment is warranted. Although the meaning of a noncohesive composite may be difficult to determine, it is reliable and valid. Nevertheless, noncohesive composites often obscure important information about an individual's strengths and weaknesses.***
The magnitude of the difference between the highest and lowest score in the composite is common in the general population	The difference between the scores that comprise the composite occurs in more than 10% of the general population and, therefore, is common. The composite is **cohesive** and, therefore, ***likely provides a good summary*** of the theoretically related abilities it was intended to represent. ***Keep in mind that more scores that comprise a composite, the larger the difference needed for the composite to be uncommon. Therefore, a composite can be cohesive but obscure important information about the individual's performance in the domain.***

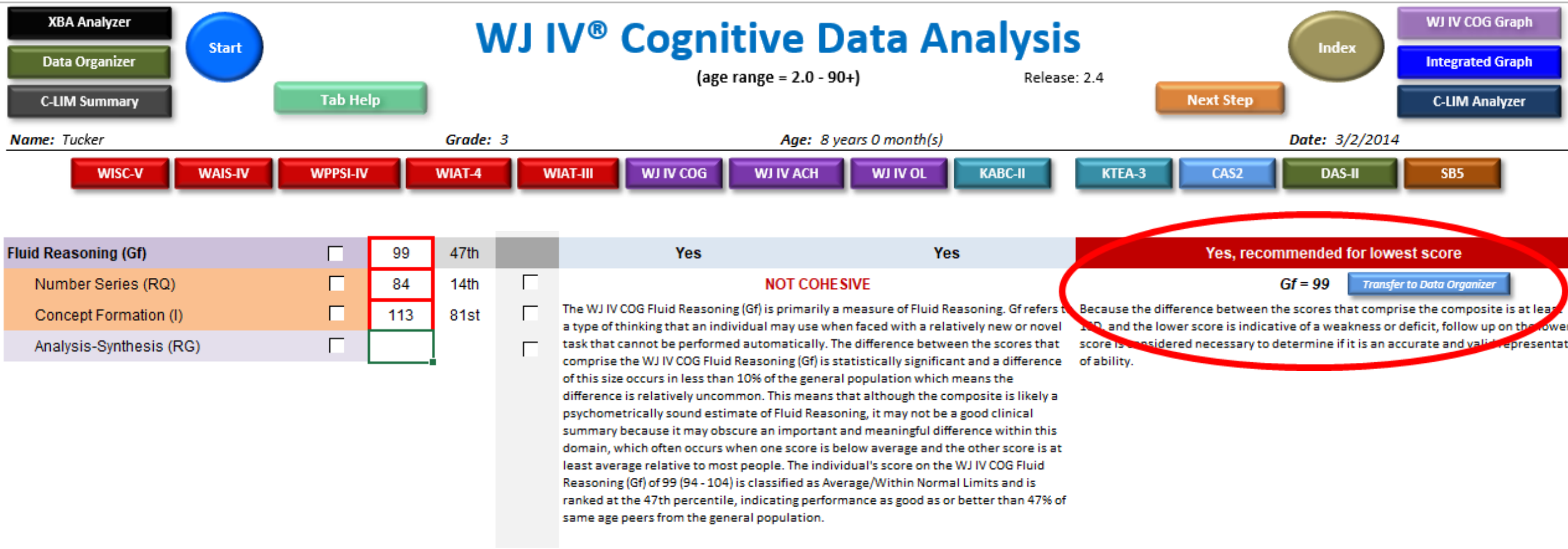
Cohesion Analysis for Three-Subtest Composites
KTEA-3 Example

Reading Fluency (Grw-R)	☐	98	45		**Not Applicable**	**No**	**No, not considered necessary**
Silent Reading Fluency (RF)	☐	100	50	☐	**COHESIVE**	*RF = 98* Transfer to Data Organizer
Word Recognition Fluency (RF;Gs:R9)	☐	97	42	☐	The difference between the scores that comprise the composite occurs in less than 10% of the general population and, therefore, is considered uncommon. The composite is not cohesive, meaning that it is not a good summary of the theoretically related abilities it was intended to represent, and should not be interpreted.	Because all scores in the composite are either not substantially different from one another or fall within the average or better range of ability, follow up assessment is not considered necessary.
Decoding Fluency (BRS;Gs:R9)	☐	99	47	☐		

Statistical Significance is only relevant for two-subtest composites; statistical rarity is determined by the difference between the highest and lowest scores that comprise the composite

How to Follow Up on Lower Score Using (Sub)Tests

Additional Data Collection	Review of Existing Data
Investigation of narrow ability performance via administration of standardized, norm-referenced tests	Evaluation of existing data to determine if it corroborates current test performance (e.g., classroom work samples reveal manifestations of current cognitive ability weakness or deficit)
Informal assessment of the manifestations of an ability weakness or deficit (e.g., curriculum-based measures, state/local exams)	Outside evaluation corroborates current findings
Formal and informal testing of hypotheses regarding variation in task characteristics and task demands	Professional, teacher, parent, and/or student report corroborates current findings
Outside evaluation of disorder or condition that may adversely affect test performance (e.g., neuropsychological evaluation of ADHD; psychological evaluation of emotional or personality functioning; functional behavioral assessment)	Error analysis explains inconsistencies in current data or reasons for weak or deficient performance
Consultation with parents, teachers or other professionals	Demand analysis explains inconsistencies in current data or reasons for weak or deficient performance
Classroom observations in areas of concerns	Review attempted interventions



- **When Following Up Using Standardized Tests**
  - Select a subtest with the same CHC narrow ability classification

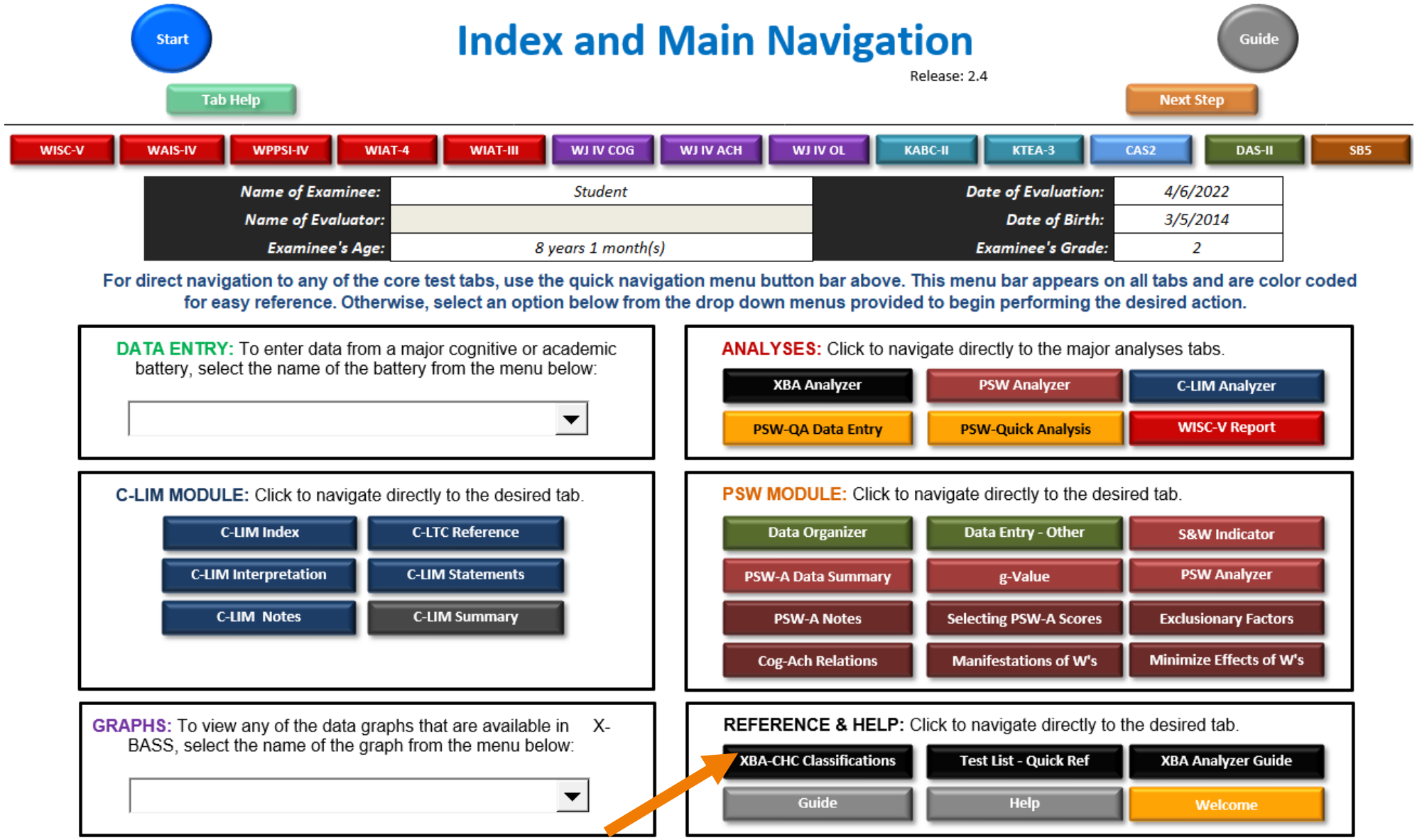
How Do I Select a Subtest with the Same Narrow Ability Classification?

- **X-BASS Output**: Not Cohesive; *Follow Up on Lower Score*
- Lower Score measures *Quantitative Reasoning*

Fluid Reasoning (Gf)	☐	99	47th
Number Series (RQ)	☐	84	14th
Concept Formation (I)	☐	113	81st
Analysis-Synthesis (RG)	☐		

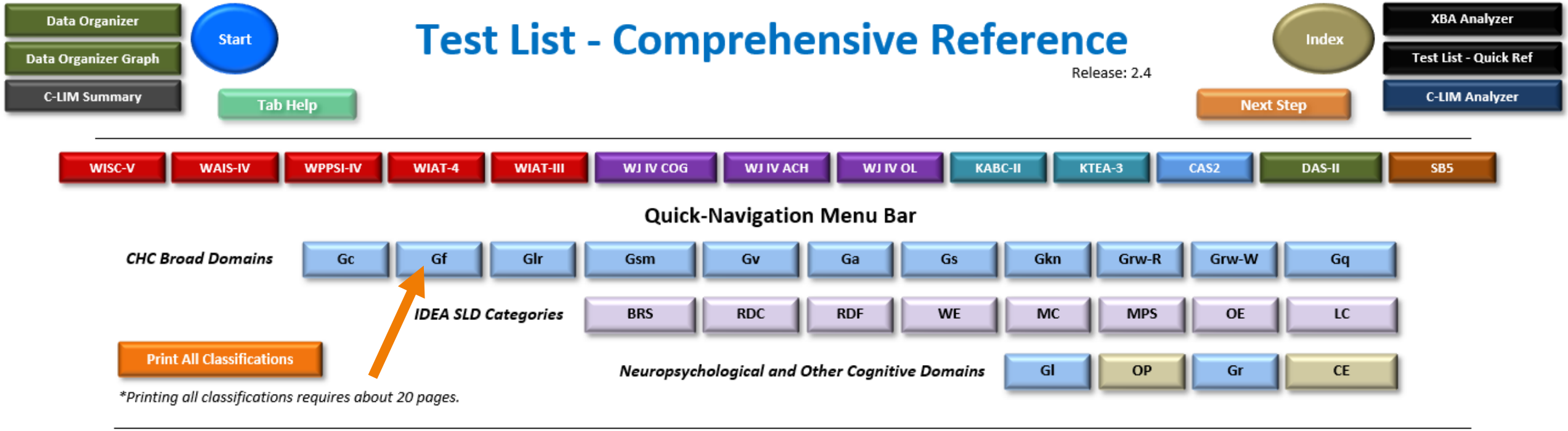
How do I find a (sub)test that measures the same narrow ability as the test I am following up on?

On Index Tab Click "XBA-CHC Classifications" Button



You Will Automatically Be Brought to This "Test List" Tab

Click on the Broad Ability (Gf in this example)



Print Gf

Gf - Fluid Reasoning

Go to XBA Gf

Back to Top

Induction (I)	Age Range
Bateria III COG Comprension Verbal (Gc:VL;Gf-I)	2-90+
Bateria III COG Formacion de Conceptos (Gf:I)	4-90+
Bateria IV COG Formacion de Conceptos (Gf:I)	4-90+
BVAT-NU Verbal Analogies (Gc:VL;Gf:I)	4-90+
CAS2 Matrices (Gf:I)	5-18
CELF-4 Semantic Relationships (Gc:LS;Gf:I;LC)	9-21
CELF-4 Understanding Spoken Paragraphs (Gc:LS;Gf:I;LC)	5-21
CELF-4 Word Classes-Expressive (Gc:VL;Gf:I)	5-21
CELF-4 Word Classes-Receptive (Gc:VL;Gf:I)	5-21
CELF-Pre2 Word Classes (Recept.,Expr.,Total) (Gc:LD,VL;Gf:I)	4-6
CTONI-2 Geometric Analogies (Gf:I)	6-89
CTONI-2 Geometric Categories (Gf:I)	6-89
CTONI-2 Pictorial Analogies (Gf:I)	6-89
CTONI-2 Pictorial Categories (Gf:I)	6-89
DAS-II Matrices (Gf:I)	3:6-17
DAS-II Picture Similarities (Gf:I)	2:6-6
DAS-II Verbal Similarities (Gc:VL;Gf:I)	7-17
D-KEFS Sorting Test: Free Sorting (Gf:I)	8-89
D-KEFS Sorting Test: Sort Recognition (Gf:I)	8-89
D-KEFS Twenty Questions Test (Gf:I;Gc:LD)	8-89
DTLA-5 Geometric Matrices (Gf:I)	6-17
DTLA-5 Geometric Sequences (Gf:I;Gv:Vz)	6-17
ITPA-3 Spoken Analogies (Gc:VL;Gf:I)	5-12
KABC-II Conceptual Thinking (Gv:Vz;Gf:I)	3-6
KABC-II Pattern Reasoning (5-6 years) (Gv:Vz;Gf:I)	5-6
KBIT-II Matrices (Gf:I)	4-90
Leiter-3 Classification and Analogies (Gf:I)	3-75
Leiter-3 Sequential Order (Gf:I,RG)	3-75
LPT3 Similarities (Gc:VL;Gf:I)	5-11
NAB Categories (Gf:I)	18-97

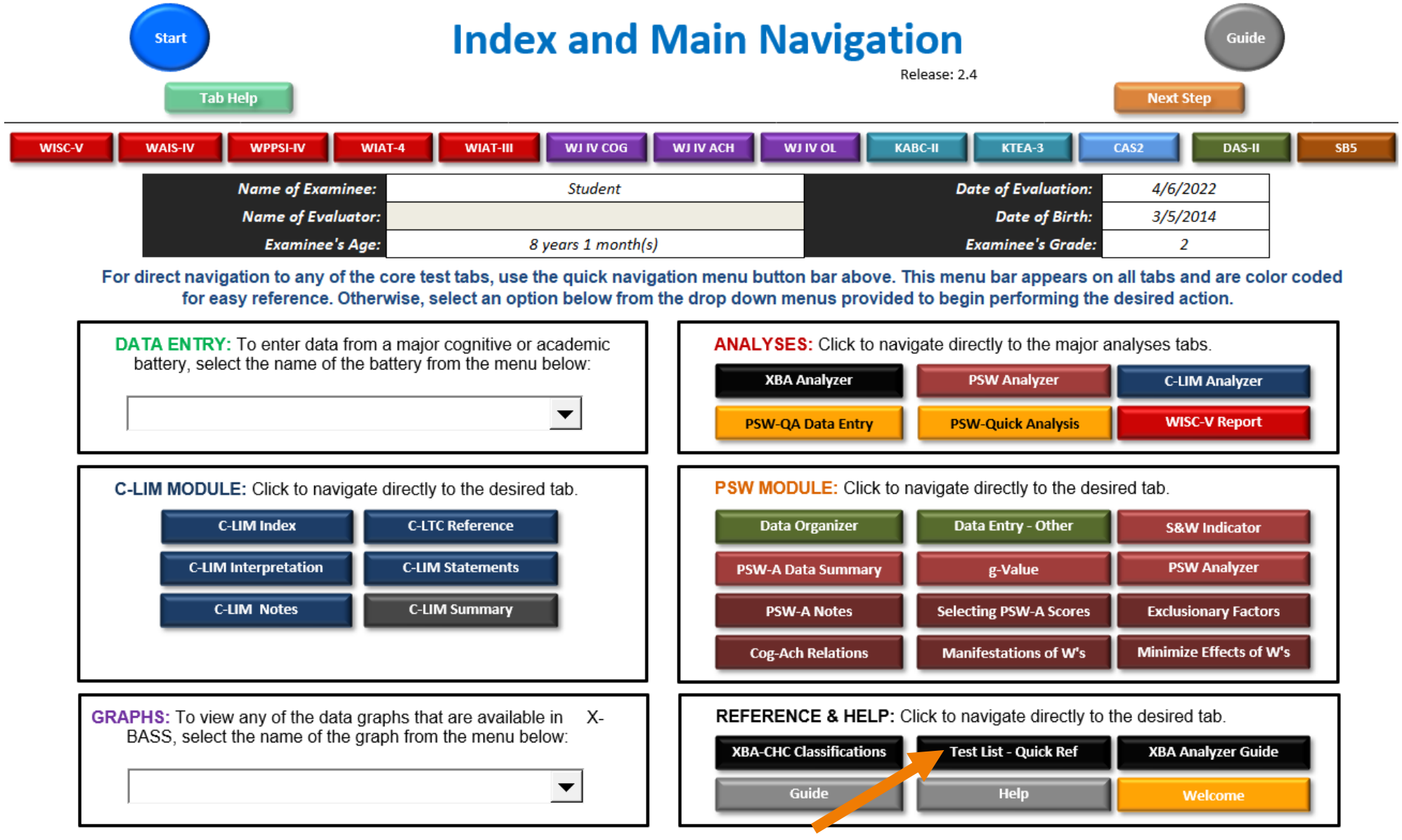
General Sequential Reasoning (RG)	Age Range
Bateria III COG Analisis-Sintesis (Gf:RG)	4-90+
Bateria III COG Planeamiento (Gv:SS;Gf:RG)	6-90+
CTONI-2 Geometric Sequences (Gf:RG)	6-89
CTONI-2 Pictorial Sequences (Gf:RG)	6-89
D-KEFS Tower (Gv:Vz;Gf:RG)	8-89
D-KEFS Word Context Test (Gf:RG;Gc:LD)	8-89
KABC-II Riddles (Gc:VL;Gf:RG)	3-18
KABC-II Rover (Gv:SS;Gf:RG)	5-18
KABC-II Story Completion (7-18 years) (Gf:RG;Gc:K0)	7-18
KBIT-II Riddles (Gc:VL;Gf:RG)	3-18
KBNA Conceptual Shifting (Gf:RG)	20-89
LCT-2 Reasoning (Gc:LS;Gf:RG;LC)	6-11
Leiter-3 Visual Patterns (Gf:RG)	3-75
LPT3 Differences (Gc:VL,LD;Gf:RG)	5-11
PLAI 2 Expressive (Gc:CM,VL;Gf:RG;OE)	3-5
PLAI 2 Reasoning (Gf:RG)	3-5
PLAI 2 Receptive (Gc:LS,VL;Gf:RG;LC)	3-5
PTONI Primary Test of Nonverbal Intelligence (Gv:Vz;Gf:RG)	3-9
RAIT Nonverbal Analogies (Gf:RG,I;Gc:K0)	10-75
RAIT Sequences (Gf:RG,I)	10-75
RIAS Odd-Item Out (Gf:RG)	3-94
SB5 Nonverbal Knowledge (Gc:K0,LS;Gf:RG)	2-85+
WAIS-IV Figure Weights (Gf:RG)	16-90
WISC-V Spanish Figure Weights (Gf:RG)	6-16
WISC-V Figure Weights (Gf:RG)	6-16
WISC-V Integrated Figure Weights Process Approach (Gf:RG)	6-16
WJ III NU COG Analysis-Synthesis (Gf:RG)	4-90+
WJ III NU COG Planning (Gv:SS;Gf:RG)	6-90+
WJ IV COG Analysis-Synthesis (Gf:RG)	5-80+

- We are following up on the WJ IV Number Series test
- Number Series is a measure of Quantitative Reasoning (Gf:RQ)
- Scroll through the tests of Quantitative Reasoning and find a battery that is available to you
- Best option is to find a battery with a subtest that is classified as Gf:RQ only (i.e., no secondary classification)
- Let's suppose you have the UNIT2
- Administer UNIT2 Numerical Series (Gf:RQ)

Quantitative Reasoning (RQ)	Age Range
AAB Mathematics Reasoning (MC;Gq:A3,KM;Gf:RQ)	4-85
AAB Mathematics Reasoning (MPS;Gq:A3,KM;Gf:RQ)	4-85
Bateria III ACH Conceptos Cuantitativos (MPS;Gq:A3,KM;Gf:RQ)	2-90+
Bateria III ACH Problemas Aplicados (MPS;Gq:A3;Gf:RQ)	2-80+
Bateria IV ACH Numeros Matrices (MPS;Gq:A3;Gf:RQ)	5-80+
Bateria IV ACH Problemas Aplicados (MPS;Gq:A3;Gf:RQ)	2-80+
Bateria IV COG Series Numericas (Gf:RQ)	5-80+
CMAT Algebra (MC;Gq:A3;Gf:RQ)	7-18
CMAT Problem Solving (MPS;Gq:A3;Gf:RQ)	7-18
DAB-3 Math Reasoning (MPS;Gq:A3;Gf:RQ)	6-13
DAB-I Math Reasoning (MPS;Gq:A3;Gf:RQ)	13-17
DAS-II Sequential & Quantitative Reasoning (Gf:RQ)	7-17
FAM Equation Building (MPS;Gq:A3;Gf:RQ)	4-21
FAM Sequences (MPS;Gq:A3;Gf:RQ)	4-21
KM3 Applied Problem Solving (MPS;Gq:A3;Gf:RQ)	5-21
KM3 Foundations of Problem Solving (MPS;Gq:A3;Gf:RQ)	5-21
KTEA-3 Math Concepts and Application (MPS;Gq:A3,KM;Gf:RQ)	4-25
KTEA-II Math Concepts and Application (MPS;Gq:A3;Gf:RQ)	4-25
RAIT Quantitative Reasoning (Gf:RQ)	10-75
SB5 Nonverbal Quantitative Reasoning (Gf:RQ;Gq:A3)	2-85+
SB5 Verbal Quantitative Reasoning (Gf:RQ;Gq:A3)	2-85+
TOMA-3 Word Problems (MPS;Gq:A3;Gf:RQ)	8-18
UNIT2 Nonsymbolic Quantity (Gf:RQ;Gq:A3)	5-21
UNIT2 Numerical Series (Gf:RQ)	5-21
WAIS-IV Arithmetic (Gsm:MW;Gf:RQ)	16-90
WIAT-4 Math Problem Solving (MPS;Gq:A3;Gf:RQ)	4-50
WJ III NU ACH Applied Problems (MPS;Gq:A3;Gf:RQ)	2-90+
WJ III NU ACH Form C Applied Problems (MPS;Gq:A3;Gf:RQ)	2-90+
WJ III NU ACH Quantitative Concepts (MPS;Gq:KM,A3;Gf:RQ)	2-90+
WJ III NU DS Number Matrices (Gf:RQ)	4-90+
WJ III NU DS Number Series (Gf:RQ)	4-90+
WJ IV ACH Applied Problems (MPS;Gq:A3;Gf:RQ)	2-80+
WJ IV ACH Number Matrices (MPS;Gq:A3;Gf:RQ)	5-80+
WJ IV COG Number Series (Gf:RQ)	5-80+
WRAT-Expanded Mathematics (MPS;Gq:A3;Gf:RQ)	5-24

How do I find a (sub)test that measures the same narrow ability as the test I am following up on?

On Index Tab Click “Test List – Quick Ref” Button



XBA-CHC Classifications | Data Organizer | C-LIM Summary | Start | Tab Help

Test List - Quick Reference

Release: 2.4

Index | XBA Analyzer | PSW-A Data Summary | C-LIM Analyzer | Next Step

WISC-V | WAIS-IV | WPPSI-IV | WIAT-4 | WIAT-III | WJ IV COG | WJ IV ACH | WJ IV OL | KABC-II | KTEA-3 | CAS2 | DAS-II | SB5

Clear Test or Battery Selection

To determine whether a particular test/battery is included in X-BASS, or to find what subtests and their classifications are contained in any particular test/battery, use the drop down menu over the left column. After the test/battery name has been selected, the list of subtests from in that battery will appear in the right column automatically. In addition, the subtests from the selected battery can be entered into the XBA Analyzer by clicking on the black button to the right.

Load Subtests in XBA Analyzer

Use the drop down menu below to select the test/battery name:

Universal Nonverbal Intelligence Test-2 (UNIT2)

The subtests from the selected test/battery will appear below automatically.

Subtests on Universal Nonverbal Intelligence Test-2 (UNIT2)

List of Test/Battery Names in X-BASS

1 Academic Achievement Battery (AAB)
2 Auditory Processing Abilities Test (APAT)
3 Auditory Phoneme Sequencing Test (APST)
4 Auditory Skills Assessment (ASA)
5 Bateria III Woodcock-Munoz: Aprovechamiento (Bateria III ACH)
6 Bateria III Woodcock-Munoz: Cognitiva (Bateria III COG)
7 Bateria IV Woodcock-Munoz: Aprovechamiento (Bateria IV ACH)
8 Bateria IV Woodcock-Munoz: Cognitiva (Bateria IV COG)
9 Bracken Basic Concept Scales-3:R (BBCS-3:R)
10 Bracken Basic Concept Scales-Expressive (BBCS-E)
11 Beery VP Test of Visual Perception (Beery VP)
12 Beery VMI Test of Visual-Motor Integration (Beery VMI)
13 Bracken School Readiness Assessment-3 (BSRA-3)
14 Bilingual Verbal Ability Test-NU (BVAT-NU)
15 Cognitive Assessment System-Second Edition (CAS2)
16 Comprehensive Assessment of Spoken Language - 2 (CASL-2)
17 Clinical Evaluation of Language Fundamentals-4 (CELF-4)
18 Clinical Evaluation of Language Fundamentals-5 (CELF-5)
19 Clinical Evaluation of Language Fundamentals-Preschool-2 (CELF-Pre2)
20 Child and Adolescent Memory Profile (ChAMP)
21 Comprehensive Mathematical Abilities Test (CMAT)
22 Comprehensive Receptive and Expressive Vocabulary Test-2 (CREVT-2)

List of Subtests in Selected Battery

1 UNIT2 Analogic Reasoning (Gf:I;Gc:K0)
2 UNIT2 Cube Design (Gv:Vz)
3 UNIT2 Nonsymbolic Quantity (Gf:RQ;Gq:A3)
4 UNIT2 Numerical Series (Gf:RQ)
5 UNIT2 Spatial Memory (Gv:MV)
6 UNIT2 Symbolic Memory (Gsm:MS,MW)

Transfer scores from individual test tabs to XBA Analyzer when

- *you need to follow up on a low score (by administering a subtest from another battery)*
- *you want to create a composite for which the publisher does not provide norms*

WJ IV® Cognitive Data Analysis

(age range = 2.0 - 90+) Release: 2.4

Fluid Reasoning (Gf)	☐	99	47th	☑	**Yes**	**Yes**	**Yes, recommended for lowest score**
Number Series (RQ)	☐	84	14th	☑			
Concept Formation (I)	☐	113	81st	☐			
Analysis-Synthesis (RG)	☐						

NOT COHESIVE

Gf = 99 *Transfer to Data Organizer*

The WJ IV COG Fluid Reasoning (Gf) is primarily a measure of Fluid Reasoning. Gf refers to a type of thinking that an individual may use when faced with a relatively new or novel task that cannot be performed automatically. The difference between the scores that comprise the WJ IV COG Fluid Reasoning (Gf) is statistically significant and a difference of this size occurs in less than 10% of the general population which means the difference is relatively uncommon. This means that although the composite is likely a psychometrically sound estimate of Fluid Reasoning, it may not be a good clinical summary because it may obscure an important and meaningful difference within this domain, which often occurs when one score is below average and the other score is at least average relative to most people. The individual's score on the WJ IV COG Fluid Reasoning (Gf) of 99 (94 - 104) is classified as Average/Within Normal Limits and is ranked at the 47th percentile, indicating performance as good as or better than 47% of same age peers from the general population.

Because the difference between the scores that comprise the composite is at least 1SD, and the lower score is indicative of a weakness or deficit, follow up on the lower score is considered necessary to determine if it is an accurate and valid representation of ability.

Check Boxes Next to Subtests

Scroll Down to Transfer Button

Click Button and X-BASS Takes You to the XBA Analyzer Tab

Transfer Scores to XBA Analyzer

Use the check boxes in this column to select subtests/scores for transfer to the XBA Analyzer tab for follow up evaluation and analysis. Click the left button to transfer or right button to clear selections.

Clear All

XBA Analyzer Guide | Start | Test List - Quick Ref | C-LIM Summary | Tab Help

XBA and Test Composite Analyzer

Release: 2.4

Index | Data Organizer | XBA Analyzer Graph | Integrated Graph | Next Step

Name: Student **Age:** 8 years 1 month(s) **Grade:** 2 **Date:** 4/6/2022

WISC-V | WAIS-IV | WPPSI-IV | WIAT-4 | WIAT-III | WJ IV COG | WJ IV ACH | WJ IV OL | KABC-II | KTEA-3 | CAS2 | DAS-II | SB5

COMPREHENSION-KNOWLEDGE (Gc)

(check these boxes to select score for integrated graph)

Clear Data

	Enter scores	Converted Standard Score	Composite Score Analyses
☐			
☐			
☐			
☐			
☐			
	☐	☐	☐

Reset Score Configuration | Evaluate Score Configuration

Go to Gc Test List Classifications | Transfer Comp(s) to Data Organizer

Score configuration and interpretation:

FLUID REASONING (Gf)

(check these boxes to select score for integrated graph)

Clear Data

		Enter scores	Converted Standard Score	Composite Score Analyses
	☐			
WJ IV COG Number Series (Gf:RQ)	☐	84	*84*	--
WJ IV COG Concept Formation (Gf:I)	☐	113	*113*	--
	☐			
	☐			
	☐	☐	☐	☐

NOT COHESIVE: Follow up recommended

Reset Score Configuration | Evaluate Score Configuration

Go to Gf Test List Classifications | Transfer Comp(s) to Data Organizer

Score configuration and interpretation:

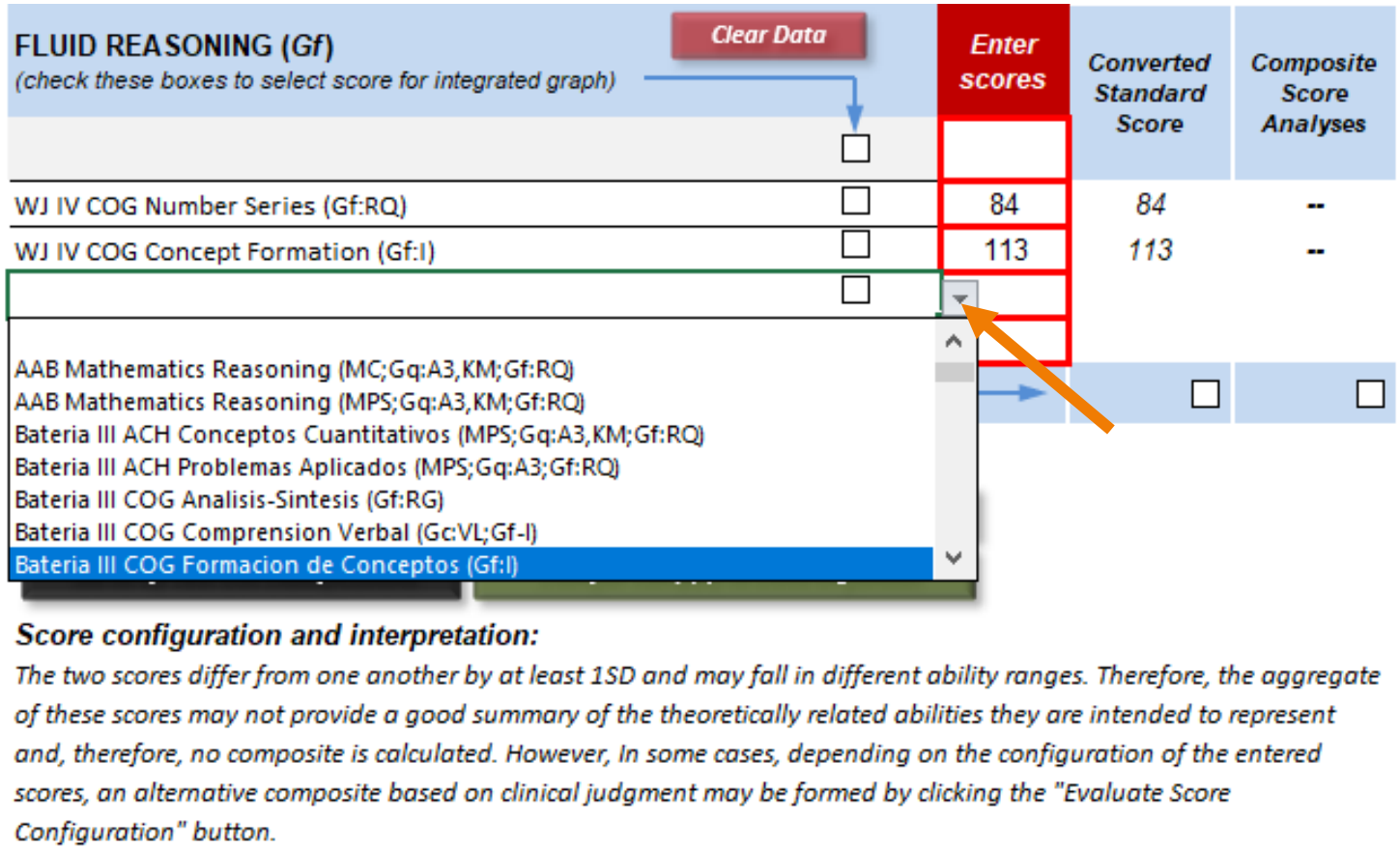
The two scores differ from one another by at least 1SD and may fall in different ability ranges. Therefore, the aggregate of these scores may not provide a good summary of the theoretically related abilities they are intended to represent and, therefore, no composite is calculated. However, In some cases, depending on the configuration of the entered scores, an alternative composite based on clinical judgment may be formed by clicking the "Evaluate Score Configuration" button.

Cognitive subtests transferred to the XBA Analyzer are automatically placed in the domain corresponding to their CHC Broad Ability classifications.

XBA Analyzer Tab

- From the Drop-Down Menu, Select the Test You Administered During Your Follow Up Assessment (e.g., UNIT2 Numerical Series)

- Note that tests are listed in alphabetical order in the Drop-Down Menu



Score configuration and interpretation:

The two scores differ from one another by at least 1SD and may fall in different ability ranges. Therefore, the aggregate of these scores may not provide a good summary of the theoretically related abilities they are intended to represent and, therefore, no composite is calculated. However, In some cases, depending on the configuration of the entered scores, an alternative composite based on clinical judgment may be formed by clicking the "Evaluate Score Configuration" button.

FLUID REASONING (*Gf*)

(check these boxes to select score for integrated graph)

Clear Data

		Enter scores	Converted Standard Score	Composite Score Analyses
	☐			
WJ IV COG Number Series (Gf:RQ)	☐	84	*84*	--
WJ IV COG Concept Formation (Gf:I)	☐	113	*113*	--
UNIT2 Numerical Series (Gf:RQ)	☐			
	☐			
			☐	☐

NOT COHESIVE: Follow up recommended

Reset Score Configuration | Evaluate Score Configuration

Go to Gf Test List Classifications | Transfer Comp(s) to Data Organizer

Score configuration and interpretation:

The two scores differ from one another by at least 1SD and may fall in different ability ranges. Therefore, the aggregate of these scores may not provide a good summary of the theoretically related abilities they are intended to represent and, therefore, no composite is calculated. However, in some cases, depending on the configuration of the entered scores, an alternative composite based on clinical judgment may be formed by clicking the "Evaluate Score Configuration" button.

WJ IV Fluid Reasoning = 99
Number Series = 84
Concept Formation = 113

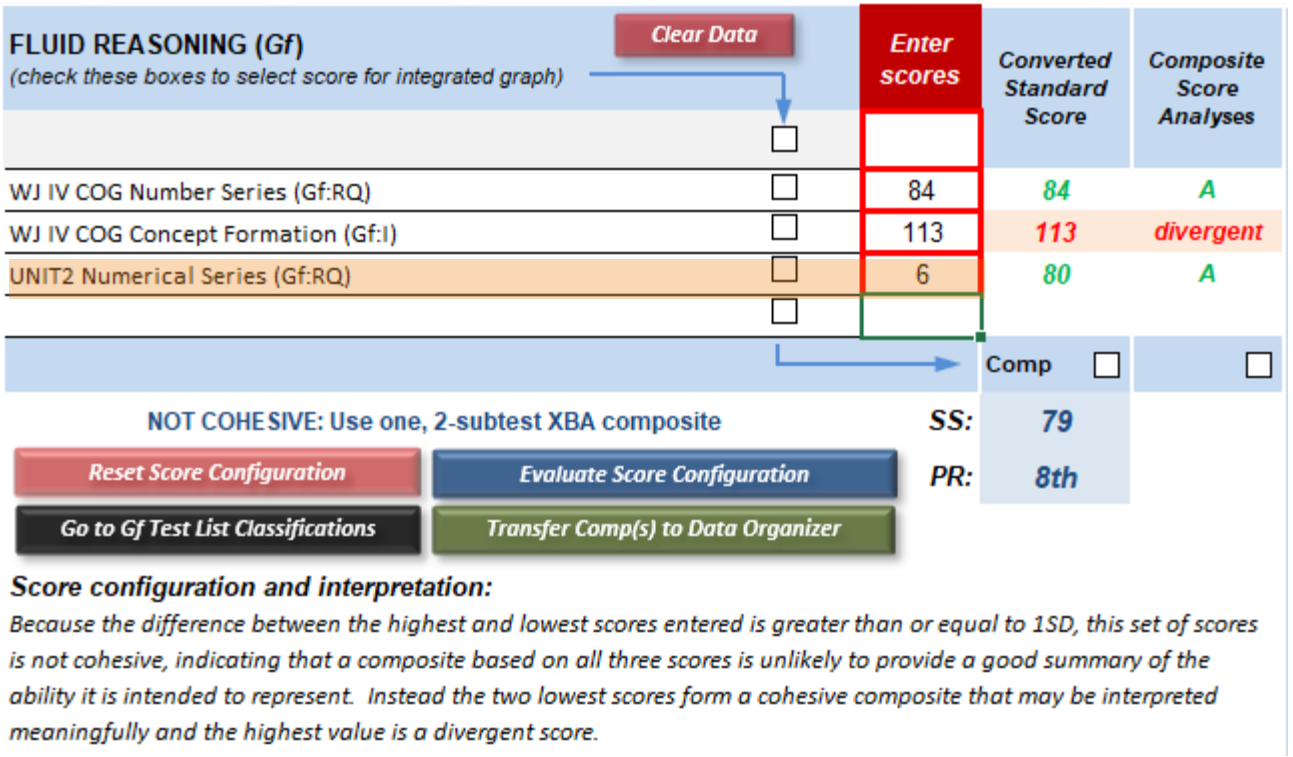
Follow up necessary

Followed up with UNIT2
Number Series = 6

XBA Output

Quantitative Reasoning (QR) Composite = 79

Inductive Reasoning Subtest is ***divergent***, meaning that it is substantially higher than the RQ subtest scores



Purpose of the XBA Analyzer Tab

- Evaluate a set of scores to determine the best way to organize, report, and interpret them
  - **Scores may come from different batteries, allowing for cross-battery composites to be calculated**
  - Scores may come from the same battery, allowing for within-battery composites to be calculated (when actual norms from the test publisher are not available)
- Evaluate Whether Composites From Other Batteries Are Cohesive
  - Batteries other than the cognitive and achievement batteries that have their own tabs in X-BASS

Woodcock Johnson IV

TESTS OF COGNITIVE ABILITIES

Purpose of the XBA Analyzer Tab

- Note that cohesion and follow up are derived differently for “cross-battery” data as compared to “within-battery” data (found on the individual test tabs)
- There are several possible outcomes of two-, three-, and four-subtest score configurations because the XBA Analyzer tab is designed to balance the “art” and the science of test interpretation

Examples of TWO Scores Entered in the XBA Analyzer Tab

Cross-Battery Assessment

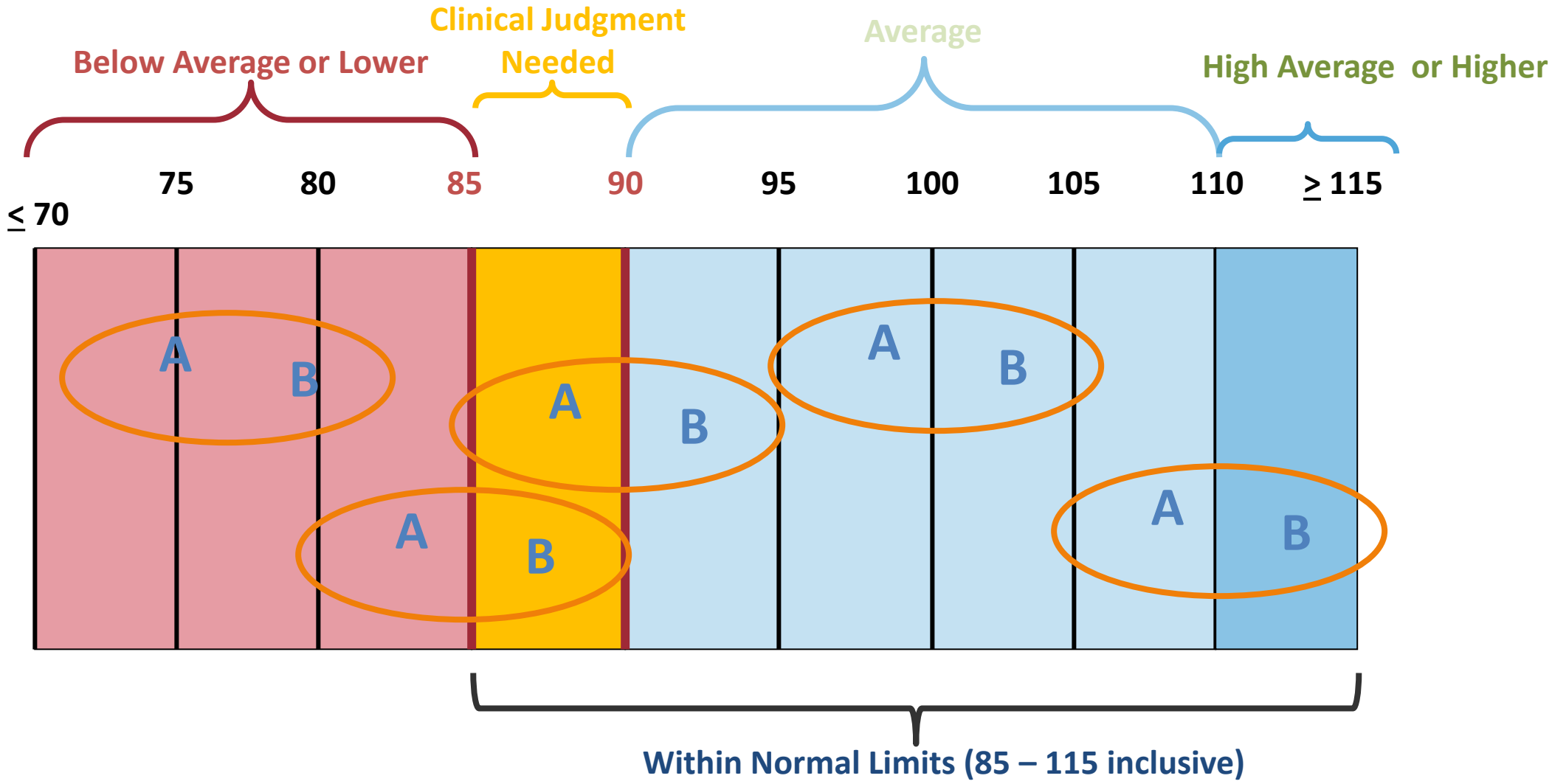
Rule 1

Interpretation of Composites Based on Two Subtests Entered or Transferred to the XBA Analyzer Tab of X-BASS (Chapter 3; Flanagan et al., 2013)

Rule for Calculating a Composite	Interpretation of Two-Subtest Configuration
If difference between scores is <15, then composite is calculated, OR	The difference between the scores that comprise the composite is < 1SD and, therefore, the composite is considered **cohesive**. The composite is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to represent.
If both scores are <80 and the difference between them is > 14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, both scores are less than 80 and represent normative weaknesses or deficits. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to represent.
If both scores are >120 and the difference between them is >14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, both scores are greater than 120 and represent normative strengths. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to represent.
If both scores are >79 and <121 and the difference between them is >14; then no composite is calculated.	The scores comprising the composite fall in different ability ranges and differ from one another by at least 1SD. Therefore, the composite is **not considered cohesive**. As such, the composite is not likely to be a good summary of the theoretically related abilities it is intended to represent. (Note: ability ranges are Below Average: 80-89; Average: 90-109; Above Average: 110-119).

Two-Subtest XBA Composites: Rules for Cohesion

Rule 1: Difference between both scores is < 15



Interpretation: A composite is calculated because the difference between the scores is < 1SD. The composite is cohesive and likely a good summary of the theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to represent.

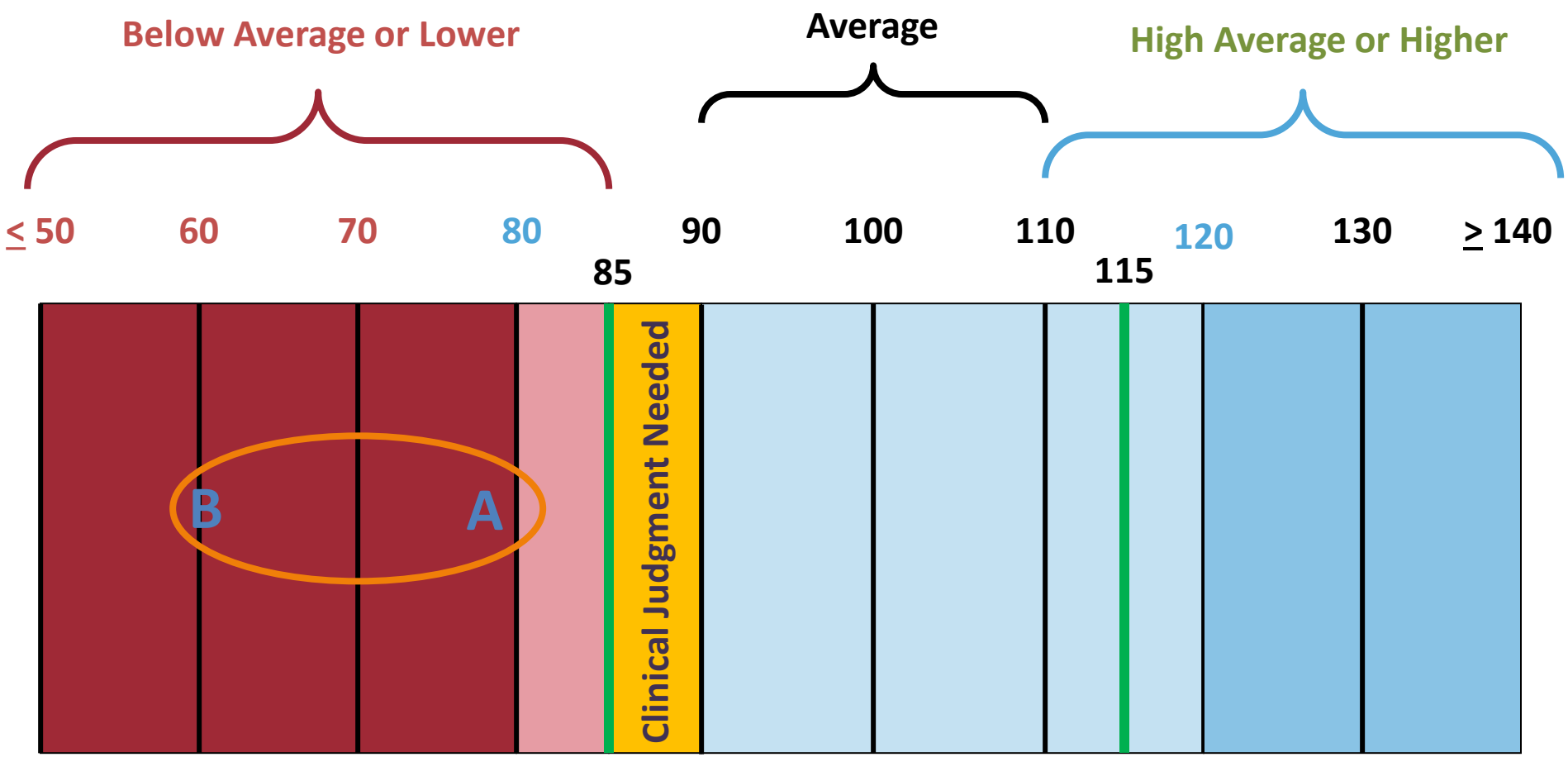
Interpretation of Composites Based on Two Subtests Entered or Transferred to the XBA Analyzer Tab of X-BASS (Chapter 3; Flanagan et al., 2013)

Rule 2

Rule for Calculating a Composite	Interpretation of Two-Subtest Configuration
If difference between scores is <15, then composite is calculated, OR	The difference between the scores that comprise the composite is < 1SD and, therefore, the composite is considered **cohesive**. The composite is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure.
If both scores are <80 and the difference between them is > 14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, both scores are less than 80 and represent normative weaknesses or deficits. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If both scores are >120 and the difference between them is >14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, both scores are greater than 120 and represent normative strengths. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If both scores are >79 and <121 and the difference between them is >14; then no composite is calculated.	The scores comprising the composite fall in different ability ranges and differ from one another by at least 1SD. Therefore, the composite is **not considered cohesive**. As such, the composite is not likely to be a good summary of the theoretically related abilities it is intended to represent. (Note: ability ranges are Below Average: 80-89; Average: 90-109; Above Average: 110-119).

Two-Subtest XBA Composites: Rules for Cohesion

Rule 2: Scores < 80, composite is calculated regardless of the difference between the scores



Interpretation: Although the difference between the scores is at least 1SD, both scores are less than 80 and represent normative weaknesses or deficits. Therefore, the composite is considered meaningful and may be interpreted as an adequate estimate of the ability that it was intended to represent unless clinical judgment suggests otherwise.

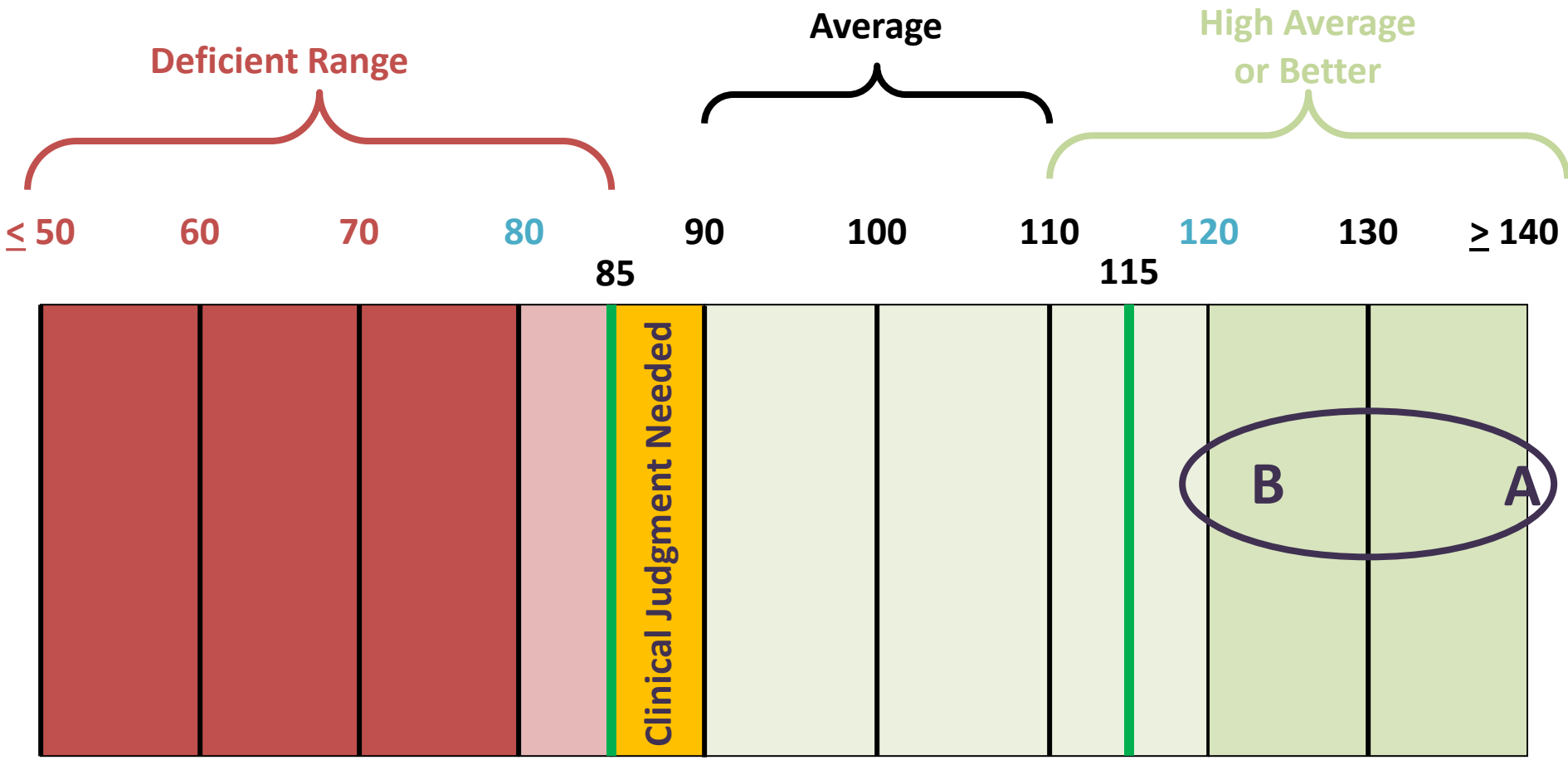
Interpretation of Composites Based on Two Subtests Entered or Transferred to the XBA Analyzer Tab of X-BASS (Chapter 3; Flanagan et al., 2013)

Rule for Calculating a Composite	Interpretation of Two-Subtest Configuration
If difference between scores is <15, then composite is calculated, OR	The difference between the scores that comprise the composite is < 1SD and, therefore, the composite is considered **cohesive**. The composite is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure.
If both scores are <80 and the difference between them is > 14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, both scores are less than 80 and represent normative weaknesses or deficits. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If both scores are >120 and the difference between them is >14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, both scores are greater than 120 and represent normative strengths. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If both scores are >79 and <121 and the difference between them is >14; then no composite is calculated.	The scores comprising the composite fall in different ability ranges and differ from one another by at least 1SD. Therefore, the composite is **not considered cohesive**. As such, the composite is not likely to be a good summary of the theoretically related abilities it is intended to represent. (Note: ability ranges are Below Average: 80-89; Average: 90-109; Above Average: 110-119).

Rule 3

Two-Subtest XBA Composites: Rules for Cohesion

Rule 3: Both scores > 120, composite is calculated regardless of the difference between the scores



Interpretation: Although the difference between the scores is > 1SD, both scores are greater than 120 and represent normative strengths. Therefore, the composite is considered meaningful and may be interpreted as an adequate estimate of the ability that it was intended to represent unless clinical judgment suggests otherwise.

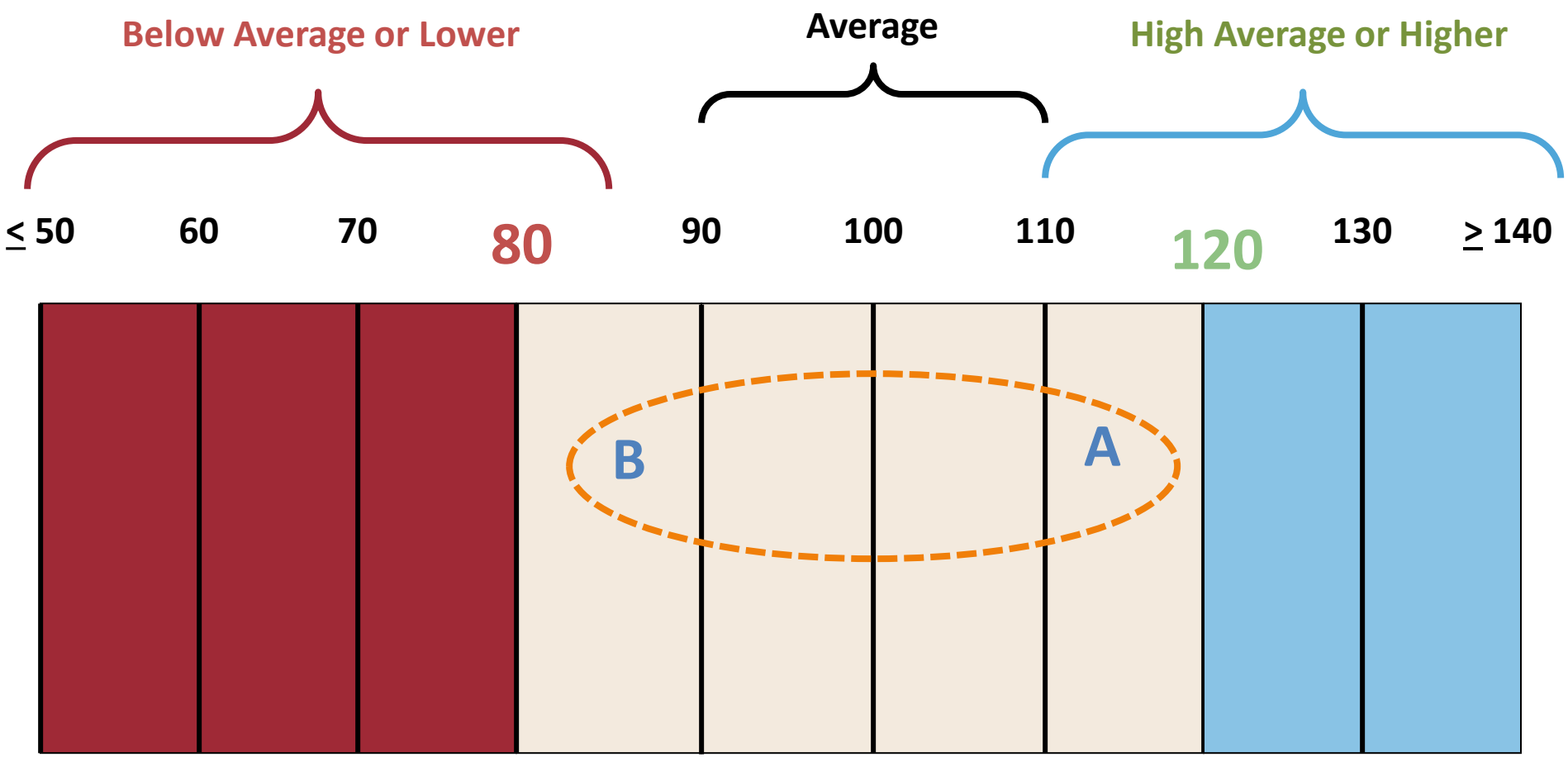
Interpretation of Composites Based on Two Subtests Entered or Transferred to the XBA Analyzer Tab of X-BASS (Chapter 3; Flanagan et al., 2013)

Rule for Calculating a Composite	Interpretation of Two-Subtest Configuration
If difference between scores is <15, then composite is calculated, OR	The difference between the scores that comprise the composite is < 1SD and, therefore, the composite is considered **cohesive**. The composite is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure.
If both scores are <80 and the difference between them is > 14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, both scores are less than 80 and represent normative weaknesses or deficits. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If both scores are >120 and the difference between them is >14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, both scores are greater than 120 and represent normative strengths. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If both scores are >79 and <121 and the difference between them is >14; then no composite is calculated.	The scores comprising the composite fall in different ability ranges and differ from one another by at least 1SD. Therefore, the composite is **not considered cohesive**. As such, the composite is not likely to be a good summary of the theoretically related abilities it is intended to represent. (Note: ability ranges are Below Average: 80-89; Average: 90-109; Above Average: 110-119).

Rule 4

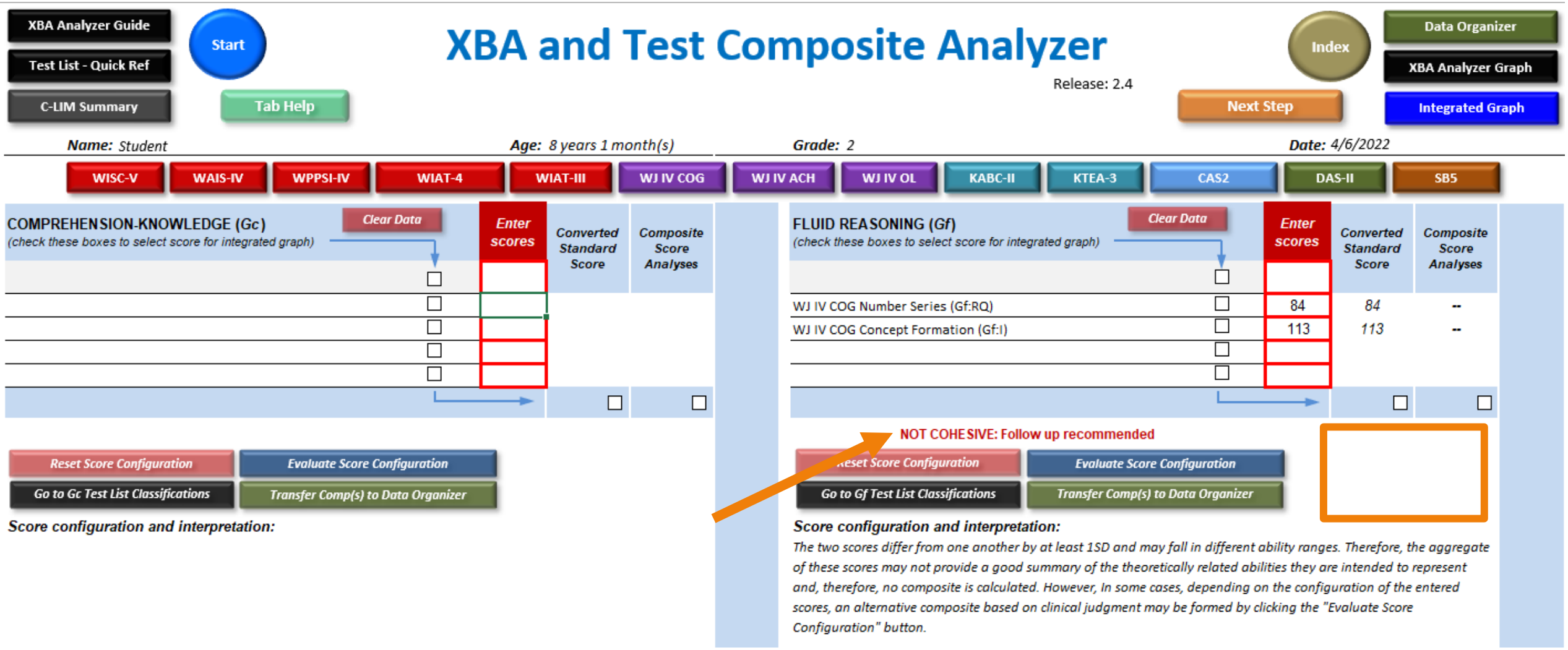
Two-Subtest XBA Composites: Rules for Cohesion

Rule 4: Both scores are between 80 and 120 (inclusive) – no composite calculated because difference is > 1SD



Interpretation: The difference between the scores is > 1SD; a composite is not calculated (and output indicates "not cohesive.")

Example of Rule 4



Enter Score(s) From Follow Up Testing

WJ IV Fluid Reasoning = 99
Number Series = 84
Concept Formation = 113

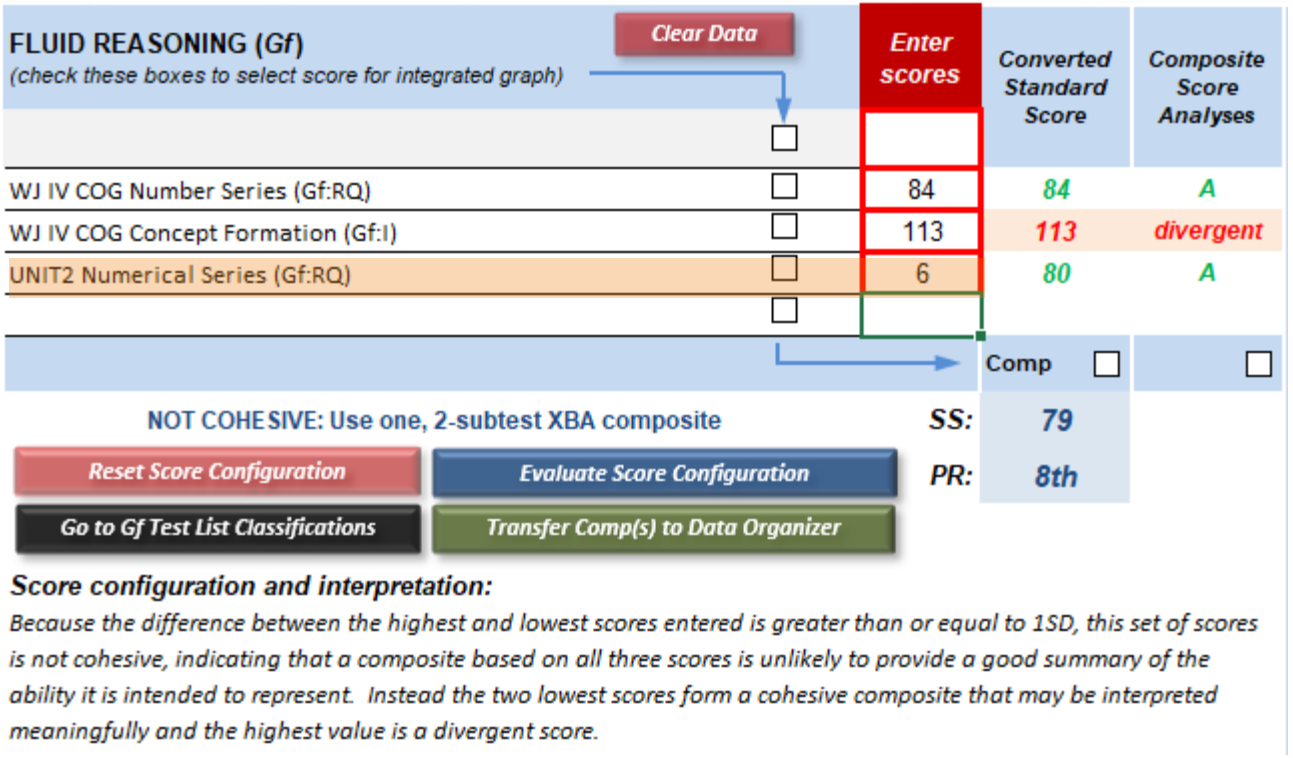
Follow up necessary

Followed up with UNIT2
Number Series = 6

XBA Output

Quantitative Reasoning (QR) Composite = 79

Inductive Reasoning Subtest is ***divergent***, meaning that it is substantially higher than the RQ subtest scores



Purpose of the XBA Analyzer Tab

When the UNIT2 Numerical Series subtest scaled score is entered into the XBA Analyzer tab in the Gf domain, three scores are analyzed to determine the best way to understand Gf performance

Scaled scores (having a mean of 10 and a standard deviation of 3) are automatically converted to standard scores (having a mean of 100 and a standard deviation of 15).

After all scores are on the same metric, they are analyzed

Examples of THREE Scores Entered in the XBA Analyzer Tab

Cross-Battery Assessment

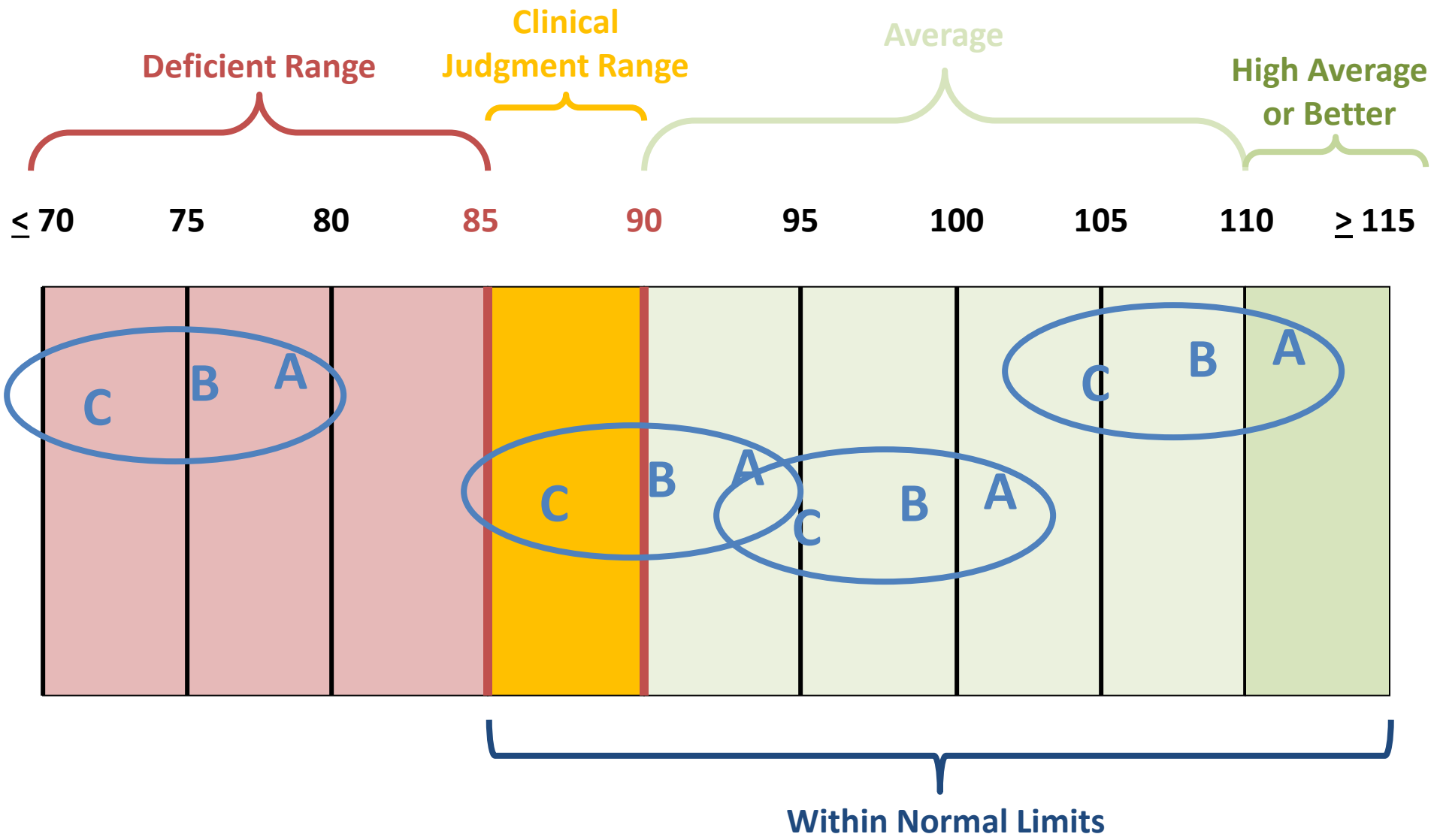
Interpretation of Composites Based on Three Subtests Entered or Transferred to the XBA Analyzer Tab of X-BASS (Chapter 3; Flanagan et al., 2013)

Rule 1

Rule for Calculating a Composite	Interpretation of Three-Subtest Configuration
If the difference between MIN and MAX is < 15, then composite is calculated based on all scores, OR	The difference between the highest and lowest scores that comprise the composite is < 1SD and, therefore, the composite is considered **cohesive**. The composite is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure.
If all three scores are <80 and the difference between any two of them is > 14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, all three scores are less than 80 and represent normative weaknesses or deficits. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If all three scores are >119 and the difference between any two of them is >14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, all scores are greater than 119 and represent normative strengths. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If the difference between MAX and MID is > 14 and the difference between MIN and MID is > 14, then no composite is calculated, OR	All scores that comprise the composite differ from one another by at least 1SD. Therefore, the composite is **not considered cohesive**. As such, the composite is not likely to be a good summary of the theoretically related abilities it is intended to represent.
If the difference between MIN and MAX is > 14, and the difference between MAX-MID and MID-MIN is equal (and < 15), then calculate composite for MID+MAX and report MIN as divergent (Chaplin Rule), OR If the difference between MIN and MAX is > 14, and MID-MIN > 14 and MAX-MID is < 15, then calculate composite for MID+MAX and report MIN as divergent OR If the difference between MIN and MAX is > 14, and MID-MIN is < 15, and MAX-MID is <15, and MID-MIN > MAX-MID, then calculate composite for MID+MAX and report MIN as divergent (Cheramie Rule A), OR	Because the difference between the highest and lowest scores entered is greater than or equal to 1SD, this set of scores is **not considered cohesive**, indicating that a composite based on all three scores is unlikely to provide a good summary of the ability it is intended to represent. Instead the ***two highest scores form a cohesive composite*** that may be interpreted meaningfully and the lowest value is a divergent score.
If the difference between MIN and MAX is > 14, and MID-MIN is < 15 and MAX-MID > 14, then calculate composite for MIN+MID and report MAX as divergent, OR If the difference between MIN and MAX is > 14, and MID-MIN is < 15, and MAX-MID is <15, and MID-MIN < MAX-MID, then calculate composite for MID+MIN and report MAX as divergent (Cheramie Rule B).	Because the difference between the highest and lowest scores entered was greater than or equal to 1SD, this set of scores is **not considered cohesive**, indicating that a composite based on all three scores is unlikely to provide a good summary of the ability it is intended to represent. Instead the ***two lowest scores form a cohesive composite*** that may be interpreted meaningfully and the highest value is a divergent score.

Rule 1

Three-Subtest XBA Composites: Rules for Cohesion



Difference between Highest and Lowest scores is less than 1SD, composite is calculated on the XBA Tab

Interpretation of Composites Based on Three Subtests Entered or Transferred to the XBA Analyzer Tab of X-BASS (Chapter 3; Flanagan et al., 2013)

Rule 2

Rule for Calculating a Composite	Interpretation of Three-Subtest Configuration
If the difference between MIN and MAX is < 15, then composite is calculated based on all scores, OR	The difference between the highest and lowest scores that comprise the composite is < 1SD and, therefore, the composite is considered **cohesive**. The composite is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure.
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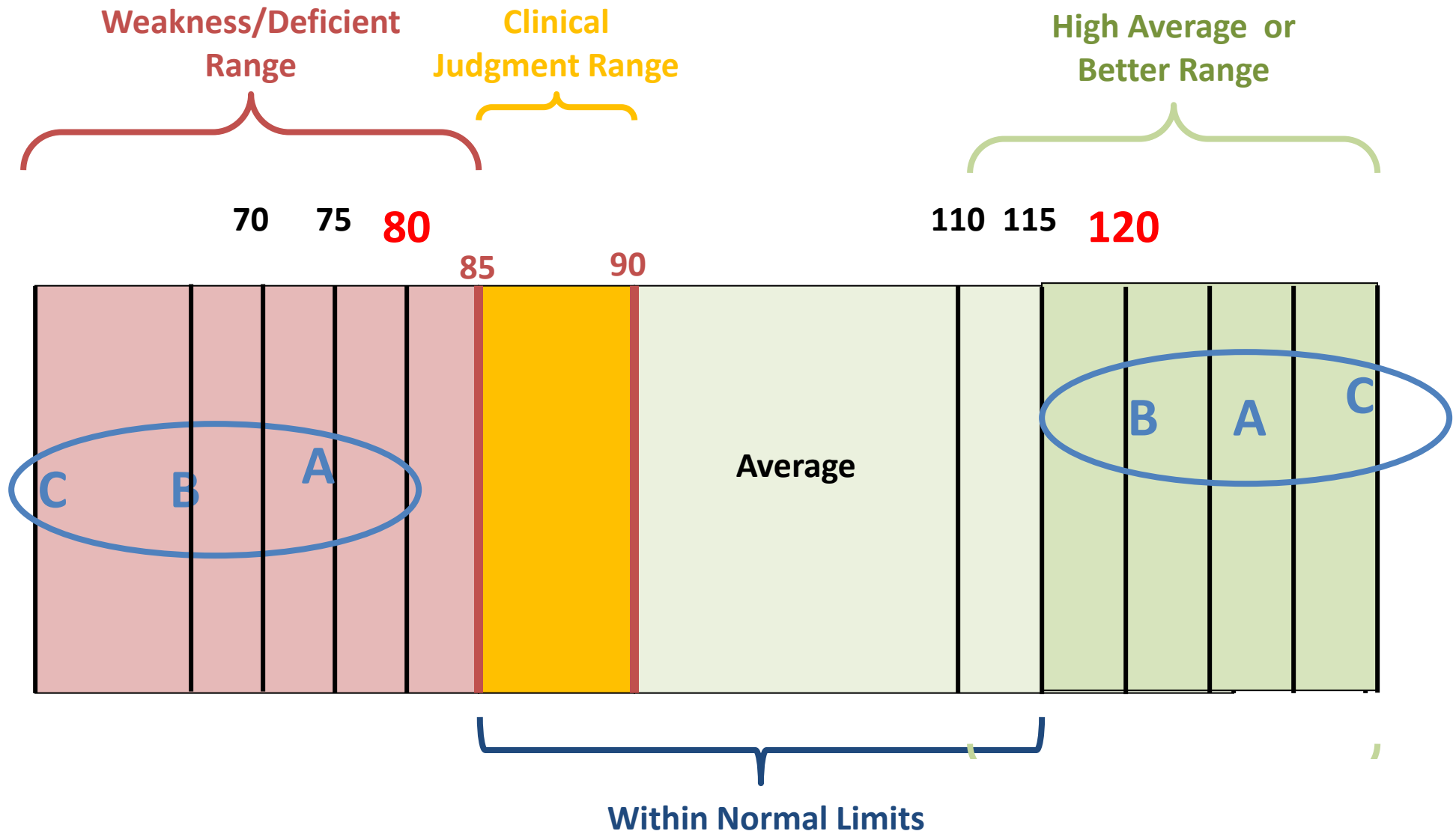
If all three scores are >120 and the difference between any two of them is >14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, all scores are greater than 119 and represent normative strengths. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If the difference between MAX and MID is > 14 and the difference between MIN and MID is > 14, then no composite is calculated, OR	All scores that comprise the composite differ from one another by at least 1SD. Therefore, the composite is **not considered cohesive**. As such, the composite is not likely to be a good summary of the theoretically related abilities it is intended to represent.
If the difference between MIN and MAX is > 14, and the difference between MAX-MID and MID-MIN is equal (and < 15), then calculate composite for MID+MAX and report MIN as divergent (Chaplin Rule), OR **If the difference between MIN and MAX is > 14, and MID-MIN > 14 and MAX-MID is < 15, then calculate composite for MID+MAX and report MIN as divergent OR** **If the difference between MIN and MAX is > 14, and MID-MIN is < 15, and MAX-MID is <15, and MID-MIN > MAX-MID, then calculate composite for MID+MAX and report MIN as divergent (Cheramie Rule A), OR**	Because the difference between the highest and lowest scores entered is greater than or equal to 1SD, this set of scores is **not considered cohesive**, indicating that a composite based on all three scores is unlikely to provide a good summary of the ability it is intended to represent. Instead the ***two highest scores form a cohesive composite*** that may be interpreted meaningfully and the lowest value is a divergent score.
If the difference between MIN and MAX is > 14, and MID-MIN is < 15 and MAX-MID > 14, then calculate composite for MIN+MID and report MAX as divergent, OR **If the difference between MIN and MAX is > 14, and MID-MIN is < 15, and MAX-MID is <15, and MID-MIN < MAX-MID, then calculate composite for MID+MIN and report MAX as divergent (Cheramie Rule B).**	Because the difference between the highest and lowest scores entered was greater than or equal to 1SD, this set of scores is **not considered cohesive**, indicating that a composite based on all three scores is unlikely to provide a good summary of the ability it is intended to represent. Instead the ***two lowest scores form a cohesive composite*** that may be interpreted meaningfully and the highest value is a divergent score.

Rule 2

Three-Subtest XBA Composites: Rules for Cohesion



All scores less than 80 or greater than 120, composite is calculated, regardless of score differences

Interpretation of Composites Based on Three Subtests Entered or Transferred to the XBA Analyzer Tab of X-BASS (Chapter 3; Flanagan et al., 2013)

Rule 3

Rule for Calculating a Composite	Interpretation of Three-Subtest Configuration
If the difference between MIN and MAX is < 15, then composite is calculated based on all scores, OR	The difference between the highest and lowest scores that comprise the composite is < 1SD and, therefore, the composite is considered **cohesive**. The composite is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure.
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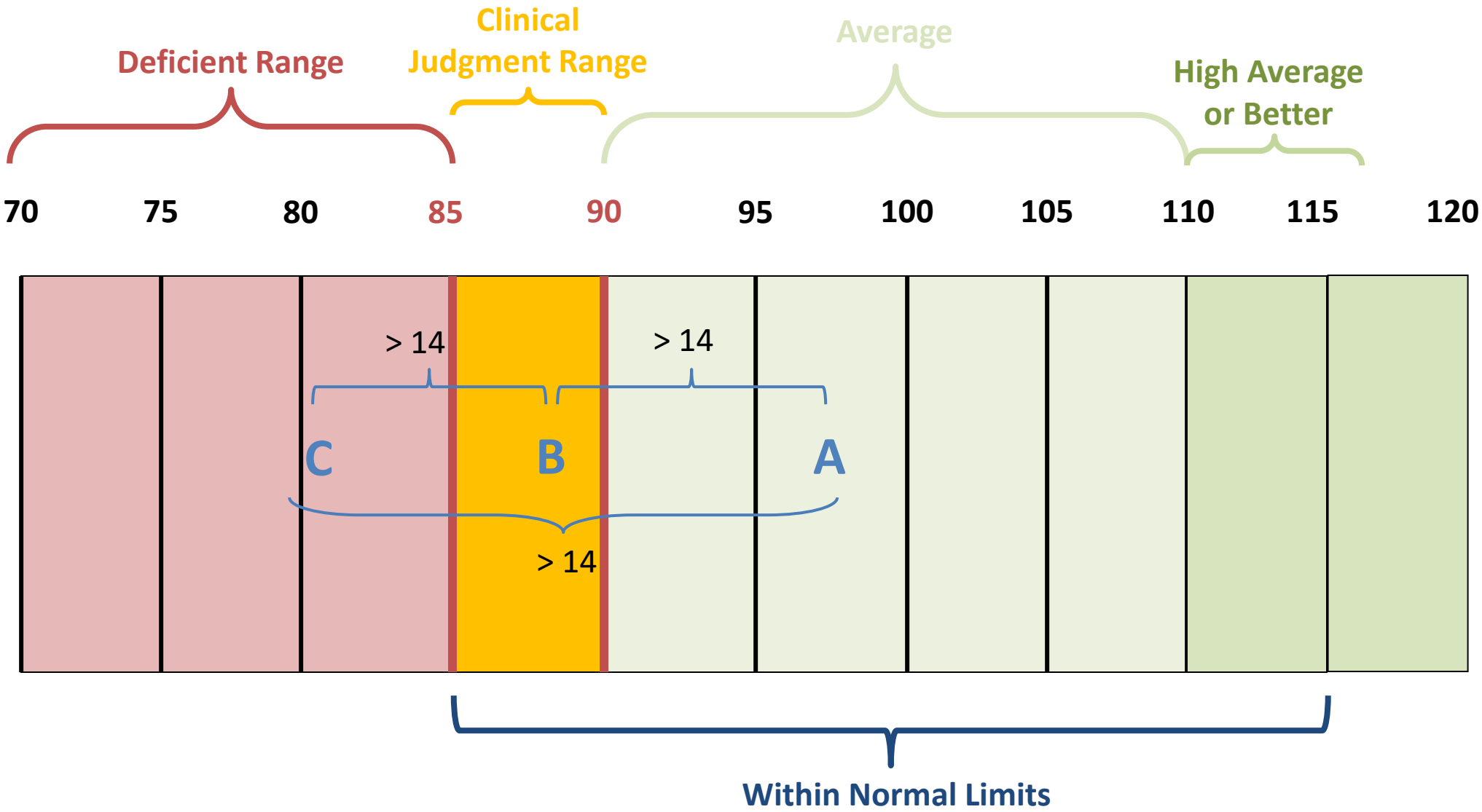
If all three scores are >119 and the difference between any two of them is >14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, all scores are greater than 119 and represent normative strengths. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If the difference between MAX and MID is > 14 and the difference between MIN and MID is > 14, then no composite is calculated, OR	All scores that comprise the composite differ from one another by at least 1SD. Therefore, the composite is **not considered cohesive**. As such, the composite is not likely to be a good summary of the theoretically related abilities it is intended to represent.
If the difference between MIN and MAX is > 14, and the difference between MAX-MID and MID-MIN is equal (and < 15), then calculate composite for MID+MAX and report MIN as divergent (Chaplin Rule), OR If the difference between MIN and MAX is > 14, and MID-MIN > 14 and MAX-MID is < 15, then calculate composite for MID+MAX and report MIN as divergent OR If the difference between MIN and MAX is > 14, and MID-MIN is < 15, and MAX-MID is <15, and MID-MIN > MAX-MID, then calculate composite for MID+MAX and report MIN as divergent (Cheramie Rule A), OR	Because the difference between the highest and lowest scores entered is greater than or equal to 1SD, this set of scores is **not considered cohesive**, indicating that a composite based on all three scores is unlikely to provide a good summary of the ability it is intended to represent. Instead the ***two highest scores form a cohesive composite*** that may be interpreted meaningfully and the lowest value is a divergent score.
If the difference between MIN and MAX is > 14, and MID-MIN is < 15 and MAX-MID > 14, then calculate composite for MIN+MID and report MAX as divergent, OR If the difference between MIN and MAX is > 14, and MID-MIN is < 15, and MAX-MID is <15, and MID-MIN < MAX-MID, then calculate composite for MID+MIN and report MAX as divergent (Cheramie Rule B).	Because the difference between the highest and lowest scores entered was greater than or equal to 1SD, this set of scores is **not considered cohesive**, indicating that a composite based on all three scores is unlikely to provide a good summary of the ability it is intended to represent. Instead the ***two lowest scores form a cohesive composite*** that may be interpreted meaningfully and the highest value is a divergent score.

Rule 3

Three-Subtest XBA Composites: Rules for Cohesion



No Composite is Calculated

Interpretation of Composites Based on Three Subtests Entered or Transferred to the XBA Analyzer Tab of X-BASS (Chapter 3; Flanagan et al., 2013)

Rule for Calculating a Composite	Interpretation of Three-Subtest Configuration
If the difference between MIN and MAX is < 15, then composite is calculated based on all scores, OR	The difference between the highest and lowest scores that comprise the composite is < 1SD and, therefore, the composite is considered **cohesive**. The composite is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure.
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If all three scores are >119 and the difference between any two of them is >14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, all scores are greater than 119 and represent normative strengths. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
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If the difference between MIN and MAX is > 14, and MID-MIN is < 15 and MAX-MID > 14, then calculate composite for MIN+MID and report MAX as divergent, OR If the difference between MIN and MAX is > 14, and MID-MIN is < 15, and MAX-MID is <15, and MID-MIN < MAX-MID, then calculate composite for MID+MIN and report MAX as divergent (Cheramie Rule B).	Because the difference between the highest and lowest scores entered was greater than or equal to 1SD, this set of scores is **not considered cohesive**, indicating that a composite based on all three scores is unlikely to provide a good summary of the ability it is intended to represent. Instead the ***two lowest scores form a cohesive composite*** that may be interpreted meaningfully and the highest value is a divergent score.

Same outcome for each as demonstrated in the next three slides

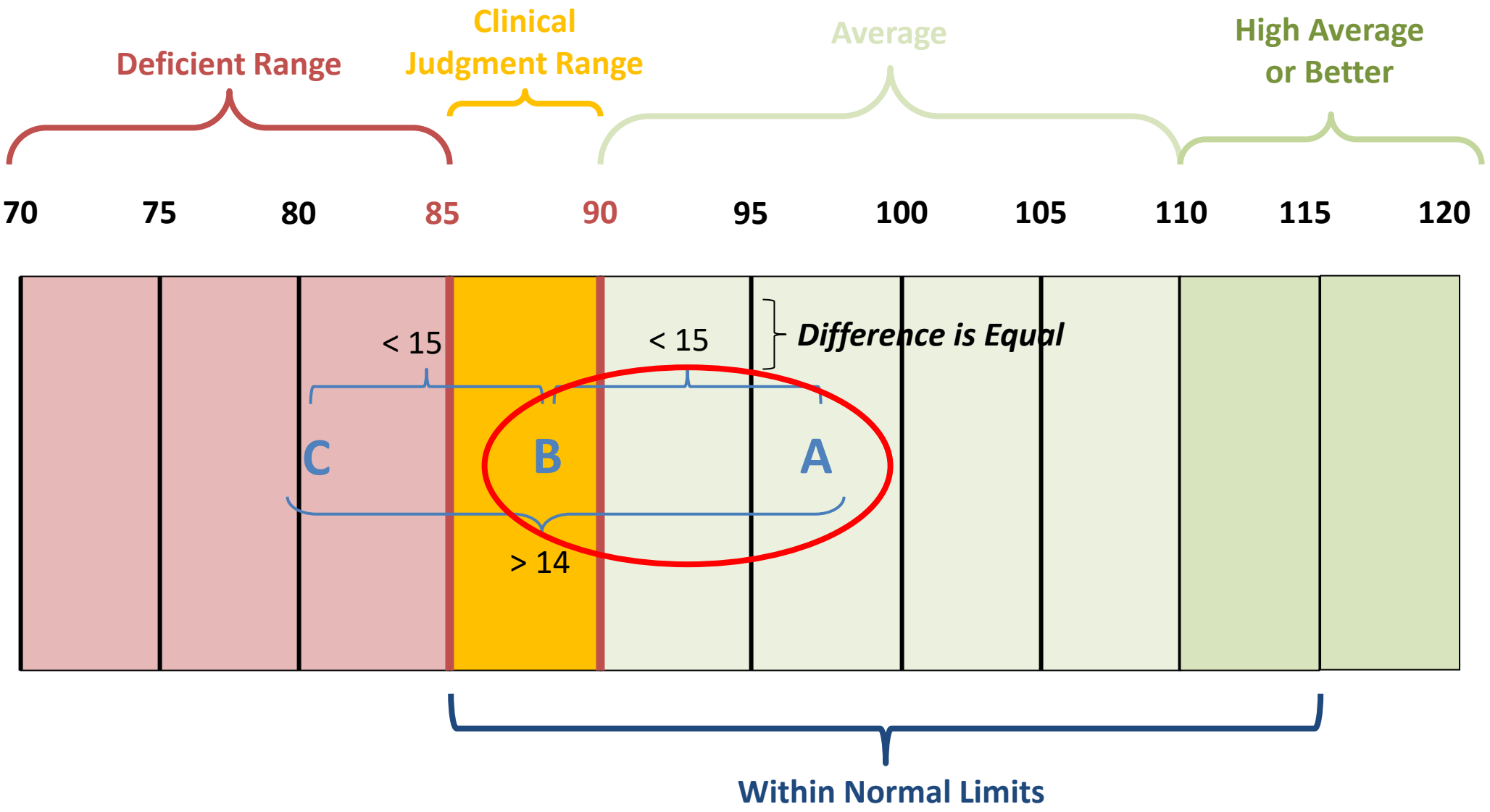
Rule 4a

Rule 4b

Rule 4c

Rule 4a

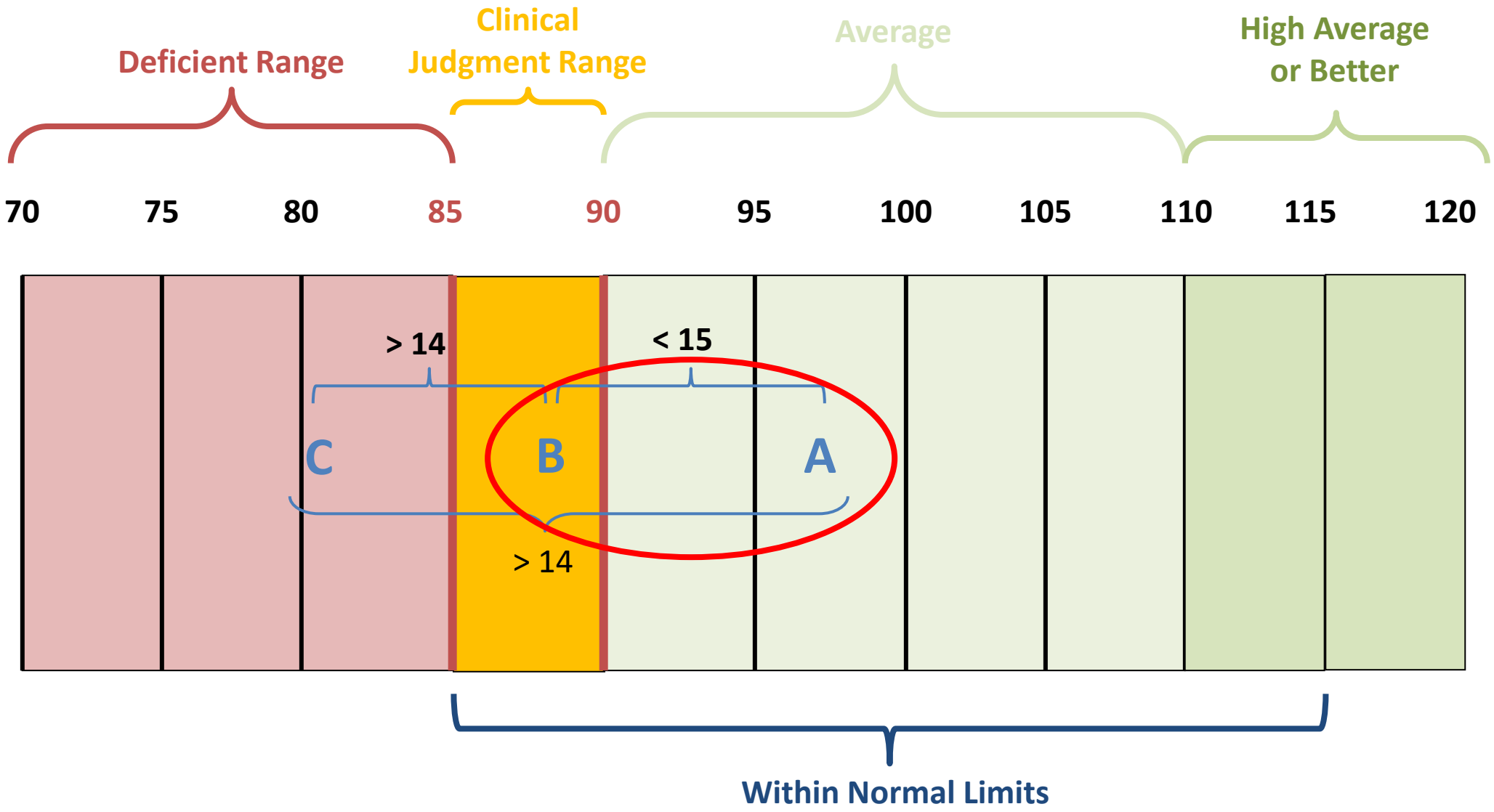
Three-Subtest XBA Composites: Rules for Cohesion



Composite based on two highest scores; Lowest score is divergent

Rule 4b

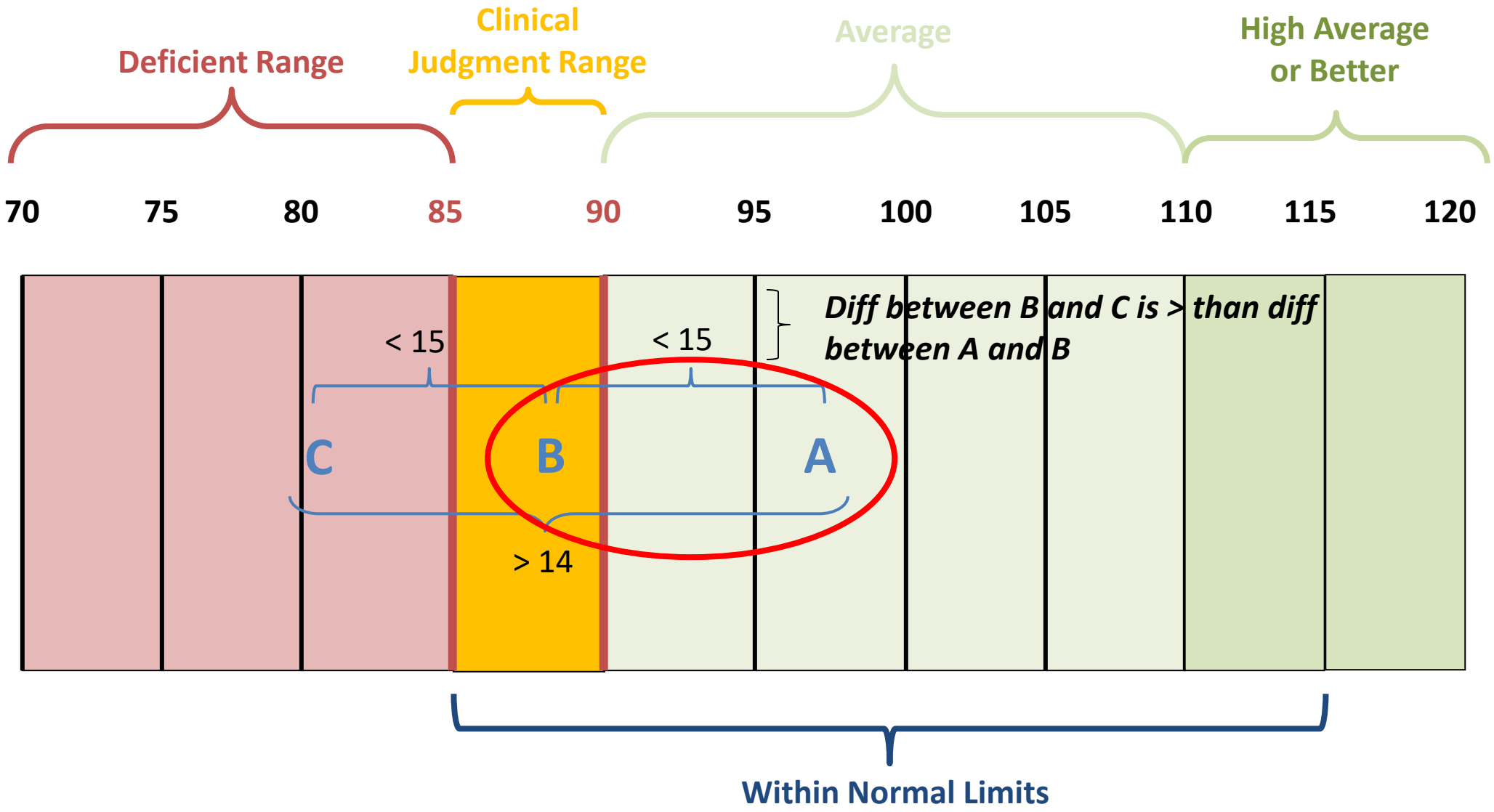
Three-Subtest XBA Composites: Rules for Cohesion



Composite based on two highest scores; Lowest score is divergent

Rule 4c

Three-Subtest XBA Composites: Rules for Cohesion



Composite based on two highest scores; Lowest score is divergent

Interpretation of Composites Based on Three Subtests Entered or Transferred to the XBA Analyzer Tab of X-BASS (Chapter 3; Flanagan et al., 2013)

Rule for Calculating a Composite	Interpretation of Three-Subtest Configuration
If the difference between MIN and MAX is < 15, then composite is calculated based on all scores, OR	The difference between the highest and lowest scores that comprise the composite is < 1SD and, therefore, the composite is considered **cohesive**. The composite is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure.
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If all three scores are >119 and the difference between any two of them is >14, then composite is calculated, OR	Although the difference between the scores is greater than or equal to 1SD, all scores are greater than 119 and represent normative strengths. Therefore, the composite is still considered **cohesive** and may be interpreted as an adequate estimate of the ability that it is intended to measure.
If the difference between MAX and MID is > 14 and the difference between MIN and MID is > 14, then no composite is calculated, OR	All scores that comprise the composite differ from one another by at least 1SD. Therefore, the composite is **not considered cohesive**. As such, the composite is not likely to be a good summary of the theoretically related abilities it is intended to represent.
If the difference between MIN and MAX is > 14, and the difference between MAX-MID and MID-MIN is equal (and < 15), then calculate composite for MID+MAX and report MIN as divergent (Chaplin Rule), OR If the difference between MIN and MAX is > 14, and MID-MIN > 14 and MAX-MID is < 15, then calculate composite for MID+MAX and report MIN as divergent OR If the difference between MIN and MAX is > 14, and MID-MIN is < 15, and MAX-MID is <15, and MID-MIN > MAX-MID, then calculate composite for MID+MAX and report MIN as divergent (Cheramie Rule A), OR	Because the difference between the highest and lowest scores entered is greater than or equal to 1SD, this set of scores is **not considered cohesive**, indicating that a composite based on all three scores is unlikely to provide a good summary of the ability it is intended to represent. Instead the ***two highest scores form a cohesive composite*** that may be interpreted meaningfully and the lowest value is a divergent score.
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If the difference between MIN and MAX is > 14, and MID-MIN is < 15, and MAX-MID is <15, and MID-MIN < MAX-MID, then calculate composite for MID+MIN and report MAX as divergent (Cheramie Rule B).	

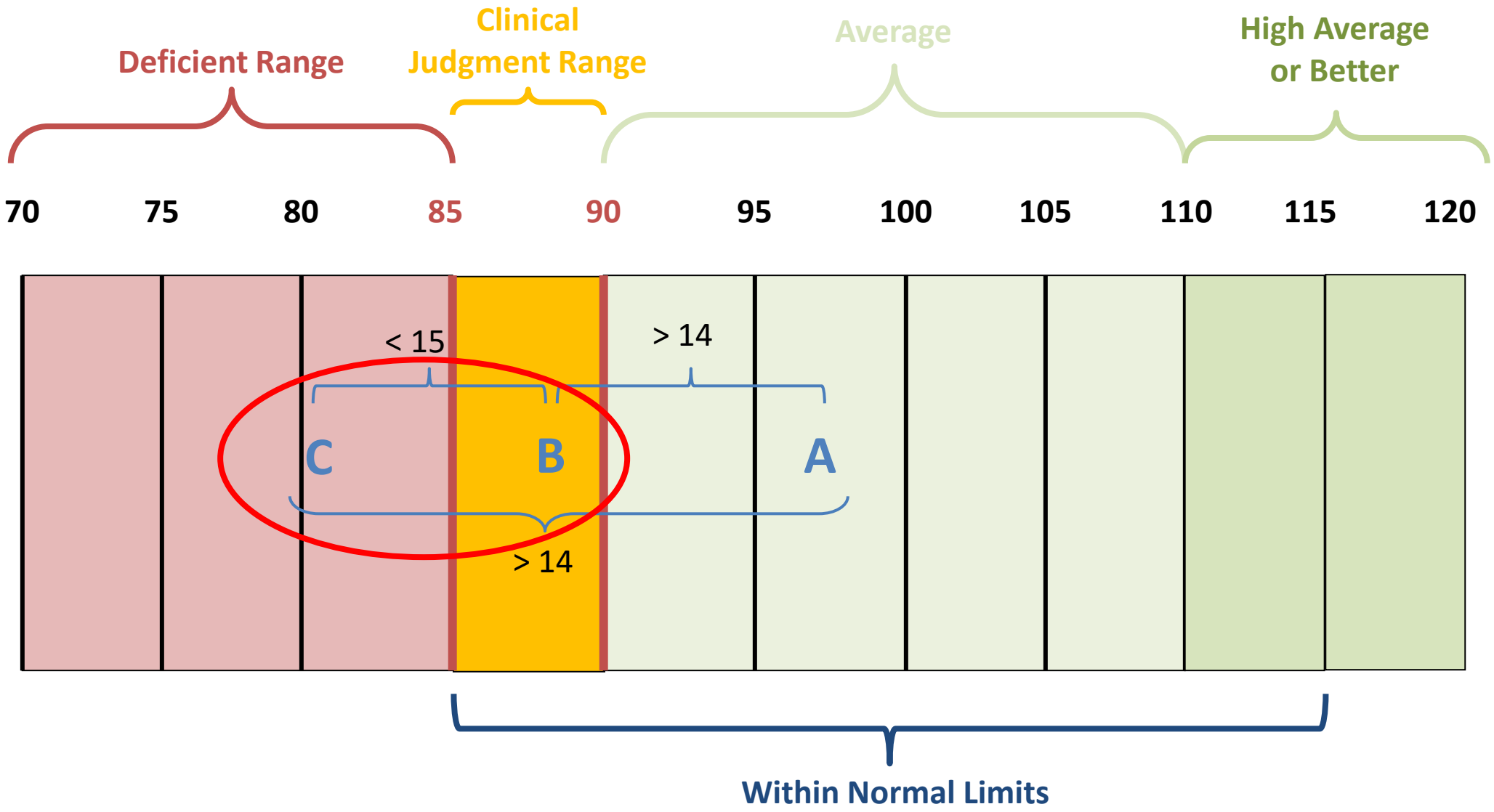
Same outcome for each as demonstrated in the next two slides

Rule 5a

Rule 5b

Rule 5a

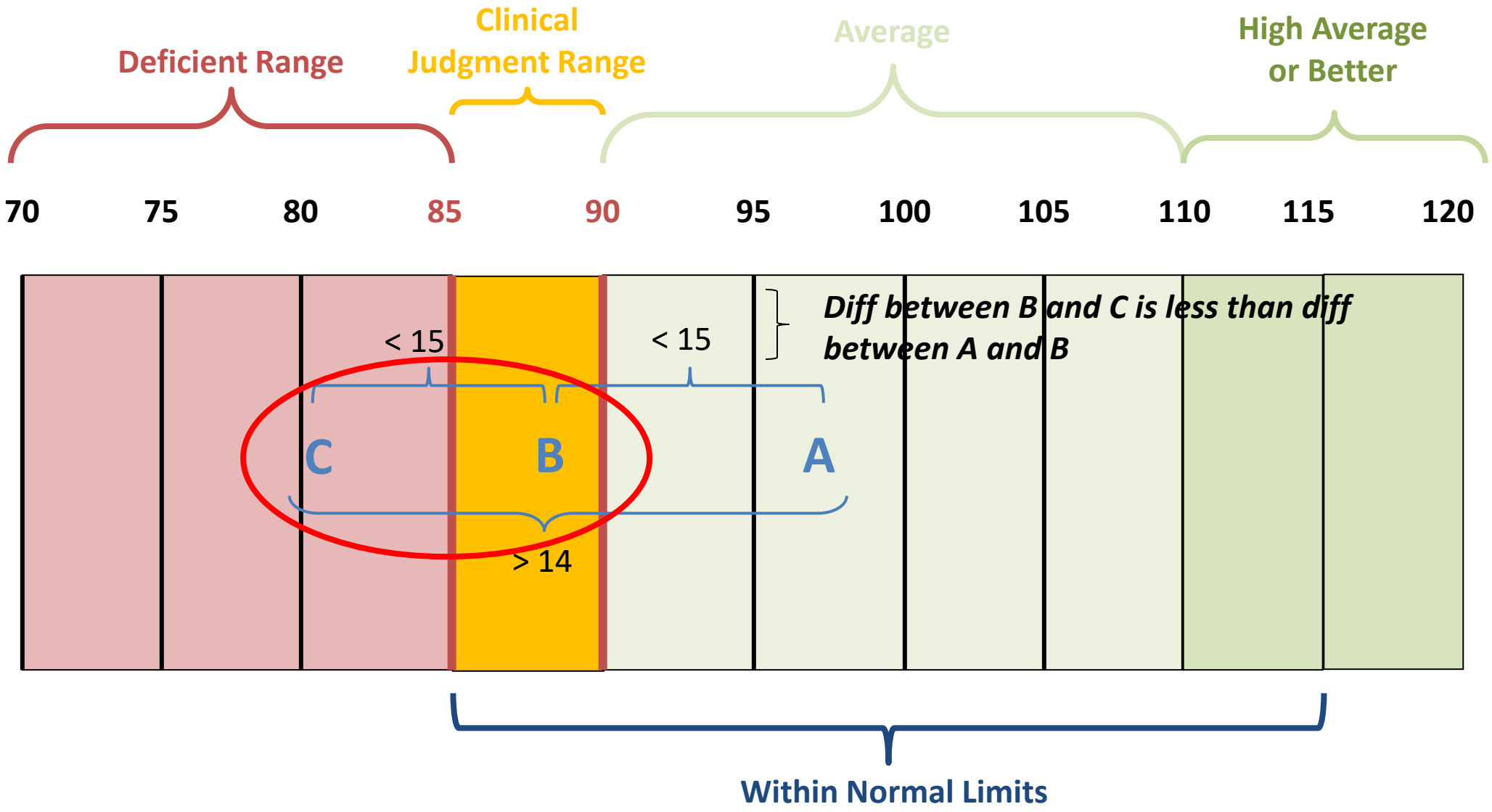
Three-Subtest XBA Composites: Rules for Cohesion



Composite based on two lowest scores; Highest score is divergent

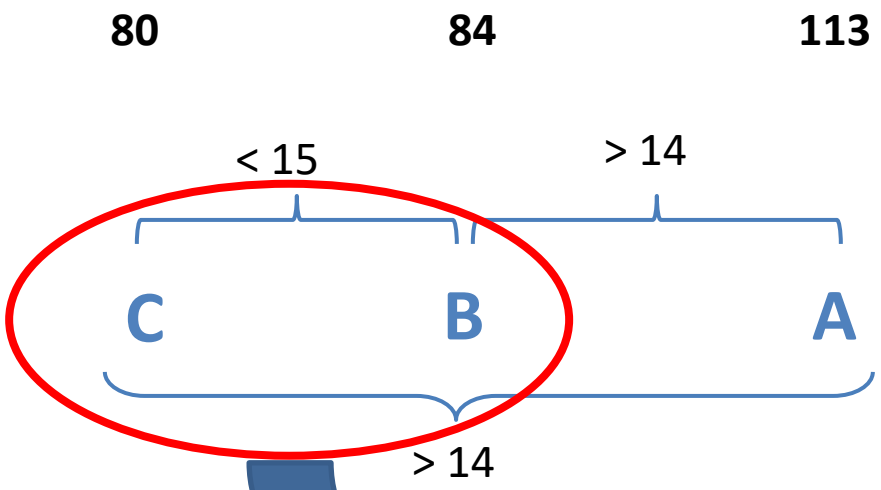
Rule 5b

Three-Subtest XBA Composites: Rules for Cohesion



Composite based on two lowest scores; Highest score is divergent

Our WJ IV and UNIT 2 Example Corresponds to Rule 5a



FLUID REASONING (*Gf*)
(check these boxes to select score for integrated graph)

Clear Data

		Enter scores	Converted Standard Score	Composite Score Analyses
WJ IV COG Number Series (Gf:RQ)	☐	84	84	A
WJ IV COG Concept Formation (Gf:I)	☐	113	113	divergent
UNIT2 Numerical Series (Gf:RQ)	☐	6	80	A
	☐			
			Comp ☐	☐

NOT COHESIVE: Use one, 2-subtest XBA composite

SS: 79

PR: 8th

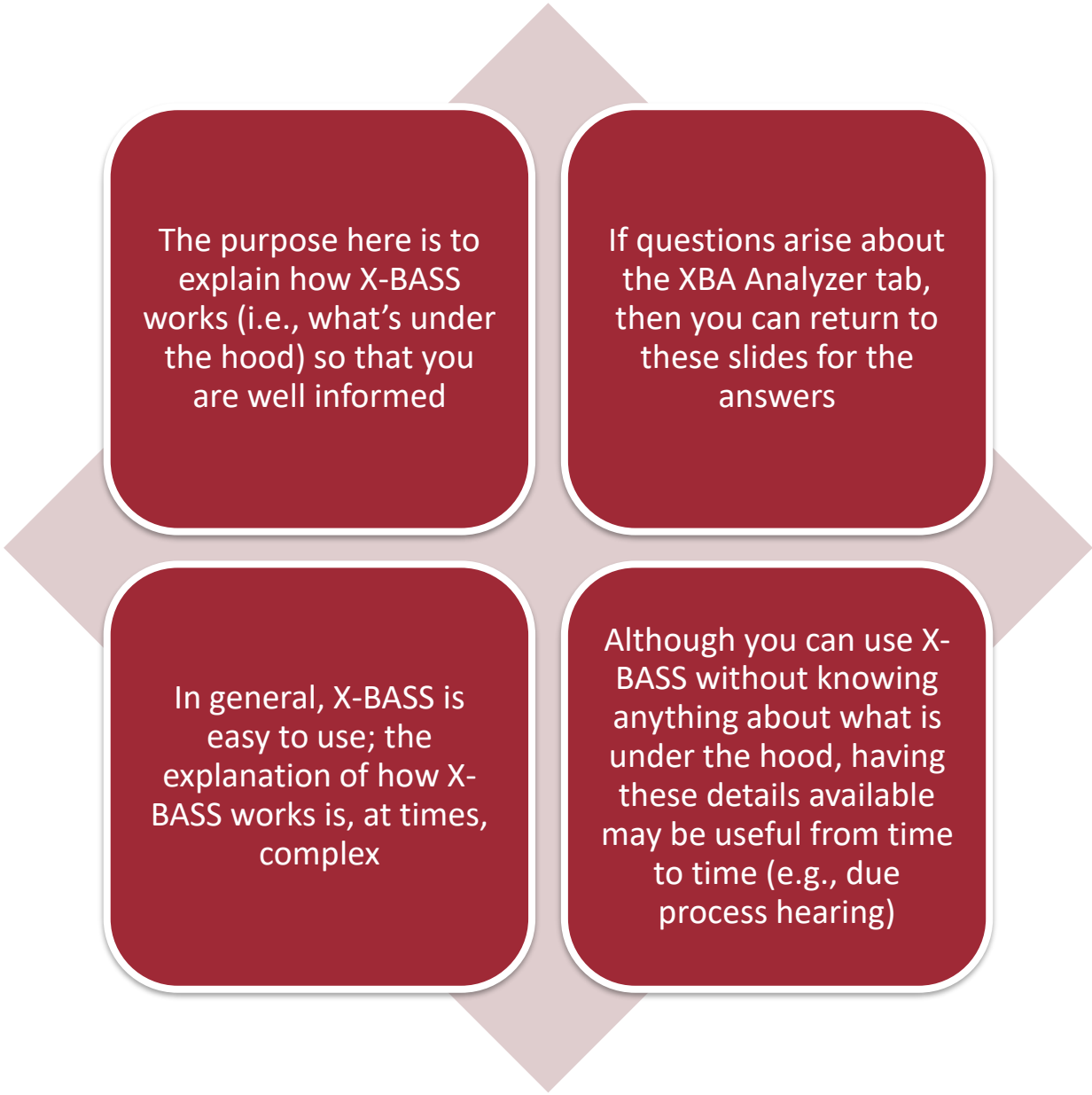
Reset Score Configuration | Evaluate Score Configuration

Go to Gf Test List Classifications | Transfer Comp(s) to Data Organizer

Score configuration and interpretation:

Because the difference between the highest and lowest scores entered is greater than or equ… , this set of scores is not cohesive, indicating that a composite based on all three scores is unlikely to provid… a summary of the ability it is intended to represent. Instead the two lowest scores form a cohesive com… hat may be interpreted meaningfully and the highest value is a divergent score.

REMINDER: ***There is No Need to Memorize All of the Ways in Which X-BASS Analyzes Data***



Examples of FOUR Scores Entered in Analyzer Tab

Cross-Battery Assessment

Rapid Reference 3.7

Calculation and Interpretation of Composites When Four Subtests Are Entered or Transferred to the XBA Analyzer Tab in X-BASS

Rule for Calculating a Composite	Interpretation of Four-Subtest Configuration
If the difference between MAX and MIN is <21, composite is calculated based on all scores (4 subtest composite), OR	The difference between the highest and lowest scores that comprise the composite is less than or equal to 1 1/3 *SD*, therefore, the composite is **cohesive**. The composite is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure.
If all four scores are <80 and the difference between MAX and MIN is >20, composite is calculated for all four scores (4 subtest composite), OR	Although the difference between the highest and lowest scores is greater than or equal to 1 1/3 *SD*, all four scores are less than 80 and represent normative weaknesses or deficits.

Source: *Essentials of Cross-Battery Assessment*, 3e (Flanagan, Ortiz, & Alfonso, 2013)

When **Four Scores** Are Entered into a Domain in the XBA Analyzer Tab

- **There are six possible outcomes**
  - Composite based on all four scores
  - Two, two-subtest composites
  - One, two-subtest composite and two divergent scores
  - One, three-subtest composite and highest score divergent
  - One, three-subtest composite and lowest score divergent
  - No composite is calculated

Purpose of the XBA Analyzer Tab

- Evaluate a set of scores to determine the best way to organize, report, and interpret them
  - Scores may come from different batteries, allowing for cross-battery composites to be calculated
  - **Scores may come from the same battery, allowing for within-battery composites to be calculated (when actual norms from the test publisher are not available)**
    - **A WISC-V Example**

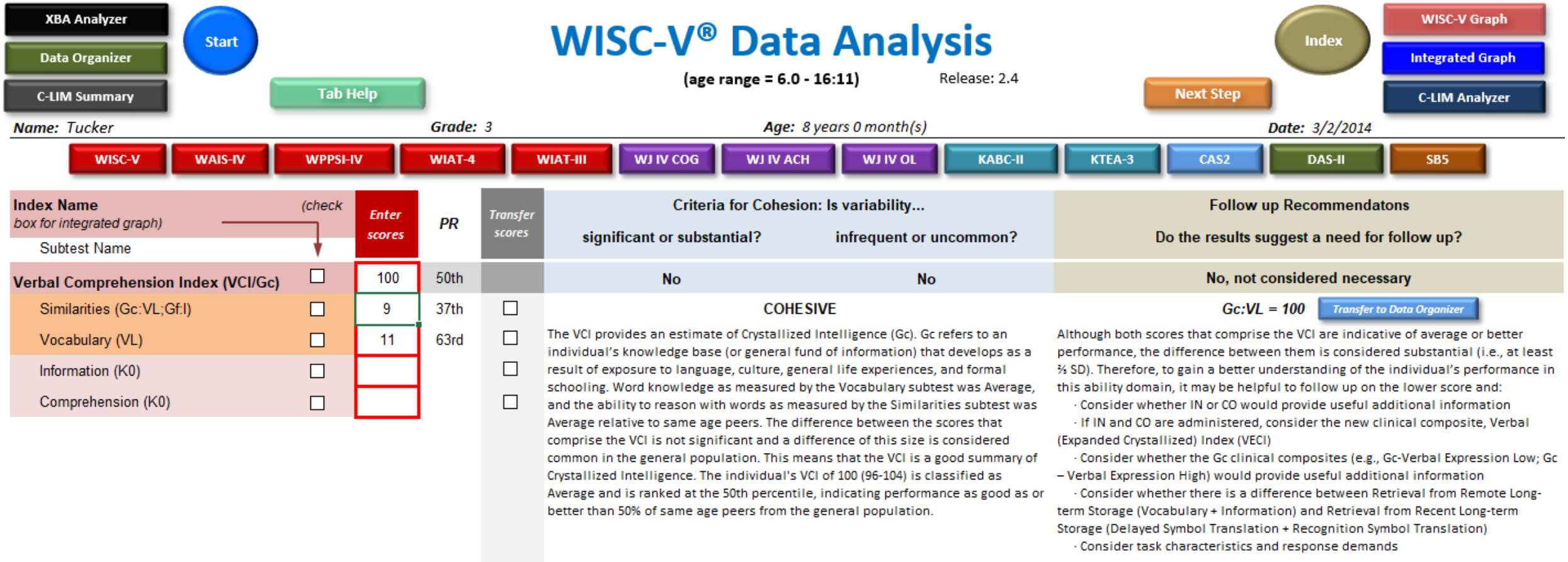
- Evaluate Whether Composites From Other Batteries Are Cohesive
  - Batteries other than the cognitive and achievement batteries that have their own tabs in X-BASS

Transfer scores from individual test tabs to XBA Analyzer when

- *you need to follow up on a low score (by administering a subtest from another battery)*
- *you want to create a composite for which the publisher does not provide norms*

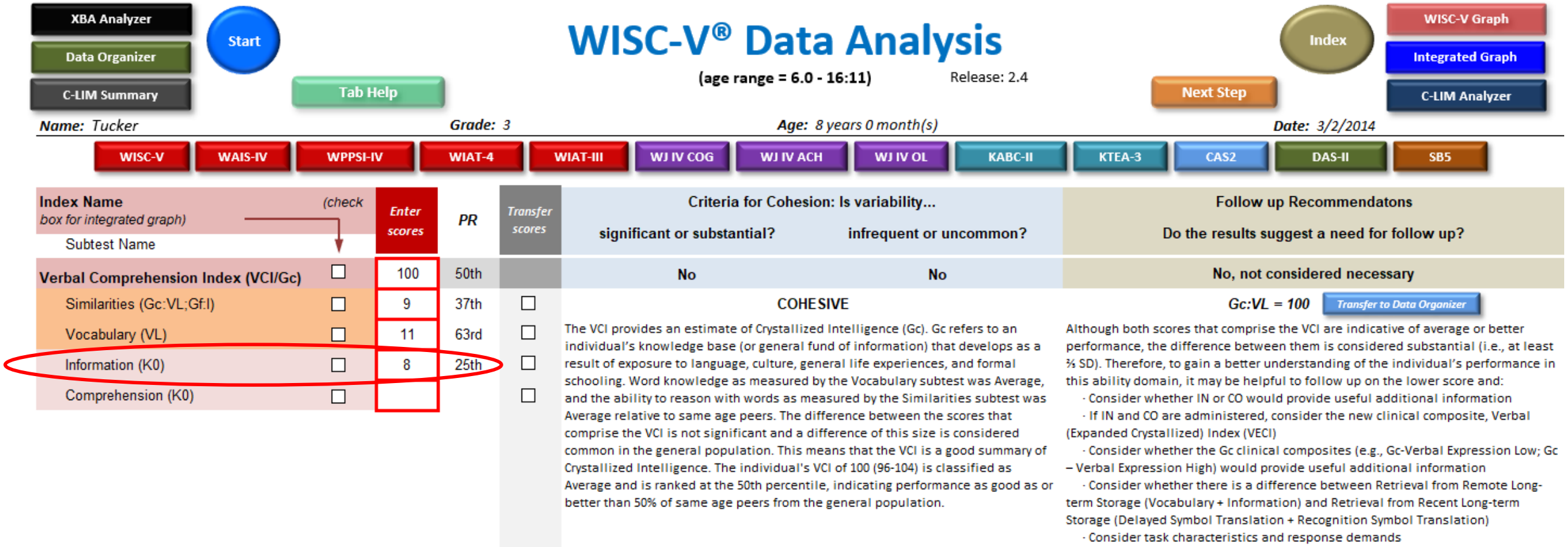
Create Within-Battery Test Composite on XBA Analyzer Tab

- Most WISC-V users will administer Similarities and Vocabulary to obtain the Verbal Comprehension Index (VCI)
- The VCI provides an estimate of mainly Vocabulary Knowledge (VL)



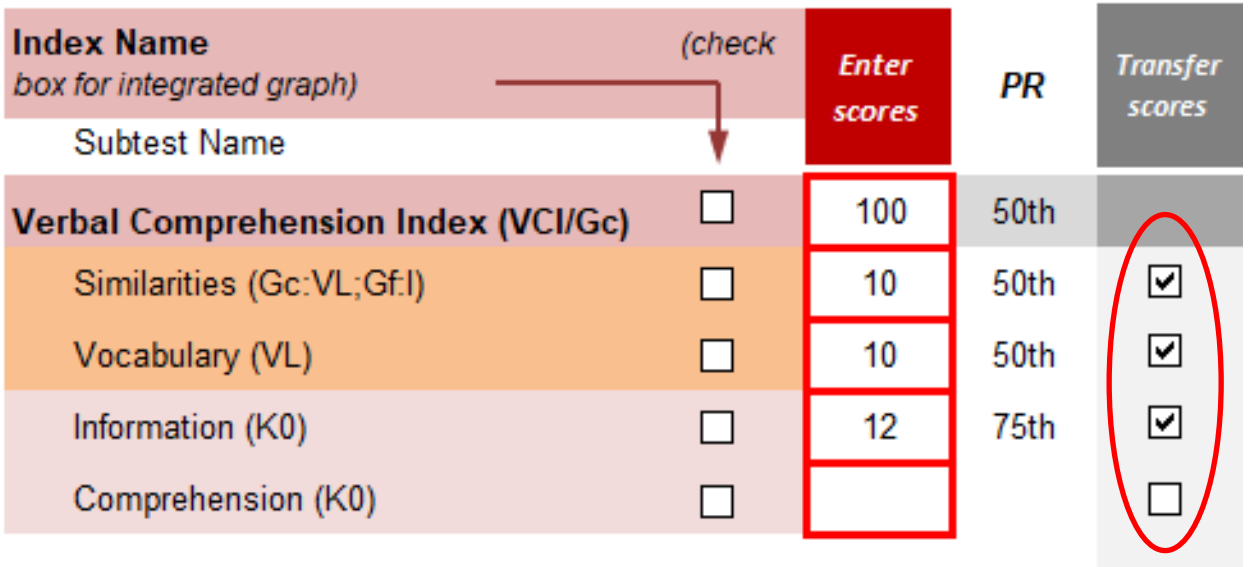
Create Within-Battery Test Composite on XBA Analyzer Tab

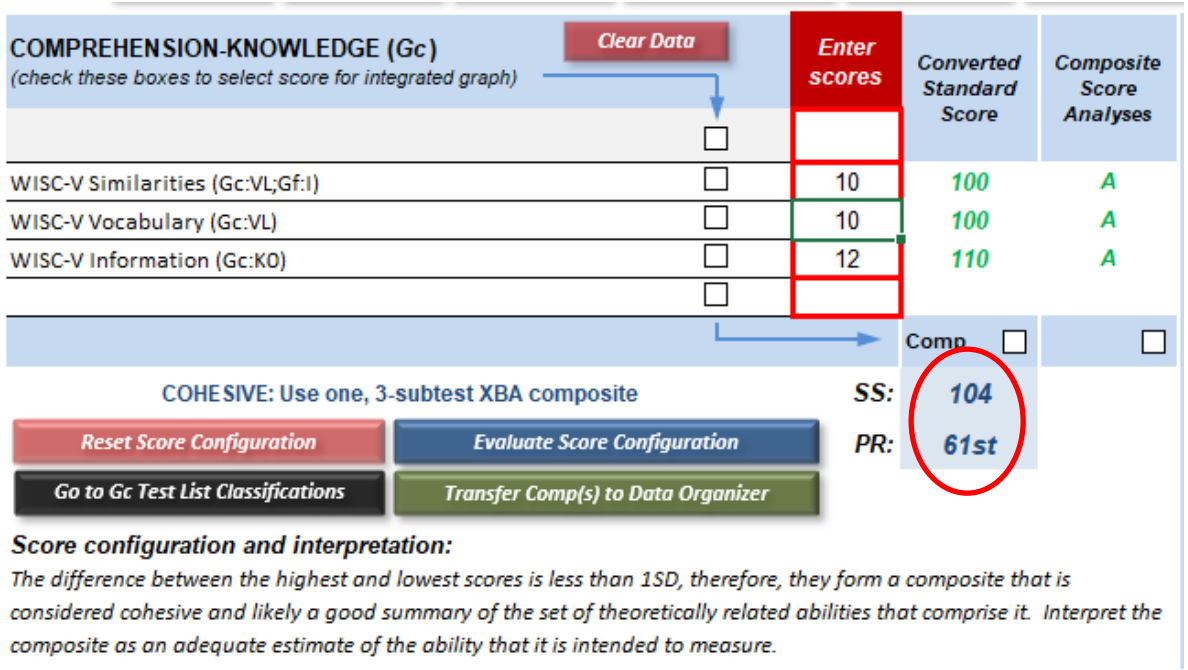
- To broaden the estimate of Comprehension Knowledge (Gc)
  - Either the Information or Comprehension subtest can be administered
  - In this example, the Information subtest was administered
  - ***Neither the WISC-V manual nor external resources provide a norm-based composite for these three subtest scores***



Create Within-Battery Test Composite on XBA Analyzer Tab

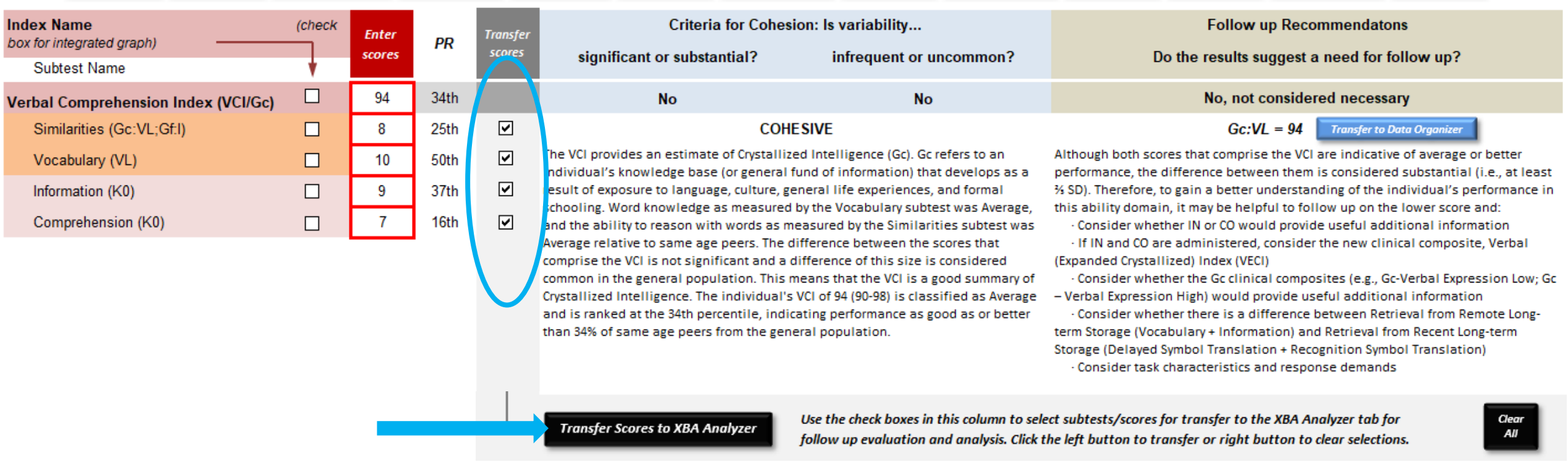
- To create a three-subtest Comprehension Knowledge (Gc) Composite, comprised of at least two-qualitatively different indicators of Gc (i.e., VL and K0):
  - Check boxes to the right of the subtest scores
  - Transfer the scores to the XBA Analyzer tab
  - Best estimate of Gc is 104



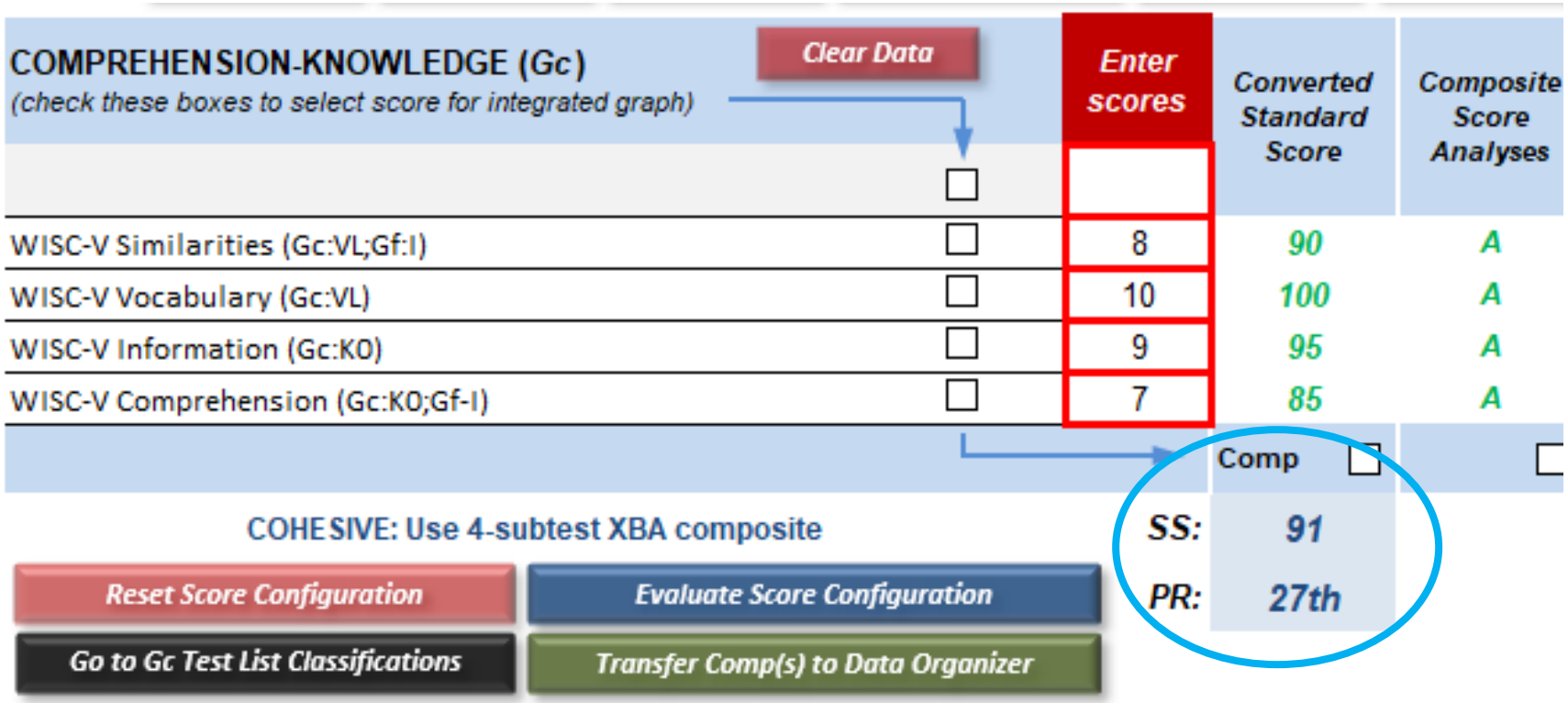


What if I Wanted A Four-Subtest Gc Composite?

I could check the four boxes next to the four Gc subtests and transfer them to the XBA Analyzer Tab



XBA Analyzer Tab Automatically Calculated a Four-Subtest Gc Composite



COMPREHENSION-KNOWLEDGE (Gc) *(check these boxes to select score for integrated graph)*	Clear Data	Enter scores	Converted Standard Score	Composite Score Analyses
WISC-V Similarities (Gc:VL;Gf:I)	☐	8	90	A
WISC-V Vocabulary (Gc:VL)	☐	10	100	A
WISC-V Information (Gc:K0)	☐	9	95	A
WISC-V Comprehension (Gc:K0;Gf-I)	☐	7	85	A
			Comp ☐	☐

COHESIVE: Use 4-subtest XBA composite

SS: 91

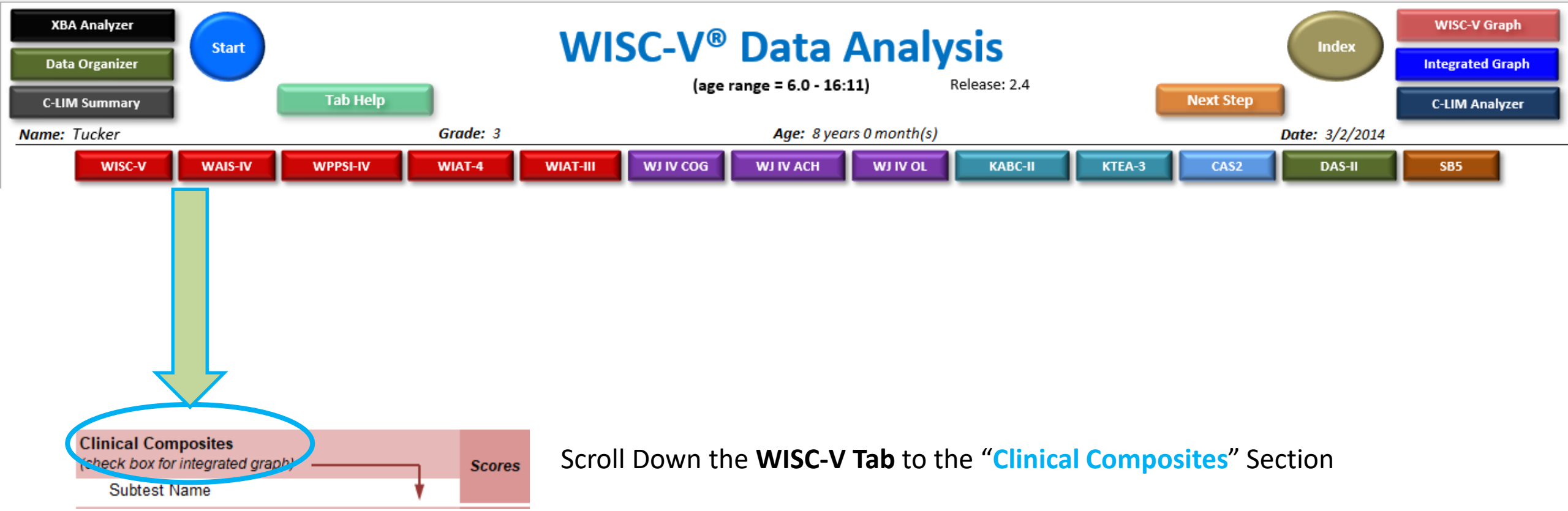
PR: 27th

Reset Score Configuration | Evaluate Score Configuration

Go to Gc Test List Classifications | Transfer Comp(s) to Data Organizer

Score configuration and interpretation:

The difference between the highest and lowest scores is less than or equal to 1 and 1/3 SD and, therefore, they form a composite that is considered cohesive and likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure. If, however, there are reasons to consider an alternative configuration based on additional data, clinical significance, narrow abilities measured, etc., click the "Evaluate Score Configuration" button.

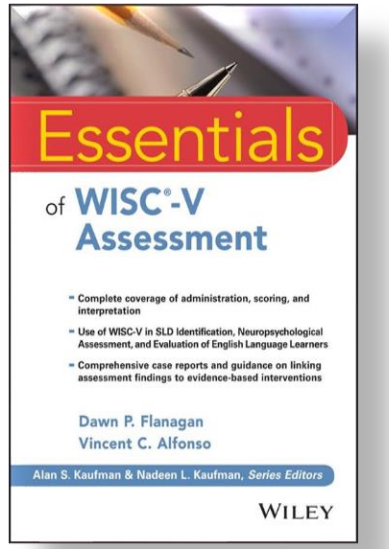


Scroll Down the **WISC-V Tab** to the "**Clinical Composites**" Section

10 Clinical Composites are Calculated Automatically If Scores Are Entered That Make Up Those Composites

Summary of Clinical Composites on WISC-V Tab

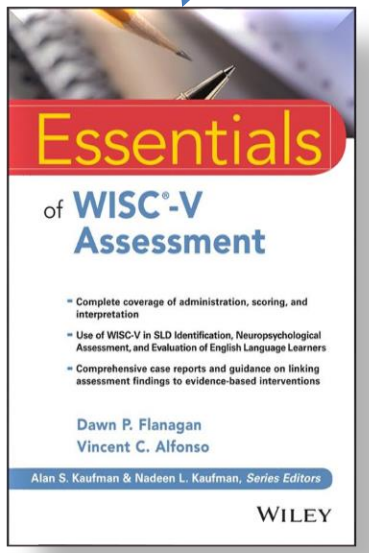
Clinical Composite	Subtest Composition	Brief Description
Gc (Verbal Expression – Low) **Gc-VE/L**	Vocabulary + Information	These two subtests form a broad Gc ability and require less verbal expression compared to the other Gc subtests (e.g., one or two word responses as compared to multi-word responses or sentences). An alternative label for this composite is Retrieval from Remote Long-term Storage (RFLT-Remote), which provides an estimate of an individual's ability to retrieve information from long-term storage that was encoded weeks, months, or years ago.
Gc (Verbal Expression – High) **Gc-VE/H**	Similarities + Comprehension	These two subtests require greater verbal expression to earn maximum credit compared to the other Gc subtests and typically involve some degree of reasoning ability.
Fluid-Crystallized **Gf-Gc**	Vocabulary + Information + Matrix Reasoning + Figure Weights	Provides an alternative to the FSIQ and GAI. Balances Gf and Gc about equally. Contains only subtests with high *g* loadings. Because Gf and Gc are highly correlated with *g* and are considered to be the cornerstones of general intelligence, research supports use of a Gf-Gc composite as an estimate of general ability (e.g., McGrew, LaForte, & Schrank, 2014).
Working Memory (Alternative) **Gsm-MW (Alt)**	Digit Span Backwards + Digit Span Sequencing + Letter-Number Sequencing	Provides an alternative to the Auditory Working Memory Index (AWMI) by eliminating Digit Span Forward (a test of memory span).
Memory Span-Working Memory **Gsm-MS,MW**	Digit Span Forward + Digit Span Backward	Provides a balance of Memory Span and Working Memory and is consistent with the composition of the Digit Span subtest on the WISC-IV.
Working Memory (Cognitive Complexity – High)	Arithmetic + Picture Span	Provides an estimate of working memory with tests that are more cognitively complex than Digit Span. Arithmetic involves Gf (i.e., Quantitative Reasoning), Gc, and Gsm (Working Memory Capacity). Picture Span

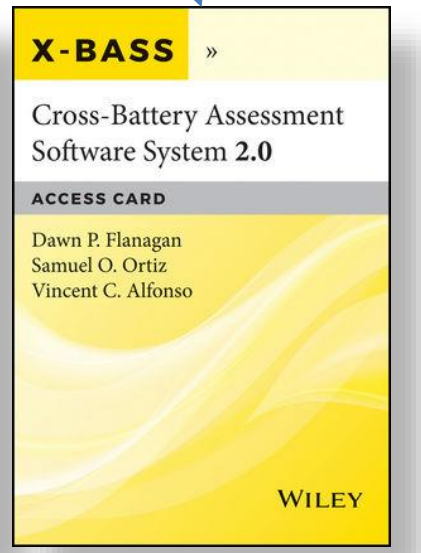


Summary of Clinical Composites on WISC-V Tab

WM-CC/H		involves Gv (Visual Memory), Memory Span, and Working Memory due to proactive interference.
Verbal (Expanded Crystallized) Index VECI*	Similarities + Vocabulary + Information + Comprehension	Provides a robust estimate of Gc as compared to the Verbal Comprehension Index (VCI), spanning two narrow ability domains (VL – Lexical Knowledge and K0 – General Information). Requires reasoning with verbal information. Involves tests that have low to high demands for verbal expression.
Expanded Fluid Index EFI*	Matrix Reasoning + Figure Weights + Picture Concepts + Arithmetic	Provides a more robust estimate of Gf as compared to the Fluid Reasoning Index (FRI), spanning three narrow ability domains, including Induction (I), General Sequential Reasoning (RG), and Quantitative Reasoning (RQ). Places more emphasis on quantitative reasoning as compared to FRI.
Perceptual Speed Gs-P**	Symbol Search + Cancellation	Provides an alternative to the PSI, eliminating the memory and motor dexterity demands inherent mainly in the Coding subtest.
Retrieval From Recent Long-Term Storage RFLT-Recent	Delayed Symbol Translation + Recognition Symbol Translation	Provides an estimate of an individual's ability to retrieve recently encoded information from long-term storage.

Actual Norms Available Here





XBA Analyzer | Data Organizer | C-LIM Summary | Start | Tab Help

WISC-V® Data Analysis

(age range = 6.0 - 16:11) Release: 2.4

Index | WISC-V Graph | Integrated Graph | C-LIM Analyzer | Next Step

Name: Tucker *Grade:* 3 *Age:* 8 years 0 month(s) *Date:* 3/2/2014

WISC-V | WAIS-IV | WPPSI-IV | WIAT-4 | WIAT-III | WJ IV COG | WJ IV ACH | WJ IV OL | KABC-II | KTEA-3 | CAS2 | DAS-II | SB5

Index Name (check box for integrated graph) / Subtest Name		Enter scores	PR	Transfer scores
Verbal Comprehension Index (VCI/Gc)	☐	94	34th	
Similarities (Gc:VL;Gf:I)	☐	8	25th	☐
Vocabulary (VL)	☐	10	50th	
Information (K0)	☐	9	37th	
Comprehension (K0)	☐	7	16th	☐

When Scores are Entered in the VCI Section, They automatically populate in the Clinical Composites Section

Clinical Composites (check box for integrated graph) / Subtest Name		Scores
Verbal-Expanded Cryst. Index (VECI)	☐	91
Similarities (Gc:VL;Gf:I)	☐	8
Vocabulary (VL)	☐	10
Information (K0)	☐	9
Comprehension (K0)	☐	7

Verbal-Expanded Cryst. Index (VECI)	☐	91	27th	
Similarities (Gc:VL;Gf:I)	☐	8	25th	
Vocabulary (VL)	☐	10	50th	
Information (K0)	☐	9	37th	☐
Comprehension (K0)	☐	7	16th	☐

pplicable **No** **No, not considered necessary**

COHESIVE

Gc-VECI = 91 Transfer to Data Organizer

Because this composite is comprised of three or more subtests, it is not possible to calculate the value for statistical significance of the difference. However, base rate data are available to evaluate whether the difference between the highest and lowest subtests is unusually large and uncommon. The analysis indicates that the difference in this case, if any, occurs in more than 10% of the general population which makes it relatively common. This means that the composite is most likely cohesive and should be interpreted as a good summary of the theoretically related abilities it was intended to represent.

The composite score reported here is based on four or more subtests and cannot be fully or properly evaluated for follow up via this tab. If the composite has been determined to be cohesive, it is very likely that no follow up is necessary. If it was determined not to be cohesive or if cohesion could not be evaluated, the scores from the subtests that form the composite may be transferred over to the XBA Analyzer for additional analysis regarding the configuration and interpretation of the obtained scores.

Note that the XBA Analyzer Tab Produced the Exact Same Composite as Actual Norms

COMPREHENSION-KNOWLEDGE (Gc) (check these boxes to select score for integrated graph)		Enter scores	Converted Standard Score	Composite Score Analyses
	☐			
WISC-V Similarities (Gc:VL;Gf:I)	☐	8	90	A
WISC-V Vocabulary (Gc:VL)	☐	10	100	A
WISC-V Information (Gc:K0)	☐	9	95	A
WISC-V Comprehension (Gc:K0;Gf-I)	☐	7	85	A
			Comp ☐	☐

Clear Data

COHESIVE: Use 4-subtest XBA composite

SS: 91

PR: 27th

Reset Score Configuration | Evaluate Score Configuration

Go to Gc Test List Classifications | Transfer Comp(s) to Data Organizer

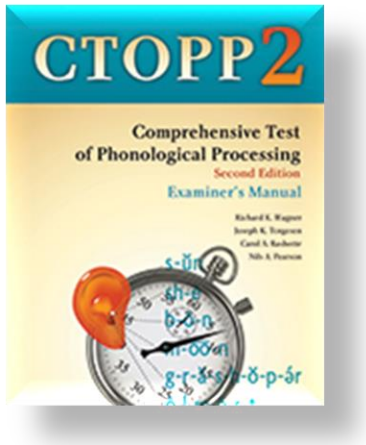
Score configuration and interpretation:

The difference between the highest and lowest scores is less than or equal to 1 and 1/3 SD and, therefore, they form a composite that is considered cohesive and likely a good summary of the set of theoretically related abilities that comprise it. Interpret the composite as an adequate estimate of the ability that it is intended to measure. If, however, there are reasons to consider an alternative configuration based on additional data, clinical significance, narrow abilities measured, etc., click the "Evaluate Score Configuration" button.

Verbal-Expanded Cryst. Index (VECI)	☐	91	27th
Similarities (Gc:VL;Gf:I)	☐	8	25th
Vocabulary (VL)	☐	10	50th
Information (K0)	☐	9	37th
Comprehension (K0)	☐	7	16th

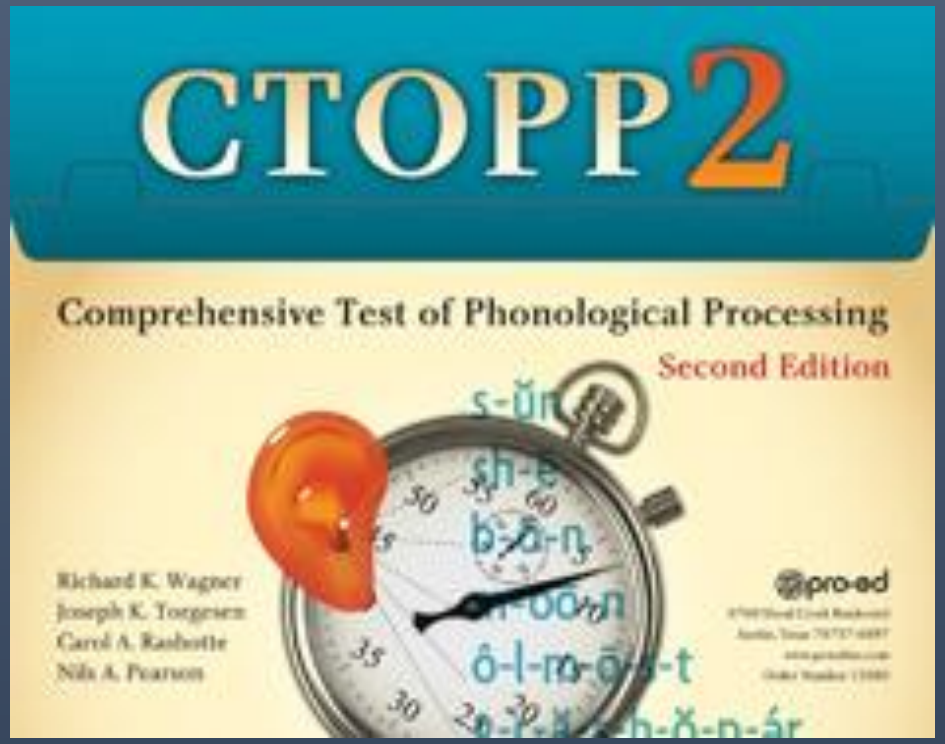
Purpose of the XBA Analyzer Tab

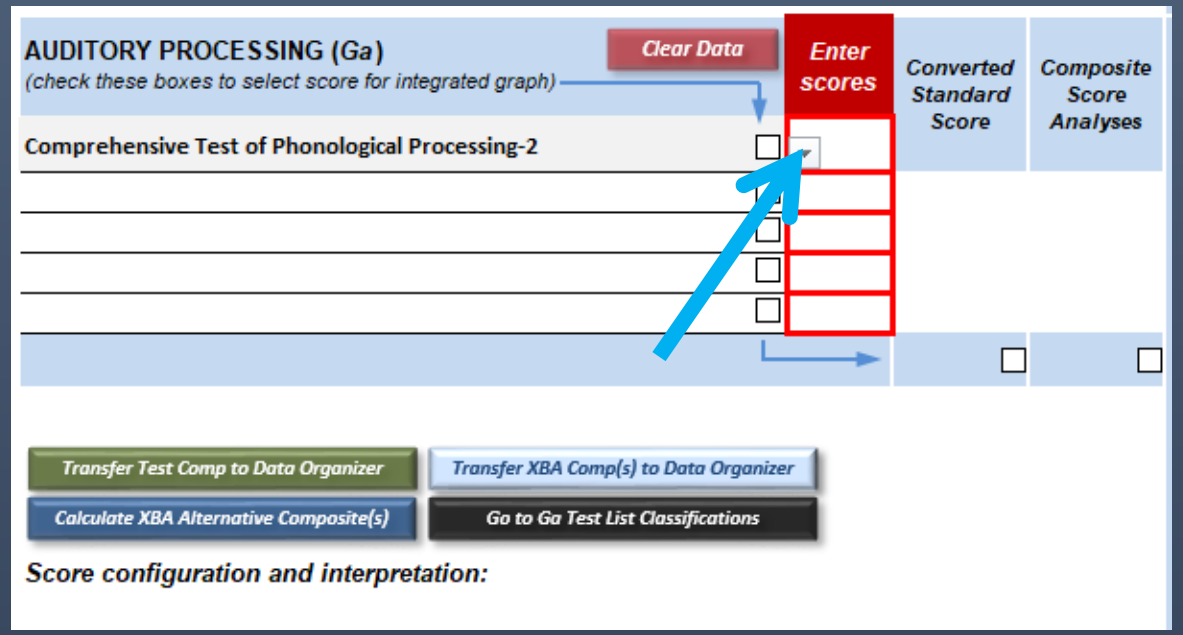
- Evaluate a set of scores to determine the best way to organize, report, and interpret them
  - Scores may come from different batteries, allowing for cross-battery composites to be calculated
  - Scores may come from the same battery, allowing for within-battery composites to be calculated (when actual norms from the test publisher are not available)
- Evaluate Whether Composites From Other Batteries Are Cohesive
  - Batteries other than the cognitive and achievement batteries that have their own tabs in X-BASS
    - **A CTOPP2 Example**

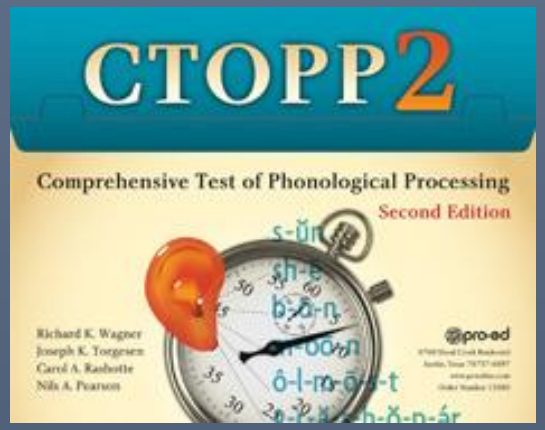


Example: CTOPP2 is often used to supplement cognitive batteries, such as WISC-V

- Top Row for all areas in XBA Analyzer Tab includes the names of Tests and Batteries that do not have their own individual tab in X-BASS. Use the drop-down menu in the top row in the Ga domain to find the CTOPP2.



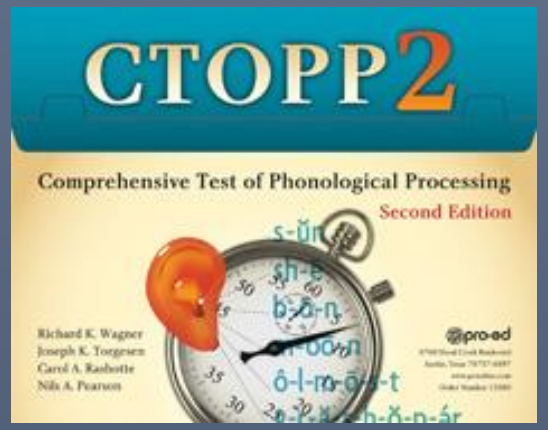




Supplement the WISC-V with tests from CTOPP-2 for Ga: Phonetic Coding

Subtests	Composite
Elision Blending Words Phoneme Awareness	Phonological Awareness

CTOPP2 Manual does not include critical values for determining cohesion of composites



Supplement the WISC-V with tests from CTOPP-2 for Ga: Phonetic Coding

Subtests

Elision (ss = 8)
Blending Words (ss = 9)
Phoneme Awareness (ss = 9)

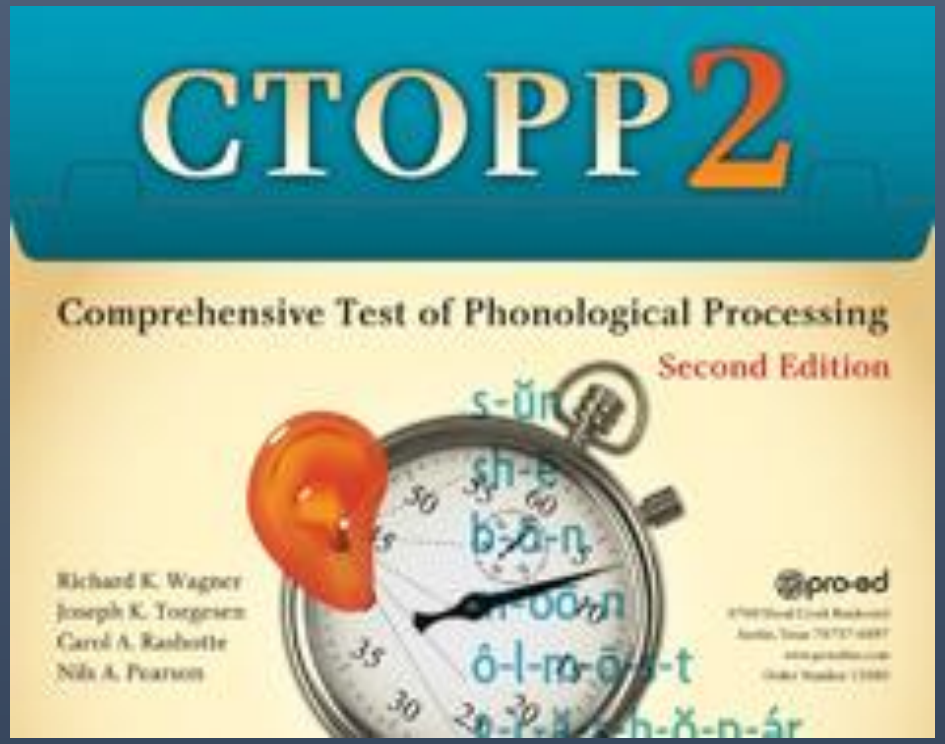
Composite

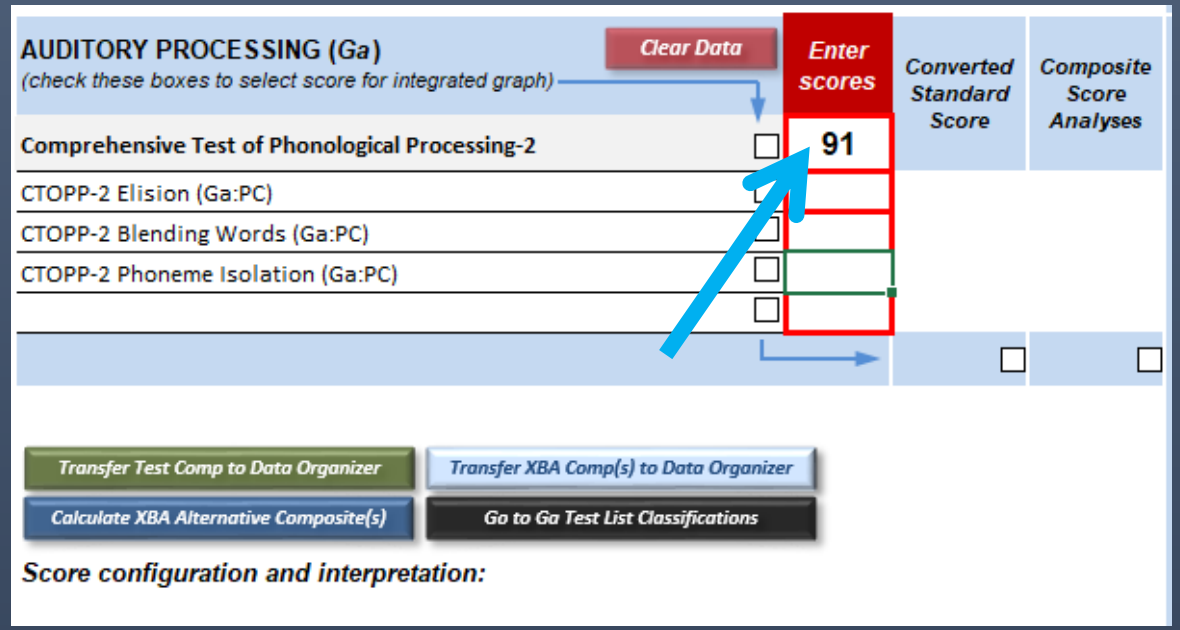
Phonological Awareness (SS = 91)

CTOPP2 Manual does not include critical values for determining cohesion of composites

Supplement the WISC-V with tests from CTOPP2 for Ga: Phonetic Coding

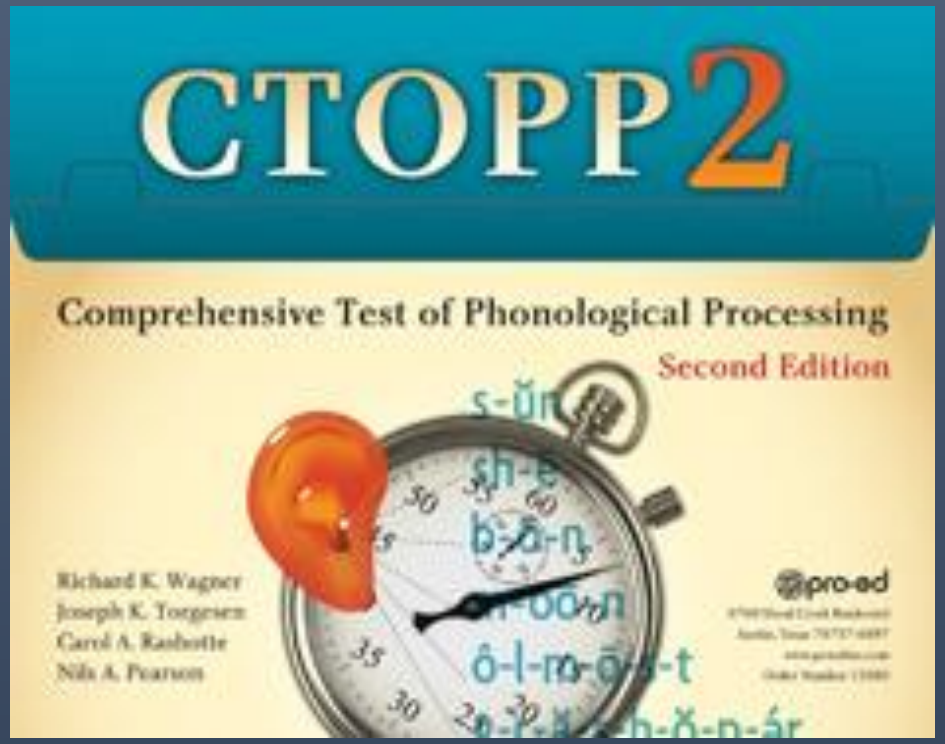
- CTOPP2 Manual does not include critical values for determining cohesion of composites.
- ***Choose CTOPP2 from top row drop-down menu on XBA Analyzer tab; Enter the composite in the top row***





Supplement the WISC-V with tests from CTOPP2 for Ga: Phonetic Coding

- CTOPP2 Manual does not include critical values for determining cohesion of composites.
- ***Select the subtests that make up the composite; and enter the scaled scores for each subtest; X-BASS will evaluate cohesion***



AUDITORY PROCESSING (Ga) (check these boxes to select score for integrated graph)	Clear Data	Enter scores	Converted Standard Score	Composite Score Analyses
Comprehensive Test of Phonological Processing-2	☐	91		
CTOPP-2 Elision (Ga:PC)	☐	8	90	A
CTOPP-2 Blending Words (Ga:PC)	☐	9	95	A
CTOPP-2 Phoneme Isolation (Ga:PC)	☐	9	95	A
	☐			

3-subtest test composite: COHESIVE - Use test composite

Transfer Test Comp to Data Organizer | Transfer XBA Comp(s) to Data Organizer

Calculate XBA Alternative Composite(s) | Go to Ga Test List Classifications

Score configuration and interpretation:

The difference between the highest and lowest scores that comprise the test composite is less than 1SD and, therefore, is considered cohesive and is likely a good summary of the set of theoretically related abilities that comprise it. Interpret the test composite as an adequate estimate of the ability that it is intended to measure.

X-BASS Builds in the Guiding Principle: Use Actual Norms Whenever they are Available

Summary: We Talked About

- How Cohesion and Follow up analyses are conducted on individual test tabs and the XBA Analyzer tab
- How and when to transfer data from individual test tabs to XBA Analyzer tab
- Purposes of the XBA Analyzer tab

Cross-Battery Assessment

Now Let's Talk About How Composites on the XBA Analyzer Tab Are Calculated

- Median Reliabilities
- Median Inter-correlations
- Standard Formula
- Based on over 2,000 Coefficients from Technical Manuals
- XBA Composites Are Psychometrically Sound

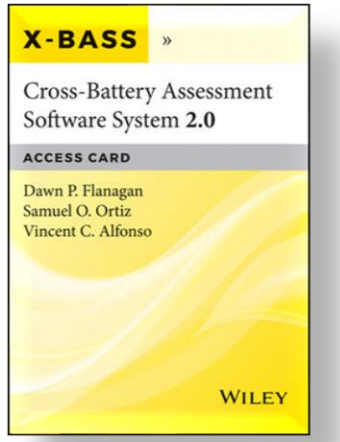
Cross-Battery Assessment

Table 5. Median Inter-correlations of CHC Broad Abilities Based on Within- and Cross-Battery Data

Broad Ability Pair	Number of Coefficients	Median Inter-correlation
Gc-Gf	36	.62
Gc-Glr	5	.60
Gc-Gsm	26	.49
Gc-Gv	31	.50
Gc-Ga	11	.49
Gc-Gs	11	.43
Gf-Glr	5	.62
Gf-Gsm	17	.52
Gf-Gv	15	.56
Gf-Ga	5	.44
Gf-Gs	11	.40
Glr-Gsm	5	.48
Glr-Gv	5	.45
Glr-Ga	5	.42
Glr-Gs	5	.43
Gsm-Gv	17	.41
Gsm-Ga	5	.46
Gsm-Gs	8	.38
Gv-Ga	5	.30
Gv-Gs	9	.46
Ga-Gs	5	.33
TOTAL	242	

Table 4. Median of Narrow Ability Reliability Coefficients within Broad CHC Ability Domains

Broad Ability Domain	Number of Coefficients	Number of Narrow Abilities Represented	Median Reliability
Gc	49	6	.88
Gf	29	3	.89
Glr	32	8	.81
Gsm	34	2	.87
Gv	21	5	.82
Ga	10	4	.89
Gs	20	3	.84
Gq	4	2	.93
Grw-R	10	3	.94
Grw-W	12	4	.87
Gp	36	4	.87
Gh	12	1	.84
Gkn	4	1	.80
EF	--	--	.80
AT	--	--	.80
CF	--	--	.80
TOTAL	273	46	



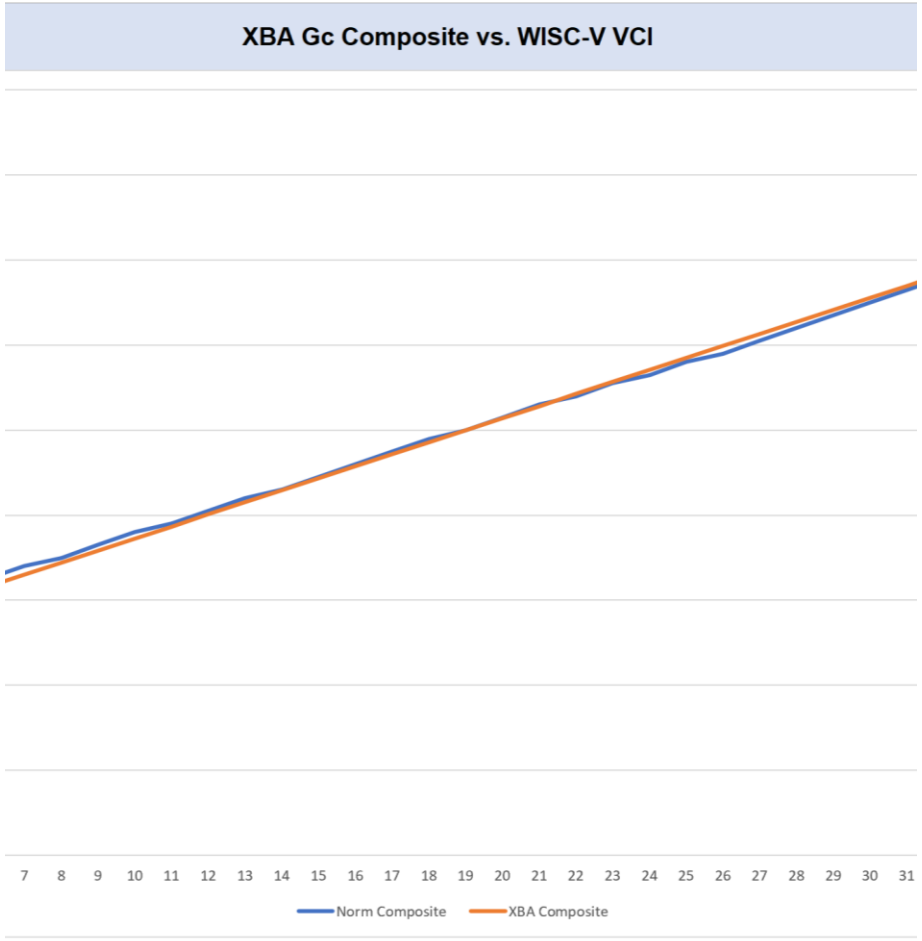
$$\text{Composite Score} = \left[\frac{((SS_x + SS_y + \ldots) - n*100)}{\sqrt{(SD_x^2 + SD_y^2 + \ldots + (2*SD_x*SD_y*R_{xy} + \ldots)}} \right] * 15 + 100$$

How Are Composites on the XBA Analyzer Tab Calculated?

- **XBA composites are calculated with a standard formula using *median reliabilities* and *median intercorrelations***

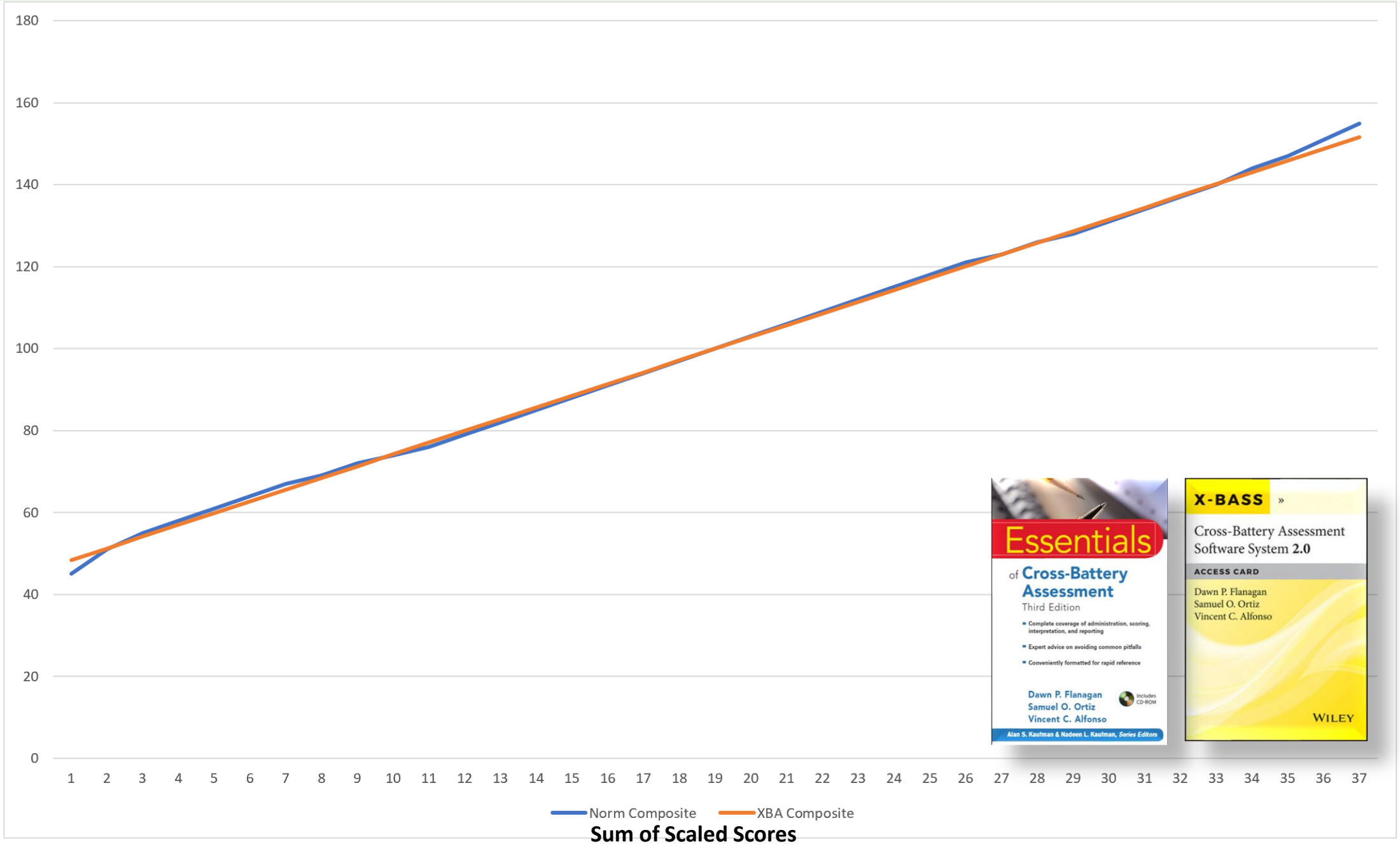
The Accuracy of Cross-Battery Assessment (XBA) Composites Generated by X-BASS

- A total of 185 comparisons were made between XBA composites generated in X-BASS and the WISC-V Primary Index Scales. All XBA composites were within one SEM of their corresponding WISC-V Index. For example, the SEM for the WISC-V Verbal Comprehension Index (VCI) is 4.22. The average difference between the XBA Comprehension Knowledge (Gc) composite and the VCI was 1.14 points (range = 0.00 – 4.05). Thus, 100% of XBA Gc composites were within one SEM of the VCI. Similar results were found with all XBA and WISC-V Index comparisons (i.e., Gf/FRI, Gv/VSI, Gwm/WMI, and Gs/PSI). Similar data are provided for the DAS-II, KABC-II, SB5, and CAS2.
- Proposal submitted for presentation at NASP 2023 in collaboration with
  - Kyle MacDonald
  - Brooke Koeppel
  - Etty Wajsfeld



Average Difference	SEM = 4.36	Range = 0 - 2.73
0.79		

XBA Gf Composite vs. WISC-V FRI



Transferring Scores in X-BASS

Scores can be transferred from individual test tabs to either the XBA Analyzer tab or to the "Data Organizer" tab

Composites can be transferred to the Data Organizer tab (when follow up is not considered necessary)

Subtest scores can be transferred to the XBA Analyzer tab when follow up is necessary

Composites are transferred to the Data Organizer tab for the purpose of conducting a PSW analysis

XBA Analyzer | Data Organizer | C-LIM Summary | Start | Tab Help

WISC-V® Data Analysis

(age range = 6.0 - 16:11) Release: 2.4

Index | WISC-V Graph | Integrated Graph | C-LIM Analyzer | Next Step

Name: Tucker *Grade:* 3 *Age:* 8 years 0 month(s) *Date:* 3/2/2014

WISC-V | WAIS-IV | WPPSI-IV | WIAT-4 | WIAT-III | WJ IV COG | WJ IV ACH | WJ IV OL | KABC-II | KTEA-3 | CAS2 | DAS-II | SB5

Index Name / Subtest Name (check box for integrated graph)		Enter scores	PR	Transfer scores
Verbal Comprehension Index (VCI/Gc)	☐	106	66th	
Similarities (Gc:VL;Gf:I)	☐	10	50th	☐
Vocabulary (VL)	☐	12	75th	☐
Information (K0)	☐			☐
Comprehension (K0)	☐			☐
Fluid Reasoning Index (FRI/Gf)	☐	97	42nd	
Matrix Reasoning (I)	☐	9	37th	☑
Figure Weights (RG,RQ)	☐	10	50th	☑
Picture Concepts (I)	☐			☐
Arithmetic (Gsm:MW;Gq:A3)	☐			☐

Criteria for Cohesion: Is variability...

	significant or substantial?	infrequent or uncommon?	Follow up Recommendatons: Do the results suggest a need for follow up?
Verbal Comprehension Index (VCI/Gc)	No	No	No, not considered necessary
Fluid Reasoning Index (FRI/Gf)	No	No	No, not considered necessary

COHESIVE

The VCI provides an estimate of Crystallized Intelligence (Gc). Gc refers to an individual's knowledge base (or general fund of information) that develops as a result of exposure to language, culture, general life experiences, and formal schooling. Word knowledge as measured by the Vocabulary subtest was High Average, and the ability to reason with words as measured by the Similarities subtest was Average relative to same age peers. The difference between the scores that comprise the VCI is not significant and a difference of this size is considered common in the general population. This means that the VCI is a good summary of ligence. The individual's VCI of 106 (102-110) is classified as nked at the 66th percentile, indicating performance as good as or f same age peers from the general population.

Gc:VL = 106 Transfer to Data Organizer

Although both scores that comprise the VCI are indicative of average or better performance, the difference between them is considered substantial (i.e., at least ⅔ SD). Therefore, to gain a better understanding of the individual's performance in this ability domain, it may be helpful to follow up on the lower score and:

- Consider whether IN or CO would provide useful additional information
- If IN and CO are administered, consider the new clinical composite, Verbal (Expanded Crystallized) Index (VECI)
- Consider whether the Gc clinical composites (e.g., Gc-Verbal Expression Low; Gc – Verbal Expression High) would provide useful additional information
- Consider whether there is a difference between Retrieval from Remote Long-term Storage (Vocabulary + Information) and Retrieval from Recent Long-term Storage (Delayed Symbol Translation + Recognition Symbol Translation)
- Consider task characteristics and response demands

Composites are cohesive; no need to follow up. Transfer scores to Data Organizer Tab

COHESIVE

The FRI provides an estimate of Fluid Reasoning (Gf). Gf refers to a type of thinking that an individual may use when faced with a relatively new or novel task that cannot be performed automatically. Inductive reasoning as measuared by the Matrix Reasoning subtest was Average and general sequential (deductive) reasoning and quantitative reasoning as measured by the Figure Weights subtest was Average relative to same age peers. The difference between the scores that comprise the FRI is not significant and a difference of this size is considered common in the general population. This means that the FRI is a good summary of Fluid Reasoning. The FRI of 97 (93-101) is classified as Average and is ranked at the 42nd percentile, indicating performance as good as or better than 42% of same age peers from the general population.

Gf = 97 Transfer to Data Organizer

Because the difference between the scores that comprise the FRI is not substantial (less than ⅔ SD) and both scores are at least average, follow up is not considered necessary.

XBA Analyzer | Data Entry - Other | C-LIM Summary | Start | Tab Help

Data Organizer and Score Summary

Release: 2.4

Index | S&W Indicator | Data Organizer Graph | C-LIM Analyzer | Next Step

Name: *Tucker* ***Age:*** *8 years 0 month(s)* ***Grade:*** *3* ***Date:*** *3/2/2014*

WISC-V | WAIS-IV | WPPSI-IV | WIAT-4 | WIAT-III | WJ IV COG | WJ IV ACH | WJ IV OL | KABC-II | KTEA-3 | CAS2 | DAS-II | SB5

Guidelines for Selecting Best Composite Scores for SLD Evaluation

The purpose of this tab is to organize composites and subtests to assist in the selection of those to be used for evaluation of the pattern of strengths and weaknesses in the PSW Analyzer. Test names and scores can not be entered into this tab directly. Rather, this tab provides a summary of test battery and XBA composites that were transferred from other tabs because they were considered the best estimates of CHC abilities, academic areas, and selected neuropsychological domains. Use this tab to select the composites and subtest scores you would like to use in PSW analyses by clicking on the check box to the right of each one in any domain for which there are data. You may select up to two composites for each of the CHC broad ability (e.g., Gc, Gf, Gsm) and neuropsychological (e.g., Executive Functions, Orthographic Processing) domains and up to three scores for each of the academic areas. Note that you may also click on the "Data Organizer Graph" to view or print the information on this tab. For more information on how to select the best scores for use in PSW analyses, click the button to the right.

Selecting Scores for PSW Analyzer | Select ALL Checkboxes | Clear ALL Checkboxes

After you have made your selections, click the "S&W Indicator" button to continue with additional steps for conducting PSW analyses.

COMPREHENSION-KNOWLEDGE (*Gc*)

Indicate which composite(s) you wish to use for PSW analyses. No more than two scores can be selected for this domain.

WISC-V Verbal Comprehension Index (Gc:VL)	106	☐ Test Comp	Clear Score 1
		☐	Clear Score 2
		☐	Clear Score 3

FLUID REASONING (*Gf*)

Indicate which composite(s) you wish to use for PSW analyses. No more than two scores can be selected for this domain.

WISC-V Fluid Reasoning Index (Gf)	97	☐ Test Comp	Clear Score 1
		☐	Clear Score 2
		☐	Clear Score 3

XBA Analyzer | Data Organizer | C-LIM Summary | Start | Tab Help

WISC-V® Data Analysis

(age range = 6.0 - 16:11) Release: 2.4

Index | WISC-V Graph | Integrated Graph | C-LIM Analyzer | Next Step

Name: Tucker *Grade:* 3 *Age:* 8 years 0 month(s) *Date:* 3/2/2014

WISC-V | WAIS-IV | WPPSI-IV | WIAT-4 | WIAT-III | WJ IV COG | WJ IV ACH | WJ IV OL | KABC-II | KTEA-3 | CAS2 | DAS-II | SB5

Index Name / Subtest Name	(check box for integrated graph)	Enter scores	PR	Transfer scores
Verbal Comprehension Index (VCI/Gc)	☐	97	42nd	
Similarities (Gc:VL;Gf:I)	☐	7	16th	☑
Vocabulary (VL)	☐	12	75th	☑
Information (K0)	☐			☐
Comprehension (K0)	☐			☐
Fluid Reasoning Index (FRI/Gf)	☐	97	42nd	
Matrix Reasoning (I)	☐	10	50th	☑
Figure Weights (RG,RQ)	☐	7	16th	☑
Picture Concepts (I)	☐			☐
Arithmetic (Gsm:MW;Gq:A3)	☐			☐

Criteria for Cohesion: Is variability...

Verbal Comprehension Index (VCI/Gc)

significant or substantial? **Yes** infrequent or uncommon? **Yes**

NOT COHESIVE

The VCI provides an estimate of Crystallized Intelligence (Gc). Gc refers to an individual's knowledge base (or general fund of information) that develops as a result of exposure to language, culture, general life experiences, and formal schooling. Word knowledge as measured by the Vocabulary subtest was High Average, and the ability to reason with words as measured by the Similarities subtest was Low Average relative to same age peers. The difference between the scores that comprise the VCI is significant and unusual, occurring in less than 10% of the general population. This means that the VCI is not necessarily a good summary of Crystallized Intelligence. Individual analysis of word knowledge (Vocabulary) and the ability to reason with words (Similarities) may be more informative than the VCI. The individual's VCI of 97 (93-101) is classified as Average and is ranked at the 42nd percentile, indicating performance as good as or better than 42% of same age peers from the general population.

Fluid Reasoning Index (FRI/Gf)

significant or substantial? **Yes** infrequent or uncommon? **No**

CLINICAL JUDGMENT NEEDED

The FRI provides an estimate of Fluid Reasoning (Gf). Gf refers to a type of thinking that an individual may use when faced with a relatively new or novel task that cannot be performed automatically. Inductive reasoning as measuared by the Matrix Reasoning subtest was Average and general sequential (deductive) reasoning and quantitative reasoning as measured by the Figure Weights subtest was Low Average relative to same age peers. The difference between the scores that comprise the FRI is significant, however a difference of this size is considered common in the general population. This means that clinical judgment is necessary to determine whether the FRI is a good summary of Fluid Reasoning. The FRI of 97 (93-101) is classified as Average and is ranked at the 42nd percentile, indicating performance as good as or better than 42% of same age peers from the general population.

Follow up Recommendatons

Do the results suggest a need for follow up?

Yes, recommended for lowest score

Gc:VL = 97 Transfer to Data Organizer

Because the difference between the scores that comprise the VCI is at least 1SD, and the lower score is indicative of a weakness or deficit, follow up on the lower score is considered necessary to determine if it is an accurate and valid representation of ability and:

- Consider whether IN or CO would provide useful additional information
- If IN and CO are administered, consider the new clinical composite, Verbal (Expanded Crystallized) Index (VECI)
- Consider whether the Gc clinical composites (e.g., Gc-Verbal Expression Low; Gc – Verbal Expression High) would provide useful additional information

Yes, recommended for lowest score

Gf = 97 Transfer to Data Organizer

Because the difference between the scores that comprise the FRI is at least 1SD, and the lower score is indicative of a weakness or deficit, follow up on the lower score is considered necessary to determine if it is an accurate and valid representation of ability and:

- If MR < FW and MR is suggestive of a weakness or deficit, consider obtaining more information about the individual's ability to reason inductively (e.g., Picture Concepts; subtest from another cognitive battery)
- If FW < MR and FW is suggestive of a weakness or deficit, consider a) obtaining more information about the individual's ability to reason deductively (e.g., subtest from another battery) and/or b) obtaining information about the individual's ability to reason quantitatively (e.g., Arithmetic; quantitative reasoning subtest from another battery; Applied Math Problems or Math Problem Solving subtests from an achievement battery)
- If AR is administered, determine whether QRI is cohesive
- Consider task characteristics and response demands

If Picture Concepts and Arithmetic were administered, consider the Expanded Fluid Index (EFI)

These composites are not cohesive and follow up is recommended. Transfer the subtest scaled scores to the XBA Analyzer.

XBA Analyzer Guide | Test List - Quick Ref | C-LIM Summary | Start | Tab Help

XBA and Test Composite Analyzer

Release: 2.4

Index | Data Organizer | XBA Analyzer Graph | Integrated Graph | Next Step

Name: *Tucker* **Age:** *8 years 0 month(s)* **Grade:** *3* **Date:** *3/2/2014*

WISC-V | WAIS-IV | WPPSI-IV | WIAT-4 | WIAT-III | WJ IV COG | WJ IV ACH | WJ IV OL | KABC-II | KTEA-3 | CAS2 | DAS-II | SB5

COMPREHENSION-KNOWLEDGE (Gc)

(check these boxes to select score for integrated graph)

Clear Data

		Enter scores	Converted Standard Score	Composite Score Analyses
WISC-V Similarities (Gc:VL;Gf:I)	☐	7	85	--
WISC-V Vocabulary (Gc:VL)	☐	12	110	--
	☐			
	☐			

NOT COHESIVE: Follow up recommended

Reset Score Configuration | Evaluate Score Configuration | Go to Gc Test List Classifications | Transfer Comp(s) to Data Organizer

Score configuration and interpretation:

The two scores differ from one another by at least 1SD and may fall in different ability ranges. Therefore, the aggregate of these scores may not provide a good summary of the theoretically related abilities they are intended to represent and, therefore, no composite is calculated. However, In some cases, depending on the configuration of the entered scores, an alternative composite based on clinical judgment may be formed by clicking the "Evaluate Score Configuration" button.

FLUID REASONING (Gf)

(check these boxes to select score for integrated graph)

Clear Data

		Enter scores	Converted Standard Score	Composite Score Analyses
WISC-V Matrix Reasoning (Gf:I)	☐	10	100	--
WISC-V Figure Weights (Gf:RG)	☐	7	85	--
	☐			
	☐			

NOT COHESIVE: Follow up recommended

Reset Score Configuration | Evaluate Score Configuration | Go to Gf Test List Classifications | Transfer Comp(s) to Data Organizer

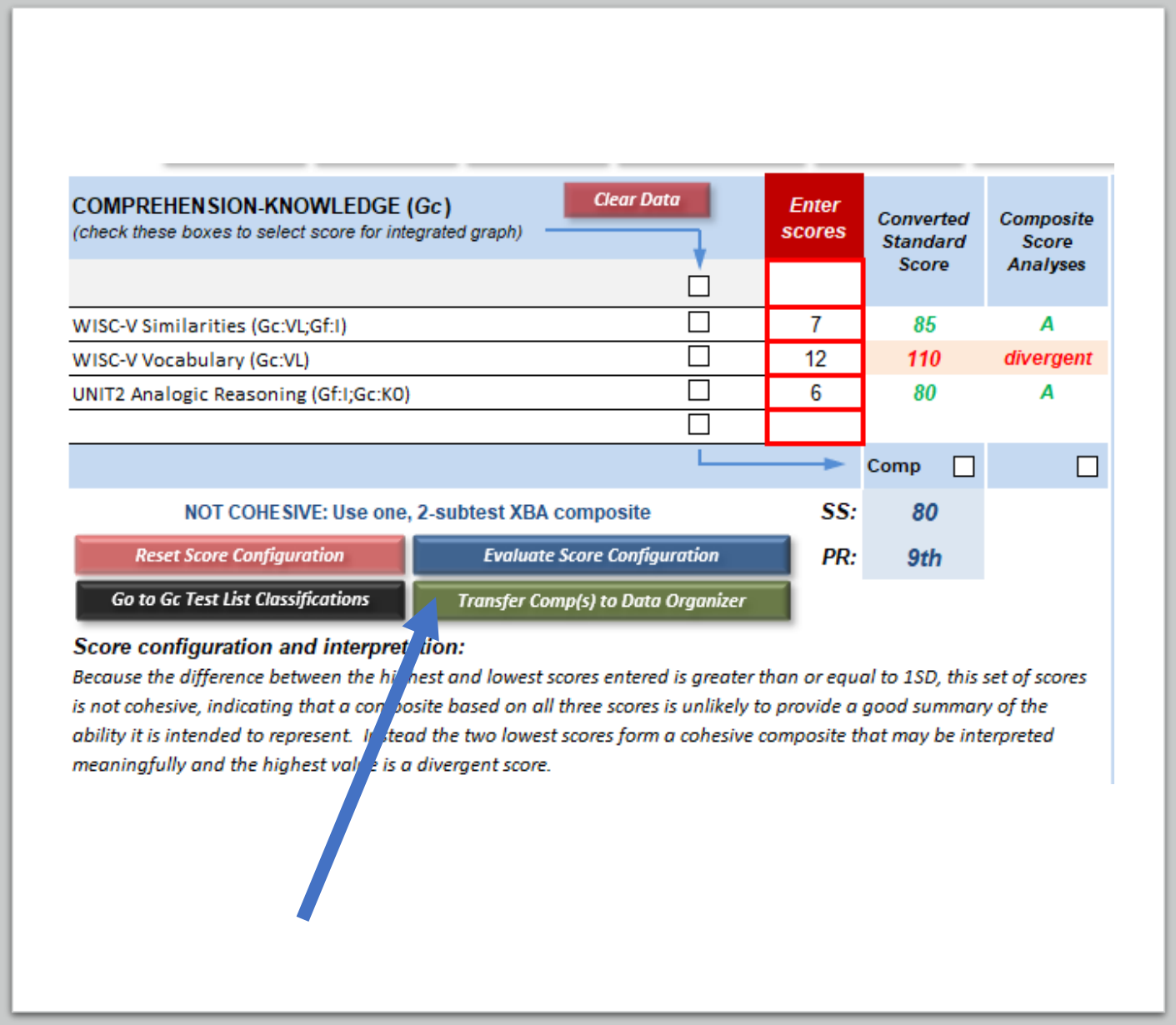
Score configuration and interpretation:

The two scores differ from one another by at least 1SD and may fall in different ability ranges. Therefore, the aggregate of these scores may not provide a good summary of the theoretically related abilities they are intended to represent and, therefore, no composite is calculated. However, In some cases, depending on the configuration of the entered scores, an alternative composite based on clinical judgment may be formed by clicking the "Evaluate Score Configuration" button.

XBA rules also indicate that follow up is recommended.

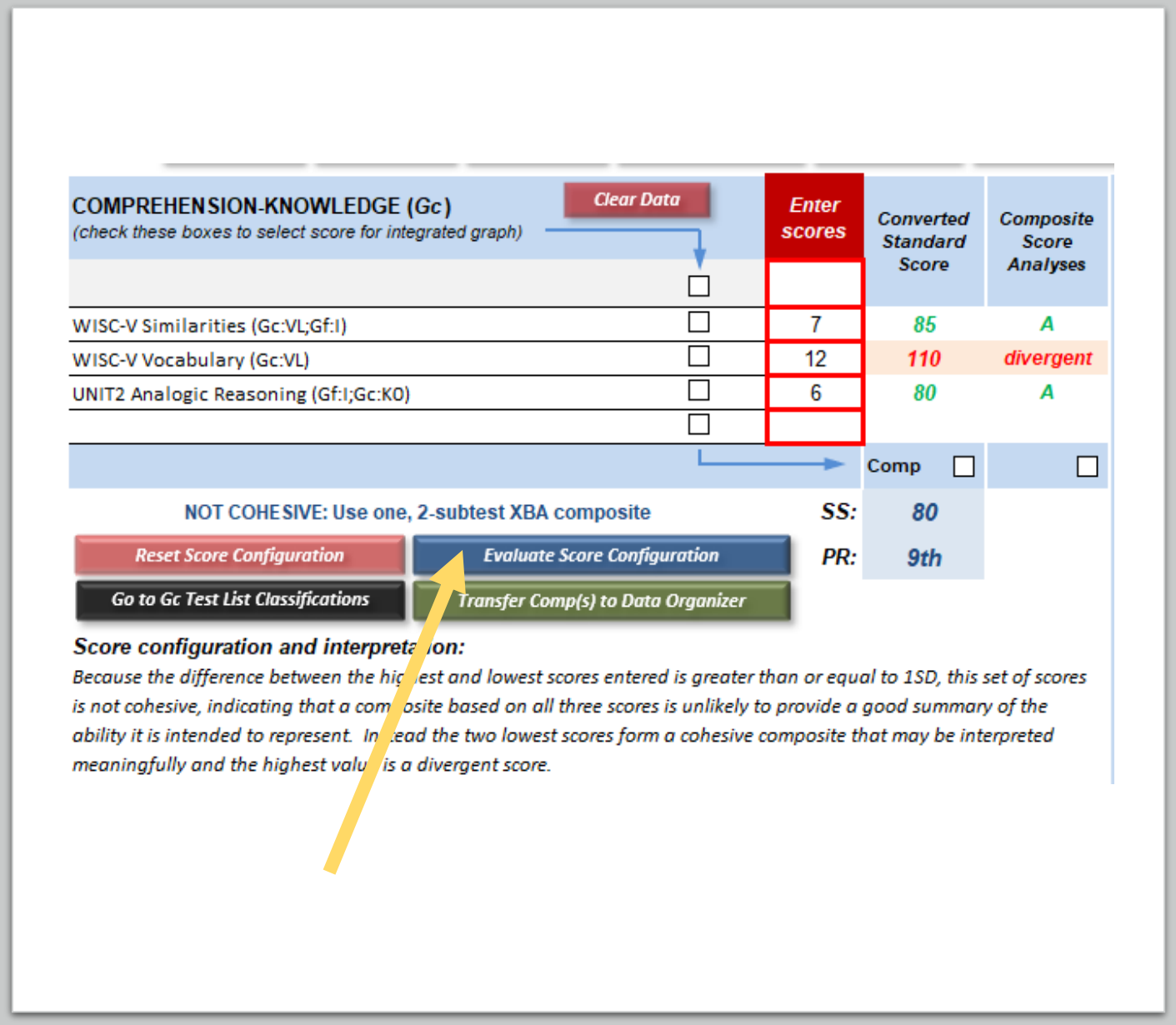
Gc Section of XBA Analyzer Tab

- Based on the XBA rules, one composite is calculated based on Similarities and Analogic Reasoning
- Vocabulary is divergent, meaning it is substantially higher than the verbal reasoning subtest scores
- ***Transfer the verbal reasoning composite to the Data Organizer tab***



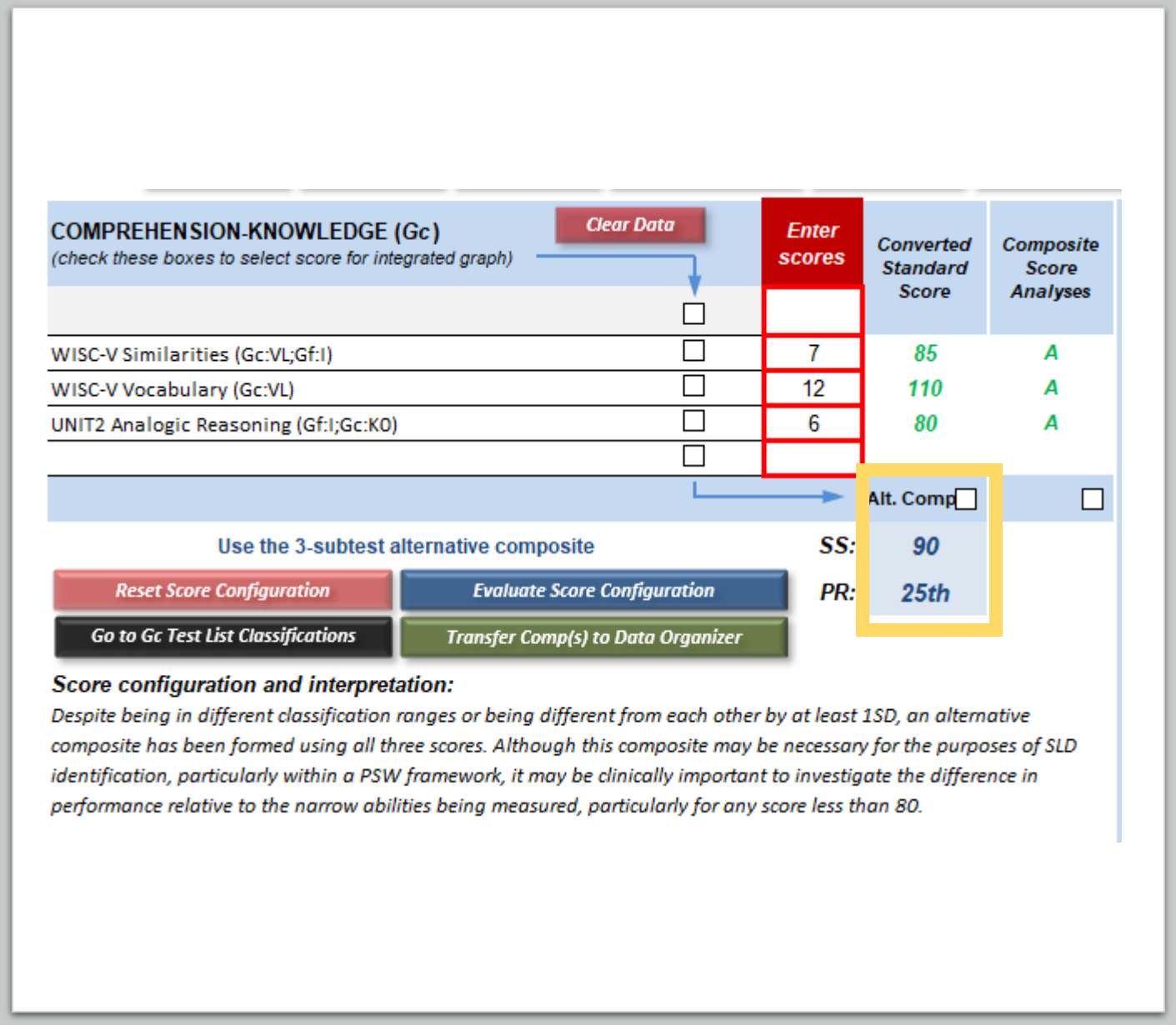
Gc Section of XBA Analyzer Tab

- What if I wanted to know the composite based on all three scores?
- A composite can be “forced” (meaning you can override the XBA rules) by clicking on “Evaluate Score Configuration” button)



Gc Section of XBA Analyzer Tab

- The three-subtest Gc composite is the best estimate of the latent Gc construct
- But is it a good representation of this student's overall Gc ability?
- The Gc composite of 90 falls at the lower end of the Average range and is within normal limits relative to same age peers
- Suppose you were doing a PSW analysis and had to indicate if Gc was a strength or a weakness for the student
- If you say strength, then you miss the fact that the student has difficulty reasoning with verbal information
- If you say weakness, then you miss the student's relative strength in vocabulary
- This is why X-BASS, via the XBA Analyzer tab, balances the art and science of test interpretation
- Both aspects of Gc should be represented in a PSW analysis



The Origin of the “Evaluate Score Configuration” Button

Fine-Tuning Cross-Battery Assessment Procedures: After Follow-Up Testing, Use All Valid Scores, Cohesive or Not

W. Joel Schneider
Illinois State University

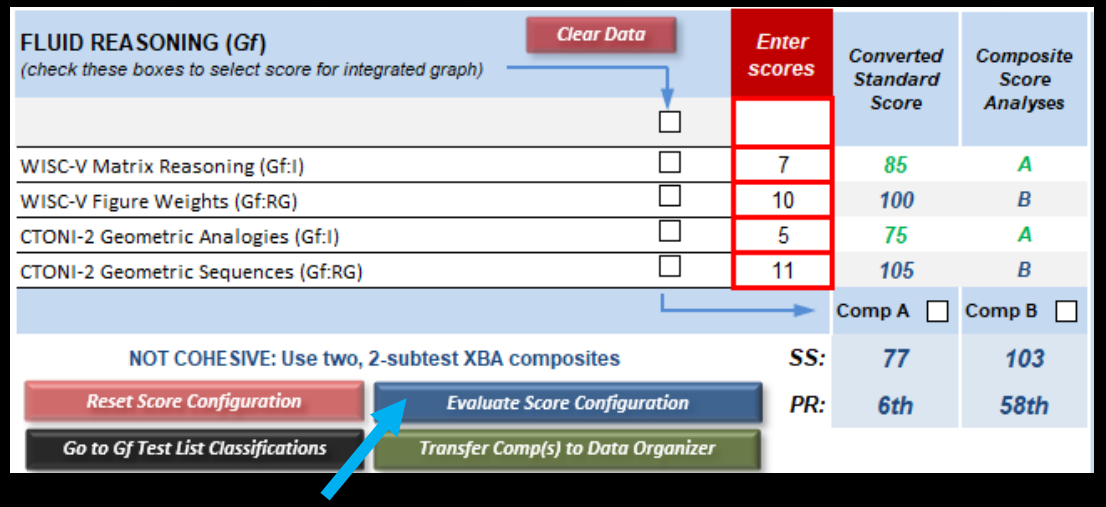
Zachary Roman
University of Kansas

We used data simulations to test whether composites consisting of cohesive subtest scores are more accurate than composites consisting of divergent subtest scores. We demonstrate that when multivariate normality holds, divergent and cohesive scores are equally accurate. Furthermore, excluding divergent scores results in biased estimates of construct scores. We show that divergent scores should prompt additional testing under some conditions. Although there are many valid reasons to exclude scores from consideration (e.g., malingering, fatigue, and misunderstood directions), no score should be discarded simply because it is different from other scores in the composite.

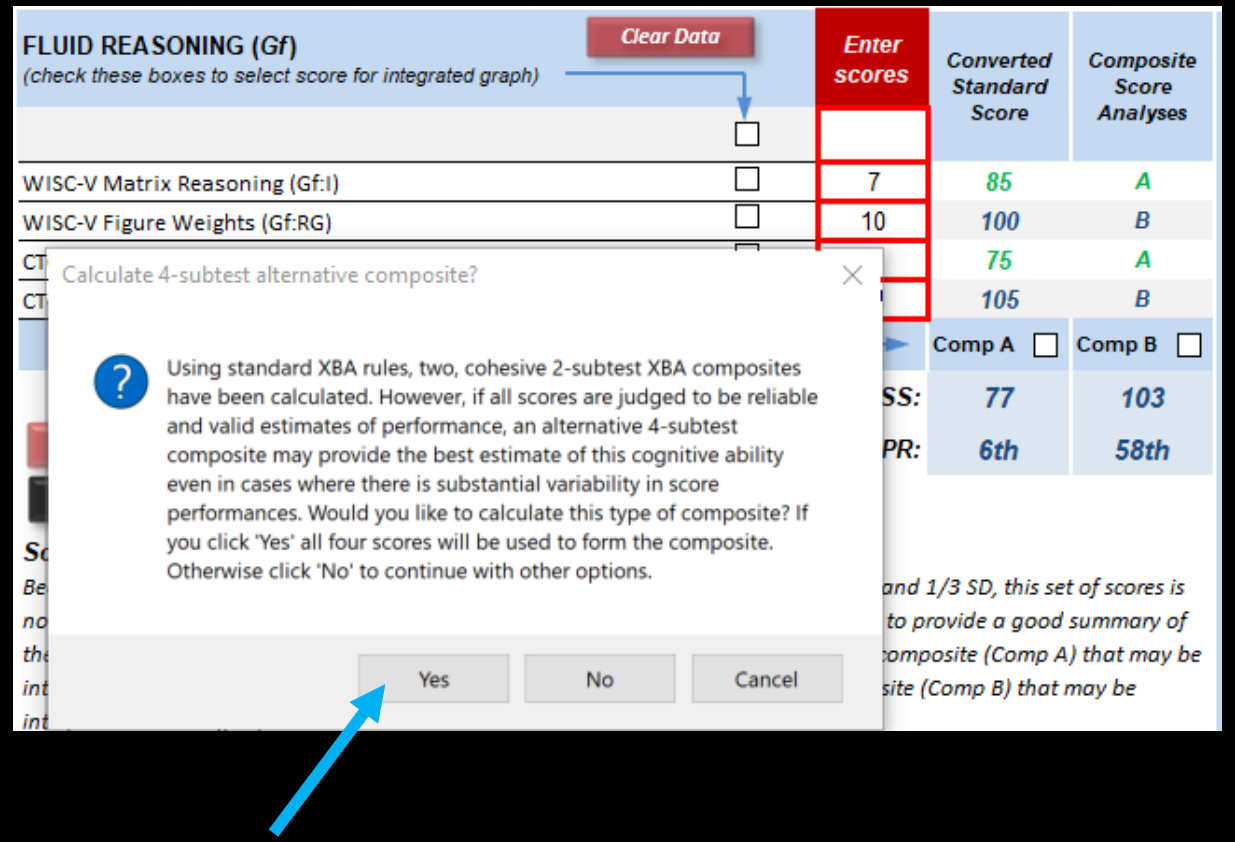
2017

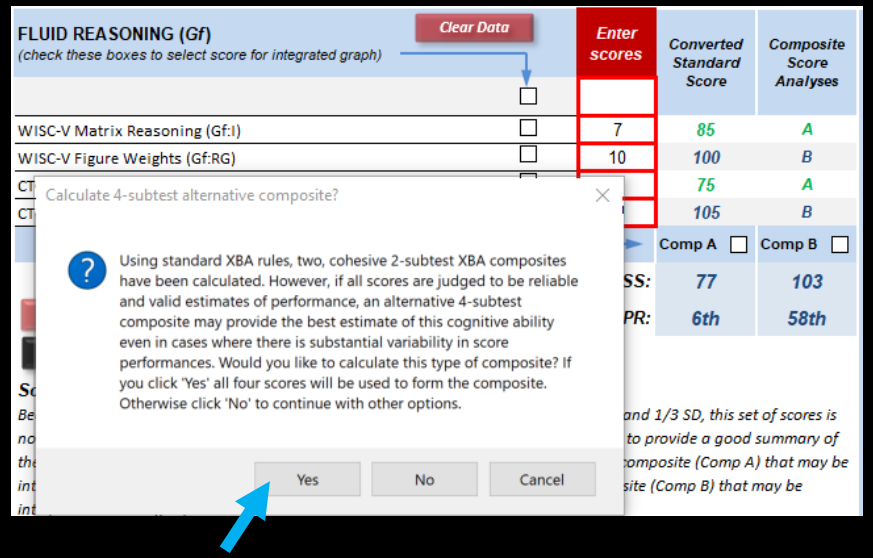
Cross-Battery Assessment

- **The Scientist**: The best estimate of the latent construct is the aggregate of all scores, regardless of cohesion
- **The Clinician**: The composite may obscure important information about the student's strengths and weaknesses

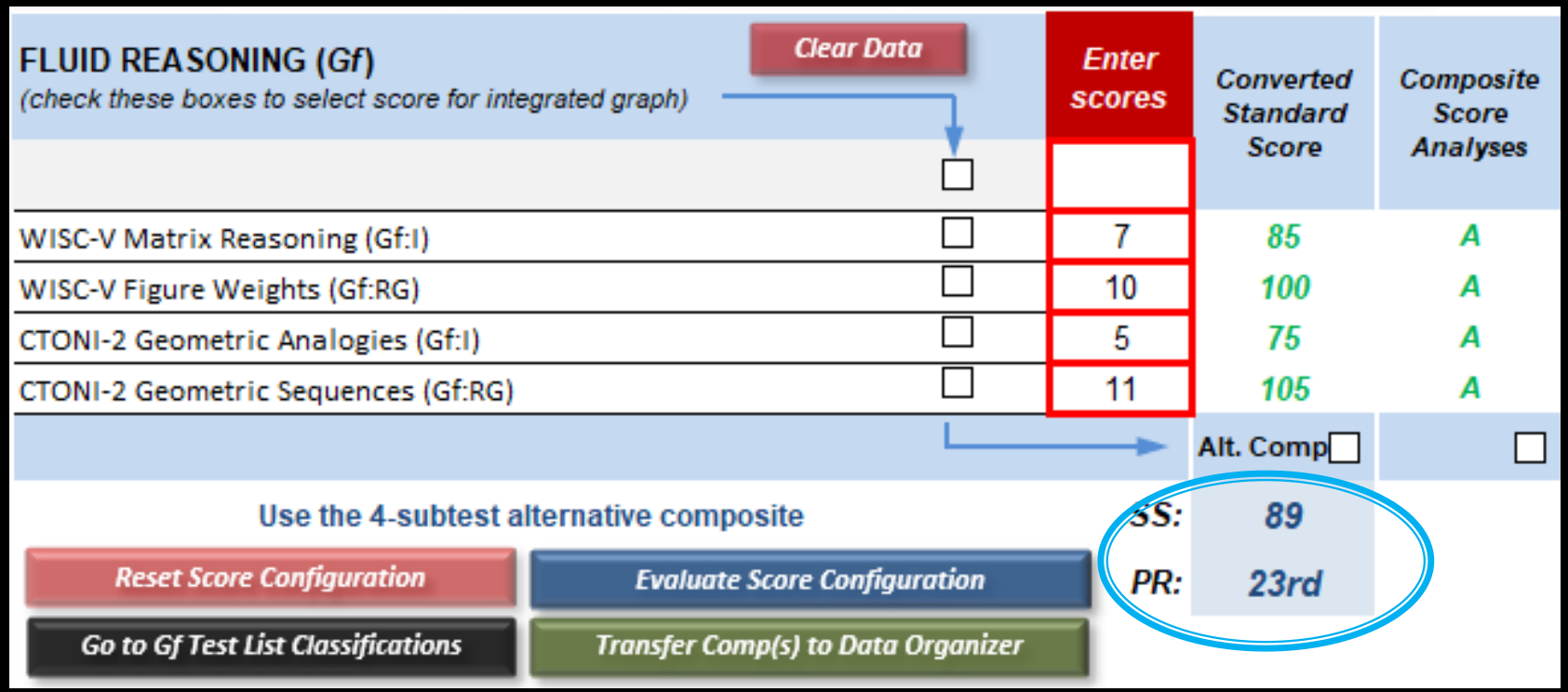


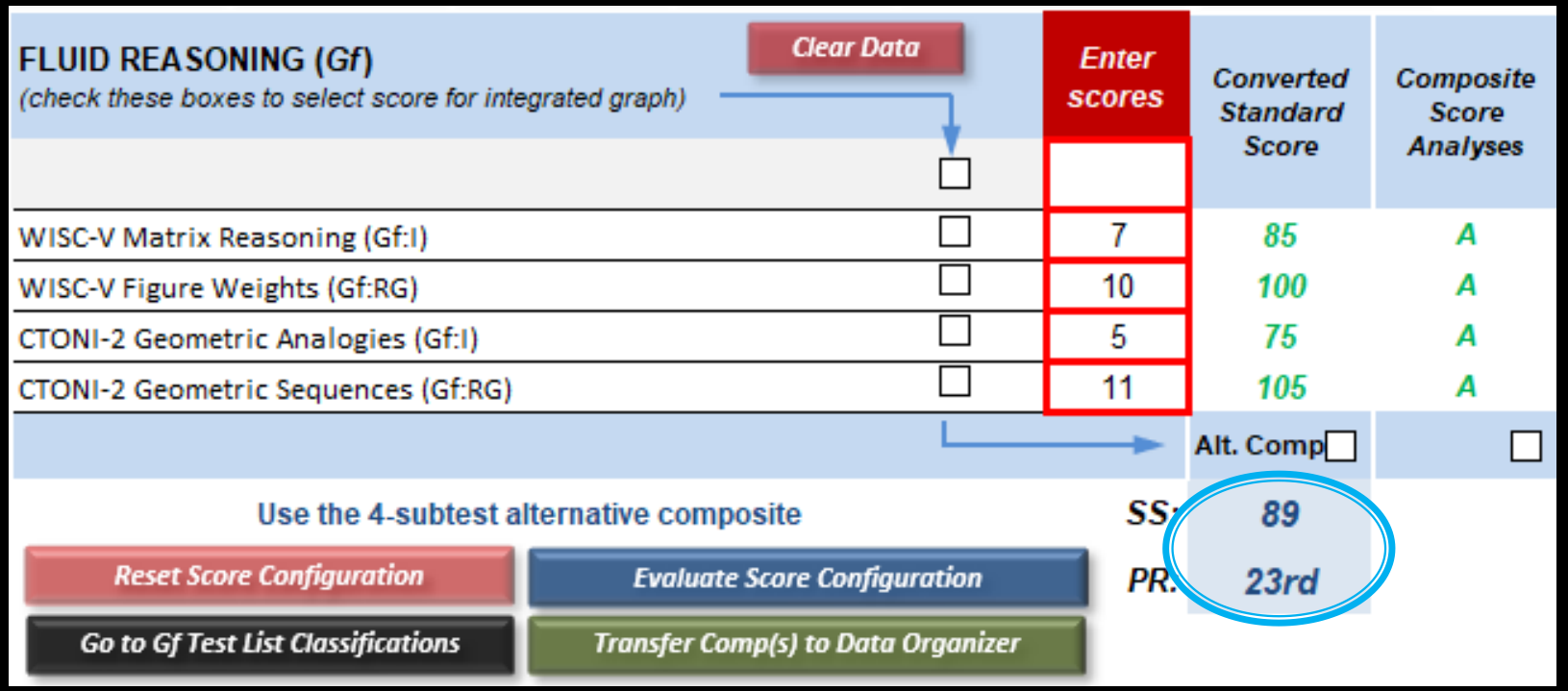
- **The Scientist**: The best estimate of the latent construct (in this example, Gf) is the aggregate of all scores, regardless of cohesion (Schneider & Roman, 2017)





- **The Scientist**: The best estimate of the latent construct (in this example, Gf) is the aggregate of all scores, regardless of cohesion (Schneider & Roman, 2017)

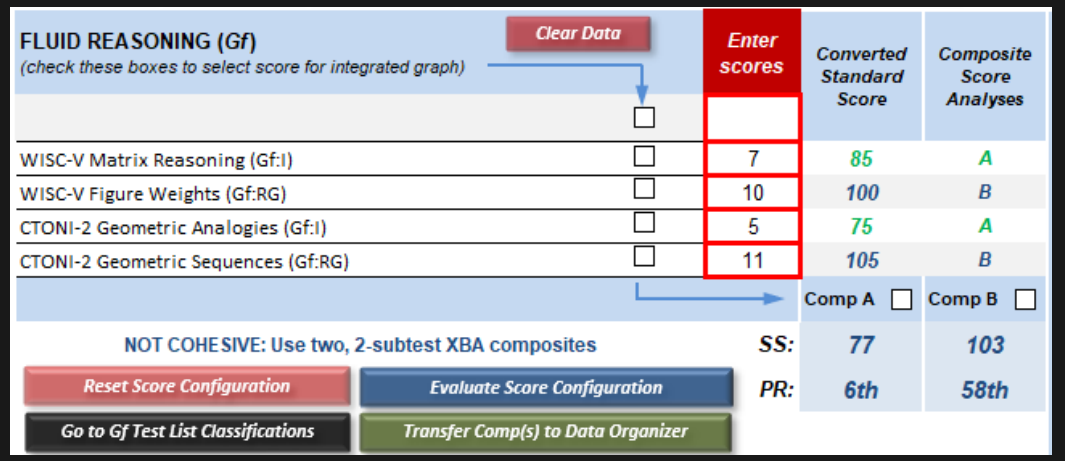




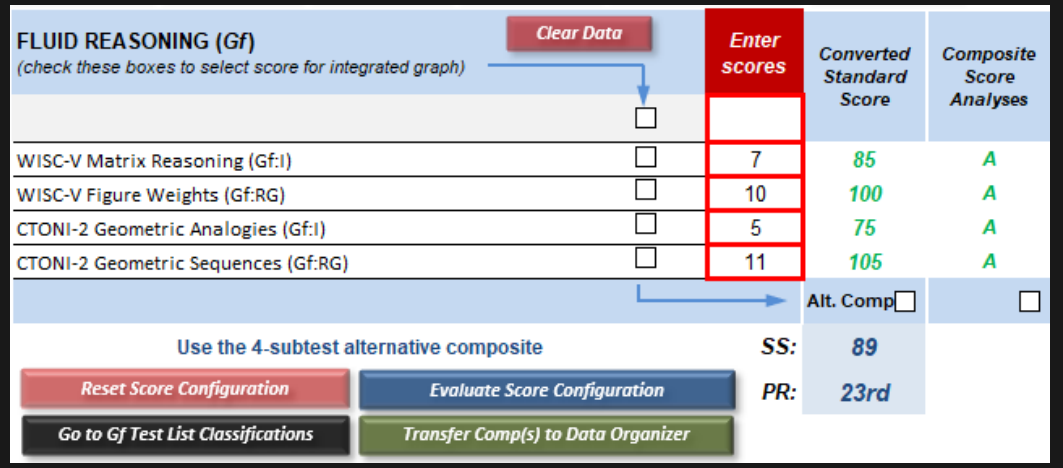
- **The Clinician**: The composite obscures important information about the student's strengths and weaknesses
- Very high probability of making an error in PSW analysis by classifying this composite as *either* a strength or as a weakness
- "Evaluate Score Configuration" provides the flexibility necessary to balance the art and science of test interpretation

Evaluate Score Configuration Button Balances Art and Science While Maintaining Psychometric Defensibility

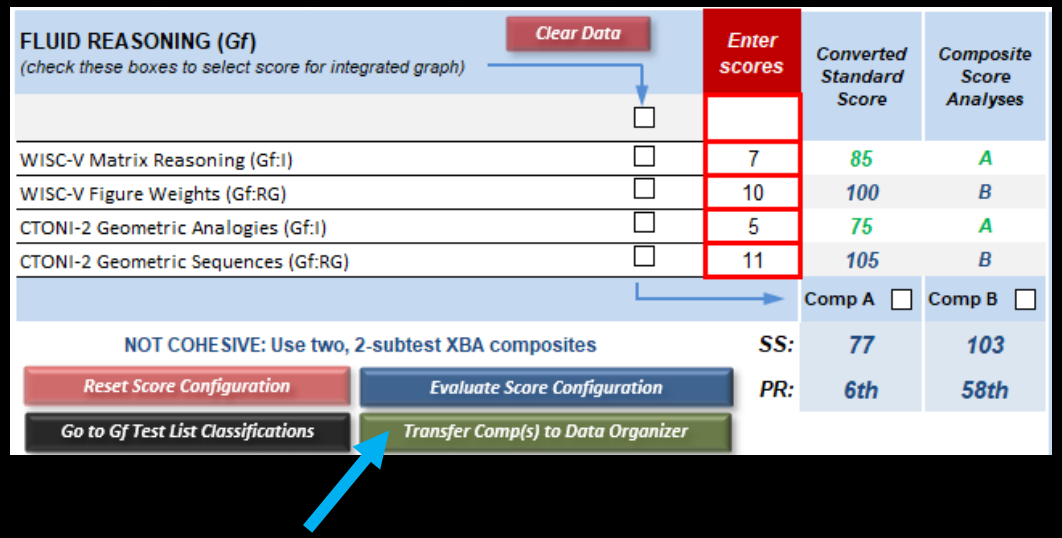
The Art



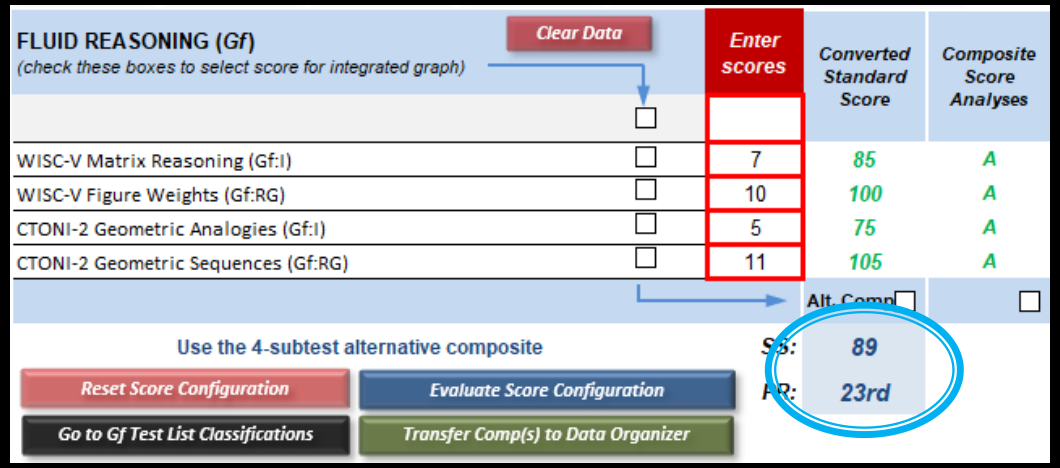
The Science



The clinician transfers composites to Data Organizer tab for use in PSW analysis



Clinician should include the overall broad Gf ability composite in report **AND** the separate composites may be used to explain variability in Gf performance



You Might Consider Writing a Paragraph in Your Report that Corresponds to this Gf Scenario

- Using X-BASS, the WISC-V and CTONI-2 reasoning subtests were combined to form an overall Fluid Reasoning composite of 89, which is ranked at the 23rd percentile and falls in the Low Average range. However, because this overall composite does not reflect the substantial variability that Holly demonstrated in this domain, separate Inductive and Deductive Reasoning composites were generated using X-BASS. Specifically, Holly's ability to reason deductively is at a level expected for children her age (Deductive Reasoning composite of 103; 58th percentile) whereas her ability to reason inductively is Well Below Average (Inductive Reasoning composite of 77; 6th percentile). Difficulties with reasoning inductively may manifest for Holly in various ways, including difficulties with higher level academic tasks such as reading comprehension (e.g., drawing inferences from text) and math problem solving (e.g., apprehending relationships between numbers).

Table 1. Diagnostic Assessment of Reading skills, cognitive correlates, with **WISC-V**/**WIAT-4** as Core Batteries via XBA and with Supplemental **CTOPP-2**, **FAR**, and **KTEA-3** tests (20 tests; Approximate Administration time – 1.5 hours)

Academic Subskill	Cognitive Correlates	Broad Ability	Narrow Ability	Core Battery Subtest	Supplemental (and *Optional*) Test
Word Reading Accuracy	Phonological Awareness	Ga	PC	**Phonemic Proficiency**	
	Phonological Memory		UM		**Nonword Repetition** (may be consistent with Gwm:Wa)
Word Reading Accuracy and Reading Rate and Fluency	Rapid Naming	Gr	NA	**Naming Speed Literacy**	***Rapid Automatic Naming***
Reading Rate and Fluency	Orthographic Processing/ Orthographic Mapping	Gs	Pc (with orthographic units)	**Coding**	***Orthographic Choice*** ***Orthographic Fluency***
			RS	**Orthographical Processing** (Pc; may involve orthographic memory or Gwm:Wv)	
Reading Comprehension	Oral Language	Gc	VL	**Vocabulary**	***Similarities*** (VL; Gf:I) ***Print Knowledge*** (PK-1) ***Oral Expression*** (VL; Gr:FI; Gwm:Wa)
			MY		**Morphological Processing** (MY; grade 2+)
			CM		**KTEA-3 Oral Expression** (CM)
	Listening Comprehension	Gc	LS	**Oral Discourse Comprehension**	
	Working Memory	Gwm	Wa	**Digit Span**	***Orthographical Processing***

					(Possibly involves Wv; orthographic memory; may also involve Gs:Pc)
	Executing Functioning and Reasoning	Gf	I	**Matrix Reasoning**	*EF rating scale; observations during testing*
			RG	**Figure Weights**	
Other		Gl	MA	**Immediate Symbol Translation**	***Delayed Symbol Translation Recognition Symbol Translation***
		Gv	MV	**Visual Puzzles**	***Block Design***

***Note*:** The Following reading **WIAT-4** subtests can be administered to gain general information about how specific cognitive processing weaknesses may manifest in the classroom – Word Reading, Oral Reading Fluency, Decoding Fluency, Reading Comprehension. This table includes "cognitive" subtests from four "achievement" batteries, demonstrating that an increasing number of tests of cognitive processes are being included on achievement batteries. Results from cognitive and academic tests can be used in a PSW analysis and considered along with data from other sources (e.g., educational, medical, familial background; work samples; parent, teacher, and student interviews; behavioral observations; rating scales; exclusionary factors; input from other school personnel familiar with the student) to determine whether an SLD is present and subsequently whether the student is eligible for special education services.

It is important to understand that the information in this table provides an example of ***an initial comprehensive and in-depth evaluation of suspected READING disability only***. It will be most appropriate when reading is the only academic area of concern in the referral. Evaluations that have academic concerns spanning more areas will necessarily be less comprehensive to accommodate measurement of the other skill areas. In addition, any form of re-evaluation is typically much shorter and can be tailored even more specifically depending on what data are already available.

[1]Assessment of Learning Efficiency (Gl) is important in all evaluations of suspected learning disability. Gv is important in determining overall ability to think and reason and is a necessary part of PSW analysis.

Table 2. Writing Achievement Subskills, Cognitive Correlates, and **WISC-V/WIAT-4** as Core Batteries in XBA with Supplemental **FAW** and tests (21 tests; Approximate Administration time – 1.5 hours)

Academic Subskill	Cognitive Correlates	Broad Ability	Narrow Ability	Core Battery Subtest	Optional/Supplemental Test
Spelling Accuracy	Phonological Processing	Ga	PC	**Phonemic Proficiency**	***Isolated Spelling***
	Orthographic Processing/ Orthographic Coding			**Orthographic Choice*; Orthographic Fluency**	***Homophone Spelling***
	Graphomotor Skills	Gp	P1, P2	**Alphabet Writing Fluency; Sentence Writing Fluency**	***Alphabet Tracing Fluency Motor Sequencing***
Grammar and Punctuation	Retrieval Fluency	Gr	FI	**Oral Word Fluency**	***Retrieval Fluency***
	English Usage	Grw-W	EU		**Copy Editing**
Clarity of Written Expression	Attention and Working Memory	Gwm	Wa	**Digit Span**	
			Wa, AC	**Letter Number Sequencing**	
	Attention and Executive Functioning	Gf	I	**Matrix Reasoning**	*EF rating scale; observations during testing*
		Gs	Ps	**Cancellation**	
	Language	Gc	VL	**Vocabulary**	***Receptive Vocabulary***
			K0	**Information**	
Other	Learning Efficiency	Gl	MA	**Immediate Symbol Translation**	***Delayed Symbol Translation; Recognition Symbol Translation***
	Visual-Spatial Ability	Gv	Vz	**Block Design**	***Motor Planning***

*Available via Q-interactive only

***Note*:** The Following writing **WIAT-4** and **FAW** subtests can be administered to gain general information about how specific cognitive processing weaknesses may manifest in the classroom – **Decoding Fluency, Spelling, Writing Fluency, Sentence Composition, Essay Composition**, and **Executive Working Memory**. Results from cognitive and academic tests can be used in a PSW analysis and considered along with data from other sources (e.g., educational, medical, familial background; work samples; parent, teacher, and student interviews; behavioral observations; rating scales; exclusionary factors; input from other school personnel familiar with the student) to determine whether an SLD is present and subsequently whether the student is eligible for special education services.

It is important to understand that the information in this table provides an example of ***an initial comprehensive and in-depth evaluation of suspected disability in WRITTEN EXPRESSION only***. It will be most appropriate when Writing is the only academic area of concern in the referral. Evaluations that have academic concerns spanning more areas will necessarily be less comprehensive to accommodate measurement of the other skill areas. In addition, any form of re-evaluation is typically much shorter and can be tailored even more specifically depending on what data are already available.

Diagnostic Assessment of Math skills, cognitive correlates, with **WISC-V/WIAT-4** as Core Batteries via XBA and with Supplemental **FAM** subtests (24-26 tests; Approximate Administration time – 1.3 hours)

Academic Subskill	Cognitive Correlates	Broad Ability	Narrow Ability	Core Battery Subtest	Optional/Supplemental Test
Number Sense	Number Representation				**Forward Number Count** **Backward Number Count** ***Object Counting***
	Number Comparison				***Number Comparison* (Gs:Pc)**
	Quantifying Sets without Counting			**Naming Speed Quantity (Gs:N; Gr:NA)**	
	Estimating Relative Magnitude of Sets				**Perceptual Estimation (Gs:N)**
Memorization of Arithmetic Facts	Long-term Retrieval	Gl	MA	**Immediate Symbol Translation**	***Delayed Symbol Translation; Recognition Symbol Translation***
Accurate or Fluent Calculation	Rapid Naming	Gr	NA	**Naming Speed Literacy**	**Rapid Number Naming**
	Processing Speed	Gs	Pc	**Coding**	**Number Comparison**
			N	**Math Fluency: Addition, Subtraction, Multiplication**	***Addition, Subtraction, Multiplication, and Division Fluency (tasks require verbal response)***
Accurate Math Reasoning	Working Memory	Gwm	Wa	**Digit Span**	
	Fluid Reasoning	Gf	RQ		**Sequences (RG)**
			I	**Matrix Reasoning**	
	Visual-Spatial Ability	Gv	Vz	**Block Design**	
			MV		**Spatial Memory**

	Attention and Executive Functioning		AC	**Letter-Number Sequencing**	**Cancellation**
Verbal Ability	Math Knowledge	Gc	K0		**Addition, Subtraction, Multiplication, Division Knowledge (Gq:KM; Gs:N)**
			VL	**Vocabulary**	***Linguistic Math Concepts***
Other[1]		Ga	PC	**Phoneme Proficiency**	

***Note*:** The Following math **WIAT-4** subtests can be administered to gain general information about how specific cognitive processing weaknesses may manifest in the classroom – **Math Problem Solving** and **Numerical Operations**. The **Equation Building** subtest from the **FAM** may also be used for this purpose. Results from cognitive and academic tests can be used in a PSW analysis and considered along with data from other sources (e.g., educational, medical, familial background; work samples; parent, teacher, and student interviews; behavioral observations; rating scales; exclusionary factors; input from other school personnel familiar with the student) to determine whether an SLD is present and subsequently whether the student is eligible for special education services.

It is important to understand that the information in this table provides an example of ***an initial comprehensive and in-depth evaluation of suspected disability in MATH only***. It will be most appropriate when Math is the only academic area of concern in the referral. Evaluations that have academic concerns spanning more areas will necessarily be less comprehensive to accommodate measurement of the other skill areas. In addition, any form of re-evaluation is typically much shorter and can be tailored even more specifically depending on what data are already available.

[1]If the student is reading at grade level and reading difficulties are not part of referral concerns, then a single phonetic coding test is sufficient for the purposes of a PSW analysis.

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Thank you!

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