One

OVERVIEW OF CROSS-BATTERY ASSESSMENT AND THE CROSS-BATTERY ASSESSMENT SOFTWARE SYSTEM (X-BASS)

The Cross-Battery Assessment method (hereafter called XBA) was introduced nearly 30 years ago by Flanagan and her colleagues (Flanagan & McGrew, 1997; Flanagan & Ortiz, 2001; Flanagan et al., 2000; McGrew, 1997; McGrew & Flanagan, 1998). It was introduced when practitioners had fewer intelligence, cognitive, and other ability batteries available to them and when test publishers and authors, in general, were not keeping pace with advancements in cognitive development, cognitive psychology, and theories of intelligence. XBA was presented as a defensible approach to narrowing the theory-practice gap and to designing assessments more responsive to referral concerns (Flanagan & McGrew, 1997). The development and history of XBA were described at length in the previous edition of this book and, therefore, will only be summarized here.

XBA was based primarily on the Cattell-Horn Fluid-Crystallized (*Gf-Gc*) model and later the Cattell-Horn-Carroll (CHC) model, and is now based on CHC and, to a lesser extent, neuropsychological theories. It provides practitioners with the means to make systematic, reliable, and theory-based interpretations of any ability battery and to augment that battery with cognitive, achievement, language, and neuropsychological subtests from other batteries to gain a more psychometrically defensible and complete understanding of an individual's strengths and weaknesses (Flanagan et al., 2017, 2018). Moving beyond the boundaries of a single cognitive, achievement, language, or neuropsychological battery by adopting the rigorous theoretical and psychometric XBA principles and procedures has been a significant improvement over single-battery assessment because it allows practitioners to focus on accurate and valid measures of the cognitive constructs and neurodevelopmental functions that are most germane to referral concerns (e.g., Caemmerer et al., 2020; Carroll, 1998; Decker, 2008; Flanagan et al., 2018; Kaufman, 2000; Reynolds et al., 2013).

DON'T FORGET

The XBA method is flexible, allowing practitioners to make systematic, reliable, and theory-based interpretations of composites composed of subtests from two or more batteries. XBA guides practitioners in supplementing any ability battery with subtests from other cognitive, achievement, language, and neuropsychological batteries, resulting in a comprehensive evaluation of an individual's strengths and weaknesses. This flexibility empowers practitioners to tailor their assessments to each individual's unique needs, fostering a more responsive, personalized approach.

Carroll (1997) noted that the CHC taxonomy of human cognitive abilities "appears to prescribe that individuals should be assessed with respect to the total range of abilities the theory specifies" (p. 129). However, he also recognized the challenges this would pose, stating that "[r]esearch is needed to spell out how the assessor can select what abilities need to be tested in particular cases" (p. 129). Flanagan and colleagues' XBA method provides this guidance, enabling practitioners to conduct assessments that cover a more comprehensive range of cognitive abilities and processes, academic skills, and linguistic and neuropsychological processes than what is possible with any single battery or collection of co-normed tests.

In an early review of the XBA method, Carroll (1998) stated that it "can be used to develop the most appropriate information about an individual in a given testing situation" (p. xi). In Kaufman's (2000) review of XBA, he said that the method is "based on sound assessment principles, adds theory to psychometrics, and improves the quality of the assessment and interpretation of cognitive abilities and processes" (p. xv). Decker (2008) stated that the XBA method "may improve school psychology assessment practice and facilitate the integration of neuropsychological methodology in school-based assessments [because it] shift[s] assessment practice from IQ composites to neurodevelopmental functions" (p. 804). A listserv thread of the *National Association of School Psychologists* focused on the potential weaknesses of XBA, Kevin McGrew, lead author of the Woodcock-Johnson V (WJ V), stated, "In the hands of 'intelligent' intelligence examiners the XBA system is safe and sound" (2011, March 30). In subsequent years, administering tests from multiple batteries became more commonplace in school and clinical settings. Perhaps the best example is Pearson's *Q-global* platform, where practitioners may select the batteries and the specific subtests from those batteries they want to administer, thus building their own cross-battery. Another example is the new WJ V, which includes a Virtual Test Library that may be used to supplement the WJ V COG and WJ V ACH batteries. However, neither *Q-global* nor the WJ V allows for the integration, analysis, and interpretation of data from batteries outside their respective platforms, such as those found in the *Cross-Battery Assessment Software System* (X-BASS 3.0; Flanagan et al., 2025). X-BASS 3.0 is referred to hereafter as X-BASS. Rapid Reference 1.1 provides a brief description of X-BASS.

Rapid Reference 1.1

What Is X-BASS?

- X-BASS is a software designed to assist practitioners in several aspects of assessment and interpretation, including:
  - The organization of evaluations specific to referrals that involve learning difficulties (see Chapters 2, 5, 6, and 7)
  - Organization of subtests into theoretically sound CHC broad and narrow ability composites (see Chapter 2)
  - Interpretation of XBA data (most chapters)
  - Recommendations for follow-up assessment (see Chapters 2 and 5)
  - Analysis of within-battery and cross-battery data according to the patterns of strengths and weaknesses (PSW) method of SLD identification, namely the Dual Discrepancy/Consistency method (see Chapters 3, 5, and 7)
  - PSW interpretation occurs within a broader operational definition of SLD (now integrated into X-BASS), providing guidance culminating in a defensible SLD decision (Chapter 3)
  - Analysis of within-battery and cross-battery data according to the degree of mainstream United States cultural influences and English language demands on test performance for multilingual learners (see Chapter 8)
  - Provision of interpretive statements and summary statements throughout to assist practitioners with report writing (most chapters)
- X-BASS is based on the most current research in the following areas:
  - The current CHC taxonomy (see Appendix A)
  - Expert consensus classifications of all new tests (see Appendix B)
  - The relations between cognitive abilities and academic skills based on large-scale data (see Appendix C)
  - Reliabilities and intercorrelations from the largest within-battery and cross-battery dataset currently available (see Appendix D)
- X-BASS 3.0 is more efficient than its predecessors in the following ways:
  - Easier to use; faster
  - Simplified and intuitive interface
  - More capabilities and features for multilingual learners
  - PSW analysis is embedded in an SLD operational definition and decision-making process designed to improve diagnostic accuracy
  - Expanded research base
  - Single data entry tab
  - Automatic features, such as graphs, score tables, and interpretation summaries, that are easily incorporated into reports

CAUTION

It is important to note that the XBA method does not simply mean using multiple batteries or parts of batteries in an evaluation. It is systematic and requires that specific procedures be followed. It also uses rules designed to reveal intraindividual strengths or weaknesses within ability domains that might otherwise have been obscured. If you are not following XBA principles and procedures, then it is more appropriate to use the term "flexible battery" rather than "cross-battery." If you use the XBA Analysis tab in X-BASS, then your data is analyzed following the XBA method.

Practitioners had "crossed" batteries before Woodcock (1990) recognized the need, before McGrew and Flanagan (1998) introduced the XBA method, and before Pearson and other test publishers made the option available online. Neuropsychologists have combined different standardized batteries to assess a wider array of brain functions than any single battery provides (Hale & Fiorello, 2004; Hale et al., 2011; Lezak, 1976, 1995; Lezak et al., 2004; Wilson, 1992). Nevertheless, many neuropsychologists' everyday test administration and interpretation practices lack the theoretical and psychometric rigor of the XBA method.

The introduction of *Gf-Gc* theory and the XBA method to school psychology dates back to the late 1980s and early 1990s (e.g., Carroll & Horn, 1981; Flanagan & McGrew, 1998; Horn, 1991; Keith, 1997). The Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R), published in 1989, was the first operationalization of *Gf-Gc* theory and measured eight broad cognitive abilities. Using data from the special validity studies from the 1977 Woodcock-Johnson Psycho-Educational Battery (WJ) and 1989 WJ-R, Woodcock (1990) completed a series of comprehensive *Gf-Gc*-driven joint factor analyses. Each analysis included the WJ-R cognitive tests and subtests from another intelligence battery (e.g., Kaufman Assessment Battery for Children [K-ABC], Stanford–Binet Intelligence Scale: Fourth Edition [SB:IV], Wechsler Intelligence Scale for Children–Revised [WISC-R]). Woodcock concluded that the WJ-R's eight-factor *Gf-Gc* model was supported based on these joint or cross-battery factor analyses. Equally important was his conclusion that other ability batteries have been underfactored, often resulting in misinterpretation of their factor structure. As such, Woodcock suggested that if practitioners are not using the WJ-R and would like to assess a broad range of abilities, they would need to "cross" batteries.

Several problems with "crossing" batteries (via flexible battery approaches) plagued assessment-related fields for years and most likely still do. Most of these problems have been circumvented by the XBA method (see Table 1.1 for examples). McGrew and Flanagan (1998) sought to create a set of principles and procedures that would allow practitioners to cross batteries psychometrically and theoretically defensibly. To achieve this goal, they used the results of Woodcock's (1990) joint-factor analyses, other similar studies, expert consensus, and an integrated version of *Gf-Gc* theory, drawn mainly from the work of John Horn and John Carroll as conceptualized by McGrew (1997), to classify all major intelligence batteries and a variety of special purpose tests according to the *Gf-Gc* broad and narrow abilities they measured.

Next, McGrew and Flanagan provided practitioners with guidelines for selecting and using the components of ability batteries either singularly or in combination to best address referral concerns. They described their assessment method as the "*Gf-Gc* cross-battery approach" in their

Table 1.1 Parallel Needs in Cognitive Assessment-Related Fields Addressed by the XBA Method

Need Within Assessment-Related Fields	Need Addressed by XBA Method
School psychology, clinical psychology, and neuropsychology have lagged in developing conceptual models for assessing individuals. Contemporary models are needed.	The XBA method is grounded in CHC theories and the network of validity evidence that supports them (McGrew, 2023; Schneider & McGrew, 2018) for measuring and interpreting cognitive and academic abilities and neuropsychological processes.
Events external to a field of endeavor are needed to give impetus to new developments and fundamental advances in that field.	The CHC taxonomy and related research in cognitive psychology, cognitive neuroscience, and neuropsychology provided the impetus for and continued refinements to the XBA method, leading to better assessment instruments (e.g., WJ V) and interpretive procedures (e.g., X-BASS).
There is a need to utilize a conceptual framework to guide any assessment method. This would aid both in selecting instruments and methods and in interpreting test findings.	The XBA method is guided by the vast CHC literature, which includes substantive, structural, and academic outcomes research. Based on this research, selective, referral-relevant guidelines were developed and included in the XBA method to aid test selection (see Chapter 2) and interpretation (see Chapters 5 through 8).
The conceptual framework or model underlying assessment must incorporate various aspects of neuropsychological and cognitive ability function that can be described in terms of constructs recognized in the neuropsychological, cognitive psychology, and cognitive neuroscience literature.	The XBA method incorporates various aspects of neuropsychological and cognitive ability functions described in terms of constructs recognized in the literature. A consistent set of terms and definitions within the CHC literature (e.g., Schneider & McGrew, 2018) and the neuropsychology literature (e.g., Miller et al., 2022) underlie the XBA approach.
A conceptual framework is needed to measure the full range of behavioral functions the brain subserves. In neuropsychological assessment, no inclusive set of measures is standardized on a single normative population.	The XBA method allows for the measurement of a wide range of broad and narrow cognitive abilities specified in CHC theories and neuropsychological processes specified by neuropsychological theory and research. Although an XBA norm group does not exist, crossing batteries and interpreting assessment results are supported by large-scale within- and cross-battery data and based on sound psychometric principles and procedures. Other than XBA, the most extensive set of tests is within the WJ V assessment system, which consists of 60 co-normed tests.
Because psychological assessment lacks truly unidimensional measures, subtests from standardized instruments that appear to reflect the neurocognitive function of interest must be selected. In neuropsychological assessment, the aim is to select measures that, based on careful task analysis, primarily tap a given construct.	The XBA method is defined in part by a CHC classification system. Most subtests from the major cognitive and achievement batteries and selected neuropsychological instruments were empirically classified as measures of broad and narrow CHC constructs (via CHC within- or cross-battery factor analysis, expert consensus, or both) (Caemmerer et al., 2020; Reynolds et al., 2013; see Appendix B). Using evidence-based classifications allows practitioners to be reasonably confident that a given test taps a given construct (e.g., Flanagan et al., 2013).
An eclectic approach is needed when selecting measures, preferably subtests rather than omnibus IQs, to gain greater specificity in delineating patterns of function and dysfunction.	The XBA method ensures that two or more relatively pure, but qualitatively different indicators (i.e., measures, such as subtests) of each *broad* cognitive ability are represented in a comprehensive assessment. Two or more qualitatively similar indicators are necessary to infer specific or *narrow* CHC abilities. This process is eclectic in its selection of measures.
It is necessary to address potential problems that can arise from crossing normative groups and sets of measures with varying reliabilities.	In the XBA method, baseline data on cognitive functioning can typically be obtained across 8–10 CHC broad abilities using only two batteries standardized within a few years of each other, thereby reducing the effects of error due to norming differences. Additionally, since the interpretation of both broad and narrow CHC abilities is made at the cluster (rather than subtest) level, issues related to low reliability are uncommon in this approach. Finally, because cross-battery composites are generated from reliabilities and intercorrelations derived from a large-scale within- and cross-battery dataset, the composites produced by this method are psychometrically sound (see Appendices D and E).

Source: Information obtained, in part, from Wilson (1992).

Woodcock-inspired *Intelligence Test Desk Reference* (ITDR; McGrew & Flanagan, 1998). They also devoted a chapter in the ITDR to "selective cross-battery assessment," which they defined as using cross-battery guidelines and principles to tailor a unique *Gf-Gc*-organized assessment battery to address specific referral concerns, mostly reading- and math-related difficulties. They presented a broad survey of the relations between individual cognitive and academic test performance to guide selective (referral-relevant) cross-battery assessment. Updates to this initial research on cognitive-achievement relations have been ongoing and continue to guide selective cross-battery assessment (e.g., Flanagan et al., 2013; Hajovsky et al., 2022, 2025; Niileksela & Hajovsky, 2024; Niileksela et al., 2016, 2026). The latest research on cognitive-achievement relations is described in Appendix C, and its applicability to identifying specific learning disabilities is discussed in Chapter 3.

Since the introduction and integration of *Gf-Gc* theory-based assessment into school psychology and other assessment-related fields, significant revisions, refinements, and expansions have been made to XBA, test development, assessment practices, and, most importantly, test interpretation (Alfonso et al., 2005; Flanagan, 2025; Flanagan et al., 2022; Keith & Reynolds, 2010; McGrew, 2023; Raiford, 2017; Schneider & McGrew, 2018). For example, McGrew's (1997) integration of the Cattell-Horn and Carroll models eventually became known as the Cattell-Horn-Carroll (CHC) theory—a union brokered by the diplomatic efforts of Richard Woodcock (cf., McGrew, 2005). CHC theory was operationalized by the Woodcock-Johnson III (WJ III) in 2001, WJ IV in 2014, and WJ V in 2025. The WJ V is the first battery to be based on the most recent CHC taxonomy (Schneider & McGrew, 2018) and will likely remain the best operationalization of CHC theories for many years to come.

Following Woodcock's lead, multiple authors and publishers explicitly used CHC theory and research to guide the revisions of their intelligence batteries (e.g., Differential Ability Scales–Second Edition [DAS-II], Kaufman Assessment Battery for Children–Second Edition [KABC-II], Stanford–Binet Intelligence Scales–Fifth Edition [SB5], and Wechsler Adult Intelligence Scale–Fifth Edition [WAIS-V]). Currently, over 120 batteries and 1,000+ subtests have been classified according to the *most recent CHC taxonomy*, using expert consensus and other data sources, and are included in X-BASS. The XBA method, automated by X-BASS, is grounded in rigorous, contemporary psychometric and theoretical research. For example, the most current research on cognitive-achievement relations was expanded to include 148 batteries, 1,160 subtests, 568 correlation matrices, over 50,000 intercorrelations, and over 200,000 individuals (e.g., Hajovskyet al., 2022, 2025; Niileksela et al., 2026), which provided a strong research foundation for the latest versions of the XBA method and X-BASS (see Appendix C for more details). Rapid Reference 1.2 provides a snapshot of the most salient research that guided current XBA procedures and the latest version of X-BASS. For those new to the method, the foundation and rationale for XBA are presented next, followed by a description of the XBA method. This chapter culminates with a section on "getting started" with X-BASS. In subsequent chapters, the reader is further instructed in using X-BASS for within-battery, cross-battery, and selective cross-battery assessments. Figure 1.1 provides a timeline for XBA's evolution. Figure 1.2 provides an overview of the information presented in this chapter.

DON'T FORGET

XBA is a method of assessing cognitive, academic, linguistic, and neuropsychological abilities and processes grounded in CHC theories (McGrew, 2023; Schneider & McGrew, 2018) and neuropsychological theory and research (e.g., Miller, 2024; Miller et al., 2022). The XBA method allows practitioners to reliably and validly measure a broader range (or a more in-depth but selective range) of abilities and processes than any given stand-alone assessment battery.

Rapid Reference 1.2

Selected Research that Guided Revisions and Refinements to XBA and X-BASS

Substantive (Content) Validity	Structural (Construct) Validity	Academic Outcomes (Predictive) Validity	Other Evidence
• CHC classifications for all new batteries in X-BASS 3.0 based on an extensive review of technical manuals, extant research, and an expert consensus study (described in Appendix B)	• Caemmerer and Reynolds (2020) • LaForte et al. (2025) • McGrew (2023) • Reynolds et al. (2013) • Schneider and McGrew (2018)	• Cognitive-achievement relations research based on data from 148 ability batteries, more than 500 correlation matrices, and over 52,000 correlations and 200,000 participants—provided guidance and support for consistency analysis in the PSW method (Hajovsky & Niileksela, 2024; Hajovsky et al., 2025)	• Psychometric network analysis (LaForte et al., 2025; McGrew et al., 2023)—*supports interpreting broad cognitive abilities*

Substantive (Content) Validity	**Structural (Construct) Validity**	**Academic Outcomes (Predictive) Validity**	**Other Evidence**
• A review of cross-battery factor analyses to verify existing classifications of all tests in X-BASS 3.0	• *These studies guided and support the CHC structure upon which within-battery and cross-battery assessments are based*	• Cognitive-achievement relations research—from studies that include individuals with specific learning disabilities (summarized by McDonough et al., 2017)—*guided selective cross-battery assessments*	• Neurocognitive evidence (e.g., Kristanto et al., 2023) *supports broad ability interpretation*. Distinct broad abilities are associated with different combinations of brain subnetworks (Wang et al., 2021) • Reliability and intercorrelation information, needed for analyses conducted in X-BASS, were derived from a large-scale dataset (described in Hajovsky et al., 2025) • Schneider et al. (2024)—provided a psychometrically sound way to determine decision accuracy for PSW, which is in the SLD module of X-BASS

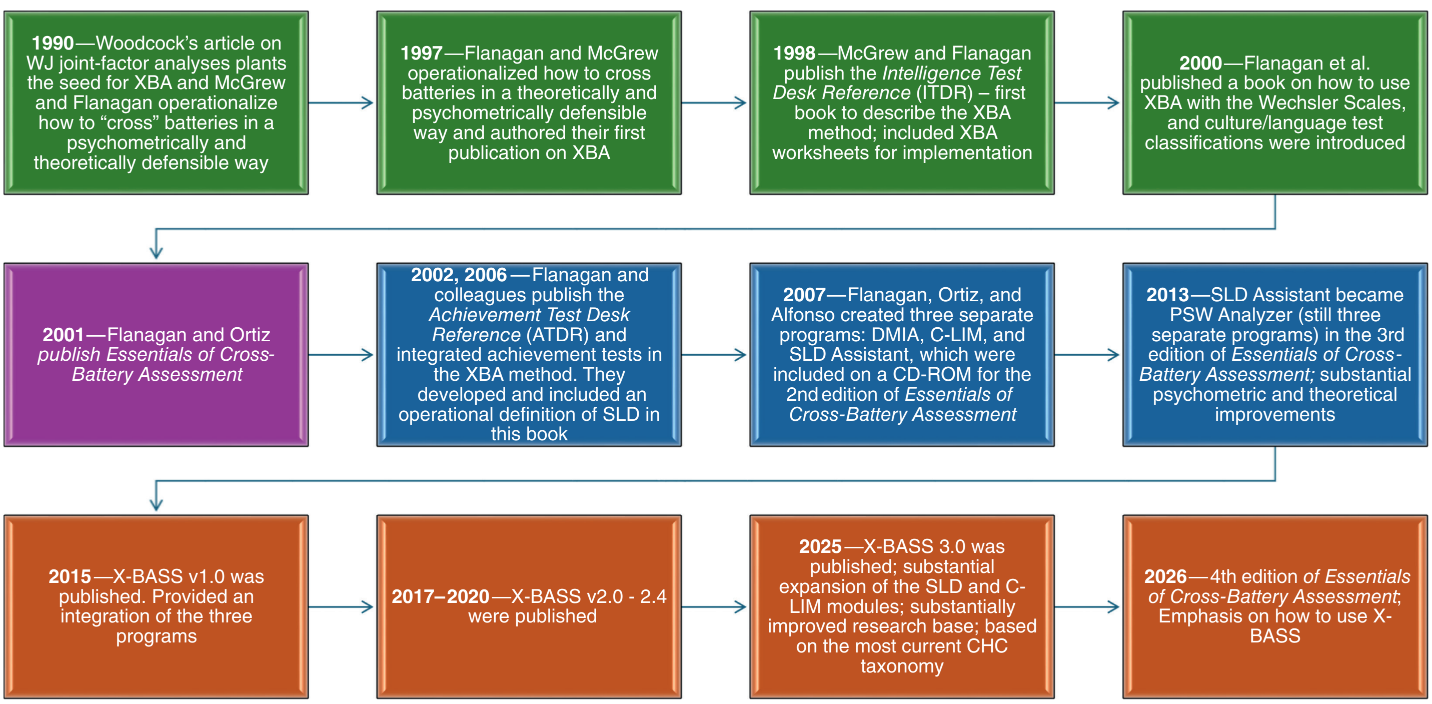


FIGURE 1.1 The Evolution of the Cross-Battery Assessment (XBA) Method. *Note:* Green = The Original Developers of XBA, McGrew and Flanagan, Introduce the Method to the Field; Purple = Ortiz Joins and Assists in Expanding upon Flanagan's Culture/Language Test Classifications First Published in the ITDR; Blue = Alfonso and Mascolo Join, Contributing to Expanding XBA to Achievement Tests and Developing the SLD Operational Definition; Orange = Flanagan, Ortiz, and Alfonso Develop X-BASS and Continually Update, Revise, Refine, and Extend it to Meet the Needs of Practitioners

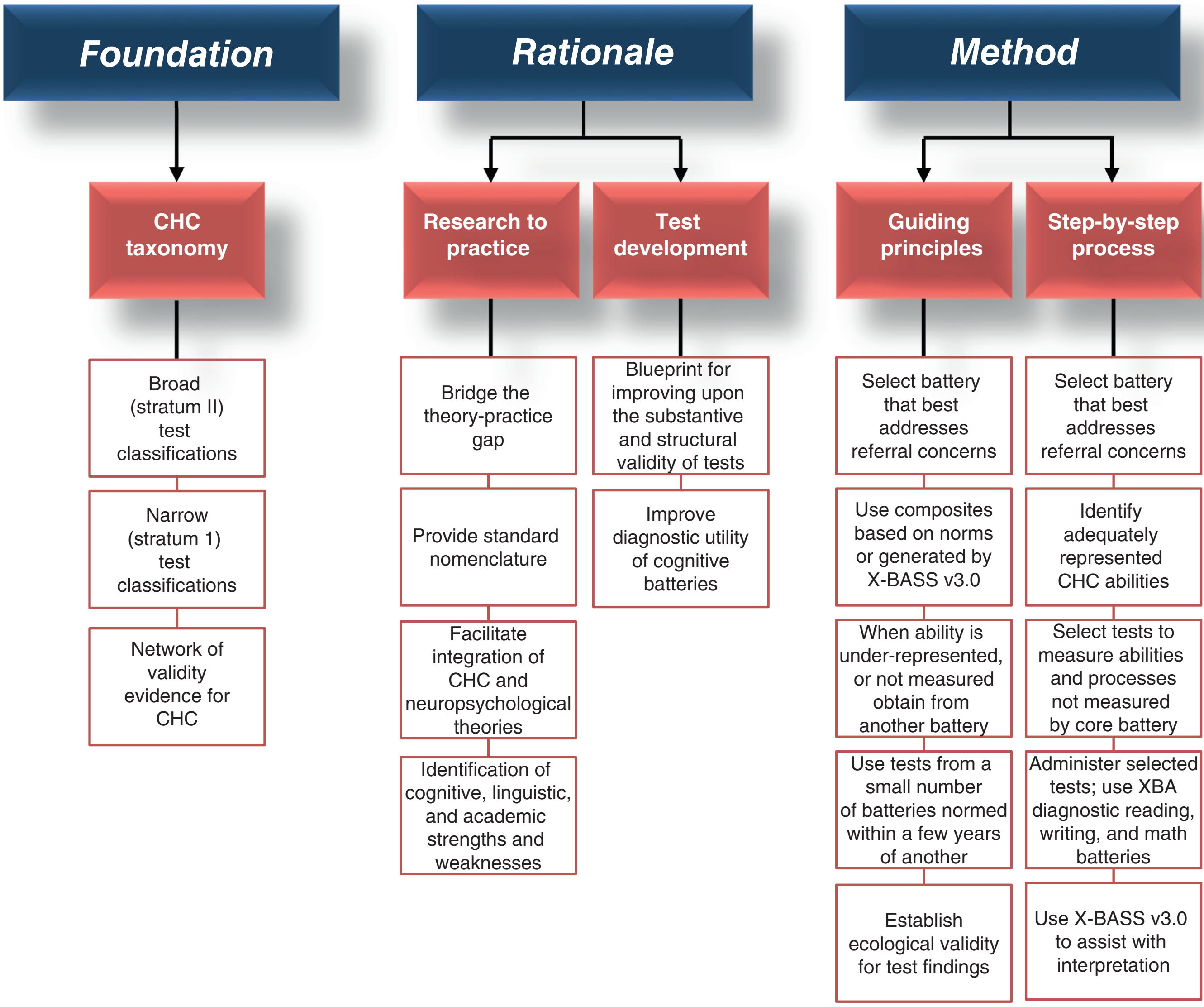


FIGURE 1.2 Overview of XBA

FOUNDATIONS OF XBA

Over a Century of Progress in Psychometric Theories of Intelligence

For decades, researchers have developed theories to explain the construct of intelligence and methods to evaluate individual differences in the abilities and processes that comprise these theories (e.g., Carroll, 1993; Cattell, 1941; Gustafsson & Undheim, 1996; Horn, 1991; Kaufman & Kaufman, 1983; McGrew, 1997; McGrew, 2023; McGrew et al., 2023; Schneider & McGrew, 2012, 2018; Taylor, 1994; Thorndike, 1997; Thurstone, 1938). Beginning with Spearman's *g* (Gottfredson, 2002; Spearman, 1904) and culminating in the most recent version of the CHC taxonomy (McGrew, 2023; Schneider & McGrew, 2018), as shown in Figure 1.3, progress in the psychometric or structural approach to understanding individual differences in intelligence and cognitive abilities has advanced considerably. Given space limitations, only the application of the CHC taxonomy to psychoeducational assessment and test interpretation is described here. See Figure 1.4 for a timeline of important developments in CHC theory and Rapid Reference 1.3 for salient revisions and refinements to the CHC taxonomy.

> **DON'T FORGET**
>
> The contemporary CHC taxonomy comprises 17 broad cognitive abilities and over 80 narrow abilities. Popular cognitive, achievement, language, and neuropsychological batteries, as well as special-purpose tests, measure a large subset of these abilities.

Note that Figure 1.2 omits a general ability (*g*) factor, primarily because the utility of the model (in assessment-related disciplines) is in understanding functioning in specific ability and processing domains, which are understood best through the operationalization of broad and narrow cognitive abilities and processes (e.g., Caemmerer et al., 2020; Compton et al., 2012; Evans et al., 2002; Flanagan et al., 2013, 2017; McCloskey et al., 2017; McGrew, 1997, 2009; Miller & Maricle, 2019; Reynolds et al., 2013;

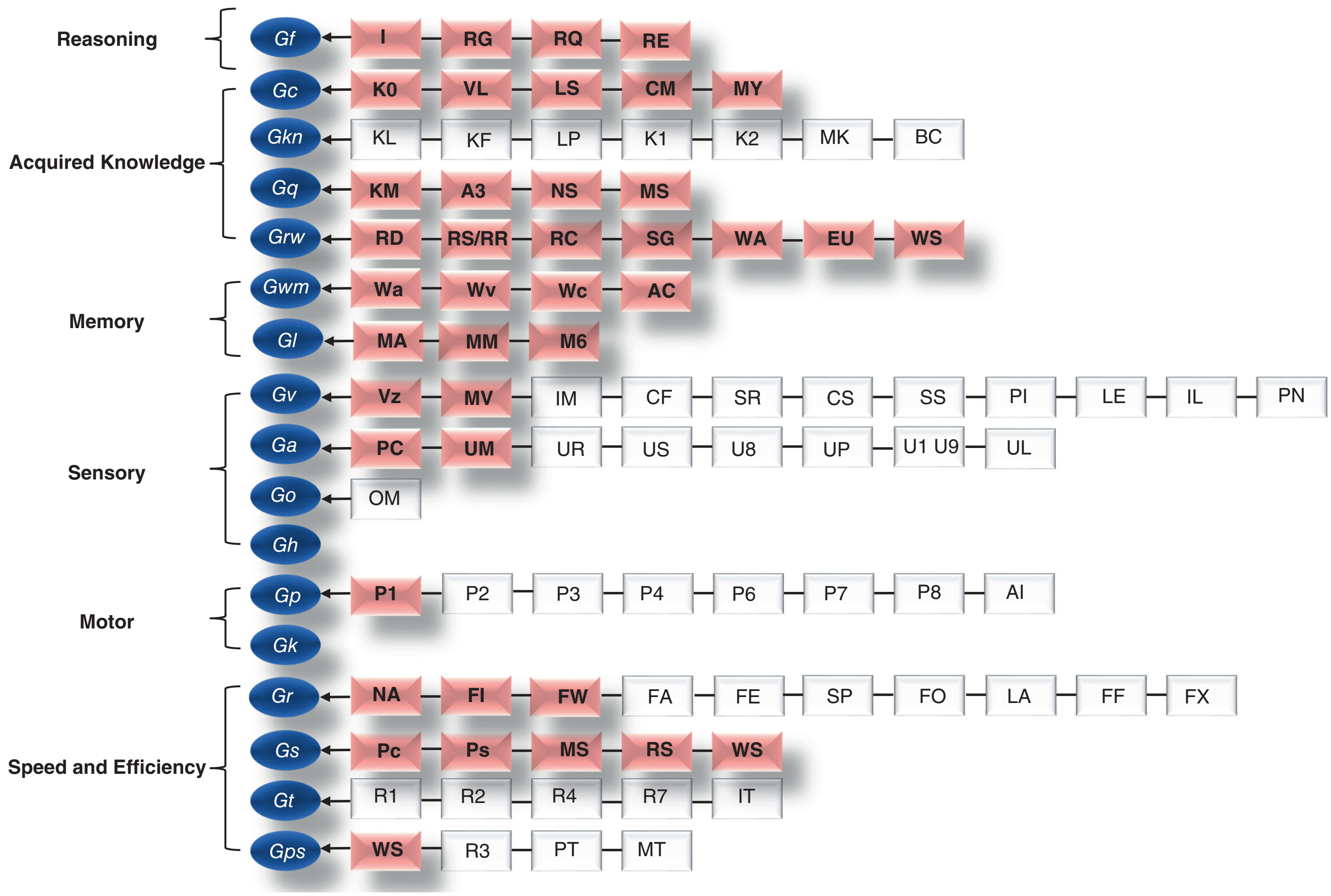


FIGURE 1.3 The Current CHC Taxonomy of 17 Broad Abilities and Over 80 Narrow Abilities (Adapted from Schneider & McGrew, 2018). ***Note:*** **Ovals Represent Broad Abilities, Rectangles Represent Narrow Abilities, and Left Braces Represent Groupings Consistent with Neuropsychological Domains. Narrow Abilities in Maroon-Shaded Rectangles Are Those More Commonly Measured Across Ability Batteries. Letter Codes and Corresponding Broad and Narrow Ability Definitions Are in Appendix A**

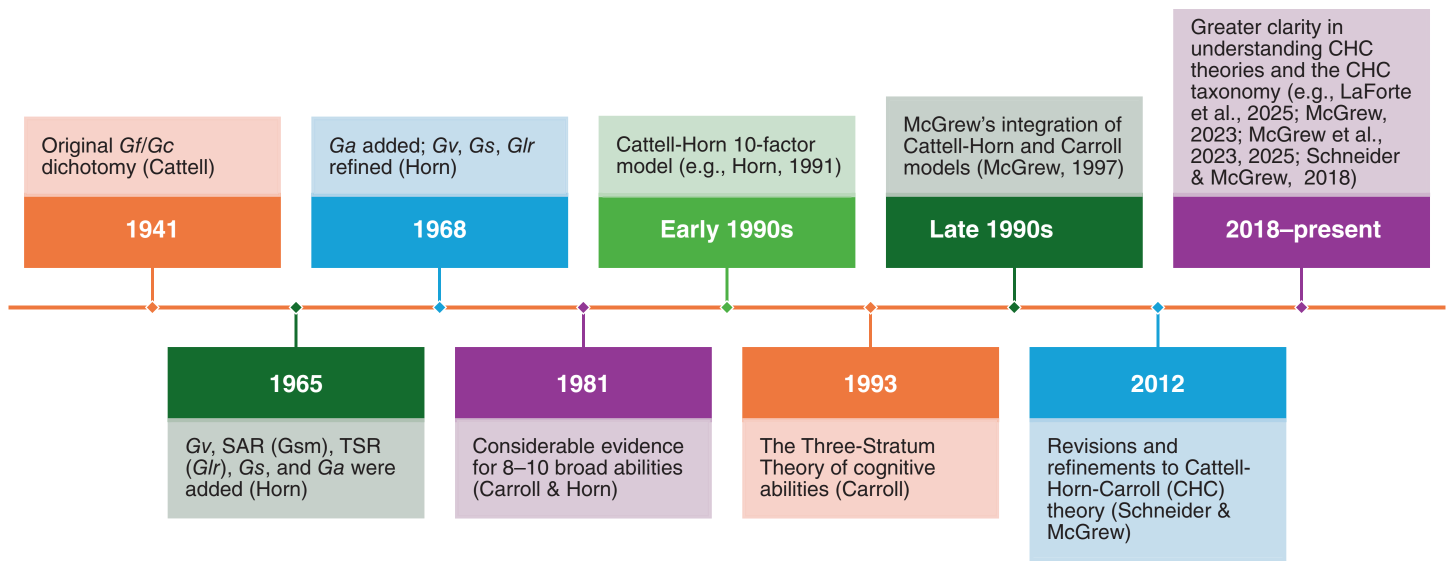


FIGURE 1.4 Highlights in the Development of CHC Theories. ***Note:*** **SAR = Short-Term Acquisition and Retrieval; TSR = Long-Term Storage and Retrieval. Critical Reviews of CHC Theories Have Been Published in Recent Years (e.g., Data from McGill & Dombrowski, 2019)**

Rapid Reference 1.3

Salient CHC Revisions and Refinements Reported in Schneider and McGrew (2018)

Revision	Details	Comments
Long-term Storage and Retrieval (*Glr*) was dropped and replaced with Learning Efficiency (*Gl*) and Retrieval Fluency (*Gr*)	The *Gl* domain subsumes the narrow abilities of Associative Memory (MA), Meaningful Memory (MM), and Free Recall Memory (M6). The *Gr* domain subsumes narrow retrieval speed abilities, such as Naming Facility (NA), Ideational Fluency (FI), and Word Fluency (FW).	There are several implications of this change. For example, subtests measuring Glr needed to be reclassified as measuring either a narrow *Gl* ability (e.g., Meaningful Memory, Free Recall Memory) or a narrow *Gr* ability (e.g., Naming Facility, Ideational Fluency), which has implications for test interpretation. The Glr composite on the WJ IV is interpreted as *Gl* based on the new CHC taxonomy. Also, the composition of total test composites may differ in subsequent editions of batteries (e.g., the WJ V eight-subtest GIA includes a measure of *Gr* whereas the WJ IV seven-subtest GIA does not; LaForte et al., 2025).
Intermediate factors were added	Three intermediate factors were added, including Language Development (LD) in the *Gc* domain, Speed of Lexical Access (LA) in the *Gr* domain, and Perceptual Speed (P) in the *Gs* domain.	Carroll (1993) referred to LD as an intermediate category between the broad *Gc* ability and narrow *Gc* abilities (e.g., Lexical Knowledge, Listening Ability, Grammatical Sensitivity), which represented a combination of *Gc* narrow abilities working together simultaneously (Adapted from Schneider & McGrew, 2018). Fewer subtests were classified as LD than all narrow *Gc* abilities. No subtests were classified as LA, but many were classified as one of its two component narrow abilities, Naming Facility (NA) and, to a lesser extent, Word Fluency (FW). Any subtests that were classified as P included Pc (compare) and Ps (search) demands to a substantial degree.
Facets were added	In the *Gr* domain, narrow abilities are grouped into three facets: words, ideas, and figures. In the *Gs* domain, narrow abilities are grouped into two facets: cognitive and academic.	The *Gr words* facet consists of two narrow abilities—Naming Facility (NA) and Word Fluency (FW)—that are subsumed by the intermediate factor, Speed of Lexical Access (LA). Within the *Gr* domain, indicators of NA and FW are typically most sensitive to reading difficulties and dyslexia (Duke & Cartwright, 2021). The *Gs cognitive* facet includes the narrow abilities of Perceptual Speed-compare (Pc) and Perceptual Speed-search (Ps). The *Gs academic* facet includes narrow abilities that require quick and accurate performance with learned information and skills (e.g., Reading Speed [RS], Writing Speed [WS]).
New narrow abilities were added, and others were dropped	The narrow ability of Rate-of-Test-Taking (R9) in the *Gs* domain was dropped, and Perceptual Speed-compare (Pc) and Perceptual Speed-search (Ps) were added. Memory Span (MS) was dropped from the *Gwm* domain, and Auditory Short-term Storage (Wa) and Visual Spatial Short-term Storage (Wv) were added. Attentional Control (AC) was also added as a narrow ability in the *Gwm* domain.	In the *Gs* domain, all subtests previously classified as R9 were reclassified, mainly as Perceptual Speed-compare (Pc) or Perceptual Speed-search (Ps). In the *Gwm* domain, tests previously classified as Memory Span (MS) were reclassified as either Auditory Short-term Storage (Wa) or Visual Spatial Short-term Storage (Wv). The narrow ability code of AC is similar to the previously used Working Memory (WM) code. In other words, subtests previously classified as WM are now classified as AC (e.g., McGrew et al., 2025). Appendix B provides a more detailed explanation of how working memory subtests are classified in expert consensus studies and in X-BASS 3.0.

Woodcock et al., 2017). Also, the CHC theory is compatible with network models, which renounce *g* and conceive of cognitive abilities as an interconnected network of cognitive processes that cognitive tests sample in various ways (Kan et al., 2019; Kovacs & Conway, 2016). Despite the ongoing debate regarding the existence of *g*, specifically in the field of school psychology, many researchers continue to accept *g* as a valid psychological construct and believe that a proxy for *g*, such as a Full Scale IQ, is the only score that can be interpreted from an intelligence or cognitive ability battery (e.g., Canivez & McGill, 2016; Dombrowski et al., 2015, 2017; Warne & Burnungham, 2019; Watkins & Beaujean, 2014). Research is abundant to the contrary. See Rapid Reference 1.4 for a commentary on test interpretation concerning *g*.

Rapid Reference 1.4

Fields Outside of School Psychology Weigh in on *g*

The studies that concluded that only total test scores from intelligence and cognitive ability batteries can be interpreted used bifactor and Schmid-Leiman (BF/SL) methods, which have been criticized for methodological confounds and for lacking a theoretical basis (see Decker, 2021; Decker et al., 2021, for a critical review of this research; see also Murray & Johnson, 2013; Schmank et al., 2021; see Dombrowski et al., 2021, for a rebuttal). Dombrowski et al. (2021) espouse *g*-theory and the importance of *g*-level interpretation over lower-order, broad-ability-level interpretations, based on their BF/SL research findings. However, the level of interpretation (*g*-level or broad ability-level) varies as a function of the methods and statistical procedures used (e.g., Burgoyne et al., 2022; Decker, 2021; Keith & Reynolds, 2018; McGrew et al., 2025; Murray & Johnson, 2013; Schmank et al., 2021; Schulze, 2005; see also Bornovalova et al., 2020, for similar issues in psychopathology). Also, these researchers rarely include or cite research that supports the interpretation of CHC broad abilities. For example, while Dombrowski et al. (2021) provided 19 references that included at least one member of their "*g*-centric" research group (or "Canivez et al. group"), they provided 0 references to any researchers who demonstrate a multi-factorial view of intelligence (i.e., the "Keith-Reynolds group," cf. McGrew et al., 2023, p. 2). Because the Canivez et al. group ignores the Keith-Reynolds group's research, it boldly promotes a *g*-centric view of intelligence test interpretation along with the de-implementation of test interpretation approaches that include CHC broad abilities (Dombrowski et al., 2021; Farmer et al., 2021a,b) *in the absence of sufficient empirical support to do so*.

"A statistical procedure is not an automatic, mechanical truth-generating machine. . ." (Meehl, 1992, p. 143) (see also Kell & Lang, 2017). Interpretations drawn from the Canivez et al. group's BF/SL models are limited because they are not based on theoretical models of intelligence and cognition (e.g., Decker, 2021; McGrew, 2023; McGrew et al., 2025; Murray & Johnson, 2013). Furthermore, the Canivez et al. group acknowledges that their bifactor models have estimation problems and, therefore, should not be trusted, but then use their untrustworthy models to promote *g*-only test interpretation and discourage CHC broad ability interpretation (see Wilson et al., 2023, for a discussion). Interpretations drawn from the Keith-Reynolds research group are less limited because they are supported by many sources of validity (e.g., Horn, 1991; Horn & Noll, 1997; McGrew, 2023; cf. Flanagan, 2025; see also LaForte et al., 2025).

Elusive *g* results from positive correlations among scores and is best conceived as positive manifold or *psychometric g*. Despite its predictive power and replicability (Jensen, 1998), it remains to be seen what *g* is. A general assumption in psychology is that an individual's intelligence or cognitive test scores are caused by *g*. However, there are other plausible explanations for *g*. For example, *g* may emerge *because* of the indicators, meaning that *g* is a formative latent variable (Conway et al., 2021; Kovacs & Conway, 2016). The latter explanation renders the strata below *g* (i.e., broad and narrow abilities) of primary importance (e.g., Colom et al., 2009; Haier et al., 2009; McGrew et al., 2023). There is a network of validity evidence for distinct CHC abilities beyond structural (i.e., factor analysis) evidence (e.g., Carroll, 1993; LaForte et al., 2025), including developmental (Schrank et al., 2014), achievement (e.g., Hajovsky et al., 2025; O'Connell, 2018), neurocognitive (e.g., Barbey, 2018; Kristanto et al., 2023), and heritability (e.g., Malanchini et al., 2020; Procopio et al., 2022) evidence (see also Daniel, 1997; Horn & Noll, 1997). Like broad abilities, an explanation of *g* requires stepping outside the domains of psychometrics and school psychology and into other fields, such as neurobiology and cognitive neuroscience (McGrew et al., 2023; cf. Flanagan, 2025).

The interested reader is directed to theories that explain *g* via overlapping brain networks (Conway et al., 2021; Decker et al., 2018; Haier & Jung, 2018; Jung & Haier, 2007; Kovacs & Conway, 2016; Schmank et al., 2021). For example, *Process Overlap Theory* (POT) postulates that domain-general executive processes, located primarily in the prefrontal cortex and partly in the parietal cortex, are the main reason for the emergence of positive manifold or *g* (Kovacs, 2019; Kovacs & Conway, 2016). The theory proposes that domain-general executive processes overlap with domain-specific cognitive processes more than the domain-specific cognitive processes overlap with one another and that any cognitive task requires several domain-general and domain-specific cognitive processes (e.g., Bailey et al., 2018; Klein & Knops, 2023). Central to the theory is that individual differences in executive processes can be a bottleneck for cognitive functioning. Theories like POT explain positive manifold or *psychometric g*, but dismiss *psychological g*.

Another brain network theory is the *Parietal Frontal Integration Theory* (P-FIT; Haier & Jung, 2018). P-FIT proposes that intelligence emerges from efficient integration across a distributed brain network, rather than from any single brain region, with individual differences in network connectivity creating the biological foundation for general intelligence. This distributed network model bridges psychometric models of intelligence structure and the underlying neurobiology, explaining how shared neural infrastructure produces positive manifold (Haier & Jung, 2018; Jung & Haier, 2007; Vakhtin et al., 2014). These theories provide a more plausible explanation of *g* than that found in the BF/SL research of the Canivez et al. group (e.g., Canivez & McGill, 2016; Dombrowski et al., 2018). Moreover, mounting neurocognitive evidence suggests that distinct broad cognitive abilities are associated with different combinations of brain subnetworks (Barbey, 2018; Decker et al., 2017; Kristanto et al., 2023; McGrew et al., 2023), thus providing additional support for the interpretation of broad cognitive abilities.

Theories such as POT and P-FIT will likely drive the future of intelligence and cognitive test development and interpretation, as well as research on intelligence and cognition (e.g., Kristanto et al., 2023; McGrew et al., 2023; Van Der Maas et al., 2017). Traditional psychometric intelligence testing may soon be replaced by portable neuroimaging technology that can provide a pathway to more precise, individualized educational approaches tailored to each student's cognitive strengths and weaknesses (Haier & Jung, 2018).

CHC Broad (Stratum II) Classifications of Subtests on Ability Batteries

Based on the results of a series of cross-battery confirmatory factor analysis studies of the major cognitive and intelligence batteries (see Caemmerer et al., 2020; Keith & Reynolds, 2010, 2012; LaForte et al., 2025; Reynolds et al., 2013) and task analyses performed by cognitive test experts, Flanagan and colleagues classified over 2,000 subtests according to the CHC broad abilities they measure since the late 1990s. Because dozens of new batteries are published each year and many others are updated to new editions, the collection of batteries and subtests in X-BASS changes accordingly.

Classification of subtests at the broad ability level is necessary to improve the validity of cognitive assessment and interpretation. Specifically, broad ability classifications ensure that the CHC constructs underlying assessments are minimally affected by *construct-irrelevant variance* (Messick, 1989, 1995). In other words, knowing what tests measure what CHC broad abilities enables practitioners to organize tests into construct-relevant composites—composites containing only subtests *relevant to* the construct or ability of interest (e.g., Caemmerer et al., 2020; Laforte et al., 2025; McGrew & Flanagan, 1998; Reynolds et al., 2013).

Construct-*irrelevant variance* is present when an “assessment is too broad, containing excess reliable variance associated with other distinct constructs . . . that affects responses in a manner irrelevant to the interpreted constructs” (Messick, 1995, p. 742). Construct-*relevant variance* is important for test interpretation because it is often assumed that any given composite provides an estimate of a *single* construct. The narrow ability classifications of subtests help to verify this assumption. The ongoing cross-battery confirmatory factor analyses conducted by Keith, Reynolds, Caemmerer, and colleagues validate existing CHC classifications of subtests and improve how subtests are organized and interpreted within the context of XBA (e.g., Caemmerer et al., 2020; Reynolds et al., 2013).

Figure 1.5 illustrates construct-irrelevant variance using the WISC-V Expanded Fluid Index (EFI). The EFI comprises four subtests—Matrix Reasoning, Figure Weights, Picture Concepts, and Arithmetic—and is used when a more detailed assessment of fluid reasoning is needed (e.g., to determine giftedness). This figure shows that the Picture Concepts subtest also measures *Gc* substantially, most likely the narrow ability of Lexical Knowledge. Furthermore, the Arithmetic subtest has a long history of being factorially complex. In factor analyses, it has been found to load on *Gf*, *Gq*, and *Gwm* (see Flanagan et al., 2013, for a summary). Figure 1.5 shows the complexity of the Arithmetic subtest, sharing variance with *Gq* (i.e., the narrow ability of Math Achievement) and *Gwm* (the narrow ability of Attentional Control or Working Memory). Because the EFI contains construct-irrelevant variance, when Arithmetic is substantially higher or lower than other *Gf* subtests, the influences of *Gq* and *Gwm* should be considered as either facilitators or inhibitors, respectively.

Construct-irrelevant variance can also operate at the subtest level (rather than at the composite level). For example, the WJ IV contained a test called Phonological Processing (PP), intended to measure the broad Auditory Processing (*Ga*) ability. The PP test included three tasks, one measuring Word Fluency, a narrow ability in the broad Retrieval Fluency (*Gr*) domain, and, therefore, largely *irrelevant to* Ga. The construct-irrelevant variance in the PP test complicated interpretation, as it was unclear whether low performance was due to poor Phonetic

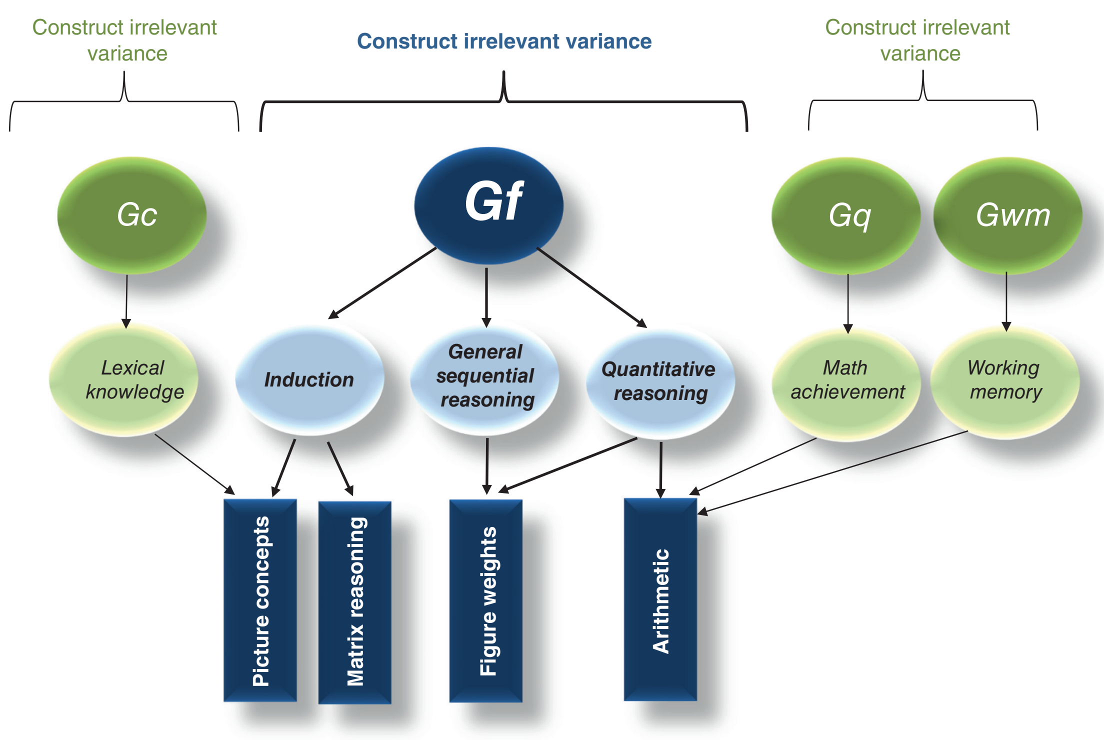


FIGURE 1.5 The WISC-V Expanded Fluid Reasoning Index Includes Construct Irrelevant Variance

Coding (a narrow *Ga* ability), poor Word Fluency (a narrow *Gr* ability), or both. Although new to the WJ IV, the PP test is not included in the WJ V, primarily because it is a mixed measure of abilities (LaForte et al., 2025). The WJ V Verbal Analogies test is another example of construct-irrelevant variance, as this test measures *Gf* and *Gc* to a substantial degree (LaForte et al.).

"Any test that measures more than one common factor to a substantial degree [e.g., the WJ IV Phonological Processing test] yields scores that are psychologically ambiguous and very difficult to interpret" (Guilford, 1954, p. 356; cf. Briggs & Cheek, 1986). Therefore, cross-battery assessments typically use only empirically strong or moderate (but not factorially complex or mixed) measures of CHC abilities. Most current cognitive and intelligence batteries contain at least a few factorially complex composites and subtests.

CAUTION

Construct-irrelevant variance occurs when a composite assesses two or more distinct constructs to a substantial degree. It can occur at the subtest or composite level, leading to scores that are psychologically ambiguous and confound interpretation.

CHC Narrow (Stratum I) Classifications of Subtests

Narrow ability classifications were initially reported in McGrew (1997), then reported in McGrew and Flanagan (1998) and Flanagan et al. (2000) following minor modifications. Flanagan and her colleagues continued to gather content validity data on cognitive ability tests, expanding their analyses to include academic achievement and language batteries (Flanagan et al., 2002, 2006) and neuropsychological processes (e.g., Flanagan et al., 2010, 2011; see also Appendix B).

Classifications of ability subtests at the narrow (stratum I) ability level were necessary to improve the content validity of batteries and facilitate interpretation. Narrow ability classifications ensure that the CHC constructs underlying assessments are well represented (LaForte et al., 2025; McGrew & Flanagan, 1998). Construct underrepresentation is present when an "assessment is too narrow and fails to include important dimensions or facets of the construct" (Messick, 1995, p. 742).

CAUTION

Construct underrepresentation occurs when too few features (i.e., narrow abilities) are represented in the measurement of a construct (i.e., a broad ability) or when a composite intended to represent a broad ability includes two or more measures of the same narrow ability.

Interpreting the WJ V COG Matrices test as a measure of Fluid Reasoning (i.e., the broad *Gf* ability) is an example of construct underrepresentation because this test measures *one* narrow aspect of *Gf* (i.e., Induction). Figure 1.6 shows that at least one *additional Gf* measure, qualitatively different from Induction, must be included in an assessment to ensure adequate representation of the *Gf* construct (e.g., the Analysis Synthesis test measures General Sequential Reasoning). Two or more qualitatively different indicators are needed to adequately represent the construct (see Caemmerer et al., 2020; Comrey, 1988; Keith & Reynolds, 2012; McGrew & Flanagan, 1998; Messick, 1989, 1995). The composite of scores from the Matrices and Analysis-Synthesis tests provides an adequate estimate of the broad *Gf* ability because these tests are strong measures of *Gf* and represent qualitatively different aspects of this broad ability.

DON'T FORGET

Two or more qualitatively different indicators (e.g., subtests representing different narrow abilities) are needed to adequately represent a broad ability construct.

Most cognitive batteries yield construct-relevant composites, though some underrepresent the broad ability intended to be measured. This is because construct underrepresentation can occur when the composite consists of two or more measures of the *same* narrow (stratum I) ability. For example, the Number Recall and Word Order subtests of the Kaufman Assessment Battery for Children–Second Edition Normative Update (KABC-II NU; Kaufman & Kaufman, 2018) were intended to be interpreted as a representation of the broad *Gwm* ability. However, these subtests primarily measure Auditory Short-term Storage (Wa), a narrow *Gwm* ability. Thus, the *Gsm* (a code used in earlier CHC theories) Scale of the KABC-II NU is most appropriately interpreted as Wa (a narrow ability), not *Gwm*.

A scale or broad CHC ability composite will yield more information—hence, be a more valid measure of a construct—if it contains more differentiated or qualitatively different tests of the construct. XBA circumvents misinterpretations arising from underrepresented constructs by requiring the use of two or more qualitatively different indicators to represent a CHC broad ability when deemed necessary. To ensure that qualitatively different aspects of broad abilities are represented in assessment, classification of ability tests at the narrow (stratum I) ability level was necessary (see Appendix B).

In sum, the classifications of tests and subtests at the broad and narrow ability levels of CHC theory guard against two ubiquitous sources of invalidity in assessment: construct-irrelevant variance and construct underrepresentation. Together, CHC theories and the CHC classifications of tests that underlie the XBA method provide the necessary foundation for organizing assessments that are theoretically driven, psychometrically defensible, relevant to the referral concerns, and supported by current research.

Before discussing the applications of the XBA method, it is important to highlight how the method has evolved. Rapid References 1.5 and 1.6 list the major changes to the XBA method and to this edition of the book, respectively.

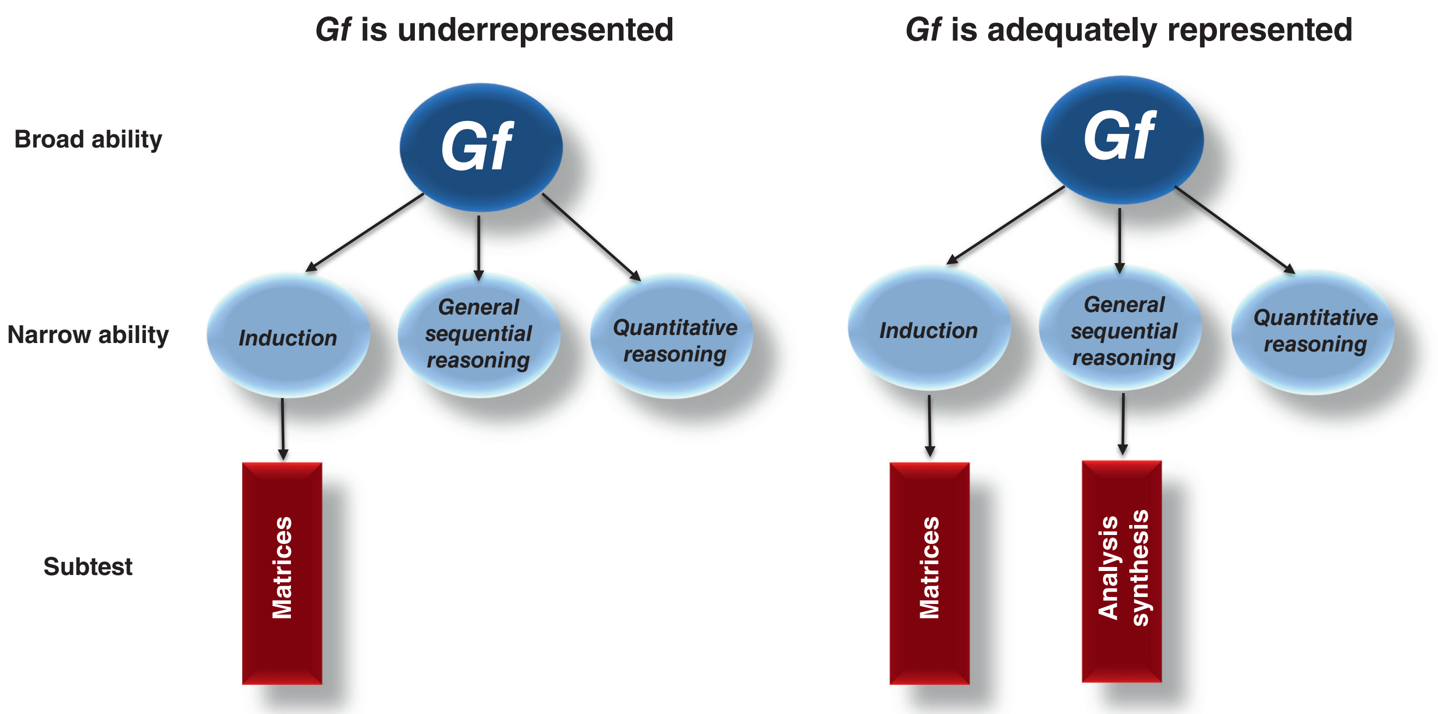


FIGURE 1.6 Construct Representation. *Note:* At least two qualitatively different narrow ability indicators (subtests) are needed to draw inferences about the broad *Gf* ability

Rapid Reference 1.5

XBA Revision Highlights

1. XBA is based primarily on current CHC theories (see McGrew, 2023) and the reclassification of all tests and subtests according to the most current CHC taxonomy (Schneider & McGrew, 2018).
2. All tests and subtests new to XBA were classified following a CHC expert consensus study (Appendix B).
3. XBA allows for the inclusion of neuropsychological constructs, such as attentional control, orthographic processing, psychomotor abilities, executive functions, sensory motor skills, and more.
4. The XBA method uses reliabilities and intercorrelations from the largest within-battery and cross-battery dataset currently available (Hajovsky et al., 2025; Appendices C and D) to create XBA composites.
5. Current research shows that the precision of XBA composites is similar to or the same as composites on norm-referenced tests (Appendix E).
6. While XBA principles remain the same, the procedure was substantially simplified because of improvements in automation via X-BASS 3.0.
7. XBA CHC composites can now be generated with up to six individual subtests (an increase from four).
8. All scores are entered into X-BASS on a single data entry tab, graphed, and organized into CHC domains, SLD areas (e.g., Basic Reading Skills, Math Calculation, Written Expression), and, if applicable, neuropsychological domains.
9. An XBA analysis is automatically conducted with one click of a button on the data entry tab.
10. Within-battery and cross-battery data are analyzed via a PSW analysis with one click of a button on the data entry tab.
11. Within-battery and cross-battery data are analyzed according to culture and language influences with one click of a button on the data entry tab.

Rapid Reference 1.6

What Is New to this Edition?

- Updated and simplified step-by-step guidance on conducting referral-relevant assessments (comprehensive and selective or diagnostic) to ensure evaluations are firmly grounded in current theory and research (e.g., Hajovsky et al., 2025; Schneider & McGrew, 2018) (Chapters 2 and 5).
- Step-by-step instructions in each chapter on how to use X-BASS.
- Updated CHC broad and narrow ability classifications of subtests based on a review of research, technical test manuals, and results of a CHC expert consensus study (see Appendix B).
- Current research on the relations between cognitive abilities and specific academic skills (see Appendix C) is used to inform decisions regarding specific learning disabilities.
- Discussion of the *True Peer Estimator* (TPE) for determining the degree of culture and language difference (Chapter 8).
- Improvements to the *Culture-Language Interpretive Matrix* (C-LIM) with new ways of viewing data and interpreting results (Chapter 8).
- Addition of the *Culture-Language Interpretive Matrix Achievement Test Extension* (C-LIM + ATE) (Chapter 8).
- Expansion of the *Dual Discrepancy/Consistency* (DD/C) method of SLD identification, including information on the probability that the user made accurate strength/weakness decisions and a summary of findings easily integrated into a report (Chapters 3 and 4, and Appendix F).
- Comprehensive guidance on how to proceed when the results of the PSW analysis are ambiguous (Chapter 4).
- Guidance on considering exclusionary factors in referrals for suspected learning disability (see Appendix G).
- Case studies demonstrating within-battery and cross-battery comprehensive and selective assessment, differential diagnosis, identification of SLD, and distinguishing learning differences from learning disabilities in individuals from diverse cultural and linguistic backgrounds. All case studies were completed using X-BASS (Chapters 5 through 8).
- Numerous examples of linking evaluation results to intervention (e.g., instructional strategies, remedial programs, compensatory strategies, and curricular and environmental modifications) (Chapter 9, and Appendices J, K, S, T, and U).

RATIONALE FOR THE XBA METHOD

Research to Practice

The XBA method has significant implications for research, practice, and test development. Regarding practice, the XBA method provided "a much-needed and updated bridge between current intellectual theory and research and practice" (Flanagan & McGrew, 1997, p. 322). The need for the XBA "bridge" was evident following Flanagan and colleagues' review of the results of several cross-battery factor analyses that were conducted prior to 2000 (Flanagan & Ortiz, 2001; Flanagan et al., 2002; McGrew & Flanagan, 1998). These results demonstrated that none of the cognitive and intelligence batteries in use at that time contained measures that sufficiently approximated the full range of broad abilities that defined the structure of cognitive abilities as specified in contemporary psychometric theory (e.g., Woodcock, 1990; see Table 1.2).

As may be seen in Table 1.2, of the major intelligence batteries in use before 2000, most failed to measure three or more broad CHC abilities (viz., *Ga*, *Glr*, *Gf*, *Gs*) that were (and are) considered important in understanding and predicting school achievement (see Chapter 2 for a summary). *Gf*, often considered to be the essence of intelligence, was either not measured or not measured adequately by most of the intelligence batteries used prior to 2000 (i.e., WISC-III, WAIS-R, WPPSI-R, K-ABC, and CAS) (Alfonso et al., 2005).

The finding that abilities not measured or underrepresented by cognitive and intelligence batteries are important for understanding students' learning difficulties provided much of the impetus for developing the XBA method (McGrew & Flanagan, 1998) and perhaps for engendering a movement away from sole or primary reliance on IQ in evaluating learning disabilities. The XBA method guided practitioners in selecting core and supplemental tests that provided sufficient measurement of abilities to explain plausible reasons for learning difficulties in the classroom.

Schneider and McGrew (2018) pointed out that "A pivotal foundation of CHC cross-battery assessment. . .which has contributed significantly to the extant construct validity evidence for the CHC model, has been CHC-organized XBA research" (p. 84), such as that conducted by Flanagan (2000), Reynolds et al. (2013), and more recently, Caemmerer et al. (2020). The CHC classification system that forms the foundation of the XBA method has improved communication among practitioners, led to improvements in research on the relations between cognitive and academic abilities (e.g., Hajovsky et al., 2025; Appendix C), and resulted in improvements in the measurement of cognitive constructs, as may be seen in the design and structure of current cognitive and intelligence batteries (e.g., WISC-V, WJ V). In summary, the XBA method has a strong research foundation. It addresses a long-standing need in assessment-related fields for a defensible assessment method for evaluating a broader range of abilities and processes. Comprehensive and selective XBA informs how students learn, how they are smart, and what may be impeding their ability to receive information from the environment and to store, process, and express that information.

Test Development

Although there was substantial evidence of at least eight or nine CHC broad cognitive abilities by the late 1980s, the batteries of the time did not reflect this diversity in measurement. For example, Table 1.2 shows that the cognitive and intelligence batteries used at that time measured only two to three CHC broad abilities adequately. Table 1.2 shows that the WJ-R included measures of a wider range of broad cognitive abilities than other batteries. Nevertheless, many broad abilities were not measured adequately by the WJ-R (Alfonso et al., 2005; McGrew & Flanagan, 1998).

In general, Table 1.2 shows that *Gf*, *Gsm* (now *Gwm*), *Glr* (now *Gl* and *Gr*), *Ga*, and *Gs* were not measured adequately by most batteries published before 2000. It was clear that most test authors and publishers did not use contemporary psychometric theories of the structure of cognitive abilities to guide the development of their cognitive and intelligence batteries, resulting in a theory–practice gap, as demonstrated by Woodcock (1990) and others in the late 1990s through the mid-2000s (e.g., Alfonso et al., 2005; Flanagan & McGrew, 1997; Flanagan et al., 2000, 2013; Keith & Reynolds, 1997, 2005; McGrew, 2005, 2009; McGrew & Flanagan, 1998; Schneider & McGrew, 2012).

Table 1.3 parallels Table 1.2 but presents the most current cognitive and intelligence batteries. Several notable findings emerge when comparing Tables 1.2 and 1.3. First, coverage of *Gf* increased from 50% to 100%, meaning *Gf* is measured by all current batteries. Second, *Gc* continues to be adequately measured by most batteries. The CAS-2 is the only battery that does not measure *Gc*, but this was by design, as the CAS-2 operationalizes PASS theory rather than CHC theory. Third, while all batteries measured *Gv* adequately prior to 2000, it is now

Table 1.2 Representation of Broad CHC Abilities on Eight Cognitive and Intelligence Batteries Published Prior to 2000

Battery	*Gf*	*Gc*	*Gv*	*Gsm**	*Glr**	*Ga*	*Gs*
WISC-III	×	√	√	•	×	×	√
WAIS-R	×	√	√	•	×	×	•
WPPSI-R	×	√	√	•	×	×	•
K-ABC	•	×	√	•	×	×	×
CAS	×	×	√	•	×	×	√
DAS	√	√	√	•	•	×	•
WJ-R	√	•	√	•	•	•	•
SB:FE	√	√	√	•	×	×	×

Note: √ = Adequately measured; • = Underrepresented; × = Not measured.
* *Gsm* is now *Gwm* and *Glr* is now two broad abilities, *Gl* and *Gr*.
WISC-III = Wechsler Intelligence Scale for Children–Third Edition (Wechsler, 1991); WAIS-R = Wechsler Adult Intelligence Scale–Revised (Wechsler, 1981); WPPSI-R = Wechsler Preschool and Primary Scale of Intelligence–Revised (Wechsler, 1989); K-ABC = Kaufman Assessment Battery for Children (Kaufman & Kaufman, 1983); CAS = Cognitive Assessment System (Naglieri & Das, 1997); DAS = Differential Ability Scales (Elliott, 1990); WJ-R = Woodcock-Johnson Psycho-Educational Battery–Revised (Woodcock & Johnson, 1989); SB:FE = Stanford-Binet Intelligence Scale–Fourth Edition (Thorndike et al., 1986).

Table 1.3 Representation of Broad CHC Abilities on Eight Current Cognitive and Intelligence Batteries

Battery	*Gf*	*Gc*	*Gv*	*Gwm*	*Gl*	*Gr*	*Ga*	*Gs*
WISC-V	√	√	•	√	•	•	×	√
WAIS-5	√	√	•	√	×	•	×	√
WPPSI-IV	•	√	√	×	×	×	×	√
K-ABC-II NU	√	•	√	•	•	×	×	×
DAS-II NU	√	•	√	√	×	•	×	•
WJ V COG	√	√	•	√	√	√	×	•
SB5	√	√	•	•	×	×	×	×
CAS-2	•	×	•	√	×	•	×	√

Note: √ = Adequately measured; • = Underrepresented; × = Not measured.
WISC-V = Wechsler Intelligence Scale for Children-Fifth Edition (Wechsler, 2014); WAIS-5 = Wechsler Adult Intelligence Scale–Fifth Edition (Wechsler et al., 2024); WPPSI-IV = Wechsler Preschool and Primary Scale of Intelligence–Fourth Edition (Wechsler, 2012); K-ABC-II NU = Kaufman Assessment Battery for Children-Second Edition Normative Update (Kaufman & Kaufman, 2018); DAS-II NU = Differential Ability Scales-Second Edition Normative Update (Elliott, 2023); WJ V COG = Woodcock-Johnson V Tests of Cognitive Abilities (Laforte et al., 2025); SB5 = Stanford Binet Intelligence Scales-Fifth Edition (Roid, 2003); CAS-2 = Cognitive Assessment System-Second Edition (Naglieri et al., 2014).

underrepresented at 50%. This change is likely the result of research findings showing that Vz is the most well-supported of all *Gv* narrow abilities (see Schneider & McGrew, 2018, for further discussion). Also, the narrow ability of Visual Memory (MV) was cross-listed under *Gsm* and *Gv* in earlier versions of CHC theory, which may have led to seemingly better *Gv* construct representation on batteries used prior to 2000. Fourth, while *Gsm* was underrepresented on all batteries prior to 2000, over 50% of batteries now measure *Gwm* adequately. Fifth, only two subtests, one from the WJ-R and one from the DAS, measured *Glr*. Now, the WISC-V and WJ V are the only batteries that measure *Gl and Gr*, which are underrepresented in the former battery and adequately measured in the latter. Although measurement of these constructs has improved, they remain underrepresented or unmeasured in most current batteries. Sixth, prior to 2000, *Ga* was measured only by the WJ-R. To date, no cognitive or intelligence battery has added measures of *Ga*, and the WJ V COG no longer includes *Ga* tests. However, measures of *Ga* are included in the WJ V Virtual Test Library (VTL; Mather et al., 2025). It is likely that *Ga* is omitted from cognitive batteries deliberately because many achievement batteries and special-purpose tests measure the narrow ability of Phonetic Coding. Finally, the representation of *Gs* remains largely unchanged across current cognitive and intelligence batteries.

In summary, a wider range of CHC broad and narrow abilities is represented on current batteries than on their predecessors. Furthermore, greater attention was paid to adequate construct representation. Table 1.4 provides several salient examples of the impact of CHC theories on test development. Notwithstanding, to adequately represent all eight broad abilities listed in Table 1.3, the XBA method is necessary. One exception is the WJ V COG, which is co-normed with the VTL and measures Phonetic Coding (Ga:PC). Examples of adequate construct representation using some of the batteries listed in Table 1.3 are provided in Chapter 2.

Guiding Principles of the XBA Method

To ensure that XBA procedures are theoretically and psychometrically sound, practitioners should adhere to a few guiding principles that have been refined over the years since the method was first introduced. These principles are described below.

1. *Select a comprehensive cognitive battery as your core battery in assessment*, ensuring that it (1) addresses referral concerns and (2) meets the examinee's unique needs. Standard core batteries include (but are not limited to) the Wechsler scales (e.g., WPPSI IV, WISC-V, WAIS-5), WJ V COG, DAS-II NU, KABC-II NU, and CAS-2.
2. *Use subtests and composites from a single battery or set of co-normed tests whenever possible to represent CHC broad and narrow abilities*. Norm-based composites are preferable to formula-generated composites that include subtests from different batteries. Notwithstanding, research shows that XBA composites are as precise as norm-based composites when generated with the same subtests (see Appendix E). Therefore, XBA composites may be used in the same way and for the same purposes as norm-based composites, *especially when there is ecological validity to support them*—a practice that should apply to norm-based composites as well (see Appendices H and P). Note that it is typically necessary to cross batteries for specific purposes, including (1) to broaden an evaluation, (2) to follow up on aberrant scores, and (3) to test hypotheses about unusual patterns in the data. The XBA method is the most psychometrically defensible way to meet these purposes. Chapter 2 details how cross-battery composites are organized, analyzed, and interpreted.
3. *When a broad ability is underrepresented or not measured by the core battery, supplement with subtests and corresponding composites from another battery*. For example, suppose an evaluator is interested in measuring Retrieval Fluency (*Gr*), and the core battery has only one or no *Gr* subtests, or two *Gr* subtests that measure the same narrow ability. In either case, the evaluator should select two qualitatively different indicators of *Gr* from another battery or a *Gr* composite from another battery to supplement the core battery. This practice ensures that actual norms are used to interpret broad-ability performance.

   Note that it is not always necessary to assess an ability broadly via two qualitatively different indicators. For example, the WAIS-5 has a Visual Spatial Index (VSI) that comprises two subtests—Block Design and Visual Puzzles—that measure the narrow Visualization (Vz) ability. As such, the VSI is better described as a measure of Vz, rather than the broad *Gv* ability. Based on the nature of the referral, however, a Vz composite may be sufficient. Moreover, Vz has the lion's share of research to support it compared to all other *Gv* narrow abilities. Unlike broad abilities, which are typically represented by two qualitatively distinct narrow-ability measures, narrow abilities are often underrepresented on cognitive batteries. This is because most batteries do not contain two or more measures of the *same* narrow ability. When batteries are crossed, X-BASS can be used to generate theoretically and psychometrically defensible narrow ability composites.
4. *Select subtests from the smallest number of batteries that were normed within 10–12 years of one another* to minimize the effect of spurious differences between test scores that may be attributable to differences in the characteristics of independent norm samples (McGrew, 1994). When tests and subtests are carefully selected and tailored to address well-defined referral concerns, it is typically not necessary to cross more than two or three batteries, depending on the evaluator's access to batteries (Shanock et al., 2022). Nearly all batteries included in X-BASS were normed within the past 12 years.
5. *Establish ecological validity for test performances that are suggestive of normative weaknesses or deficits*. The identification of a cognitive weakness or deficit is meaningless without evidence of its manifestation in activities of daily living, including academic performance in the classroom (Mascolo et al., 2014). The validity of test findings is bolstered when clear connections are made between the cognitive weakness and its educational impact. Furthermore, manifestations of weaknesses provide a focus for intervention (see Appendices H and P for a comprehensive list of manifestations of cognitive and academic weaknesses by grade level, respectively).

Once the practitioner has completed the evaluation, scores are entered into X-BASS for analysis and to determine whether a follow-up assessment is necessary. The next and final section of this chapter is a brief tutorial on how to begin using X-BASS. Data analysis is covered in detail in subsequent chapters.

Table 1.4 Impact of CHC Theory and XBA CHC Classifications on Cognitive and Intelligence Test Development

Test (Year of Publication) **Impact**	**Revision (Year of Publication)** **Impact**
WISC-IV (2003) Minor. Eliminated Verbal and Performance IQs; replaced the Freedom from Distractibility Index with the Working Memory Index; replaced the Perceptual Organization Index with the Perceptual Reasoning Index; included the measurement of fluid reasoning by adding the Matrix Reasoning and Picture Concepts subtests; enhanced measurement of Processing Speed with the Cancellation subtest.	**WISC-V (2014)** Minor to moderate. CHC theory was one guiding factor in the development of this battery; the PRI was divided into the Fluid Reasoning Index (*Gf*) and Visual Spatial Index (*Gv*); a Glr factor was added that assessed associative memory and retrieval fluency; improvements were made in the measurement of working memory and fluid reasoning.
WAIS-IV (2008) Minor to moderate. Eliminated Verbal and Performance IQs; replaced the Perceptual Organization Index with the Perceptual Reasoning Index; enhanced the measurement of fluid reasoning by adding the Figure Weights and Visual Puzzles subtests; enhanced the measurement of Processing Speed with the Cancellation subtest; enhanced the measurement of memory with the Working Memory Index.	**WAIS-5 (2025)** Moderate to major. Includes many composites based on CHC theories; these include the Verbal-Expanded Crystallized Index, Expanded Fluid Index, and Expanded Working Memory Index; also included are more cognitively complex subtests such as Running Digits and Set Relations.
WPPSI-III (2002) Minor. Incorporated measures of Processing Speed that yielded a Processing Speed Quotient based on recent research indicating the importance of processing speed for early academic success; enhanced the measurement of fluid reasoning by adding the Matrix Reasoning and Picture Concepts subtests.	**WPPSI-IV (2012)** Minor. Eliminated Verbal and Performance IQs; enhanced measures of working memory, processing speed, and inhibitory control.
K-ABC (1983) No obvious impact.	**KABC-II (2007)/KABC-II NU* (2018)** Moderate to major. Provided a second global score that includes fluid and crystallized abilities; included several new subtests measuring reasoning; interpretation of test performance may be based on either CHC theory or Luria's theory; includes measures of five CHC broad abilities.
WJ IV (2014) Major. Used expanded CHC theory (Schneider & McGrew, 2012) and introduced cognitive complexity in test development; changed Gsm to *Gwm*; added attentional control (AC) under *Gwm*; added speed of lexical access (LA) under Glr; added a *Gf-Gc* composite; brought back Scholastic Aptitude Clusters; added an Oral Language battery; provided adequate measurement of 10 broad CHC abilities across three co-normed batteries.	**WJ V (2025)** Major. Used CHC theories as the blueprint for the battery; includes a Virtual Test Library (VTL) to supplement the primary batteries; includes many new or revised tests as well as new or revised clusters such as the Retrieval Fluency; covers the greatest breadth of CHC broad and narrow abilities across the two primary batteries and VTL than any other battery, as the WJ V COG, ACH, and VTL are co-normed.
SB: IV (1986) Minor. Used a three-level hierarchical model of the structure of cognitive abilities to guide the construction of the test: The top level included a general reasoning factor or *g*; the middle level included three broad factors called Crystallized Abilities, Fluid-Analytic Abilities, and Short-Term Memory; the third level included more specific factors, including Verbal Reasoning, Quantitative Reasoning, and Abstract/Visual Reasoning.	**SB5 (2003)** Minor to moderate. Used CHC theory to guide test development; increased the number of measures of fluid reasoning; included a Working Memory Factor based on research, indicating its importance for academic success.
DAS (1990) No obvious impact.	**DAS-II (2007)/DAS-II NU* (2023)** Moderate to major. Measures seven broad CHC abilities and also includes measures of certain narrow abilities not found on other major cognitive batteries (e.g., F6 or free recall memory).

* The normative update (NU) did not change the content or structure of the battery.

GETTING STARTED WITH X-BASS

X-BASS opens to a dashboard shown in Figure 1.7. The first time you open X-BASS, you will see "**NOTIFICATIONS: ON**" in the top right corner. This means that you will receive pop-up messages instructing you along the way. One of the initial pop-ups ask whether you would like to review the "**GUIDE**," which provides orientation to the program, system requirements, frequently asked questions, and more. You may return to the guide at any time by going to the dashboard and clicking the bottom-left button. Directly below the notifications option, there are two additional options labeled "**HELP**" and "**NEXT**." The help option describes where you are in the program (e.g., the purpose of the tab you are on), and the next option tells you what to do next. It is recommended that you enter at least one case into X-BASS before turning off notifications. When you do turn them off, each tab will display, in the exact location, "**NOTIFICATIONS: OFF**." You may click notifications on and off at any time while using the program.

The top blue-shaded area on the dashboard is where you enter the examinee's name, grade, and age, as well as the evaluator's name. If the examinee is a multilingual learner, be sure to check the box just below the space for the evaluator's name. By checking this box, the program will perform specific operations differently than for monolingual English-speaking peers, as described in Chapter 8. After entering the identifying information, click the "**CREATE RECORD**" button, which appears directly below "**NO ACTIVE DATA RECORD**" on the top right of your screen. When you create the record, the blue shading disappears, and the aforementioned text changes to "**DATA RECORD IS ACTIVE**" as shown in Figure 1.8.

Figure 1.8 also shows that the examinee's name appears in a drop-down menu containing all the records saved (the arrow on the left side of the figure points to this menu). Note that X-BASS can store over 100 cases, to which you can return at any time. The recommended next step is to click the "DATA ENTRY" button (see the arrow on the right side of the figure pointing to its location on the dashboard).

Figure 1.9 shows the data entry tab. When you start data entry on the data entry tab, you can move your data to other tabs for analysis. If you start data entry on another tab (e.g., XBA tab, C-LIM tab), your scores cannot be transferred from that tab to the data entry tab. At the top left of Figure 1.9, you will see a place to select a test or battery. You can begin entering either the test or battery name or its acronym, and the full name will appear. At the same time, all composites and subtests will appear in the spaces below the battery name, in the same order they appear on the battery's record form. The data entry tab contains 124 tests and batteries and over 1,100 subtests. The tests and batteries included in X-BASS are listed in Appendix I.

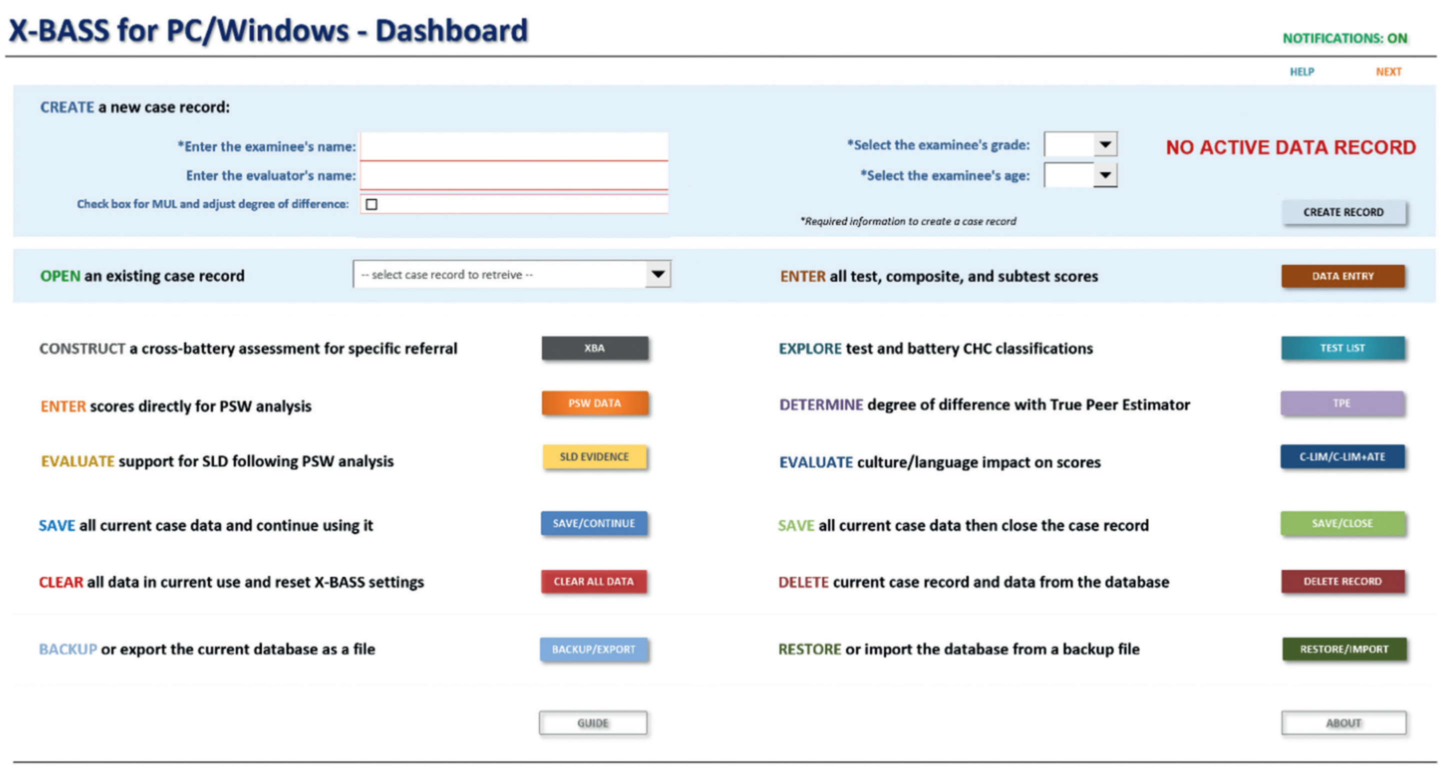


FIGURE 1.7 X-BASS 3.0 Dashboard

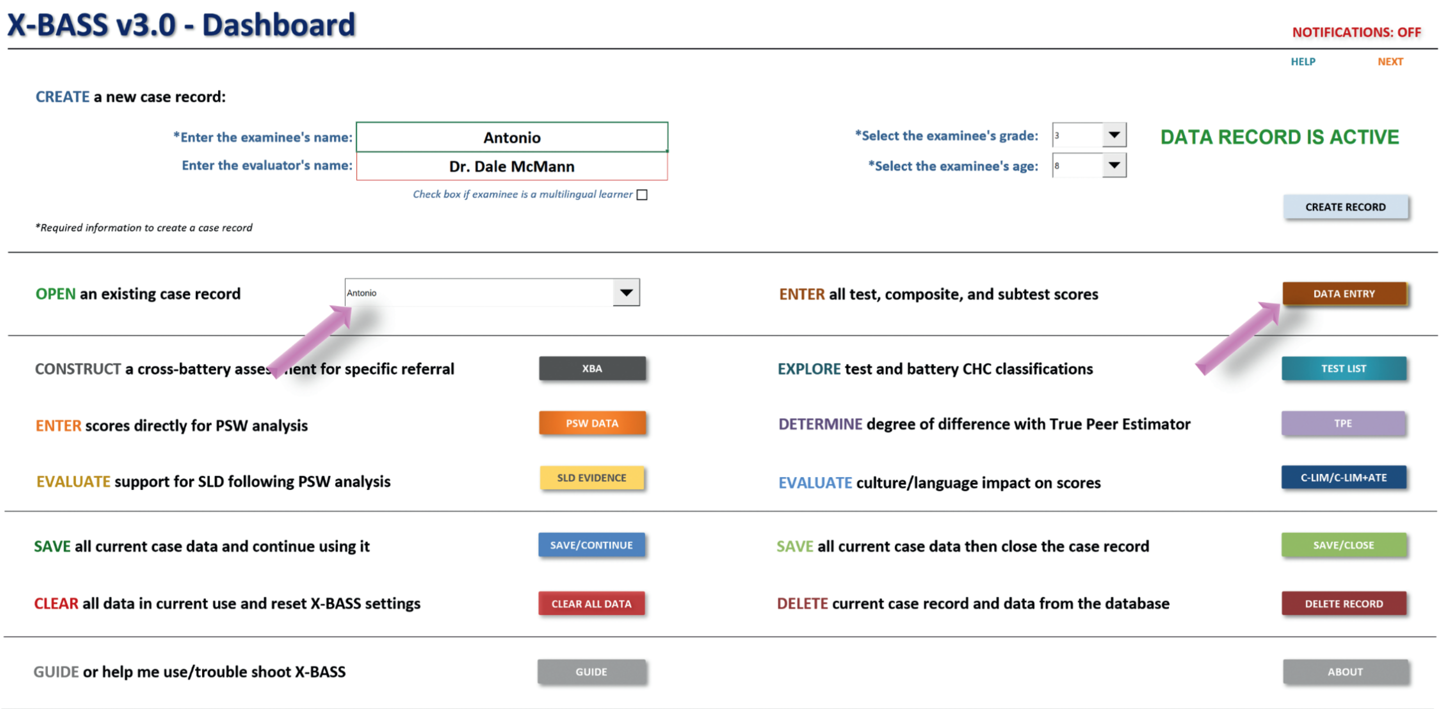


FIGURE 1.8 Completing a Case Record

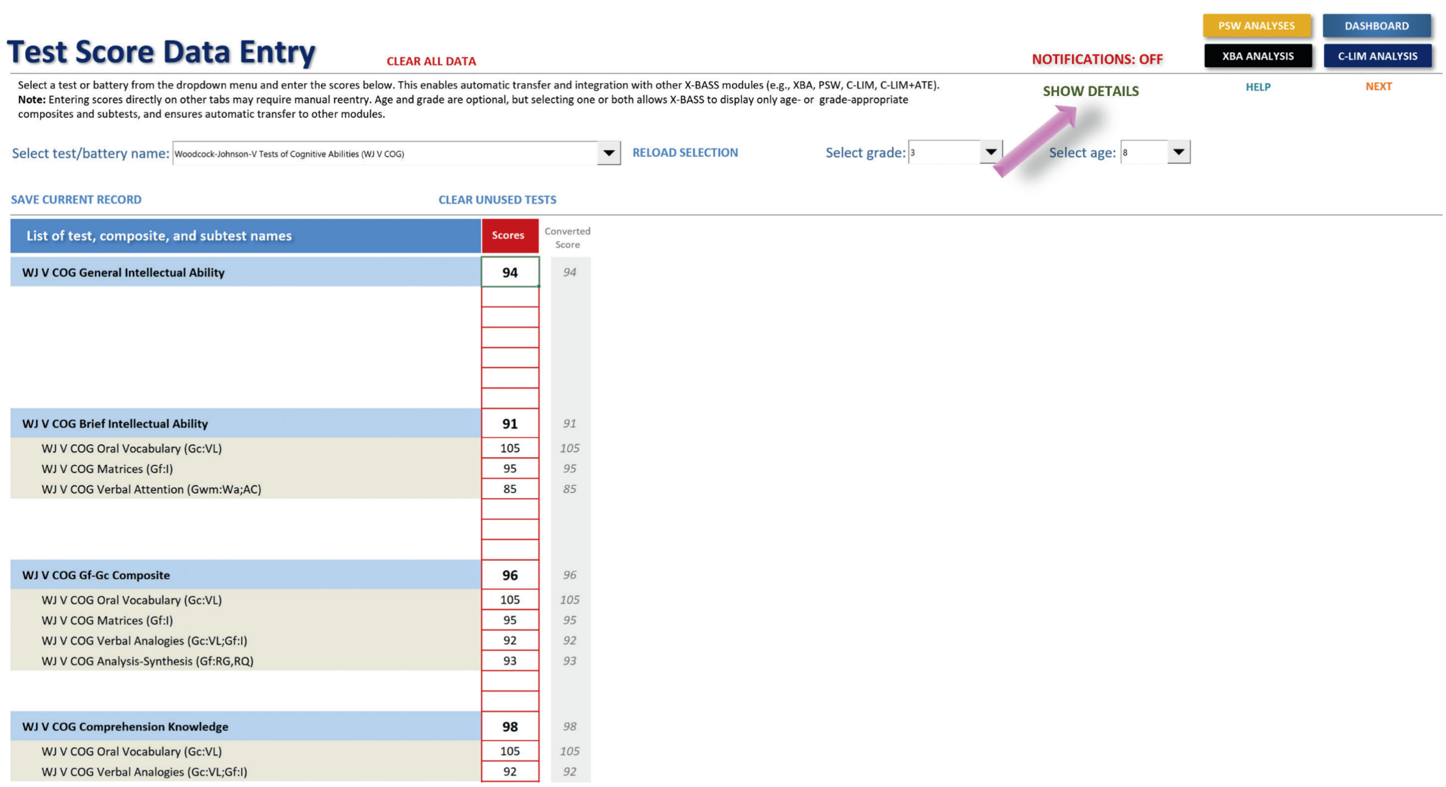


FIGURE 1.9 Data Entry Tab

Figure 1.9 shows ample white space to the right of the data entry column. The decision to leave this area blank was intentional, as one of the primary purposes of this version of X-BASS was to reduce the amount of visible information and details throughout the program. Details can be accessed by clicking "**SHOW DETAILS**" (see the arrow at the top right of the figure pointing to its location on the data entry tab). You can also "**HIDE DETAILS**."

By clicking "**SHOW DETAILS**," you can view either a score graph (top left arrow) or a domain summary (top right arrow), or both, as shown in Figure 1.10. The score graph shows where scores fall within a normal distribution of standard scores from 40 to 160. The light shading on the score graph shows the Average range of ability (i.e., standard scores of 90–110). The darker shading on the left and right sides of Average extends the shading to encompass standard scores from 85 to 115, generally referred to as "within normal limits" (WNL) or "within typical limits" (WTL). As you scroll down this tab, you can quickly see where test scores fall for the examinee.

The domain summary shows scores organized according to the current CHC taxonomy, which may differ from how the test developer and publisher group scores. For example, on the WJ IV, the *Gf* composite included Number Series and Concept Formation. Based on current research, the Number Series test is best interpreted as a measure of math achievement (see Laforte et al., 2025; Schneider, 2016), which falls under *Gq* (Quantitative Knowledge) rather than *Gf*. Therefore, the score graph shows these two subtest scores directly beneath the *Gf* composite, whereas the domain summary does not show the WJ IV *Gf* composite in the *Gf* domain graph. This may appear to be an error at first glance. However, the WJ IV *Gf* composite is now considered "mixed" (MX), comprising one *Gq* and one *Gf* test. Therefore, the WJ IV *Gf* composite is graphed at the bottom of the domain summary column under a domain called "**MX – Mixed Composites**." Because batteries carried over from X-BASS v2.0 to X-BASS v3.0 were reclassified, you may encounter other examples like this one on other batteries.

> **DON'T FORGET**
>
> Always enter your data on the DATA ENTRY tab. If you choose to begin data entry on another tab (e.g., the XBA tab), you will not be able to transfer your scores to the data entry tab.

> **DON'T FORGET**
>
> If you do not see a composite you believe should have been graphed in a CHC or SLD domain, on the DATA ENTRY tab, scroll down to "MX – Mixed Composites," where it is most likely graphed.

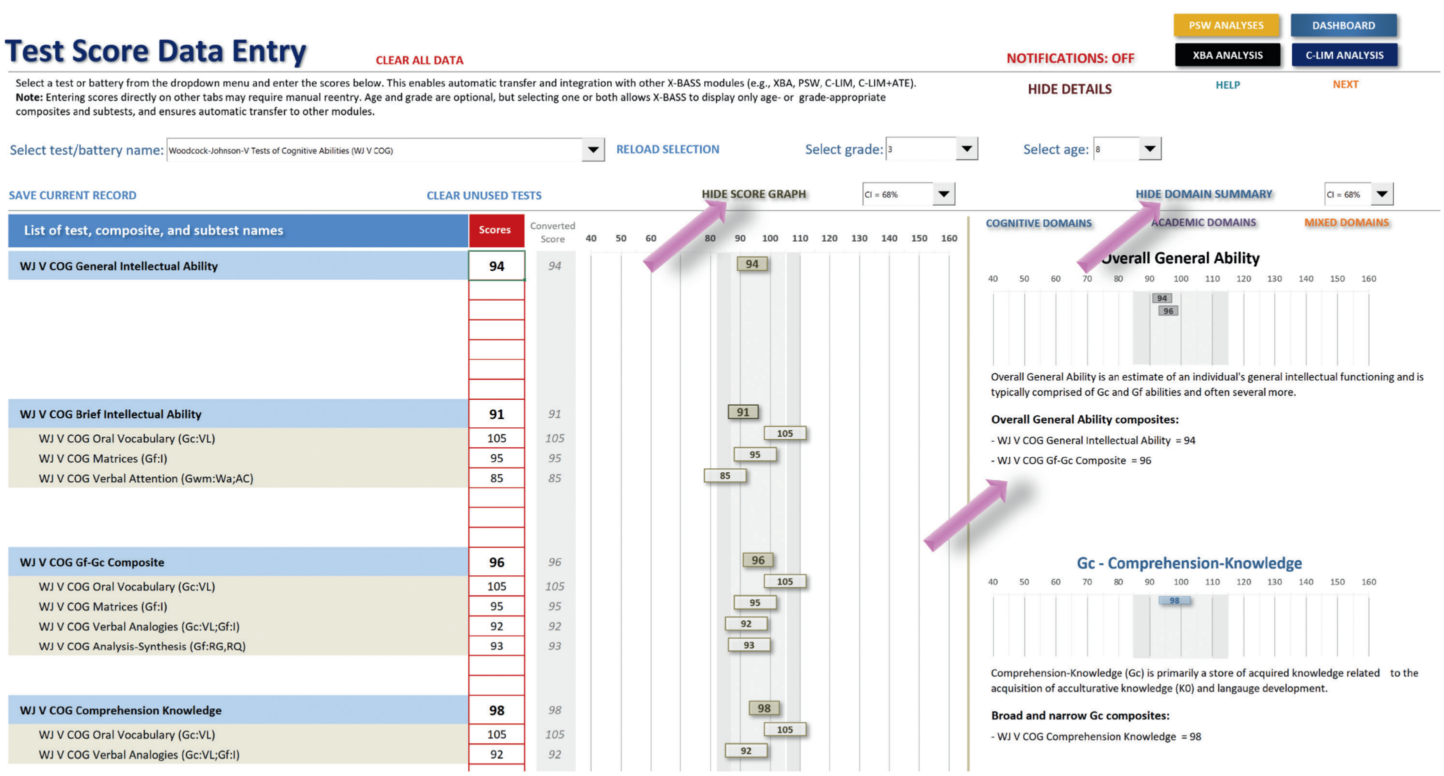


FIGURE 1.10 Viewing Additional Details on the Data Entry Tab

After entering scores for the WJ V COG, as shown in Figure 1.10, you may enter scores from another battery, such as the WJ V ACH. Begin typing the name or acronym for the WJ V ACH, and the name will automatically populate. At the same time, any WJ V COG test names for which no score was entered will disappear to ensure there is enough room for the next test or battery. In this example, the WJ V ACH composites and comprising tests will be displayed automatically directly below the last score entered for the WJ V COG, as shown in Figure 1.11. You may repeat this process until you have entered all scores from your evaluation. Note that the data entry tab can accommodate up to 40 composites and their subtests. Be sure to "SAVE CURRENT RECORD" after entering your scores. This option appears just below and to the left of the dropdown menu on the Data Entry tab. This option also appears on the Dashboard and at the bottom of all tabs. Rapid Reference 1.7 provides critical information on saving and storing your data within the program.

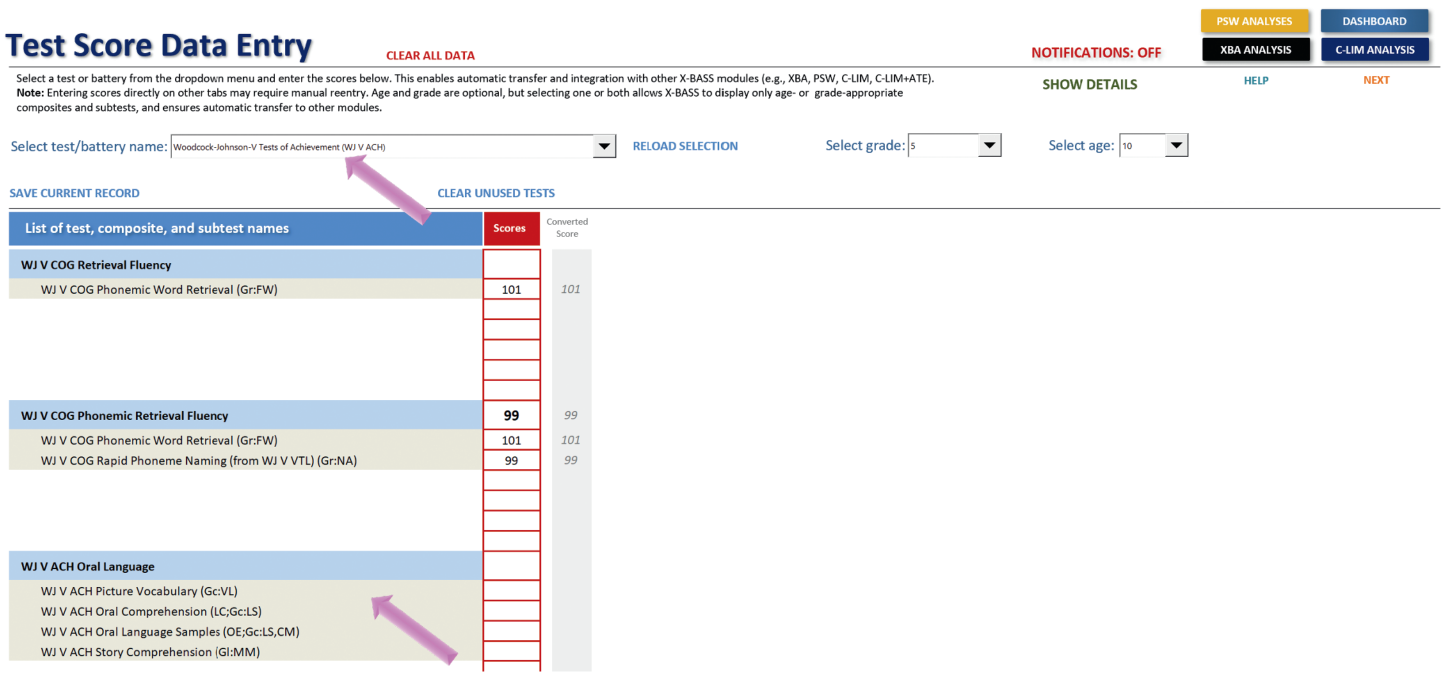
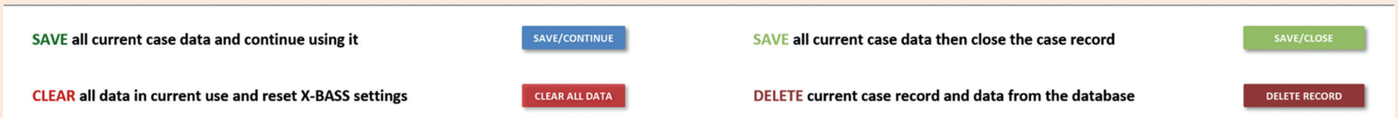


FIGURE 1.11 Adding Additional Tests on the Data Entry Tab

Rapid Reference 1.7

How to Save Data and a Case Record Within X-BASS

On the Dashboard, there are four buttons related to saving and deleting data, as shown below. The "SAVE/CONTINUE" button will save your data just as the "SAVE CURRENT RECORD" option.



- The "CLEAR ALL DATA" button will delete all data on all tabs but will not delete any saved case records. This button resets X-BASS so that you can begin entering data for a new case. The only time you would use this button is if you do not want to keep the data you entered. If you want to keep the data, use the "SAVE/CLOSE" button.
- The "SAVE/CLOSE" button will save the current record and close it. This allows you to return to that record at any time in the future, as it is stored in the program and appears in the drop-down menu on the Dashboard.
- The "DELETE RECORD" button allows you to delete a case record that you previously saved so that it no longer appears in the drop-down menu on the Dashboard.

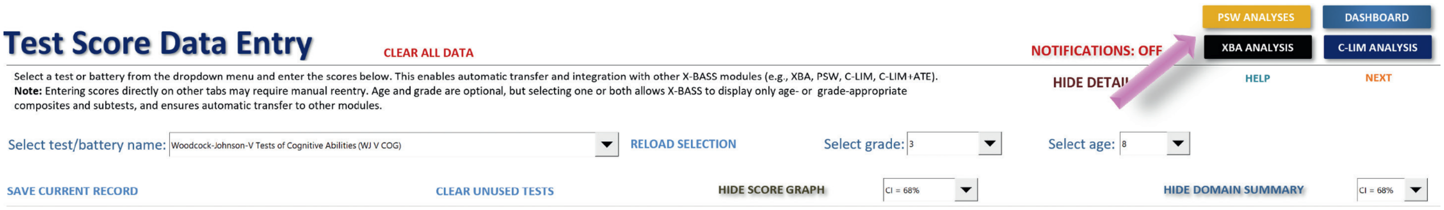


FIGURE 1.12 Transferring Data from the Data Entry Tab

After you have completed entering all scores, the next step is to analyze them. To do this, click on one of the buttons on the top right of the screen corresponding to the type of analysis you wish to conduct. The arrow in Figure 1.12 points to the location of these buttons on the Data Entry tab. There are four buttons. Three of them are for a type of analysis, and the fourth is a button that will take you back to the Dashboard. The three types of analyses you may conduct are: (1) an XBA analysis that will group all data according to CHC domain and SLD area and provide information related to composite cohesion and follow-up assessment, which is described in the next chapter; (2) a PSW analysis that will organize your scores and analyze them according to the DD/C method and guide you through the SLD decision-making process, as described in Chapters 3 and 4; and (3) a C-LIM analysis of test score validity for multilingual learners, as described in Chapter 8.

CONCLUSIONS

The XBA method allows practitioners to augment or supplement any ability battery to ensure reliable and valid measurement of a broader range of abilities, in a manner consistent with contemporary theory and research. The foundation upon which the XBA method was built, along with its guiding principles and procedures, provides a systematic approach to construct a theoretically driven, comprehensive, and valid assessment of abilities that is responsive to referral concerns. X-BASS provides an efficient way to organize, analyze, and interpret data for different purposes, as described in Chapter 2.

TEST YOURSELF

1. **The primary purpose of the XBA method is to:**
   (a) increase Full Scale IQ interpretability.
   (b) replace norm-referenced intelligence tests.
   (c) narrow the theory–practice gap by aligning assessment with contemporary theory and psychometrics.
   (d) maximize the number of subtests administered.
2. **According to the chapter, which of the following best distinguishes cross-battery assessment from a flexible battery approach?**
   (a) use of multiple tests
   (b) reliance on expert judgment
   (c) adherence to systematic, theory- and psychometric-based rules
   (d) emphasis on qualitative interpretation
3. **An example of construct underrepresentation is interpreting a single narrow ability measure as representative of a broad CHC ability. True or False?**
4. **When a broad ability is underrepresented on a core battery, XBA principles recommend:**
   (a) interpreting the available composite cautiously without supplementing.
   (b) supplementing with qualitatively different indicators from another battery.
   (c) relying on a general ability score.
   (d) postponing interpretation until additional normed data are available.
5. **Establishing ecological validity in XBA requires demonstrating that test-based weaknesses are meaningfully related to real-world functioning, including academic performance. True or False?**

6. Which of the following statements best reflects the role of X-BASS?
   (a) X-BASS replaces professional judgment in assessment.
   (b) X-BASS automates XBA procedures while preserving theoretical and psychometric rigor.
   (c) X-BASS standardizes cross-battery norms.
   (d) X-BASS limits assessments to within-battery analyses.

7. Based on revisions to the CHC taxonomy, Long-Term Storage and Retrieval (Glr) was replaced by:
   (a) Learning Efficiency (*Gl*) and Retrieval Fluency (*Gr*).
   (b) Attentional Control (AC) and Working Memory (WM).
   (c) Perceptual Speed (*Gs*) and Processing Speed (*Gt*).
   (d) It wasn't replaced.

8. The XBA method is currently grounded primarily in:
   (a) *Gf–Gc* theory only.
   (b) PASS theory and neuropsychological models.
   (c) CHC theory, with selective integration of neuropsychological theory.
   (d) Hierarchical *g*-theory.

9. Fluid Reasoning (*Gf*), Comprehension Knowledge (*Gc*), and Processing Speed (*Gs*) are examples of:
   (a) general (stratum III) abilities.
   (b) broad (stratum II) abilities.
   (c) narrow (stratum I) abilities.
   (d) intermediate factors.

10. Narrow ability classifications were developed primarily to:
   (a) replace broad ability interpretation.
   (b) improve the construct representation of composites.
   (c) reduce administration time.
   (d) support *g*-level interpretation.

Answers: 1. c; 2. c; 3. True; 4. b; 5. True; 6. b; 7. a; 8. c; 9. b; 10. b

REFERENCES

Alfonso, V. C., Flanagan, D. P., & Radwan, S. (2005). The impact of the Cattell-Horn-Carroll theory on test development and interpretation of cognitive and academic abilities. In D. P. Flanagan & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (2nd ed, pp. 185–202). Guilford Press, New York, NY.

Bailey, D. H., Duncan, G. J., Watts, T., Clements, D. H., & Sarama, J. (2018). Risky business: Correlation and causation in longitudinal studies of skill development. *American Psychologist*, *73*(1), 81–94.

Barbey, A. K. (2018). Network neuroscience theory of human intelligence. *Trends in Cognitive Sciences*, *22*(1), 8–20.

Bornovalova, M. A., Choate, A. M., Fatimah, H., Petersen, K. J., & Wiernik, B. M. (2020). Appropriate use of bifactor analysis in psychopathology research: Appreciating benefits and limitations. *Biological Psychiatry*, *88*(1), 18–27.

Briggs, S. R., & Cheek, J. M. (1986). The role of factor analysis in the development and evaluation of personality scales. In special issue: Methodological developments in personality research. *Journal of Personality*, *54*(1), 106–148.

Burgoyne, A. P., Mashburn, C. A., Tsukahara, J. S., & Engle, R. W. (2022). Attention control and process overlap theory: Searching for cognitive processes underpinning the positive manifold. *Intelligence*, *91*, 101–629.

Caemmerer, J. M., & Reynolds, M. R. (2020). The relation between intelligence and academic achievement: A meta-analysis. *Intelligence*, *79*, 101449.

Caemmerer, J. M., Keith, T. Z., & Reynolds, M. R. (2020). Beyond individual intelligence tests: Application of Cattell-Horn-Carroll theory. *Intelligence*, *79*, 101433.

Canivez, G. L., & McGill, R. J. (2016). Factor structure of the differential ability scales–second edition: Exploratory and hierarchical factor analyses with the core subtests. *Psychological Assessment*, *28*(11), 1475–1488.

Carroll, J. B. (1997). The three-stratum theory of cognitive abilities. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 122–130). Guilford Press.

Carroll, J. B. (1998). Foreword. In K. S. McGrew & D. P. Flanagan (Eds.), *The intelligence test desk reference: Gf-Gc cross-battery assessment* (pp. xi–xii). Allyn & Bacon.

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

Carroll, J. B., & Horn, J. L. (1981). On the scientific basis of ability testing. *American Psychologist*, *36*(10), 1012–1020. https://doi.org/10.1037/0003-066X.36.10.1012.

Cattell, R. B. (1941). An objective test of character-temperament: I. *The Journal of General Psychology*, *25*(1), 59–73.

Colom, R., Haier, R. J., Head, K., Álvarez-Linera, J., Quiroga, M. Á., Shih, P. C., & Jung, R. E. (2009). Gray matter correlates of fluid, crystallized, and spatial intelligence: Testing the P-FIT model. *Intelligence*, *37*(2), 124–135.

Compton, D. L., Fuchs, L. S., Fuchs, D., Lambert, W., & Hamlett, C. (2012). The cognitive and academic profiles of reading and mathematics learning disabilities. *Journal of Learning Disabilities*, *45*(1), 79–95.

Comrey, A. L. (1988). Factor-analytic methods of scale development in personality and clinical psychology. *Journal of Consulting and Clinical Psychology*, *56*, 754–761.

Conway, A. R., Kovacs, K., Hao, H., Rosales, K. P., & Snijder, J. P. (2021). Individual differences in attention and intelligence: A united cognitive/psychometric approach. *Journal of Intelligence*, *9*(3), 34.

Daniel, M. H. (1997). Intelligence testing: Status and trends. *American Psychologist*, *52*(10), 1038–1045.

Decker, S., Fillmore, P. T., & Roberts, A. (2017). Coherence: The measurement and application of brain connectivity. *NeuroRegulation*, *4*(1), 3–3.

Decker, S. L. (2008). School neuropsychology consultation in neurodevelopmental disorders. *Psychology in the Schools*, *45*, 799–811.

Decker, S. L. (2021). Don't use a bifactor model unless you believe the true structure is bifactor. *Journal of Psychoeducational Assessment*, *39*(1), 39–49.

Decker, S. L., Bridges, R. M., Luedke, J. C., & Eason, M. J. (2021). Dimensional evaluation of cognitive measures: Methodological confounds and theoretical concerns. *Journal of Psychoeducational Assessment*, *39*(1), 3–27. https://doi.org/10.1177/0734282920940879.

Decker, S. L., Bridges, R. M., & Vetter, T. (2018). Cognitive neuroscientific contributions to theoretical understanding of SLD. In V. C. Alfonso & D. P. Flanagan (Eds.), *Essentials of specific learning disabilities identification* (2nd ed, pp. 285–306). Wiley.

Dombrowski, S. C., Canivez, G. L., & Watkins, M. W. (2018). Factor structure of the 10 WISC-V primary subtests across four standardization age groups. *Contemporary School Psychology*, *22*(1), 90–104.

Dombrowski, S. C., Canivez, G. L., Watkins, M. W., & Beaujean, A. A. (2015). Exploratory bifactor analysis of the Wechsler intelligence scale for children—fifth edition with the 16 primary and secondary subtests. *Intelligence*, *53*, 194–201.

Dombrowski, S. C., McGill, R. J., & Canivez, G. L. (2017). Exploratory and hierarchical factor analysis of the WJ-IV cognitive at school age. *Psychological Assessment*, *29*(4), 394–407.

Dombrowski, S. C., McGill, R. J., Canivez, G. L., Watkins, M. W., & Beaujean, A. A. (2021). Factor analysis and variance partitioning in intelligence test research: Clarifying misconceptions. *Journal of Psychoeducational Assessment*, *39*, 28–38.

Duke, N. K., & Cartwright, K. B. (2021). The science of reading progresses: Communicating advances beyond the simple view of reading. *Reading Research Quarterly*, *56*(S1), S25–S44. https://doi.org/10.1002/rrq.411.

Elliott, C. D. (1990). *Differential ability scales*. The Psychological Corporation.

Elliott, C. D. (2023). *Differential ability scales* (2nd ed). Pearson. Normative update.

Evans, J. J., Floyd, R. G., McGrew, K. S., & Leforgee, M. H. (2002). The relations between measures of Cattell-Horn-Carroll (CHC) cognitive abilities and reading achievement during childhood and adolescence. *School Psychology Review*, *31*(2), 246–262.

Farmer, R. L., McGill, R. J., Dombrowski, S. C., & Canivez, G. L. (2021a). Why questionable assessment practices remain popular in school psychology: Instructional materials as pedagogic vehicles. *Canadian Journal of School Psychology*, *36*(2), 98–114.

Farmer, R. L., Zaheer, I., Duhon, G. J., & Ghazal, S. (2021b). Reducing low-value practices a functional-contextual consideration to aid in de-implementation efforts. *Canadian Journal of School Psychology*, *36*(2), 153–165.

Flanagan, D. P. (2025). The Woodcock-Johnson V: Fifty years of excellence in ability assessment. *Journal of Psychoeducational Assessment*, *43*(8), 799–801.

Flanagan, D. P., Alfonso, V. C., Mascolo, J. T., & Hale, J. B. (2011). The Wechsler intelligence scale for children–fourth edition in neuropsychological practice. In A. S. Davis (Ed.), *Handbook of pediatric neuropsychology* (pp. 397–414). Springer.

Flanagan, D. P., Alfonso, V. C., Ortiz, S. O., & Dynda, A. M. (2010). Integrating cognitive assessment in school neuropsychological evaluations. In D. C. Miller (Ed.), *Best practices in school neuropsychology: Guidelines for effective practice, assessment, and evidence-based intervention* (pp. 101–140). Wiley.

Flanagan, D. P., Alfonso, V. C., Zinkiewicz, C. J., Ortiz, S. O., & Dynda, A. M. (2022). An integrative theoretical framework for cognitive test interpretation in school neuropsychological evaluations. In D. C. Miller, D. E. Maricle, C. L. Bedford, & J. A. Gettman (Eds.), *Best practices in school neuropsychology: Guidelines for effective practice, assessment, and evidence-based intervention* (2nd ed, pp. 87–119). Wiley. https://doi.org/10.1002/9781119790563.ch6.

Flanagan, D. P., Costa, M., Palma, K., Leahy, M. A., Alfonso, V. C., & Ortiz, S. O. (2018). Cross-battery assessment, the cross-battery assessment software system, and the assessment–intervention connection. In D. P. Flanagan & E. M. McDonough (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (4th ed, pp. 731–776). Guilford Press.

Flanagan, D. P., & McGrew, K. S. (1997). A cross-battery approach to assessing and interpreting cognitive abilities: Narrowing the gap between practice and cognitive science. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 314–325). Guilford Press.

Flanagan, D. P., & McGrew, K. S. (1998). Interpreting intelligence tests from modern *Gf-Gc* theory: Joint confirmatory factor analysis of the WJ-R and Kaufman adolescent and adult intelligence test (KAIT). *Journal of School Psychology*, *36*, 151–182.

Flanagan, D. P., McGrew, K. S., & Ortiz, S. O. (2000). *The Wechsler intelligence scales and Gf-Gc theory: A contemporary approach to interpretation*. Allyn & Bacon.

Flanagan, D. P., & Ortiz, S. O. (2001). *Essentials of cross-battery assessment*. Wiley.

Flanagan, D. P., Ortiz, S. O., & Alfonso, V. C. (2013). *Essentials of cross-battery assessment* (3rd ed). Wiley.

Flanagan, D. P., Ortiz, S. O., & Alfonso, V. C. (2017). *Cross-battery assessment software system 2.0 (X-BASS 2.0)*. Wiley.

Flanagan, D. P., Ortiz, S. O., & Alfonso, V. C. (2025). *Cross-battery assessment software system 3.0 (X-BASS 3.0)*. Wiley.

Flanagan, D. P., Ortiz, S. O., Alfonso, V. C., & Mascolo, J. T. (2002). *The achievement test desk reference (ADTR): Comprehensive assessment and learning disabilities*. Allyn & Bacon.

Flanagan, D. P., Ortiz, S. O., Alfonso, V. C., & Mascolo, J. T. (2006). *The achievement test desk reference (ADTR): A guide to learning disability identification*. Allyn & Bacon.

Gottfredson, L. S. (2002). Where and why g matters: Not a mystery. *Human Performance*, *15*(1–2), 25–46.

Guilford, J. P. (1954). *Psychometric methods* (2nd ed). McGraw-Hill.

Gustafsson, J.-E., & Undheim, J. O. (1996). Individual differences in cognitive functions. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 186–242). Macmillan Library Reference USA: Prentice Hall International.

Haier, R. J., Colom, R., Schroeder, D. H., Condon, C. A., Tang, C., Eaves, E., & Head, K. (2009). Gray matter and intelligence factors: Is there a neuro-g? *Intelligence*, *37*(2), 136–144.

Haier, R. J., & Jung, R. E. (2018). The parieto-frontal integration theory: Assessing intelligence from brain images. In *Contemporary intellectual assessment: Theories, tests, and issues* (4th ed, pp. 219–224). Guilford Press.

Hajovsky, D. B., Niileksela, C. R., Flanagan, D. P., Alfonso, V. C., Schneider, J., & Zinkiewicz, C. J. (2022, August 4–7). *A consensus model of cognitive-achievement relations using meta-SEM* [Poster Presentation]. American Psychological Association, Minneapolis, MN, United States.

Hajovsky, D. B., Niileksela, C. R., Flanagan, D. P., Alfonso, V. C., Schneider, W. J., & Robbins, J. (2025). Toward a consensus model of cognitive–reading achievement relations using meta-structural equation modeling. *Journal of Intelligence*, *13*(8), 104.

Hale, J. B., & Fiorello, C. A. (2004). *School neuropsychology: A practitioner's handbook*. Guilford Press.

Hale, J. B., Wycoff, K. L., & Fiorello, C. A. (2011). RTI and cognitive hypothesis testing for specific learning disabilities identification and intervention: The best of both worlds. In D. P. Flanagan & V. C. Alfonso (Eds.), *Essentials of specific learning disability identification* (pp. 173–202). Wiley.

Horn, J. L. (1991). Measurement of intellectual capabilities: A review of theory. In K. S. McGrew, J. K. Werder, & R. W. Woodcock (Eds.), *Woodcock-Johnson technical manual* (pp. 197–232). Riverside.

Horn, J. L., & Noll, J. (1997). Human cognitive capabilities: *Gf-Gc* theory. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests and issues* (pp. 53–91). Guilford Press.

Jensen, A. R. (1998). *The factor*. Prager.

Jung, R. E., & Haier, R. J. (2007). The Parieto-frontal integration theory (P-FIT) of intelligence: Converging neuroimaging evidence. *The Behavioral and Brain Sciences*, *30*(2), 135–154.

Kan, K. J., van der Maas, H. L., & Levine, S. Z. (2019). Extending psychometric network analysis: Empirical evidence against g in favor of mutualism? *Intelligence*, *73*, 52–62.

Kaufman, A. S. (2000). Foreword. In D. P. Flanagan, K. S. McGrew, & S. O. Ortiz (Eds.), *The Wechsler intelligence scales and Gf-Gc theory: A contemporary approach to interpretation* (pp. xiii–xv). Allyn & Bacon.

Kaufman, A. S., & Kaufman, N. L. (1983). *Kaufman Assessment Battery for Children*. American Guidance Service.

Kaufman, A. S., & Kaufman, N. L. (1993). *Kaufman adolescent and adult intelligence test*. American Guidance Service, Circle Pines, MN.

Kaufman, A. S., & Kaufman, N. L. (2018). *Kaufman Assessment Battery for Children* (2nd ed). Pearson. Normative update.

Keith, T. Z. (1997). Comments on the relationship between intelligence, working memory capacity, and information processing speed and efficiency: A reply. *School Psychology Quarterly*, *12*, 117–118.

Keith, T. Z., & Reynolds, M. R. (2010). CHC and cognitive abilities: What we've learned from 20 years of research. *Psychology in the Schools*, *47*, 635–650.

Keith, T. Z., & Reynolds, M. R. (2012). Using confirmatory factor analysis to aid in understanding the constructs measured by intelligence tests. In D. F. Flanagan & P. H. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (3rd ed, pp. 758–799). Guilford Press.

Keith, T. Z., & Reynolds, M. R. (2018). Using confirmatory factor analysis to aid in understanding the constructs measured by intelligence tests. In D. F. Flanagan & E. M. McDonough (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (4th ed, pp. 853–900). Guilford Press.

Kell, H. J., & Lang, J. W. (2017). Specific abilities in the workplace: More important than g? *Journal of Intelligence*, *5*(2), 13.

Klein, E., & Knops, A. (2023). The two-network framework of number processing: A step towards a better understanding of the neural origins of developmental dyscalculia. *Journal of Neural Transmission*, *130*(3), 253–268.

Kovacs, K. (2019). Process overlap theory: How the interplay between specific and general mental abilities accounts for the positive manifold in intelligence. In D. J. McFarland (Ed.), *General and specific mental abilities* (pp. 132–152). Cambridge Scholars Publishing.

Kovacs, K., & Conway, A. R. (2016). Process overlap theory: A unified account of the general factor of intelligence. *Psychological Inquiry*, *27*(3), 151–177.

Kristanto, D., Hildebrandt, A., Sommer, W., & Zhou, C. (2023). Cognitive abilities are associated with specific conjunctions of structural and functional neural subnetworks. *NeuroImage*, *279*, 120304.

LaForte, E. M., Dailey, D., & McGrew, K. S. (2025). *Technical manual. Woodcock-Johnson V*. Riverside Assessments, LLC.

Lezak, M. D. (1976). *Neuropsychological assessment*. Oxford University Press.

Lezak, M. D. (1995). *Neuropsychological assessment* (3rd ed). Oxford University Press.

Lezak, M. D., Howieson, D. B., & Loring, D. W. (2004). *Neuropsychological assessment* (4th ed). Oxford University Press.

Malanchini, M., Rimfeld, K., Allegrini, A. G., Ritchie, S. J., & Plomin, R. (2020). Cognitive ability and education: How behavioural genetic research has advanced our knowledge and understanding of their association. *Neuroscience & Biobehavioral Reviews*, *111*, 229–245.

Mascolo, J. T., Alfonso, V. C., & Flanagan, D. P. (2014). *Essentials of planning, selecting, and tailoring interventions for unique learners*. Wiley.

Mather, N., McGrew, K. S., LaForte, E. M., & Wendling, B. J. (2025). *Woodcock-Johnson V virtual test library*. Riverside Assessments, LLC.

McCloskey, G., Slonim, J., Whitaker, R., Kaufman, S., & Nagoshi, N. (2017). A neuropsychological approach to interpretation of the WISC-V. In D. P. Flanagan & V. C. Alfonso (Eds.), *Essentials of WISC-V assessment* (pp. 287–333). Wiley.

McDonough, E. M., Flanagan, D. P., Sy, M., & Alfonso, V. C. (2017). Specific learning disorder. In *Handbook of DSM-5 disorders in children and adolescents* (pp. 77–104). Springer International Publishing, Cham.

McGill, R. J., & Dombrowski, S. C. (2019). Critically reflecting on the origins, evolution, and impact of the Cattell-Horn-Carroll (CHC) model. *Applied Measurement in Education*, *32*(3), 216–231.

McGrew, K. S. (1994). *Clinical interpretation of the Woodcock-Johnson tests of cognitive ability-revised*. Allyn & Bacon.

McGrew, K. S. (1997). Analysis of the major intelligence batteries according to a proposed comprehensive CHC framework. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 151–180). Guilford Press.
McGrew, K. S. (2005). The Cattell-Horn-Carroll theory of cognitive abilities: Past, present, and future. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 136–182). Guilford Press.
McGrew, K. S. (2009). CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research. *Intelligence*, *37*(1), 1–10.
McGrew, K. S. (2023). 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. *Journal of Intelligence*, *11*(2), 32 https://doi.org/10.3390/jintelligence11020032.
McGrew, K. S., & Flanagan, D. P. (1998). *The intelligence test desk reference (ITDR): CHC cross-battery assessment*. Allyn & Bacon.
McGrew, K. S., Flanagan, D. P., Keith, T. Z., & Vanderwood, M. (1997). Beyond *g*: The impact of CHC specific cognitive abilities research on the future use and interpretation of intelligence tests in the schools. *School Psychology Review*, *26*, 189–210.
McGrew, K. S., Mather, N., LaForte, E. M., & Wendling, B. J. (2025). *Woodcock-Johnson V*. Riverside Assessments, LLC.
McGrew, K. S., Schneider, W. J., Decker, S. L., & Bulut, O. (2023). A psychometric network analysis of CHC intelligence measures: Implications for research, theory, and interpretation of broad CHC scores "Beyond g". *Journal of Intelligence*, *11*(1), 19 https://doi.org/10.3390/jintelligence11010019.
Meehl, P. E. (1992). Factors and taxa, traits and types, differences of degree and differences in kind. *Journal of Personality*, *60*(1), 117–174.
Messick, S. (1989). Validity. In R. Linn (Ed.), *Educational measurement* (3rd ed, pp. 104–131). American Council on Education.
Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist*, *50*, 741–749.
Miller D. C. (2024, January 25–26). *Integration of CHC theory with neuropsychological theories* [Conference Presentation]. State of the Art of SLD Identification 2024: Innovations in Theory, Research, and Practice. Virtual.
Miller, D. C., & Maricle, D. E. (2019). *Essentials of school neuropsychological assessment* (3rd ed). Wiley.
Miller, D. C., Maricle, D. E., Bedford, C. L., & Gettman, J. A. (Eds.) (2022). *Best practices in school neuropsychology: Guidelines for effective practice, assessment, and evidence-based intervention*. John Wiley & Sons.
Murray, A. L., & Johnson, W. (2013). The limitations of model fit in comparing the bi-factor versus higher-order models of human cognitive ability structure. *Intelligence*, *41*(5), 407–422.
Naglieri, J. A., & Das, J. P. (1997). *Cognitive Assessment System*. Riverside Publishing.
Naglieri, J. A., Das, J. P., & Goldstein, S. (2014). *Cognitive Assessment System* (2nd ed). Pro-Ed.
Niileksela, C. R., & Hajovsky, D. B. (2024, January 25–26). *Consolidating evidence of cognitive-achievement relations: A preliminary meta-analysis of 496 datasets* [Conference Presentation]. State of the Art of Specific Learning Disabilities Identification: Innovations in Theory, Research, and Practice, Virtual.
Niileksela, C. R., Hajovsky, D. B., Montenegro, F. P., Schneider, W. J., Flanagan, D. P., & Alfonso, V. C. (2026). Cognitive-mathematics relations: A meta-analysis of norm-referenced standardized test batteries. Manuscript submitted for publication.
Niileksela, C. R., Reynolds, M. R., Keith, T. Z., & McGrew, K. S. (2016). A special validity study of the Woodcock–Johnson IV: Acting on evidence for specific abilities. In D. P. Flanagan & V. C. Alfonso (Eds.), *WJ IV clinical use and interpretation: Scientist-practitioner perspectives* (pp. 65–106). Elsevier.
O'Connell, M. (2018). The power of cognitive ability in explaining educational test performance, relative to other ostensible contenders. *Intelligence*, *66*, 122–127.
Procopio, F., Zhou, Q., Wang, Z., Gidziela, A., Rimfeld, K., Malanchini, M., & Plomin, R. (2022). The genetics of specific cognitive abilities. *Intelligence*, *95*, 101689.
Raiford, S. E. (2017). *Essentials of WISC-V integrated assessment*. John Wiley & Sons.
Reynolds, M. R., Keith, T. Z., Flanagan, D. P., & Alfonso, V. C. (2013). A cross-battery, reference variable, confirmatory factor analytic investigation of the CHC taxonomy. *Journal of School Psychology*, *51*(4), 535–555.
Roid, G. H. (2003). *Stanford Binet intelligence scales* (5th ed). Riverside.
Schmank, C. J., Goring, S. A., Kovacs, K., & Conway, A. R. (2021). Investigating the structure of intelligence using latent variable and psychometric network modeling: A commentary and reanalysis. *Journal of Intelligence*, *9*(1), 8.
Schneider, W. J., Flanagan, D. P., Niileksela, C. R., & Engler, J. R. (2024). The effect of measurement error on the positive predictive value of PSW methods for SLD identification: How buffer zones dispel the illusion of inaccuracy. *Journal of School Psychology*, *103*, 101280.
Schneider, W. J. (2016). Strengths and weaknesses of the Woodcock-Johnson IV tests of cognitive abilities: Best practice from a scientist-practitioner perspective. In D. P. Flanagan & V. C. Alfonso (Eds.), *WJ IV clinical use and interpretation: Scientist-practitioner perspectives* (pp. 192–211). Academic Press.
Schneider, W. J., & McGrew, K. (2012). The Cattell-Horn-Carroll model of intelligence. In D. Flanagan & P. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (3rd ed, pp. 99–144). Guilford Press.
Schneider, W. J., & McGrew, K. S. (2018). The Cattell-Horn-Carroll theory of cognitive abilities. In D. P. Flanagan & E. M. McDonough (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (4th ed, pp. 73–163). Guilford Press.
Schrank, F. A., Mather, N., & McGrew, K. S. (2014). *Woodcock-Johnson IV tests of achievement*. Riverside.
Schulze, R. (2005). Modeling structures of intelligence. In O. Wilhelm & R. W. Engle (Eds.), *Handbook of understanding and measuring intelligence* (pp. 241–263). Sage Publications, Inc.
Shanock, A., Flanagan, D. P., Alfonso, V. C., & McHale-Small, M. (2022). Helping school psychologists and districts estimate the cost of adopting the dual discrepancy/consistency PSW method for SLD identification. *Journal of Applied School Psychology*, *38*(4), 316–351.
Spearman, C. (1904). "General intelligence," objectively determined and measured. *The American Journal of Psychology*, *15*(2), 201–293. https://doi.org/10.2307/1412107.
Taylor, T. R. (1994). A review of three approaches to cognitive assessment, and a proposed integrated approach based on a unifying theoretical framework. *South Africa Journal of Psychology*, *24*(4), 184–193.
Thorndike, R. L., Hagen, E. P., & Sattler, J. M. (1986). *Standford-Binet intelligence scale* (4th ed). Riverside.

Thorndike, R. M. (1997). The early history of intelligence testing. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 3–16). Guilford Press.

Thurstone, L. L. (1938). *Primary mental abilities*. University of Chicago Press.

Vakhtin, A. A., Ryman, S. G., Flores, R. A., & Jung, R. E. (2014). Functional brain networks contributing to the Parieto-Frontal integration theory of intelligence. *NeuroImage*, *103*, 349–354.

Van der Maas, H. L. J., Kan, K. Y. J., Marsman, M., & Stevenson, C. E. (2017). Network models for cognitive development and intelligence. *Journal of Intelligence*, *5*, 16.

Wang, R., Liu, M., Cheng, X., Wu, Y., Hildebrandt, A., & Zhou, C. (2021). Segregation, integration, and balance of large-scale resting brain networks configure different cognitive abilities. *Proceedings of the National Academy of Sciences*, *118*(23), e2022288118.

Warne, R. T., & Burnungham, C. (2019). Spearman's g found in 31 non-western nations: Strong evidence that g is a universal phenomenon. *Psychological Bulletin*, *145*, 237–272.

Watkins, M. W., & Beaujean, A. A. (2014). Bifactor structure of the Wechsler preschool and primary scale of intelligence—fourth edition. *School Psychology Quarterly*, *29*(1), 52–63.

Wechsler, D. (1981). *Wechsler adult intelligence scale–revised*. The Psychological Corporation.

Wechsler, D. (1989). *Wechsler preschool and primary scale of intelligence–revised*. The Psychological Corporation.

Wechsler, D. (1991). *Wechsler intelligence scale for children* (3rd ed). The Psychological Corporation.

Wechsler, D. (2012). *Wechsler preschool and primary scale of intelligence* (4th ed). Pearson.

Wechsler, D. (2014). *Wechsler intelligence scale for children* (5th ed). Pearson.

Wechsler, D., Raiford, S. E., & Presnell, K. (2024). *Wechsler adult intelligence scale* (5th ed). Pearson.

Wilson, B. C. (1992). The neuropsychological assessment of the preschool child: A branching model. In I. Rapin & S. I. Segalowitz (Eds.), *Handbook of neuropsychology: Vol. 6. Child neuropsychology* (pp. 377–394). Elsevier.

Wilson, C. J., Bowden, S. C., Byrne, L. K., Vannier, L. C., Hernandez, A., & Weiss, L. G. (2023). Cross-national generalizability of WISC-V and CHC broad ability constructs across France, Spain, and the US. *Journal of Intelligence*, *11*(8), 159.

Woodcock, R. W. (1977). Woodcock-Johnson Psycho-Educational Battery. Technical Report.

Woodcock, R. W. (1990). Theoretical foundations of the WJ-R measures of cognitive ability. *Journal of Psychoeducational Assessment*, *8*, 231–258.

Woodcock, R. W., & Johnson, M. B. (1989). *Woodcock-Johnson psycho-educational battery-revised*. DLM Teaching Resources.

Woodcock, R. W., Miller, D. C., Maricle, D. E., & McGill, R. J. (2017). *Evidence-based selective assessment for academic disorders*. School Neuropsych Press.