Essentials of Cross-Battery Assessment, Including Overview of KABC-II and its Use in Cross-Battery and Nondiscriminatory Assessment

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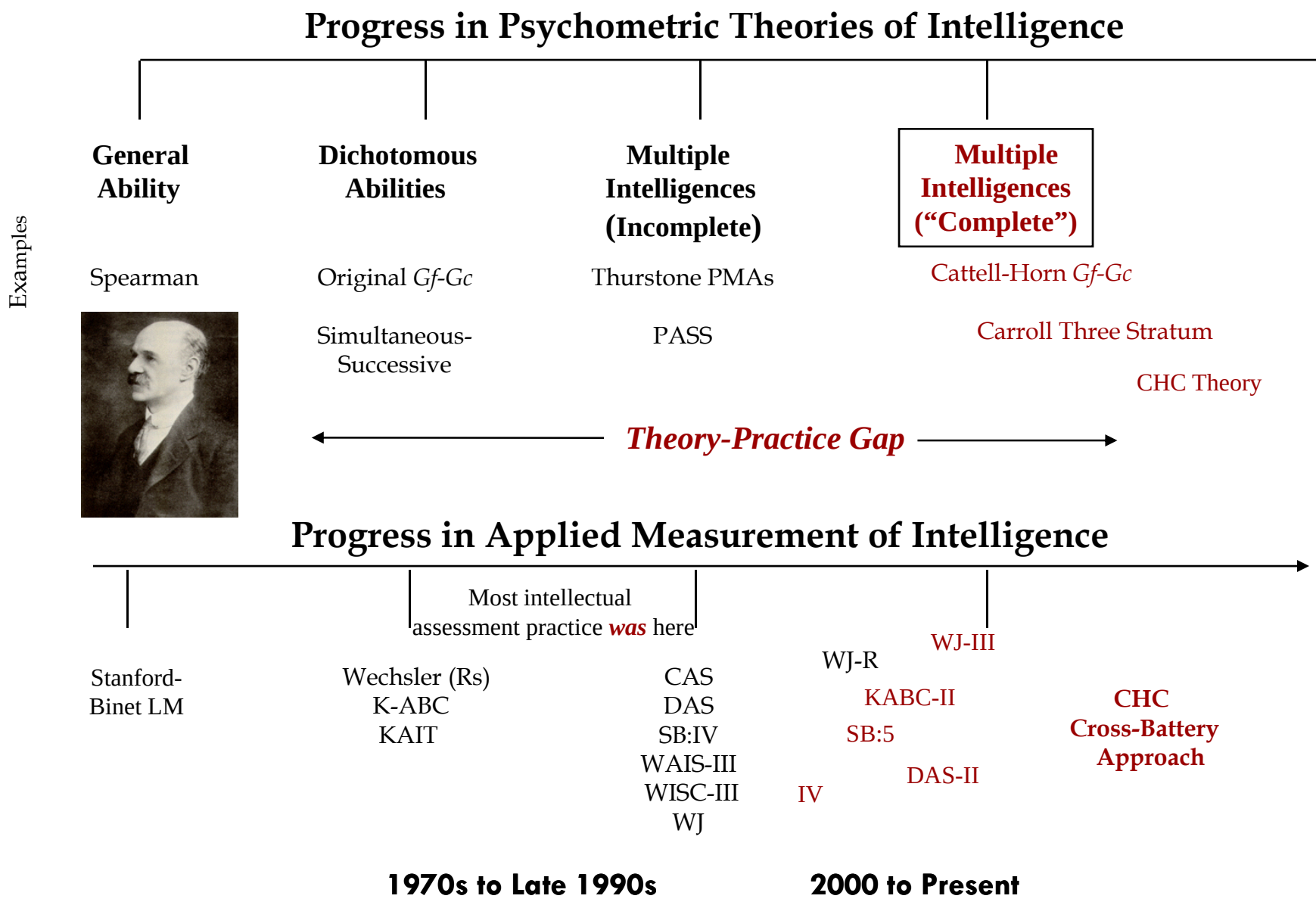
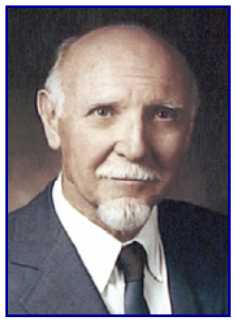
Overview

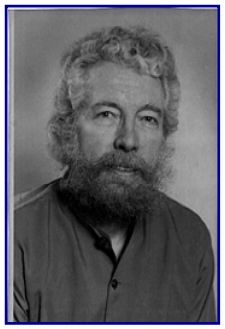
- Continuum of Progress in Theories and Tests of Intelligence and Cognitive Abilities/Processes
- Brief Description of CHC Theory
- Rationale for Development of the Cross-Battery Approach
- Description of the Cross-Battery Approach
- Ethnic Differences on Intelligence Tests
- Description of KABC-II
- Use of KABC-II in Nondiscriminatory Assessment
- Conclusions

Theory-Practice Gap



Cattell-Horn *Gf-Gc* Theory





Broad (Stratum II)

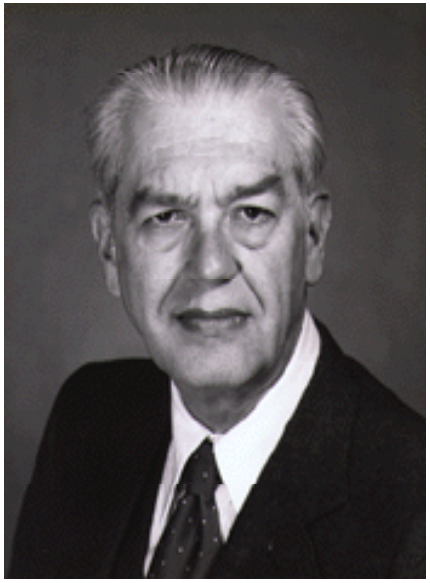
Gf	*Gq*	*Gc*	*Gsm*	*Gv*	*Ga*	*Glr*	*Gs*	*CDS*	*Grw*
Fluid Intelligence	Quantitative Knowledge	Crystallized Intelligence	Short-Term Memory	Visual Processing	Auditory Processing	Long-Term Retrieval	Processing Speed	Correct Decision Speed	Reading/ Writing

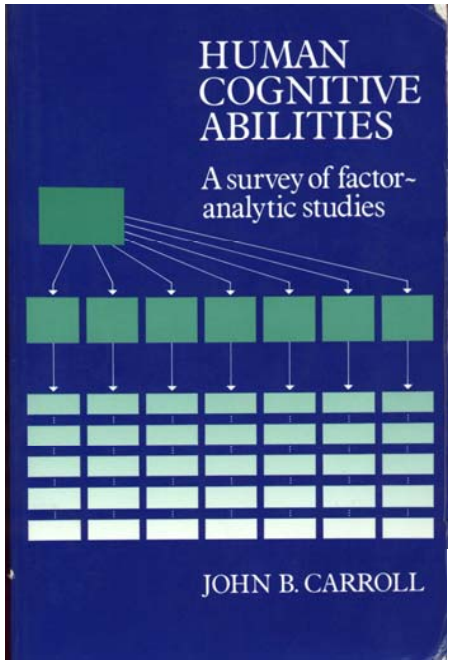
Narrow (Stratum I)

69 narrow abilities found in data sets analyzed by Carroll (1993)

A Landmark Event in Understanding the Structure of Intelligence

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





Reviews of Carroll's Book

"He has reviewed and reanalyzed the *world's literature* on individual differences in cognitive abilities, collected over most of a century....No one else could have done it. No one else would have applied so consistent and impartial a system on the literature, and reached so balanced, complete, and useful a conclusion...It is a monumental contribution...*it defines the taxonomy of cognitive differential psychology for many years to come.*"

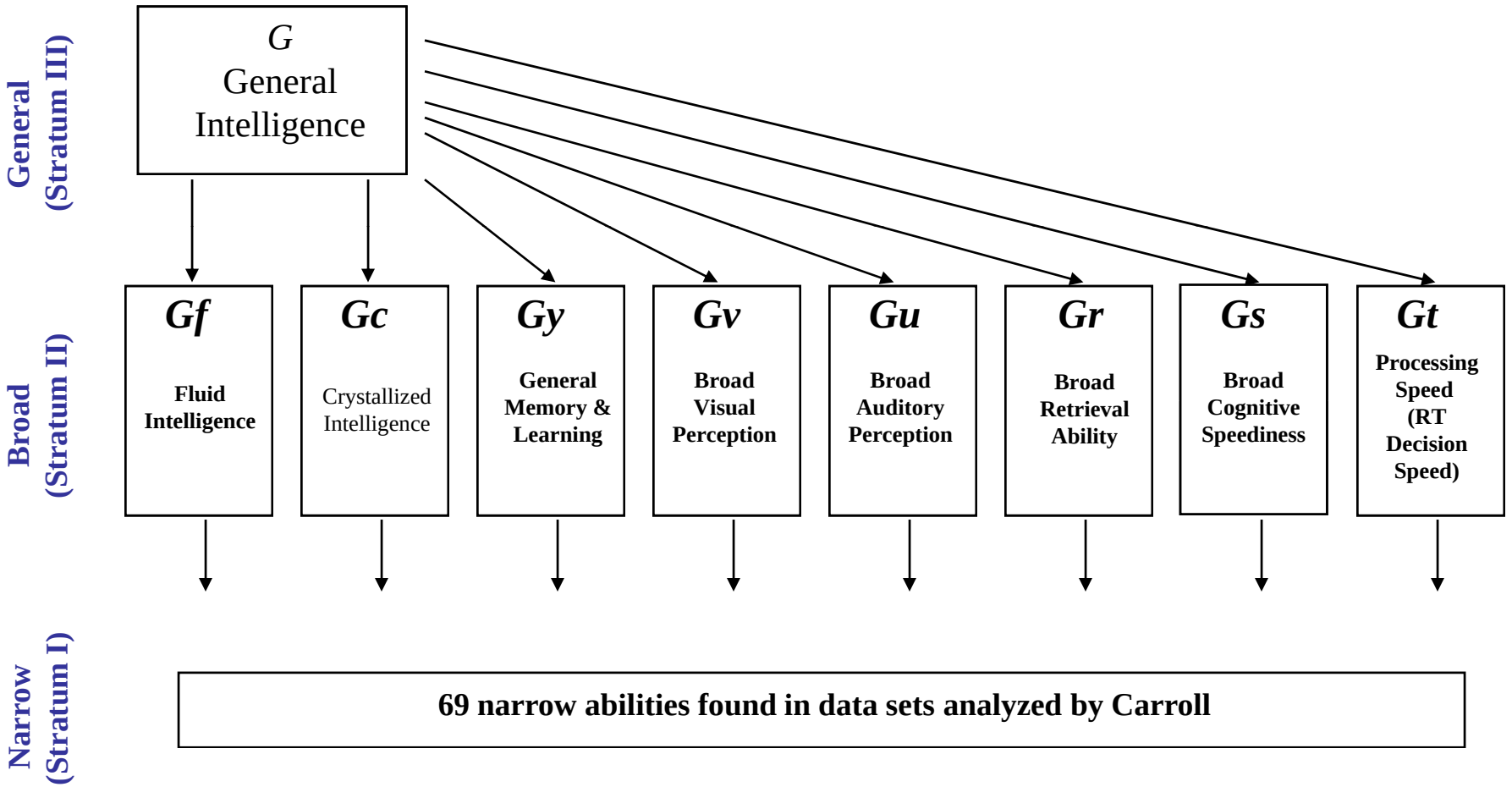
Snow (1993)

Reviews of Carroll's Book

"This is truly a remarkable book. It is simply the finest work of research and scholarship I have read and is destined to be *the classic study and reference work on human abilities* for decades to come. Each of these chapters alone is a *major* literature review of research in a particular cognitive domain."

Burns (1994)

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



Comments on the Cattell-Horn Model

"The Cattell-Horn model...is a true hierarchical model covering all major domains of intellectual functioning...among available models it appears to offer *the most well-founded and reasonable approach to an acceptable theory of the structure of cognitive abilities"*

Carroll (1993)

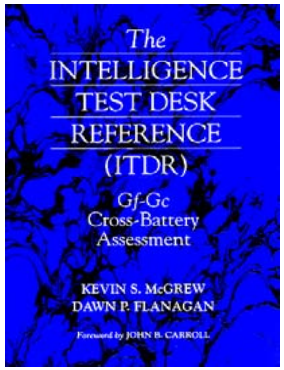
THE CROSS-BATTERY APPROACH: AN EXTERNAL REVIEW

- **This multifactor model (Carroll/*Gf-Gc*) provides a common frame of reference for test analysis and interpretation...**

- **It has already led to an intriguing approach to testing and interpretation called cross-battery assessment ...**

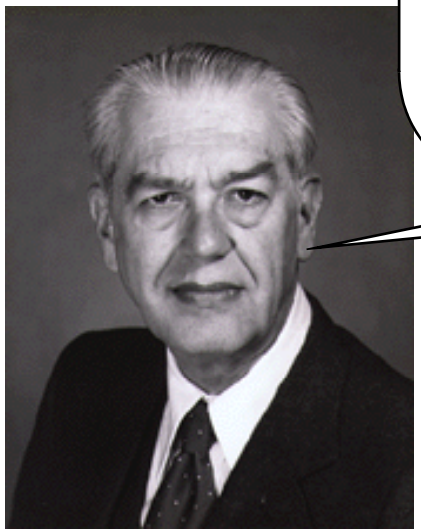
- **The creative work now being done to integrate and interpret all cognitive batteries within the framework of a single intelligence theory...**

(Daniel, 1997) - Special issue on Intelligence and Lifelong Learning in the American Psychologist

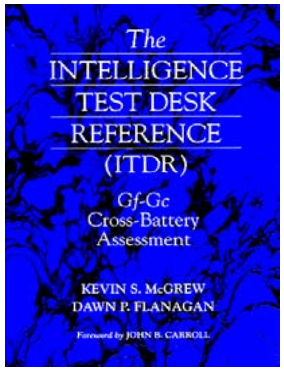


WHAT DOES JOHN CARROLL THINK ABOUT THE ITDR: CROSS-BATTERY APPROACH ?

- **This is a remarkable book. It covers or touches on just about everything that can now be stated about the structure of intellectual abilities as measured by currently available individual intelligence and cognitive ability tests**



(Carroll, 1998)



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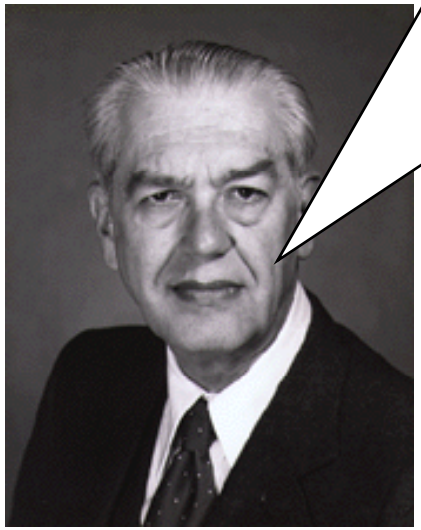
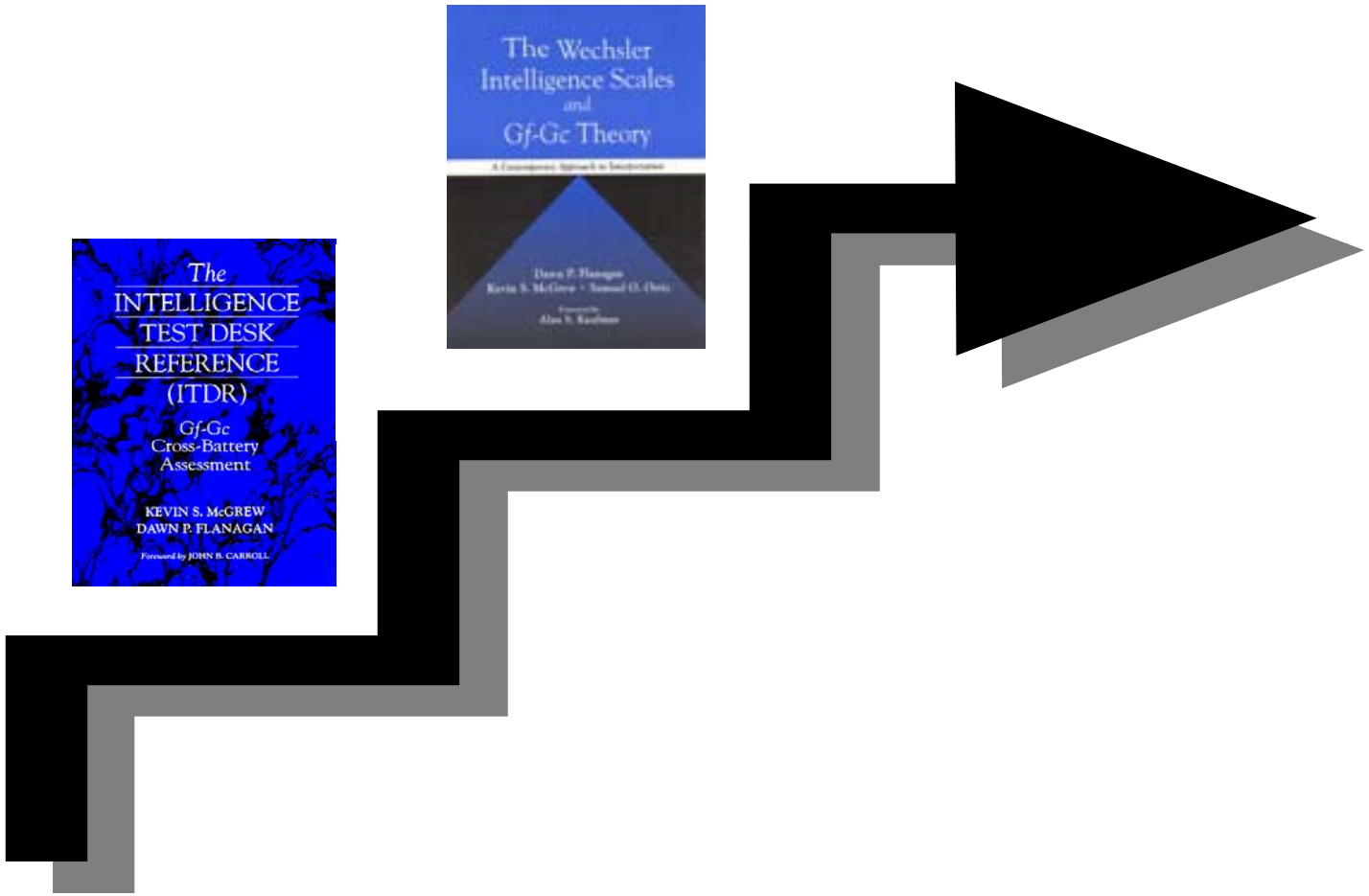


•In the past, there have been problems in training psychologists to use proper procedures and judgment in administering individual intelligence tests, with the result that … many mistakes have been made. This book has every chance of assisting in the proper training and proper guidance of those who use individual intelligence and cognitive ability tests

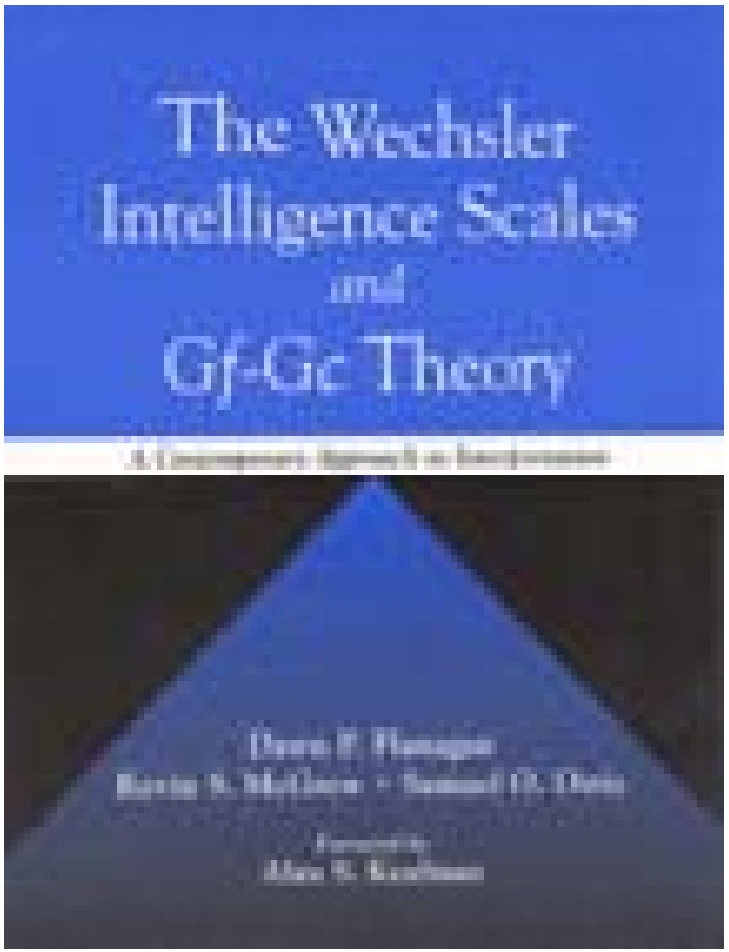
(Carroll, 1998)

Progress in Cross-Battery Methods……



Which Model Should Be Used?

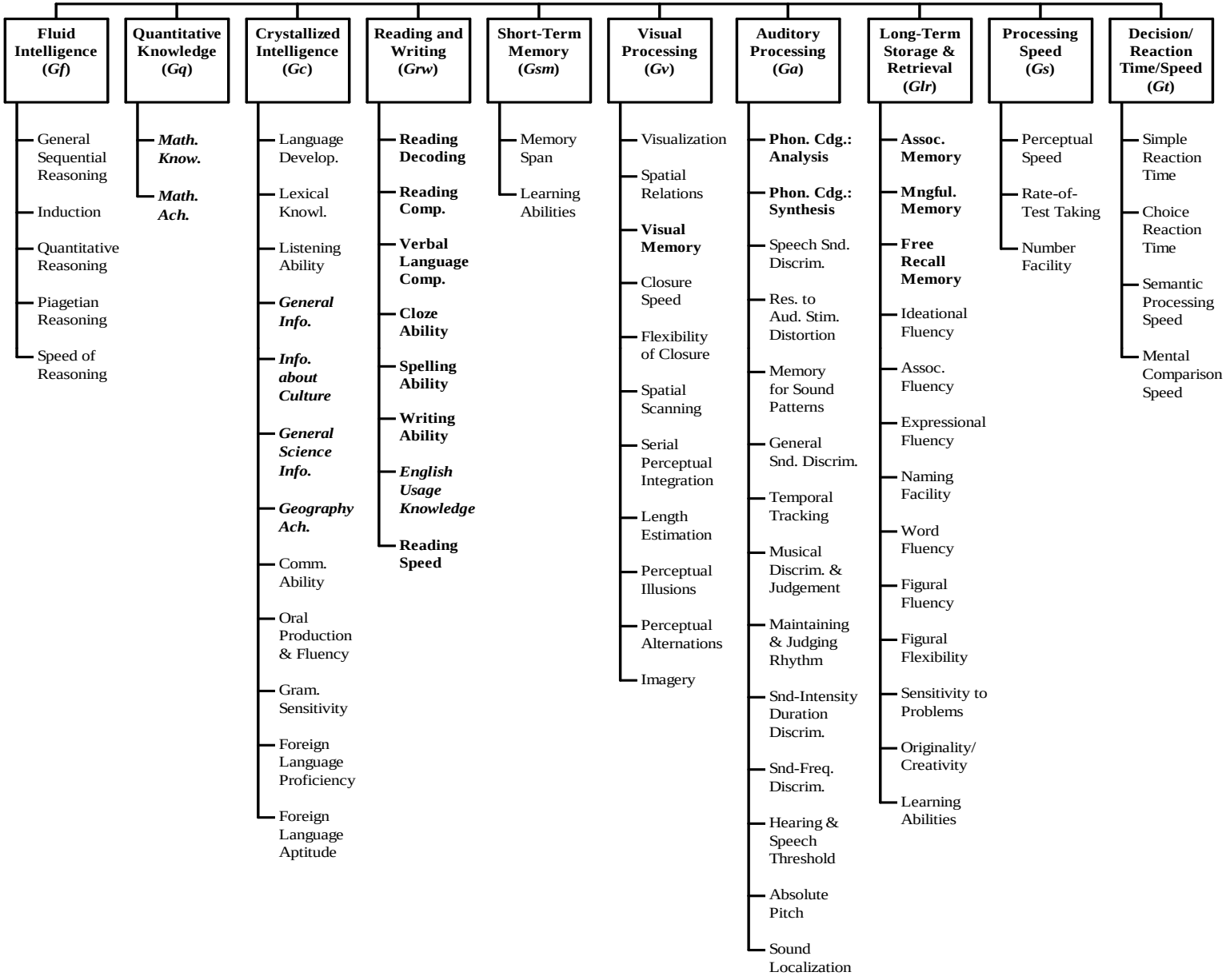
Contemporary Psychometric Theory Applied to the Wechsler Intelligence Scales

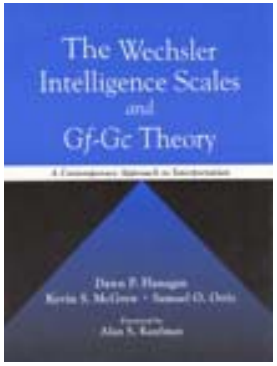


An Integration of the *Gf-Gc* and Three-Stratum Theories of Cognitive Abilities

Based largely on McGrew's analyses in 1997-1999

Integrated Theory of Cognitive Abilities

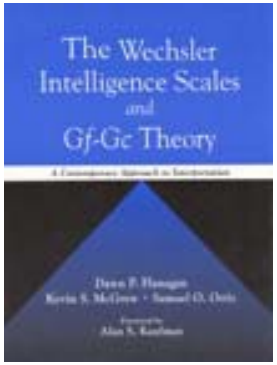




THE CROSS-BATTERY APPROACH: AN EXTERNAL REVIEW

" Flanagan, McGrew, and Ortiz have taken my pleas for an integrated research-based and theoretical approach to IQ test interpretation to a new level. I asked for research results to be applied to profile interpretation...Every chapter has research at its foundation. I asked for theory to be applied to profile interpretation. Flanagan, McGrew, and Ortiz have achieved more than anyone else in operationalizing my plea into action."

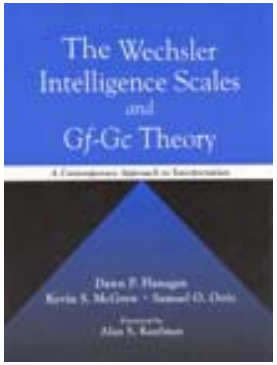
Alan Kaufman foreword for
Flanagan, McGrew & Ortiz, 2000



THE CROSS-BATTERY APPROACH: AN EXTERNAL REVIEW

"One of the basic tenets of my approach to IQ test interpretation is to supplement Wechsler's scales with pertinent tasks to round out the assessment and to follow-up hunches and hypotheses. This psychoeducational approach to assessment...has been implemented to near perfection by Flanagan et al."

Alan Kaufman foreword for Flanagan, McGrew & Ortiz, 2000

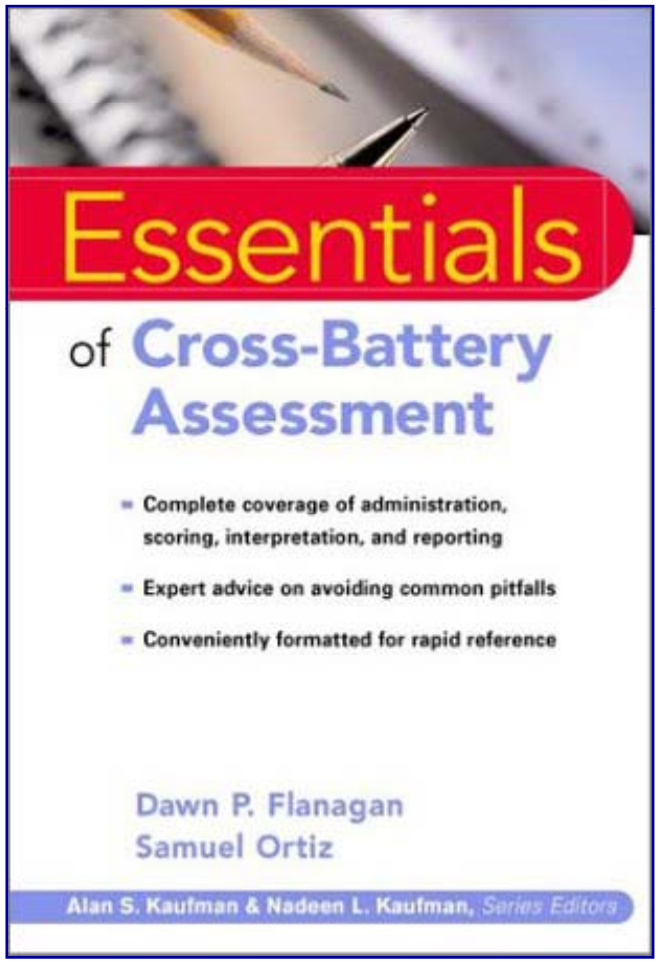


THE CROSS-BATTERY APPROACH: AN EXTERNAL REVIEW

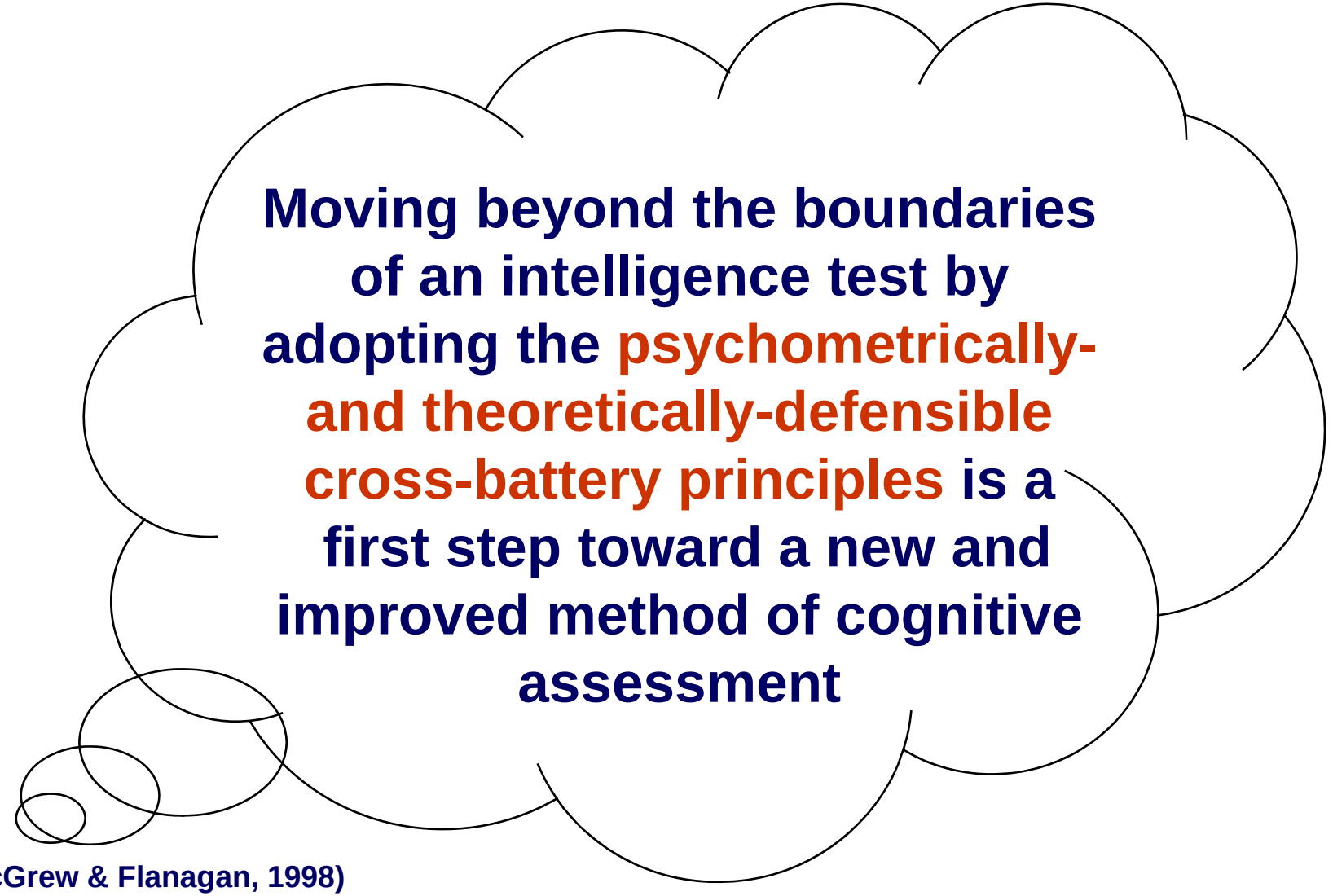
"Flanagan-McGrew have applied their research findings to elevate profile interpretation to a higher level, to add theory to psychometrics and thereby to improve the quality of the psychometric assessment of intelligence. One thing is obvious to me. Flanagan, McGrew, and Ortiz have internalized sound assessment principles. And they might even understand my method of profile interpretation better than I do."

Alan Kaufman foreword for
Flanagan, McGrew & Ortiz, 2000

The CHC Cross-Battery Approach

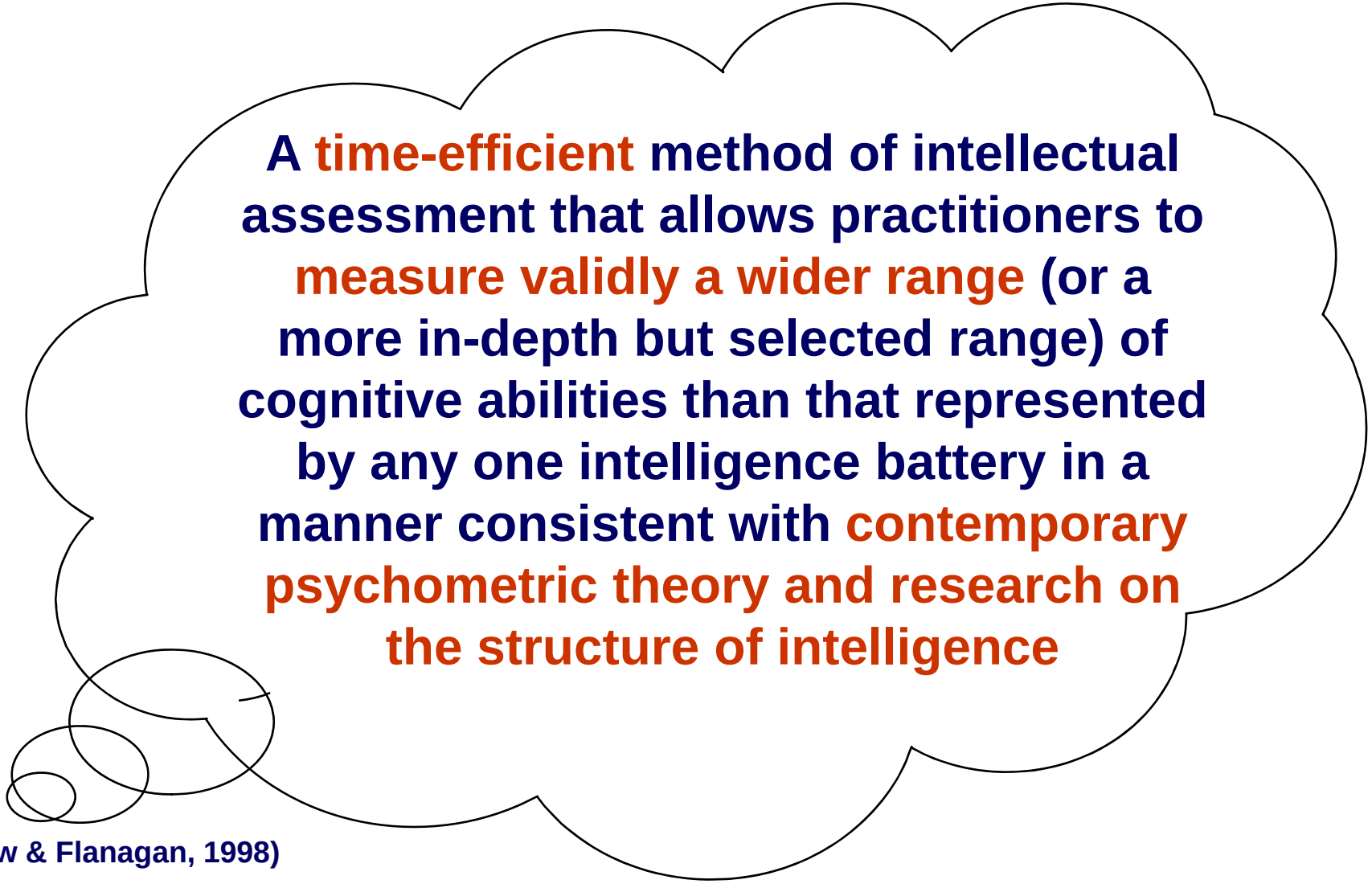


CHC Cross-Battery Assessment



(McGrew & Flanagan, 1998)

The CHC Cross Battery Approach: A Definition



(McGrew & Flanagan, 1998)

CHC Cross-Battery Approach

- The appeal of the CHC Cross-Battery Approach lies in the fact that:
  - *It is based on the most validated and established contemporary theory of cognitive abilities within the psychometric tradition*
  - *It provides a defensible interpretive method for identifying cognitive processing strengths and weaknesses (important in LD evaluations)*
  - *It guards against the major sources of invalidity in assessment and interpretation*
  - *It is psychometrically sound*
  - *It allows for flexibility in designing assessment batteries to meet the unique needs of the individual*
  - *It is systematic in its approach and specifies methods for evaluating the cognitive capabilities of all individuals, including those from diverse cultural and linguistic backgrounds*

The CHC Cross-Battery Approach

The Three Pillars of CHC Cross-Battery Approach

CHC Theory

Broad (Stratum II) CHC Classifications

Narrow (Stratum I) CHC Classifications

Guard against two ubiquitous sources of invalidity in assessment -- construct irrelevant variance and Construct under-representation

The three pillars provide the necessary foundation from which to build more theoretically-driven, comprehensive, and valid measures of cognitive abilities

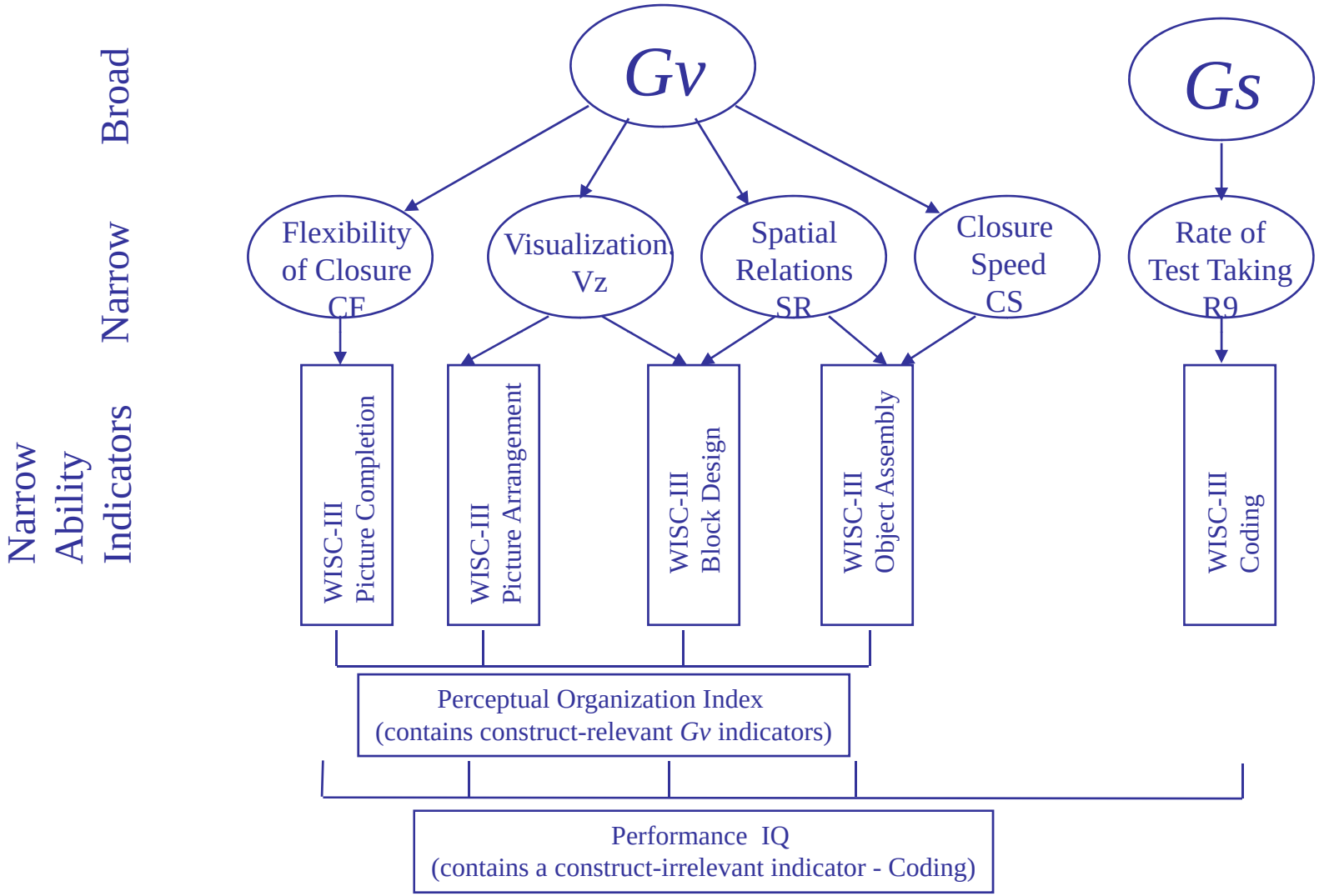
Sources of Invalidity in Assessment

Pillar #2

- CHC broad (stratum II) ability classifications guard against *construct irrelevant variance* in assessment

- Construct Irrelevant Variance:
  - *The assessment is too broad, containing excess reliable variance associated with other distinct constructs….that affects repsponses in a manner irrelevant to the interpreted construct (Messick, 1995).*

Construct Relevant/Irrelevant Variance: A WISC-III *Gv* Example

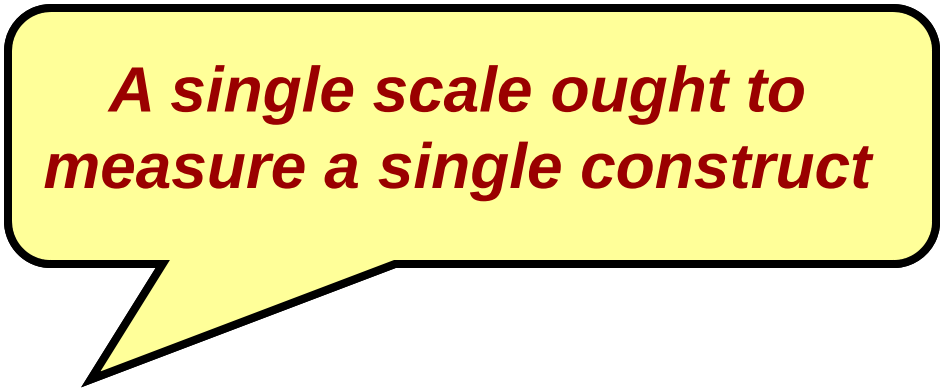


Construct Relevant Variance

- A composite score will provide a valid estimate of a broad CHC ability when it contains *at least two reliable measures of two different narrow (stratum I) abilities* subsumed by that broad ability only.

Construct Relevant Variance

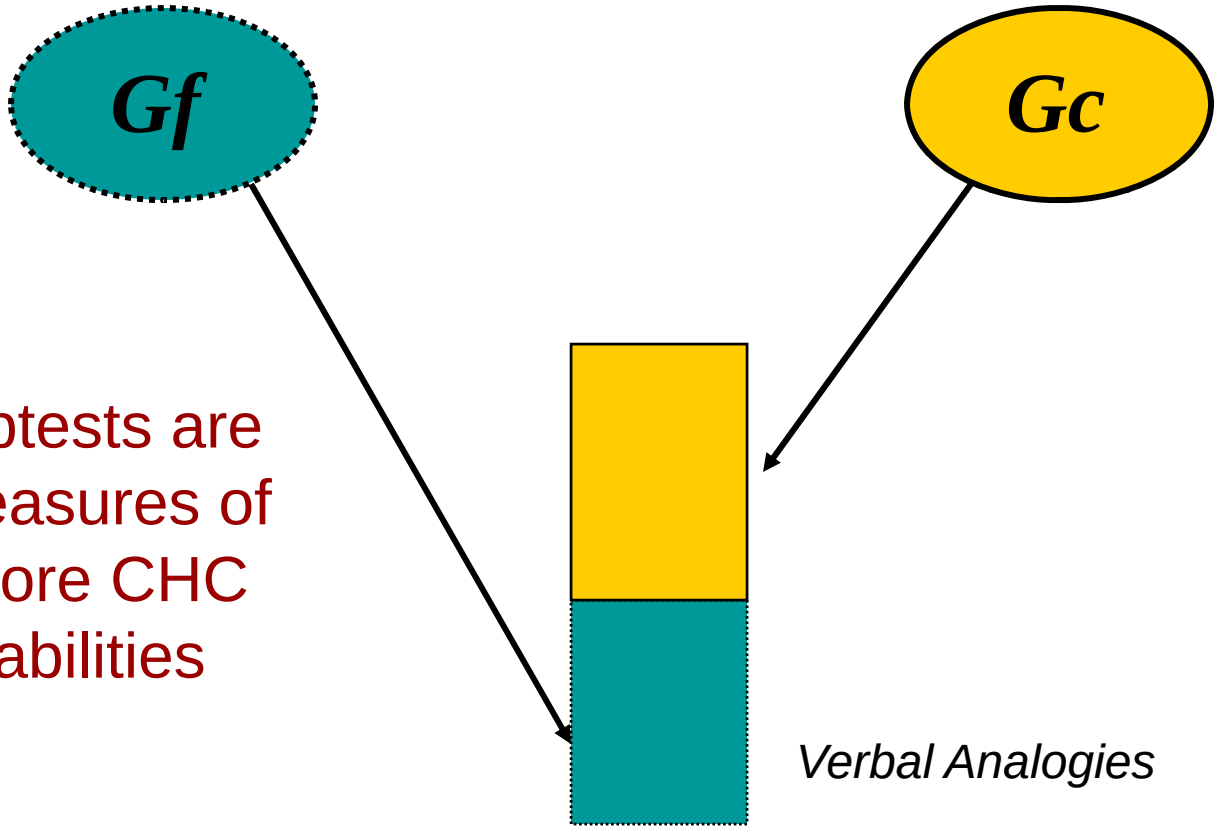
One assumption behind the CHC Cross-Battery approach…



Briggs & Cheek (1986)

Construct Irrelevant Variance at the Subtest Level

Many subtests are mixed measures of two or more CHC ***broad*** abilities



Construct Irrelevant Variance at the Subtest Level

Any test that measures more than one common factor to a substantial degree yields scores that are ***psychologically ambiguous and very difficult to interpret***

Guilford (1954, p. 356)

CHC Cross-Battery Approach

Pillar #2

- CHC Broad Classification of Tests Based on Cross-Battery Factor Analysis Research
  - K-ABC, SB-IV, Wechslers, and WJ-R

    a series of analyses across 9 large data sets (Woodcock, 1990)
  - DTLA-3, DAS, WJ-R

    McGhee, 1993
  - KAIT, WJ-R

    Flanagan & McGrew, 1998
  - WISC-III, WJ-III

    Phelps et al., 1999; 2003
  - CAS, WJ-III

    Keith, Kranzler, & Flanagan, 2000

CHC Cross-Battery Approach

Pillar #3

- The CHC *narrow (stratum I) classifications* of cognitive ability tests form the third pillar of the CHC Cross-Battery approach.

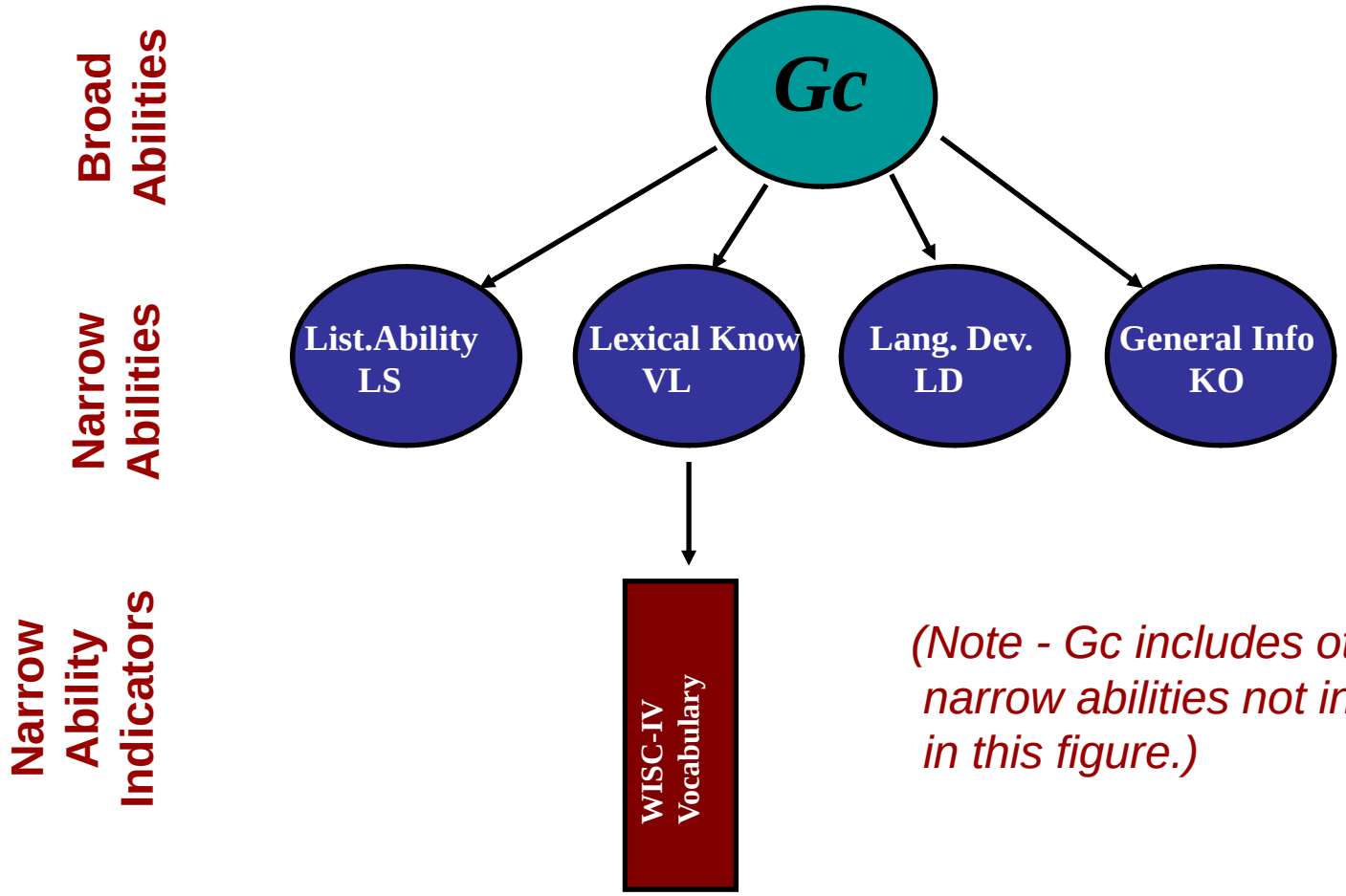
- This is necessary to ensure that the CHC constructs that underlie cross-battery assessments are *well represented*

Sources of Invalidity in Assessment

- Construct under-representation:
  - *The assessment is too narrow and fails to include important dimensions or facets of the construct*

Construct Under-representation

Example - WISC-IV Vocabulary as a Measure of *Gc*

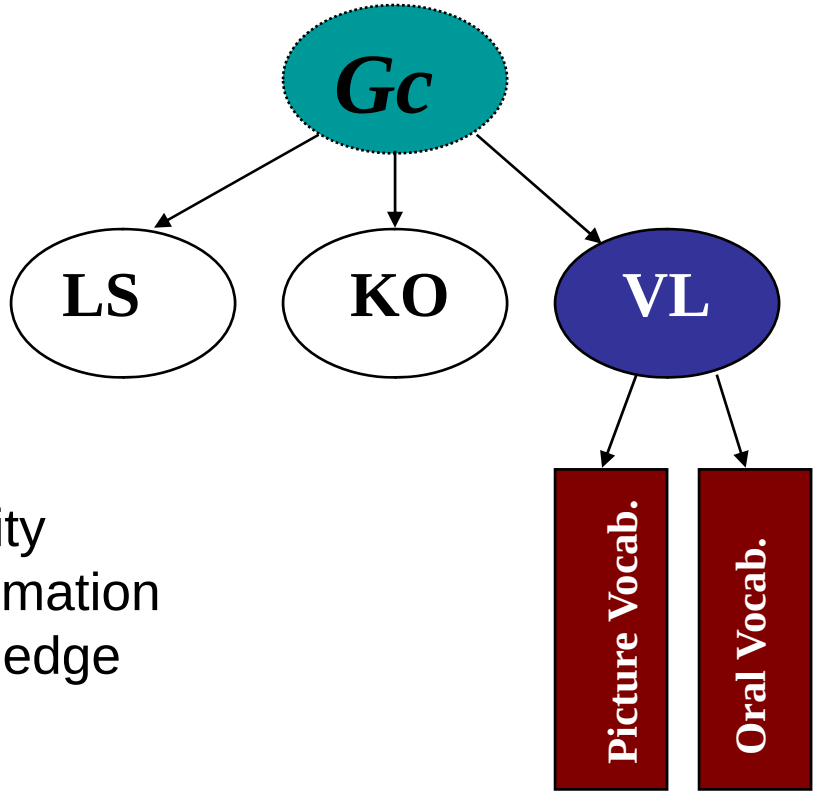


(Note - Gc includes other narrow abilities not included in this figure.)

Construct Under-representation

The most appropriate description of the ability underlying the WJ-R *Gc* cluster *is not broad Gc* as purported but rather, the narrow ability of Lexical Knowledge which is subsumed by *Gc.*

(Note - Gc includes other narrow abilities not included in this figure.)

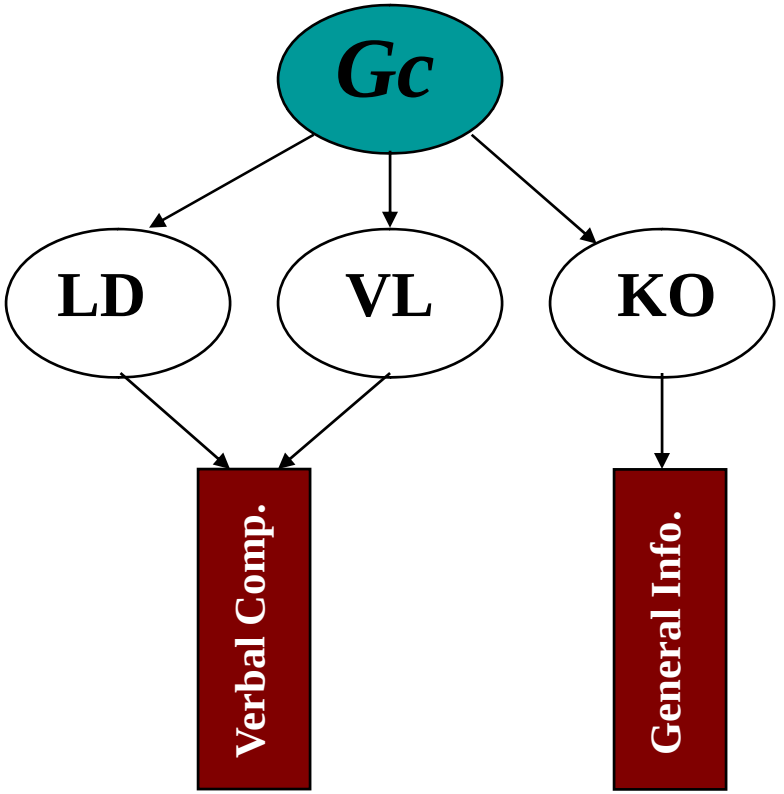


LS - Listening Ability
KO - General Information
VL - Lexical Knowledge

Adequate Construct Representation

The most appropriate description of the ability underlying the WJ-III *Gc* cluster is *broad Gc* as purported.

(Note - Gc includes other narrow abilities not included in this figure.)



LD – Language Development
KO - General Information
VL - Lexical Knowledge

Good Construct Representation

A Scale (or Broad CHC cluster) will yield far more information -- and, hence be a more valid measure of a construct -- if it contains more *differentiated* items (or tests)

Clark & Watson (1995)

CHC Cross-Battery Approach

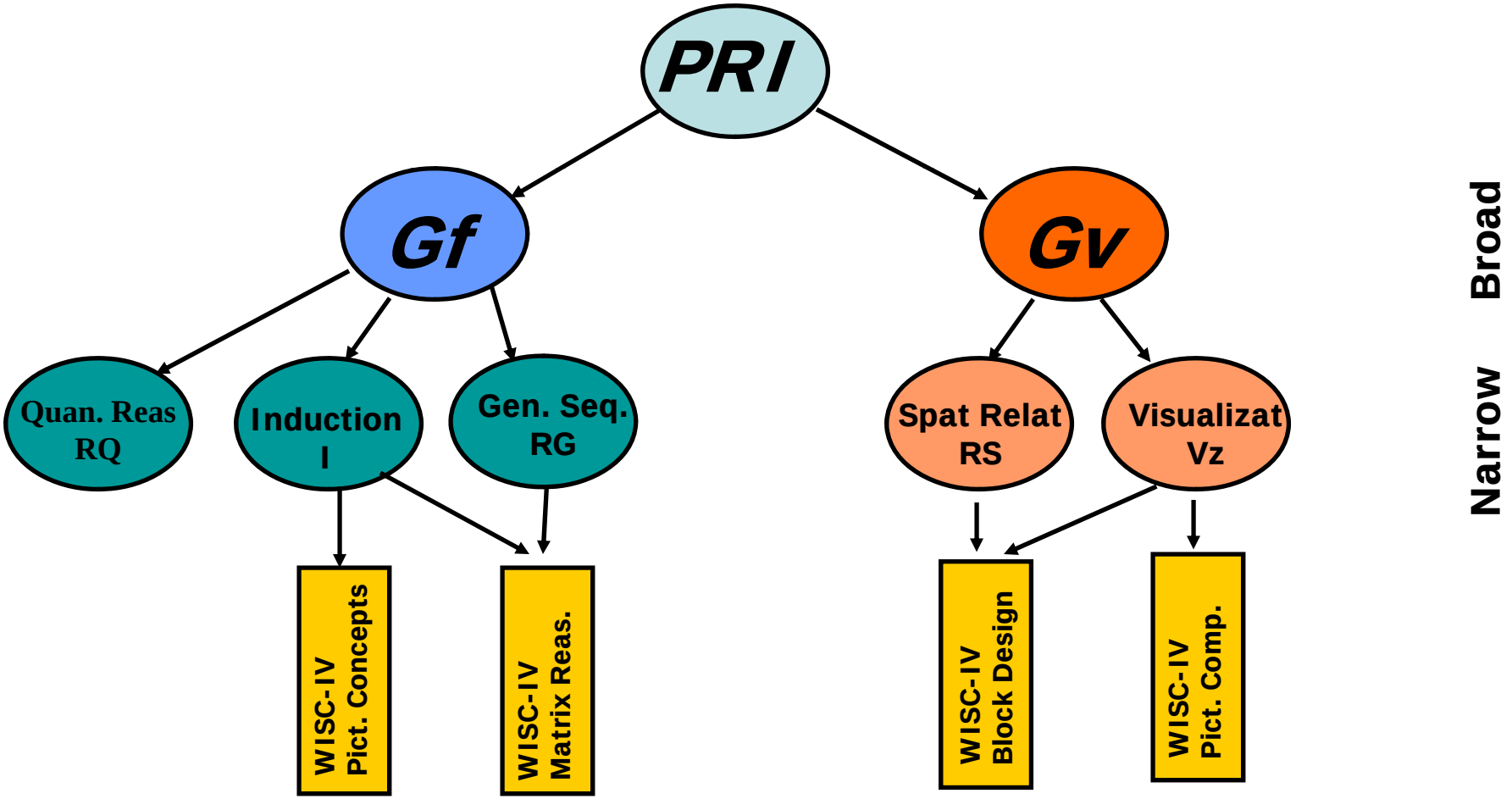
Pillar #3

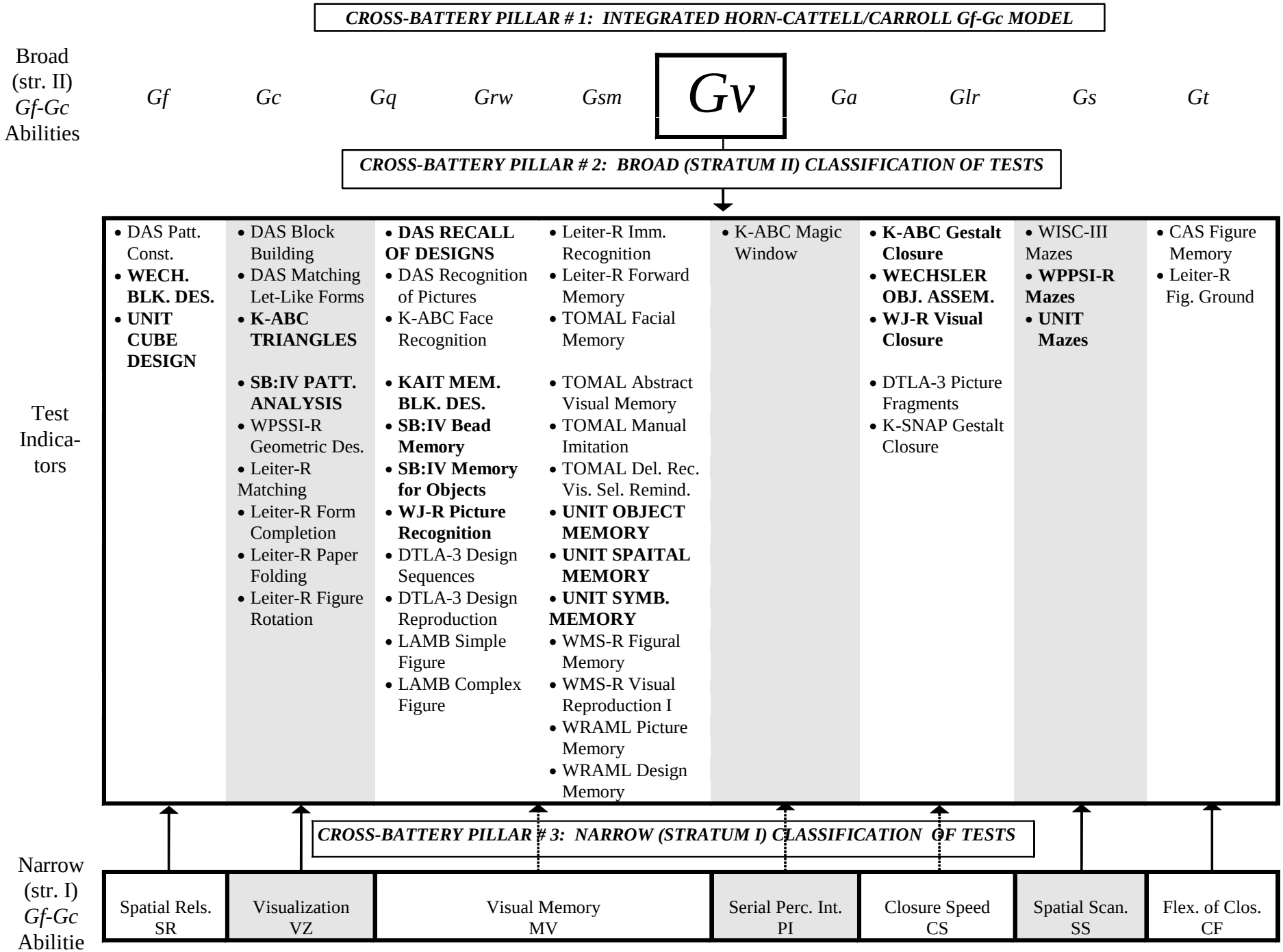
- CHC (Narrow) Test Classifications
  - *Expert* classification of individual tests in intelligence batteries as measures of *narrow* abilities
    - *15+ experts in psychological and psychoeducational assessment (McGrew, 1997).*
    - *Cognitive Consensus Process (Flanagan et al., 2005:*
      - *20+ Experts*
      - *90%+ Agreement for existing classifications*
    - *Achievement Consensus (cited in Flanagan et al., 2002)*
      - *96% of the tests included in the study were classified at the broad ability level based on the criteria put forth by the authors.*
      - *87% of the tests included in the study were classified at the narrow ability level based on the criteria put forth by the authors.*

CHC Test Classifications:

Appropriate Broad/Narrow Analysis:

WISC-IV Example




CROSS-BATTERY PILLAR # 1: INTEGRATED HORN-CATTELL/CARROLL Gf-Gc MODEL
Broad (str. II) Gf-Gc Abilities
Gf
Gc
Gq
Grw
Gsm
Gv
Ga
Glr
Gs
Gt
CROSS-BATTERY PILLAR # 2: BROAD (STRATUM II) CLASSIFICATION OF TESTS
Test Indica-tors
• DAS Patt. Const.
• WECH. BLK. DES.
• UNIT CUBE DESIGN
• DAS Block Building
• DAS Matching Let-Like Forms
• K-ABC TRIANGLES
• SB:IV PATT. ANALYSIS
• WPSSI-R Geometric Des.
• Leiter-R Matching
• Leiter-R Form Completion
• Leiter-R Paper Folding
• Leiter-R Figure Rotation
• DAS RECALL OF DESIGNS
• DAS Recognition of Pictures
• K-ABC Face Recognition
• KAIT MEM. BLK. DES.
• SB:IV Bead Memory
• SB:IV Memory for Objects
• WJ-R Picture Recognition
• DTLA-3 Design Sequences
• DTLA-3 Design Reproduction
• LAMB Simple Figure
• LAMB Complex Figure
• Leiter-R Imm. Recognition
• Leiter-R Forward Memory
• TOMAL Facial Memory
• TOMAL Abstract Visual Memory
• TOMAL Manual Imitation
• TOMAL Del. Rec. Vis. Sel. Remind.
• UNIT OBJECT MEMORY
• UNIT SPAITAL MEMORY
• UNIT SYMB. MEMORY
• WMS-R Figural Memory
• WMS-R Visual Reproduction I
• WRAML Picture Memory
• WRAML Design Memory
• K-ABC Magic Window
• K-ABC Gestalt Closure
• WECHSLER OBJ. ASSEM.
• WJ-R Visual Closure
• DTLA-3 Picture Fragments
• K-SNAP Gestalt Closure
• WISC-III Mazes
• WPPSI-R Mazes
• UNIT Mazes
• CAS Figure Memory
• Leiter-R Fig. Ground
CROSS-BATTERY PILLAR # 3: NARROW (STRATUM I) CLASSIFICATION OF TESTS
Narrow (str. I) Gf-Gc Abilitie
Spatial Rels. SR
Visualization VZ
Visual Memory MV
Serial Perc. Int. PI
Closure Speed CS
Spatial Scan. SS
Flex. of Clos. CF

Ga – AUDITORY PROCESSING
CHC CROSS-BATTERY WORKSHEET

Battery or Test	Age	*Ga* – Auditory Processing Narrow Abilities Tests	LD Area	SS*	SS (100 ± 15)
Phonetic Coding: Analysis (PC:A)					
Tests of Achievement					
CTOPP	5-24	Elision	BR		
CTOPP	5-7	Sound Matching	BR		
CTOPP	7-24	Phoneme Reversal (Gsm-MW)	BR		
CTOPP	7-24	Segmenting Words	BR		
CTOPP	7-24	Segmenting Nonwords	BR		
DAB-3	6-14	Phonemic Analysis	BR		
ITPA-3	5-12	Sound Deletion	BR		
TOCL	5-8	Knowledge of Print	BR		
TOLD-P:3	4-8	Phonemic Analysis	BR		
TOPA	5-6	Initial Sounds	BR		
TOPA	6-8	Ending Sounds	BR		
WJ III	4 –90+	**SOUND AWARENESS (PC:S)**	BR		
Other					
Tests of Cognitive Ability					
NEPSY	3-12	Phonological Processing (PC:S)			
TPAT	5-9	Segmentation			
TPAT	5-9	Isolation			
TPAT	5-9	Deletion			
TPAT	5-9	Rhyming			
WJ III	2-85+	**INCOMPLETE WORDS**			
Other					
		1. Sum of column			
		2. Divide by number of tests			
		3. **Phonetic Coding: Analysis** average			
Phonetic Coding: Synthesis (PC:S)					
Tests of Achievement					
CTOPP	5-24	Blending Words	BR		
CTOPP	5-24	Blending Nonwords	BR		
WDRB	4-95	Incomplete Words	BR		
WDRB	5-95	Sound Blending	BR		

Name:_____
Age: _____
Grade:_____
Examiner:_____
Date of Evaluation: _____

AUDITORY PROCESSING *is the ability to perceive, analyze, and synthesize patterns among auditory stimuli. It includes the following narrow abilities:*

Phonetic Coding (Analysis) (PC:A): Ability to process speech sounds, as in identifying, isolating, and analyzing sounds.

Phonetic Coding (Synthesis) (PC:S): Ability to process speech sounds, as in identifying, isolating, and blending or synthesizing sounds.

Speech/General Sound Discrimination (US/U3): Ability to detect differences in speech sounds under conditions of little distraction or distortion.

Resistance to Auditory Stimulus Distortion (UR): Ability to understand speech and language that has been distorted or masked in one or more ways.

Impact of CHC Theory and Cross-Battery Test Classifications on Test Development after 2000

Timeline of Events Leading to CHC Theory

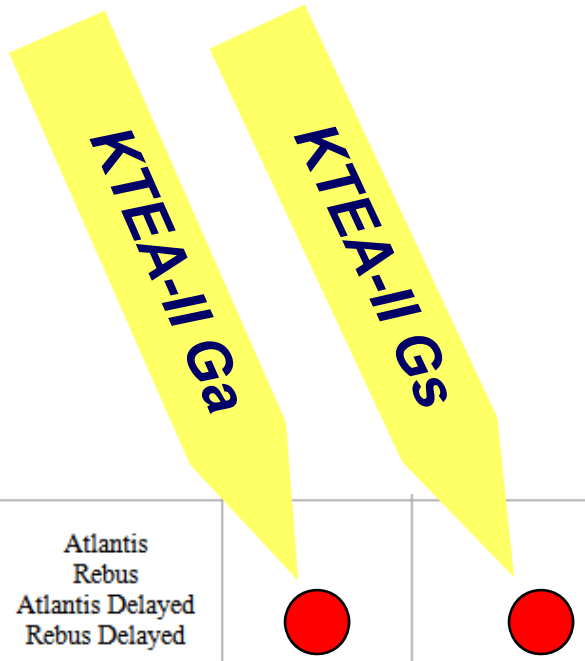
- Cattell-Horn *Gf-Gc* theory (Horn, 1991); Three-Stratum theory (Carroll, 1993)
- McGrew and Flanagan developed the ***Cross-Battery*** approach and classified all cognitive ability tests according to *Gf-Gc* theory at both broad and narrow ability levels (1997, 1998)
- McGrew presented ***integrated model*** from Flanagan et al. Wechsler book (2000) to Woodcock team
- Horn and Carroll were consultants to Woodcock on WJ-R and WJ III (2001)
- Horn and Carroll accepted the integration from the Flanagan et al. book
- Horn and Carroll agreed on a new name for the theory "***Cattell-Horn-Carroll theory of Cognitive Abilities***" or CHC theory
- Process was informal but CHC language caught on quickly

For the most comprehensive presentation of the evolution of CHC theory, see chapter by McGrew (2005) in ***Contemporary Intellectual Assessment: Theories, Tests, and Issues*** (2nd Edition). Guilford.

CHC Theory and XBA Classifications and Their Impact on a New Generation of Tests

- WJ III (2001) – Based on CHC theory
- SB5 (2003) – Based on CHC theory
- WISC-IV (2003) – CHC terminology (e.g., Fluid Reasoning, Working Memory)
- KABC-II (2004) – Based on CHC theory
- DAS-II (2007) – Based on CHC theory

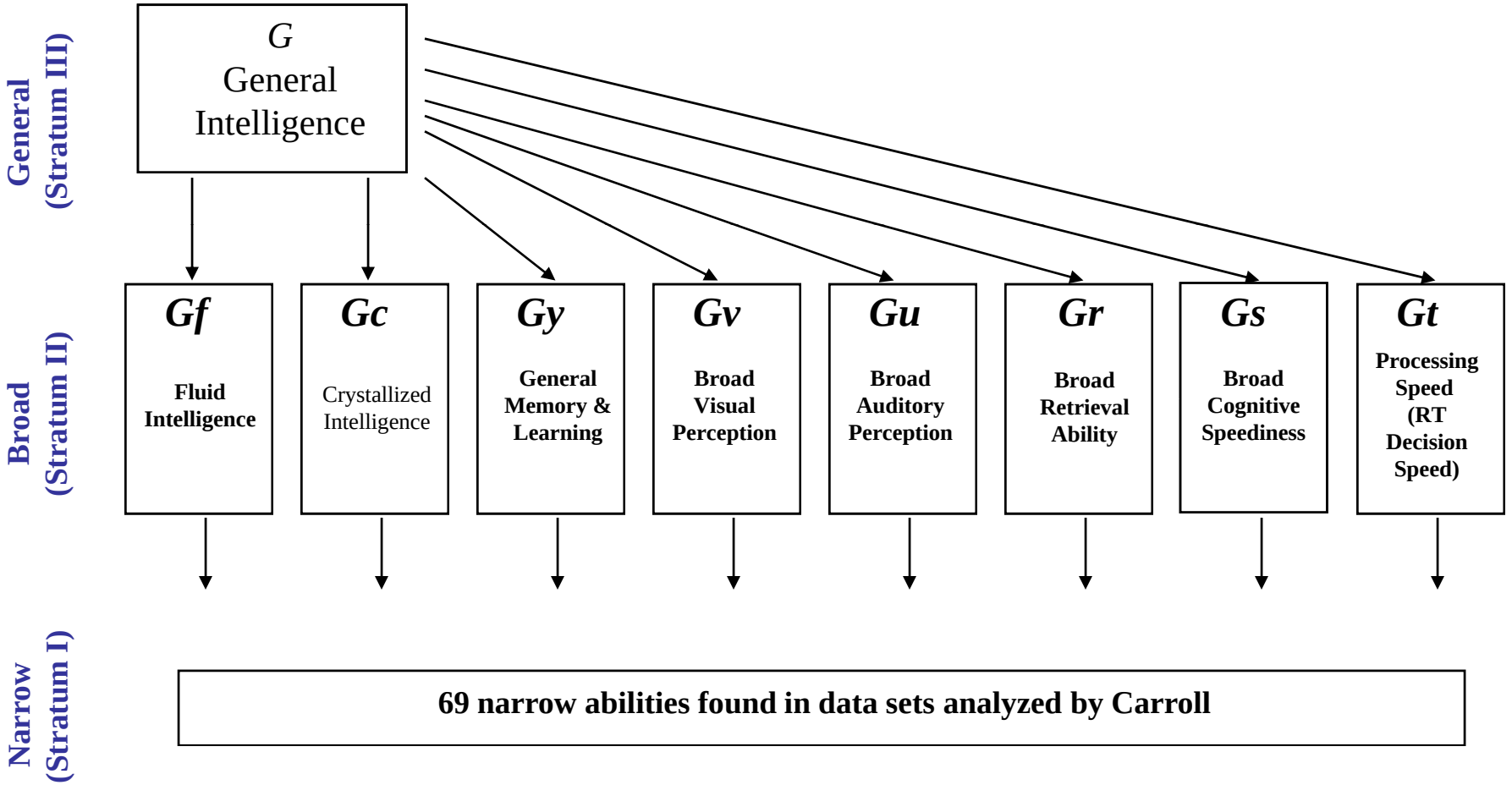
	Gf	*Gc*	*Gv*	*Gsm*	*Glr*	*Ga*	*Gs*
KABC-II	Pattern Reasoning Story Completion	Expressive Vocabulary Verbal Vocabulary Riddles	Face Recognition Triangles Gestalt Closure Rover Block Counting Conceptual Thinking	Number Recall Word Order Hand Movements	Atlantis Rebus Atlantis Delayed Rebus Delayed		



Questions

- What is a Specific Learning Disability?
- What test should you use to identify “Gifted”?

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



Are Cross-Battery Methods Still Needed?

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New Features of the XBA Approach

- More easily incorporates and integrates all current intelligence batteries (i.e., WJ III, WISC-IV, SB5, KABC-II, DAS-II), numerous special purpose tests, and tests of academic achievement.
- Uses *core tests (and supplemental as may be necessary) from a single battery,* rather than selected components of a battery, as part of the assessment because (a) current intelligence tests have better representation of the broad CHC abilities and use only two or three subtests to represent them; and (b) the broad abilities measured by current intelligence batteries are typically represented by qualitatively different indicators that are relevant only to the broad ability intended to be measured.
- Uses actual norms provided by the test's publisher for CHC broad ability clusters when available.
- Places greater emphasis on narrow CHC abilities as supported by research linking them to acquisition and development of specific academic skills.
- Includes an *automated Data Management and Interpretive Assistant* (on the CD-ROM that accompanies the book) that incorporates and integrates all features of the XBA approach.
- Incorporates and integrates features of prevailing interpretive systems of the major intelligence batteries, including optional clinical clusters unique to WISC-IV, WAIS-III and SB5.

New Features of the XBA Approach

- *Calculates CHC broad and narrow ability clusters that are generated from two or three subtest scores.*
- *Graphs data to provide a pictorial representation of all data entered.*
- *Interpretive statements are included for all possible outcomes regarding data from two or three subtest combinations for broad and narrow ability areas.*
- *Expands coverage of CHC theory to include abilities typically measured on achievement tests (e.g., Broad Reading and Writing [Grw], Quantitative Knowledge [Gq], and extended components of Auditory Processing [Ga]), providing additional information integral to the identification of specific learning disability.*
- *Interpretive system incorporates the identification of disorders in basic psychological processes in a manner consistent with the definition of specific learning disability in IDEA 2004 and its attendant regulations (August, 2006).*
- *Includes advancements to the interpretive system for the Culture-Language Interpretive Matrix, including an automated program that calculates and graphs results.*
- *An SLD Assistant program is included on the CD-ROM that assists in answering questions relevant to the operational definition of SLD presented in Chapter 4.*

XBA Guiding Principle #1

- **Select a comprehensive intelligence battery as your core battery in assessment that is most responsive to referral concerns.**

- **These tests may include, but are not limited to, the WJ III, SB5, Wechsler Scales (i.e., WPPSI-III, WISC-IV, WAIS-III), or KABC-II.**

- **Noteworthy is the fact that use of co-normed tests may allow for the broadest coverage of CHC abilities (e.g., WJ III COG and WJ III ACH, KABC-II and KTEA-II).**

XBA Guiding Principle #2

- Use subtests and *clusters/composites* from a single battery whenever possible to represent broad CHC abilities.

XBA Guiding Principle #3

- When constructing CHC broad and narrow ability clusters, select tests that have been classified through an acceptable method, such as through CHC theory driven factor analyses or expert consensus content validity studies.

- All subtests included in the Cross-Battery tables located in Appendix A were classified through these methods.

The matrix below provides a quick reference to understanding how the subtests listed in the Appendix were classified

	Bold Font	Regular Font
UPPERCASE LETTERS	**EMPIRICALLY STRONG MEASURE**	CONSENSUS EXPERT
Lowercase letters	**Empirical Moderate Measure**	Consensus Authors
Italic letters	***Empirical mixed measure***	*Consensus Expert or Author Mixed measure*

Note:
Bold Font = tests were classified empirically (i.e., results of factor analysis as explained in Ch. 1)
Regular Font = tests were classified via consensus (i.e., results of expert consensus/content validity studies as explained in Ch. 1 or as agreed upon by the present authors)
Italic Font = tests were classified as mixed measures

FLUID INTELLIGENCE (*Gf*)
Mental operations that an individual may use when faced with a relatively novel task that cannot be performed automatically.

Induction (I)			General Sequential Reasoning (RG)			Quantitative Reasoning (RQ)		
Ability to discover the underlying characteristic that governs a problem or set of materials.			Ability to start with stated rules, premises or conditions and to engage in one or more steps to reach a solution to a problem.			Ability to inductively and deductively reason with concepts involving mathematical relations and properties.		
CAS	5-17	**NONVERBAL MATRICES (I)**	SB5	2-85	**NONVERBAL FLUID REASONING (RG, I) †**	SB5	2-85	**NONVERBAL QUANTITATIVE REASONING (RQ) †**
DTLA-4	6-17	**SYMBOLIC RELATIONS (I)**	SB5	2-85	**VERBAL FLUID REASONING (RG, I) †**	SB5	2-85	**VERBAL QUANTITATIVE REASONING (RQ) †**
KABC-II	7-18	**PATTERN REASONING (I) †**	UNIT	5-17	**CUBE DESIGN (RG)**	WISC-IV	11-16	**ARITHMETIC (RQ)**
KABC-II	7-18	**STORY COMPLETION (I,RG) †**	WJ III	4-90+	**ANALYSIS-SYNTHESIS (RG)**	WJ III DS	4-90+	**NUMBER MATRICES (RQ)**
UNIT	5-17	**ANALOGIC REASONING (I)**	Leiter-R	2-10	PICTURE CONTEXT (RG)	WJ III DS	4-90+	**NUMBER SERIES (RQ)**
WECH	6-89	**MATRIX REASONING (I,RG)**	Leiter-R	6-18+	VISUAL CODING (RG)	KM-R/NU	7:6-22:11	*Problem Solving (RQ; Gq-A3)*
WJ III	4-90+	**CONCEPT FORMATION (I)**						
WRIT	4-85	**MATRICES (I)**						
WISC-IV	8-16	**Picture Concepts (I)**						
CTONI	6-18	GEOMETRIC SEQUENCES (I,RG)						
Leiter-R	2-6	CLASSIFICATION (I)						
Leiter-R	5-18+	DESIGN ANALOGIES (I)						
Leiter-R	2-18+	REPEATED PATTERNS (I)						
Leiter-R	2-18+	SEQUENTIAL ORDER (I)						
TONI-3	5-85	TEST OF NONVERBAL INTELLIGENCE-3 (I)						
KBIT-2	4-90	Matrices (I)						
WPPSI-III	4-7	*Picture Concepts (I; Gc-KO)*						

VISUAL PROCESSING (*Gv*)

The ability to generate, perceive, analyze, synthesize, manipulate, transform, and think with visual patterns and stimuli.

Spatial Relations (SR)

Ability to rapidly perceive and manipulate visual patterns or to maintain orientation with respect to objects in space.

KABC-II	3-18	**TRIANGLES (SR,Vz)**
SB5	2-85	**NONVERBAL VISUAL-SPATIAL PROCESSING (SR,CS)**
WECH	2-89	**BLOCK DESIGN (SR,Vz)**
WJ III DS	6-90+	**SPATIAL RELATIONS (SR,Vz)**
WRIT	4-85	**DIAMONDS (SR,Vz)**
Leiter-R	11-18+	FIGURE ROTATION (SR,Vz)
UNIT	5-17	CUBE DESIGN (SR,Vz)

Visualization (Vz)

Ability to mentally manipulate objects or visual patterns and to "see" how they would appear under altered conditions.

KABC-II	5-18	**BLOCK COUNTING (Vz) †**
KABC-II	3-6	**CONCEPTUAL THINKING (Vz)†**
KABC-II	5-6	**PATTERN REASONING (Vz) †**
KABC-II	5-6	**STORY COMPLETION (Vz) †**
SB5	2-85	**VERBAL VISUAL-SPATIAL PROCESSING (Vz) †**
WAIS-III	16-89	**PICTURE ARRANGE.(Vz) †**
WJ III	6-90+	**BLOCK ROTATION (Vz,SR)**
Leiter-R	2-18+	FORM COMPLETION (Vz,SR)
Leiter-R	2-10	MATCHING (Vz)
Leiter-R	11-18+	PAPER FOLDING (Vz)
NEPSY	3-12	BLOCK CONSTRUCTION (Vz)
RIAS	3-94	***Odd-Item Out (Vz; Gc-KO) †***

Visual Memory (MV)

Ability to form and store a mental representation or image of a visual stimulus and then recognize or recall it later.

RIAS	3-94	**NONVERBAL MEMORY (MV)**
UNIT	5-17	**OBJECT MEMORY (MV)**
UNIT	5-17	**SPATIAL MEMORY (MV)**
UNIT	5-17	**SYMBOLIC MEMORY (MV)**
WJ III	6-90+	**PICTURE RECOGNITION (MV)**
WRAML2	5-85+	**DESIGN MEMORY (MV)**
WRAML2	5-85+	**DESIGN MEMORY RECOG. (MV)**
WRAML2	5-85+	**PICTURE MEMORY (MV)**
WRAML2	5-85+	**PICTURE MEMORY RECOG. (MV)**
KABC-II	3-5	**Face Recognition (MV)**
CMS	5-16	DOT LOCATIONS (MV)
CMS	5-16	DOT LOCATIONS 2 (MV)
CMS	5-16	PICTURE LOCATIONS (MV)
DTLA-4	6-17	DESIGN REPRODUCTION (MV)
DTLA-4	6-17	DESIGN SEQUENCES (MV)
Leiter-R	2-18+	FORWARD MEMORY (MV)
Leiter-R	4-10	IMMEDIATE RECOGNITION (MV)
NEPSY	3-12	IMITATING HAND POSITIONS (MV)
WMS-III	16-89	VISUAL REPRODUCTION I (MV)

Closure Speed (CS)

Ability to quickly combine disconnected, vague, or partially obscured visual stimuli or patterns into a meaningful whole, without knowing in advance what the pattern is.

KABC-II	3-18	**GESTALT CLOSURE (CS)**
WJ III DS	6-90+	**VISUAL CLOSURE (CS)**
WAIS-III	19-89	OBJECT ASSEMBLY (CS,SR)
WPPSI-III	2-7	OBJECT ASSEMBLY (CS,SR)

Spatial Scanning (SS)

Ability to accurately and quickly survey a spatial field or pattern and identify a path through the visual field or pattern.

KABC-II	5-18	**ROVER (SS) †**
WJ III	6-90+	**PLANNING (SS) †**
UNIT	5-17	**Mazes (SS)**
NEPSY	5-12	ROUTE FINDING (SS)

Flexibility of Closure (CF)

Ability to identify a visual figure or pattern embedded in a complex visual array, when knowing in advance what the pattern is.

CAS	5-17	**FIGURE MEMORY (CF,MV)**
WECH	4-89	**PICTURE COMPLET. (CF) †**
WJ III DS	6-90+	**VISUAL CLOSURE (CF)**
Leiter-R	2-18+	FIGURE GROUND (CF)
RIAS	3-94	***What's Missing (CF; Gc-KO)***

XBA Guiding Principle #4

- When constructing CHC broad ability clusters, include two or more qualitatively different narrow ability indicators for each CHC domain to ensure appropriate construct representation.
  - The core battery may include such a cluster
  - Another battery may include such a cluster
  - Cross batteries to create your own broad ability cluster
- Follow guidelines for test selection

XBA Guiding Principle #5

- When constructing CHC broad or narrow ability clusters using tests from different batteries, select tests that were developed and normed within a few years of one another to minimize the effect of spurious differences between test scores that may be attributable to the “Flynn effect” (Flynn, 1984).

- The tables included in Appendix A list only those tests that were normed within a 10-year timeframe (i.e., from 1996 to present).

XBA Guiding Principle #6

- Select tests from the smallest number of batteries 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).

- In most cases, using select tests from a single battery to augment the constructs measured by any other major intelligence battery is sufficient to represent the breadth of broad cognitive abilities adequately as well as to allow for at least three qualitatively different narrow ability indicators of most broad abilities.

How Many Broad and Narrow Abilities are Represented on the Co-Normed Kaufman and Woodcock Batteries?

- Nine broad cognitive abilities may be measured through approximately 3-5 qualitatively different indicators for each of these abilities.

- Nearly 40 narrow abilities are represented across these batteries and close to half of them can be assessed adequately through the use of two or more subtests.

- The careful selection of tests from the Woodcock and Kaufman batteries, following Cross-Battery principles and procedures, should provide sufficient information about a child's cognitive and academic capabilities for most purposes.

Steps of the XBA Approach

- **Step 1: Selection of an Intelligence Battery**
- **When selecting an intelligence battery, evaluators should consider the following:**
  - **referral concerns;**
  - **background information (e.g., fine motor difficulties);**
  - **psychometric features of the battery;**
  - **the extent to which they are engaging to young children;**
  - **the amount of receptive language requirements needed to comprehend subtest directions;**
  - **the level of expressive language necessary on the part of the examinee to demonstrate success; and**
  - **the extent to which exposure to mainstream U.S. culture is necessary for success.**

Steps of the XBA Approach

- **Step 2: Identify the CHC *Broad* Abilities that are Measured by the Selected Intelligence Battery**

Rapid Reference 2.1. Representation of Broad CHC Ability Constructs on Seven Intelligence Batteries

	Gf	*Gc*	*Gv*	*Gsm*	*Glr*	*Ga*	*Gs*
WISC-IV	Adequate	Adequate	Adequate	Adequate	**Not Measured**	**Not Measured**	Adequate
WAIS-III	*Underrepresented*	Adequate	Adequate	Adequate	**Not Measured**	**Not Measured**	Adequate
WPPSI-III	Adequate	Adequate	Adequate	**Not Measured**	**Not Measured**	**Not Measured**	Adequate
KABC-II	Adequate	Adequate	Adequate	*Underrepresented*	Adequate	**Not Measured**	**Not Measured**
WJ III	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
SB5	Adequate	Adequate	Adequate	Adequate	**Not Measured**	**Not Measured**	**Not Measured**
DAS-II	Adequate	Adequate	Adequate	Adequate	Adequate	*Underrepresented*	*Underrepresented*

WISC-IV = Wechsler Intelligence Scale for Children-Fourth Edition (Wechsler, 2003); WAIS-III = Wechsler Adult Intelligence Scale-Third Edition (Wechsler, 1997); WPPSI-III = Wechsler Preschool and Primary Scale of Intelligence-Third Edition (Wechsler, 2002); KABC-II = Kaufman Assessment Battery for Children-Second Edition (Kaufman & Kaufman, 2004); WJ III = Woodcock-Johnson III Tests of Cognitive Abilities (Woodcock, McGrew, & Mather, 2001); SB5 = Stanford-Binet Intelligence Scales-Fifth Edition (Roid, 2003); Differential Ability Scales-Second Edition (Elliott, 2006).

Steps of the XBA Approach

- **Step 3: Identify the CHC *Narrow* Abilities that are Measured by the Selected Intelligence Battery**

Summary of Relations between CHC Abilities and Specific Areas of Academic Achievement (Flanagan et al., 2007)

CHC Ability	Reading Achievement	Math Achievement	Writing Achievement
Gf	Inductive (I) and general sequential reasoning (RG) abilities play a moderate role in reading comprehension.	**Inductive (I) and general sequential (RG) reasoning abilities are consistently very important at all ages.**	Inductive (I) and general sequential reasoning abilities is related to basic writing skills primarily during the elementary school years (e.g., 6 to 13) and consistently related to written expression at all ages.
Gc	**Language development (LD), lexical knowledge (VL), and listening ability (LS) are important at all ages. These abilities become increasingly more important with age.**	**Language development (LD), lexical knowledge (VL), and listening abilities (LS) are important at all ages. These abilities become increasingly more important with age.**	**Language development (LD), lexical knowledge (VL), and general information (K0) are important primarily after age 7. These abilities become increasingly more important with age.**
Gsm	Memory span (MS) is important especially when evaluated **within the context of working memory.**	Memory span (MS) is important especially when evaluated **within the context of working memory.**	Memory span (MS) is important to writing, especially spelling skills whereas working memory has shown relations with advanced writing skills (e.g., written expression).
Gv	Orthographic processing	May be important primarily for higher level or advanced mathematics (e.g., geometry, calculus).	
Ga	**Phonetic coding (PC) or "phonological awareness/processing" is very important during the elementary school years.**		**Phonetic coding (PC) or "phonological awareness/processing" is very important during the elementary school years for both basic writing skills and written expression (primarily before age 11).**
Glr	**Naming facility (NA) or "rapid automatic naming" is very important during the elementary school years.** Associative memory (MA) may be somewhat important at select ages (e.g., age 6).		Naming facility (NA) or "rapid automatic naming' has demonstrated relations with written expression, primarily the fluency aspect of writing.
Gs	**Perceptual speed (P) abilities are important during all school years, particularly the elementary school years.**	**Perceptual speed (P) abilities are important during all school years, particularly the elementary school years.**	**Perceptual speed (P) abilities are important during all school years for basic writing and related to all ages for written expression.**

Note. The absence of comments for a particular CHC ability and achievement area (e.g., *Ga* and mathematics) indicates that the research reviewed either did not report any significant relations between the respective CHC ability and the achievement area, or if significant findings were reported, they were weak and were for only a limited number of studies. Comments in bold represent the CHC abilities that showed the strongest and most consistent relations with the respective achievement domain. Information in this table was

Rapid Reference 2.2 Sample of subtests that measure CHC narrow abilities that are significantly related to reading achievement

CHC Narrow Ability	Battery	Age	Subtest
Gf-I: Inductive Reasoning ability plays a moderate role in reading comprehension.			
	DAS-II	2-17	Matrices (I)
	KABC-II	7-18	Pattern Reasoning (I)
	KABC-II	7-18	Story Completion (I, RG)
	SB5	2-85+	Nonverbal Fluid Reasoning (RG, I)
	SB5	2-85+	Verbal Fluid Reasoning (RG, I)
	WECH	4-89	Matrix Reasoning (I, RG)
	WISC-IV	8-16	Picture Concepts (I)
	WJ III	4-90+	Concept Formation (I)
	WPPSI-III	4-7	Picture Concepts (I; Gc-K0; Gf-I)
Gf-RG: General Sequential Reasoning ability plays a moderate role in reading comprehension.			
	KABC-II	7-18	Story Completion (I, RG)
	SB5	2-85+	Nonverbal Fluid Reasoning (RG, I)
	SB5	2-85+	Verbal Fluid Reasoning (RG, I)
	WECH	4-89	Matrix Reasoning (I, RG)
	WJ III	4-90+	Analysis-Synthesis (RG)
Gc-LD: Language Development is important at all ages. This ability becomes increasingly more important with age.			
	DAS-II	6-17	Verbal Similarities (LD)
	DAS-II	6-17	Word Definitions (VL, LD)
	KABC-II	3-18	Riddles (VL, LD)
	WECH	4-89	Comprehension (K0, LD)
	WECH	4-89	Similarities (VL, LD)
	WJ III	2-90+	Verbal Comprehension (VL, LD)
	WPPSI-III	2-7	Receptive Vocabulary (VL, LD)
Gc-VL: Lexical Knowledge is important at all ages. This ability becomes increasingly more important with age.			
	DAS-II	2-6	Early Number Concepts (VL, Gq-KM)
	DAS-II	2-6	Naming Vocabulary (VL)
	DAS-II	6-17	Word Definitions (VL, LD)
	KABC-II	3-18	Expressive Vocabulary (VL)
	KABC-II	3-18	Riddles (VL, LD)
	KABC-II	3-18	Verbal Knowledge (VL, K0)
	SB5	2-85+	Verbal Knowledge (VL)
	WECH	4-89	Similarities (VL, LD)
	WECH	4-89	Vocabulary (VL)
	WECH	4-16	Word Reasoning (VL)
	WJ III	2-90+	Verbal Comprehension (VL, LD)

	WPPSI-III	2-7	Picture Naming (VL, K0)
	WPPSI-III	2-7	Receptive Vocabulary (VL, LD)
Listening Ability (LS) is an important at all ages. This ability becomes increasingly more important with age.			
	CAS	2-6	Verbal Spatial Relations (LS; *Gsm*-MW)
	DAS-II	2-6	Verbal Comprehension (LS)
	SB5[1]	2-85+	Nonverbal Knowledge (K0, LS)
Gsm-MS: Memory span is important especially when evaluated **within the context of working memory.**			
	DAS-II	6-17	Recall Of Digits – Forward (MS)
	KABC-II	3-18	Hand Movements (MS)
	KABC-II	3-18	Number Recall (MS)
	KABC-II	3-18	Word Order (MS, MW)
	SB5	2-85+	Nonverbal Working Memory (MS, MW)
	SB5	2-85+	Verbal Working Memory (MS, MW)
	WECH	6-89	Digit Span (MS, MW)
	WJ III	4-90+	Memory For Words (MS)
Gv: Orthographic processing			
	TOSWRF[2]	6-17	Test of Silent Word Reading Fluency (RS)
Ga-PC:A: Phonetic coding: Analysis or "phonological awareness/processing" is very important during the elementary school years.			
	DAS-II	2-6	Phonological Processing (PC:S, PC:A)
	WJ III	2-90+	Incomplete Words (PC:A, PC:S)
Ga-PC:S: Phonetic coding: Synthesis or "phonological awareness/processing" is very important during the elementary school years.			
	DAS-II	2-6	Phonological Processing (PC:S, PC:A)
	WJ III	2-90+	Incomplete Words (PC:A, PC:S)
	WJ III	2-90+	Sound Blending (PC:S)
Glr-NA: Naming facility or "rapid automatic naming" is very important during the elementary school years.			
	DAS-II	2-17	Rapid Naming (NA)
	WJ III	4-90+	Rapid Picture Naming (NA)
	WJ III	6-90+	Retrieval Fluency (FI, NA)
Glr-MA: Associative memory may be somewhat important at select ages (e.g., age 6).			
	KABC-II	3-18	Atlantis (MA, L1)
	KABC-II	5-18	Atlantis Delayed (MA, L1)
	KABC-II	4-18	Rebus (MA, L1)
	KABC-II	5-18	Rebus Delayed (MA, L1)
	WJ III	4-90+	Del Rec: Vis-Aud Lrng (MA)
	WJ III	2-90+	Visual-Aud Learning (MA)

Steps of the XBA Approach

- **Step 4: Administer and Score Selected Intelligence Battery and Supplemental Tests**

Table 2.2 Examples of XBAs for Seven Intelligence Batteries

	Gf	*Gc*	*Gv*	*Gsm*	*Glr*	*Ga*	*Gs*
WISC-IV	Picture Concepts (I) Arithmetic (RQ)	Vocabulary (VL) Information (K0)	Block Design (SR, Vz) Picture Completion (CF)	Digit Span (MS, MW) Letter-Number Sequencing (MW)	*WJ III Visual-Auditory Learning (MA)* *WJ III Retrieval Fluency (FI, NA)*	*WJ III Sound Blending (PC:S)* *WJ III Auditory Attention (US/U3)*	Coding (R9) Symbol Search (P, R9)
WAIS-III	Matrix Reasoning (I, RG) *WJ III Analysis-Synthesis (RG)* *WJ III concept Formation (I)*	Vocabulary (VL) Information (K0)	Block Design (SR, Vz) Picture Completion (CF)	Digit Span (MS, MW) Letter-Number Sequencing (MW)	*WJ III Visual-Auditory Learning (MA)* *WJ III Retrieval Fluency (FI, NA)*	*WJ III Sound Blending (PC:S)* *WJ III Auditory Attention (US/U3)*	Coding (R9) Symbol Search (P, R9)
WPPSI-III	Picture Concepts (I; Gc-K0) Matrices (I)	Picture Naming (VL, K0) Information (K0)	Block Design (SR, Vz) Picture Completion (CF)	*DAS-II Recall of Digits - Forward (MS)* *DAS-II Recall of Digits - Backward (MW)*	*DAS-II Recall of Objects - Immediate (M6)* *DAS-II Rapid Naming (NA)*	*WJ III Sound Blending (PC:S)* *WJ III Auditory Attention (US/U3)*	Coding (R9) Symbol Search (P, R9)
KABC-II	Pattern Reasoning (I) Story Completion (I, RG)	Expressive Vocabulary (VL) Verbal Knowledge (VL, K0)	Triangles (SR, Vz) Gestalt Closrue (CS)	Hand Movements (MS) *WJ III Numbers Reversed (MW)* *WJ III Memory for Words (MS)*	Atlantis (MA, L1) Rebus (MA, L1)	*WJ III Sound Blending (PC:S)* *WJ III Auditory Attention (US/U3)*	*WJ III Visual Matching (P, R9)* *WJ III Decision Speed (RE)*
DAS-II	Matrices (I) Sequential & Quantitative Reasoning (RQ)	Naming Vocabulary (VL, LD) Verbal Comprehension (LD, LS)	Pattern Construction (SR) Recall of Designs (MV)	Recall of Digits - Forward (MS) Recall of Digits - Backward (MW)	Recall of Objects - Immediate (M6) Rapid Naming (NA)	Phonological Processing (PC:S, PC:A) *WJ III Sound Blending (PC:S)* *WJ III Auditory Attention (US/U3)*	Speed of Information Processing (N, R9) *WJ III Visual Matching (P, R9)* *WJ III Decision Speed (RE)*
WJ III	Concept Formation (I) Analysis-Synthesis (RG)	Verbal Comprehension (VL, LD) General Information (K0)	Spatial Relations (Vz, SR) Picture Recognition (MV)	Memory for Words (MS) Numbers Reversed (MW)	Visual Auditory Learning (MA) Retrieval Fluency (FI)	Sound Blending (PC:S) Auditory Attention (US/U3)	Visual Matching (P, R9) Decision Speed (RE)

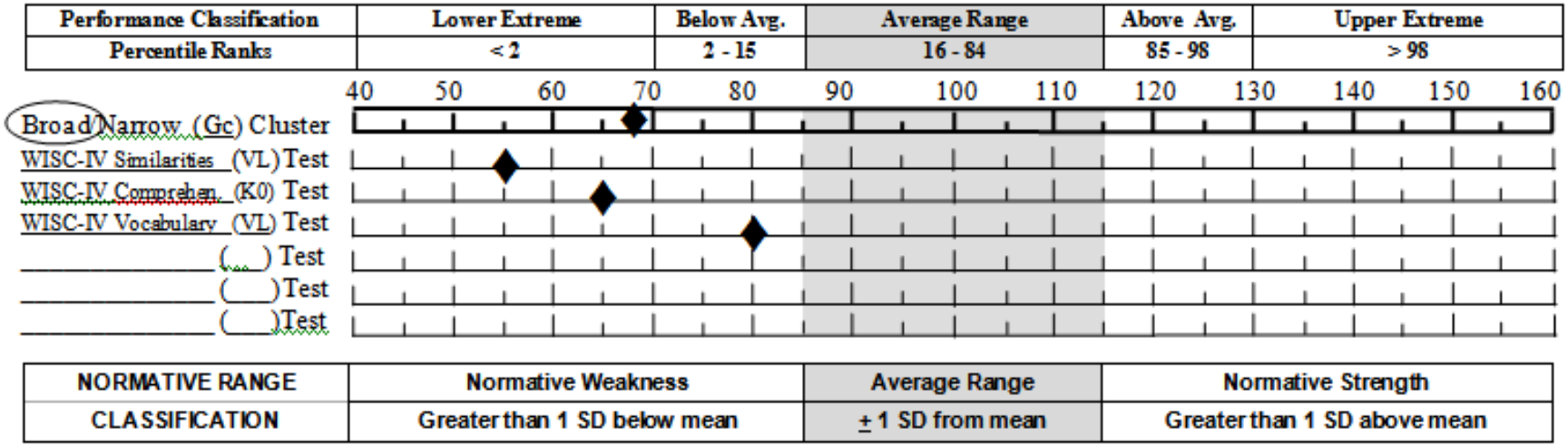
Steps of the XBA Approach

- **Step 5: Enter Scores into the Cross-Battery Assessment Data Management and Scoring Program (XBA DMIA)**

Demonstrate Use of Cross-Battery Assessment Data Management and Interpretive Assistant

XBA DMIA v1.0

Figure 3.4 Decision points corresponding to Interpretive Statement 1 in Rapid Reference 3.5.



Decision Points:

a) WISC-IV data were entered into the WISC-IV tab of the XBA DMSP™.

b) The XBA DMSP™ reported that the broad *Gc* ability/process based on the WISC-IV subtests comprising the Verbal Comprehension Index (VCI) (i.e., Vocabulary, Similarities, and Comprehension) is nonunitary and noninterpretable (see criteria reported in Table 3.1).

c) The WISC-IV VCI subtest scores were entered into the *Gc* tab of the XBA DMSP™ to better understand functioning in the *Gc* domain.

d) The XBA DMSP™ calculated and reported a cluster based on the WISC-IV VCI subtests.

e) Cluster is interpreted as representing broad *Gc* ability.

f) See Statement 1 in Rapid Reference 3.5 for an interpretation of this cluster.

Table 3.1 Criteria Used to Determine a Nonunitary or Noninterpretable Cluster for Seven Intelligence Batteries

Battery (Source)	Cluster(s)	Criterion
WISC-IV (Flanagan & Kaufman, 2004)	VCI and PRI	A difference between highest and lowest scaled scores of ≥ 5 points (i.e., ≥1.5 SDs)
	WMI, PSI, Gf Cluster, Gv Cluster	A difference between scaled scores of ≥ 5 points (i.e., ≥1.5 SDs)
	FSIQ	A difference between highest and lowest Index of ≥ 23 standard score points (i.e.,≥1.5 SDs)
	GAI	A difference between VCI and PRI of ≥ 23 standard score points (i.e., ≥1.5 SDs)
WAIS-III (Kaufman & Lichtenberger, 2006)	VCI, POI, WMI, VIQ, and PIQ	A difference between highest and lowest scaled scores of ≥5 points (i.e., ≥1.5 SDs)
	PSI, Gf, and Gv	A difference between scaled scores of ≥5 points (i.e., ≥1.5 SDs)
	FSIQ	A difference between highest and lowest Index of ≥23 standard score points (i.e., ≥1.5 SDs)

WISC-IV Interpretation

Enter the scores in cells bordered in red with examinee's scores.

COMPOSITE Subtest	Score	Percentile Rank	Descriptive Category	Is Composite Interpretable?
VERBAL COMPREHENSION (Gc)	69	2	Lower Extreme/Normative Weakness	*No*
Similarities	1	0.1		
Vocabulary	6	9		
Comprehension	3	1		
(Information)			*Does not contribute to Index or IQ*	
(Word Reasoning)			*Does not contribute to Index or IQ*	

XBA Interpretation Guidelines

CRYSTALLIZED KNOWLEDGE (Gc)	Subtest Standard Score	Converted Standard Score
WECH VOCABULARY (VL)	6	80
WECH COMPREHENSION (K0,LD)	3	65
WECH SIMILARITIES (VL,LD)	1	55
Average Standard Score		67

Rapid Reference 3.5. A guide to interpreting three scores within an ability/processing domain.

		Cluster		
		SS ≤84	SS ≥85 AND ≤115	SS ≥116
Outlier	SS ≤ 84	Interpretive Statement 1	Interpretive Statement 2	Interpretive Statement 3
	SS ≥85 AND ≤115	Interpretive Statement 4	Interpretive Statement 5	Interpretive Statement 6
	SS ≥116	Interpretive Statement 7	Interpretive Statement 8	Interpretive Statement 9

= Ability cluster based on Average of three scores. All other Interpretive Statements are based on the average of two scores and a single outlier score.

Interpretive Statement 1

On the three tasks that comprise the WISC-IV Verbal Comprehension Index (VCI), Jim's performance was consistently Below Average and in the Normative Weakness range. For example, when required to give definitions of words presented orally his performance was slightly below average (Vocabulary = 6 [SS = 80]; 9th percentile). When asked to give oral responses to hypothetical questions that assess everyday problems or understanding of social rules and concepts his performance was lower (WISC-IV Comprehension = 3 [SS = 65]; 1st percentile). And, when required to explain the similarity between the concepts represented by two different words his performance was the lowest (WISC-IV Similarities = 1 [SS = 55], <1st percentile). The difference between his highest and lowest performances on these tests is statistically significant rendering the VCI nonunitary and noninterpretable. To better assess and understand Jim's functioning in this domain, his scores were examined using XBA interpretive guidelines. Analysis of his scores within this framework indicated that although the VCI is nonunitary, a valid Crystallized Intelligence (*Gc*) cluster can be formed based on these three subtest performances because they were all in the same normative range. Jim's Gc cluster of 67 is ranked at the 1st percentile and is a Normative Weakness. Overall, this suggests that Jim's functioning in the broad *Gc* domain is deficient as compared to same-age peers from the general population. Therefore, Jim has a disorder in the basic psychological process of Gc – a finding that should play a significant role in educational intervention planning.