"Intelligent" intelligence testing with the WJ IV cognitive battery

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Links to more complete sets of handouts and/or PPT slides will be provided the day of the workshop

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Affiliations and Disclosures

- Institute for Applied Psychometrics (IAP)-Director
- University of Minnesota - Visiting Professor (Educ. Psych.)
- Interactive Metronome - Director of Research and Science (External Consultant) *
- Darhma Berkmana Foundation (YDB; Indonesia) – Intelligence expert for development of first Indonesian CHC-based intelligence battery for children

* Conflict of interest disclosure: Financial relationship and interest in IM; Coauthor of WJ III and WJ IV (royalty interest)

“Intelligent” intelligence testing with the WJ IV cognitive battery

- General introduction and workshop logistics
- Intelligence testing in the “big picture” context
- Brief overview of Kaufman’s “intelligent” testing approach
- Foundational empirical knowledge– “romancing the stones” (tests)
  - The WJ IV/CHC Periodic Table of Cognitive Test Elements
  - WJ IV variation and comparison procedures - brief
  - Test/cluster score difference (% base rate) rules-of-thumb

“Intelligent” intelligence testing with the WJ IV cognitive battery

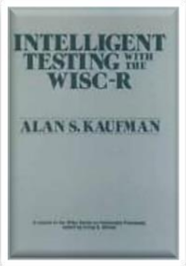
Will be covered <u>concurrently</u> with aid of case study

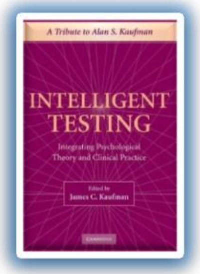
- WJ IV published & new supplemental/clinical test groupings
- WJ IV assessment trees
  - Within-CHC domain assessment trees (“drilling down”)
  - Academic domain referral-focused assessment trees
- Miscellaneous topics and tidbits
- Conclusions and Q/A

Waves Of Intelligence Test Interpretation

(Kamphaus et al., 1997)

- Wave 1 - Quantification of a General Level (*g*)
- Wave 2 - Clinical Profile Analysis
- Wave 3 - Psychometric Profile Analysis
- Wave 4 - Applying Theory to Intelligence Test Interpretation

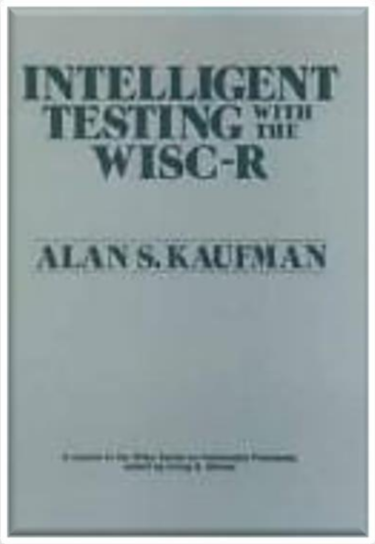




Wave 3:
Psychometric Profile Analyses

Cohen, J. (1959). The factorial structure of the WISC at ages 7-6, 10-6, and 13-6, Journal of Consulting Psychology, 23, 285-299.

Kaufman, A. S. (1979). Intelligent testing with the WISC-R. New York: Wiley-Interscience.



Picture Completion

Empirical Analysis

Reliability:	
Split-half	.77
Test-retest	.81
g loading	.60 (Fair)
Subtest specificity vs. error variance	39% vs. 23% (Ample)

Most related to:

Block Design	.52
Object Assembly	.49

Least related to:

Coding	.18
Digit Span	.25

Proportion of Variance Attributed to:

Factor 1. Verbal Comprehension	14%
Factor 2. Perceptual Organization	28%
Factor 3. Freedom from Distractibility	1%
Factor 4. Processing Speed	1%
Abilities other than the 4 factors	33%
Error	23%

Proportion of Variance When 2 Factors Are Rotated:

Factor 1. General Verbal Ability	15%
Factor 2. General Nonverbal Ability	25%

***Abilities Shared with Other Subtests* (Unique abilities are asterisked)**

INPUT

Visual perception of meaningful stimuli (people—things)

INTEGRATION/STORAGE

Perceptual Organization (Factor Analysis: 4-Factor and 2-Factor)

Gv—Broad Visual Intelligence (Horn)

Holistic (right-brain) processing

Cognition and Evaluation of figural stimuli (Guilford)

Spatial (Bannatyne)

Simultaneous processing

Distinguishing essential from nonessential details

Visual organization without essential motor activity

*Visual recognition and identification (long-term memory)

OUTPUT

Simple motor (pointing) or vocal

Subject to Influence of:

Ability to respond when uncertain

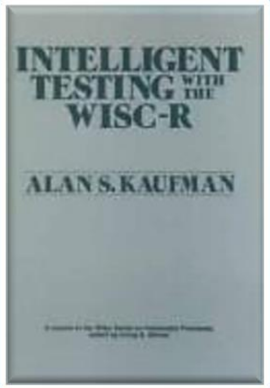
Alertness to the environment

Cognitive style (field dependence—field independence)

Concentration

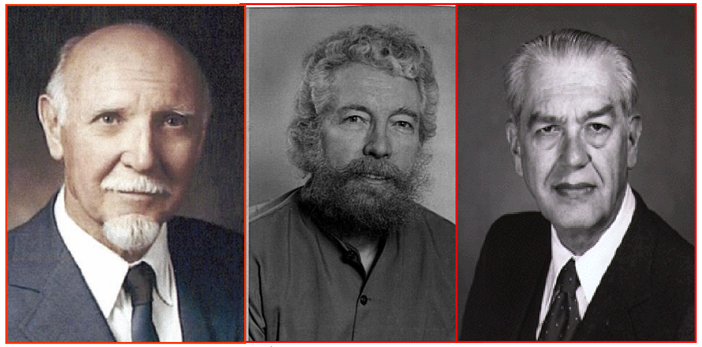
Negativism ("Nothing's missing")

Working under time pressure

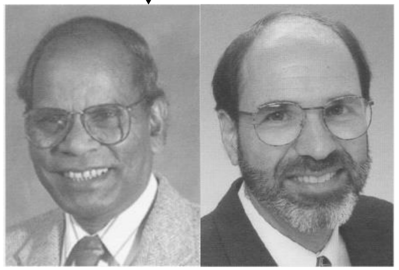


Wave 4:
Applying Theory to Test Interpretation
(and research & development)

Sim/Suc→ KABC/KABC-II



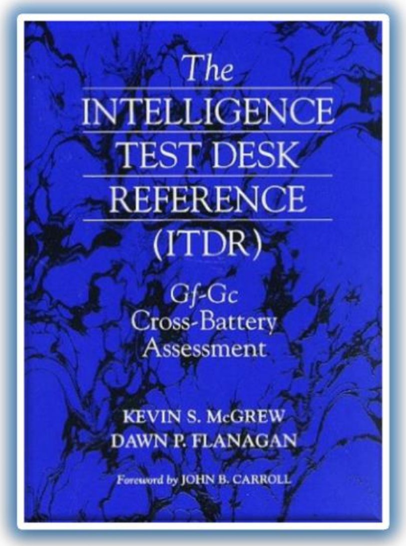
Gf-Gc → KAIT
CHC→KABC-II



PASS→ CAS/CAS II

CHC (*Gf-Gc*) → WJ-R/III/IV

CHC (*Gf-Gc*) → SB5



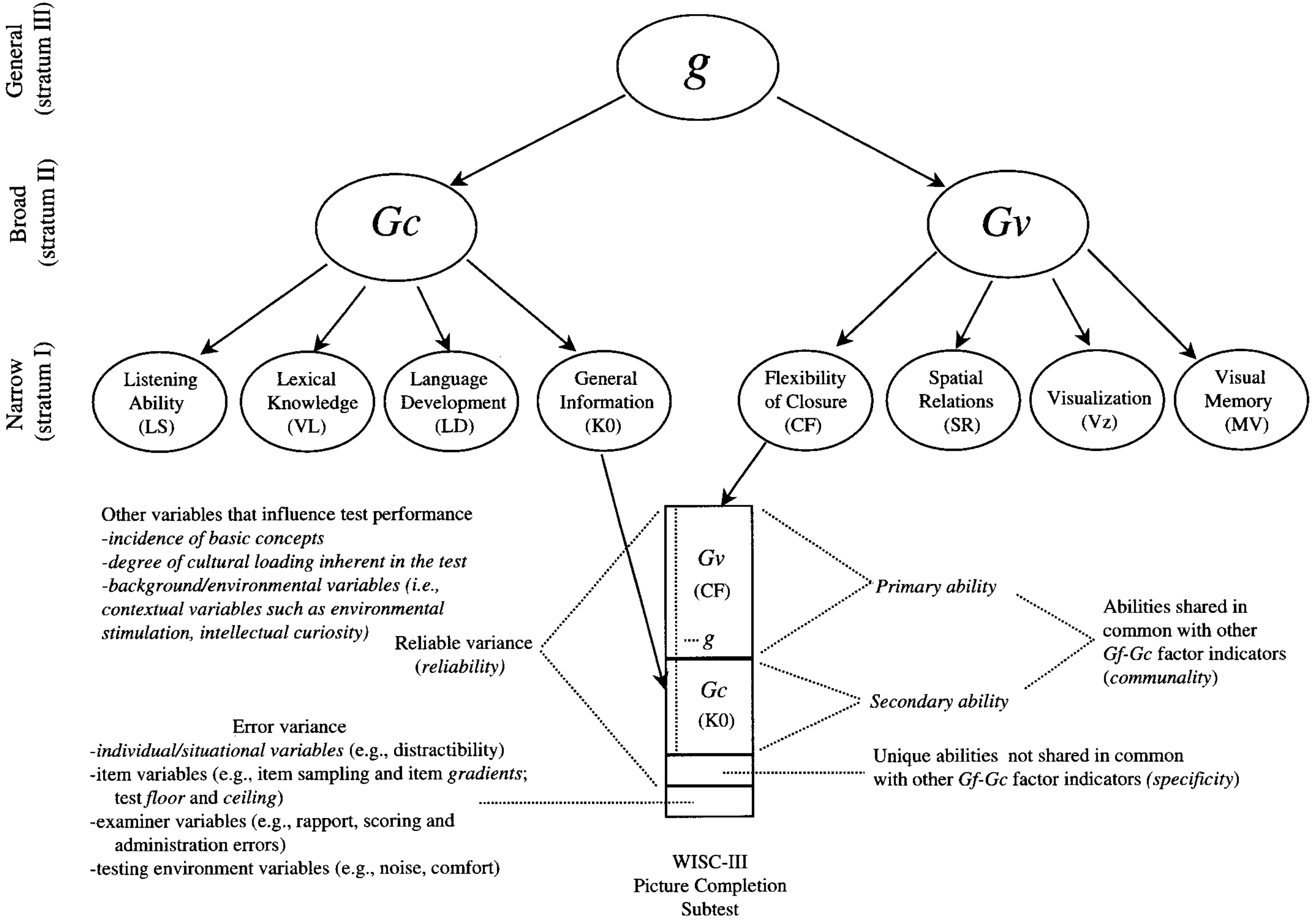
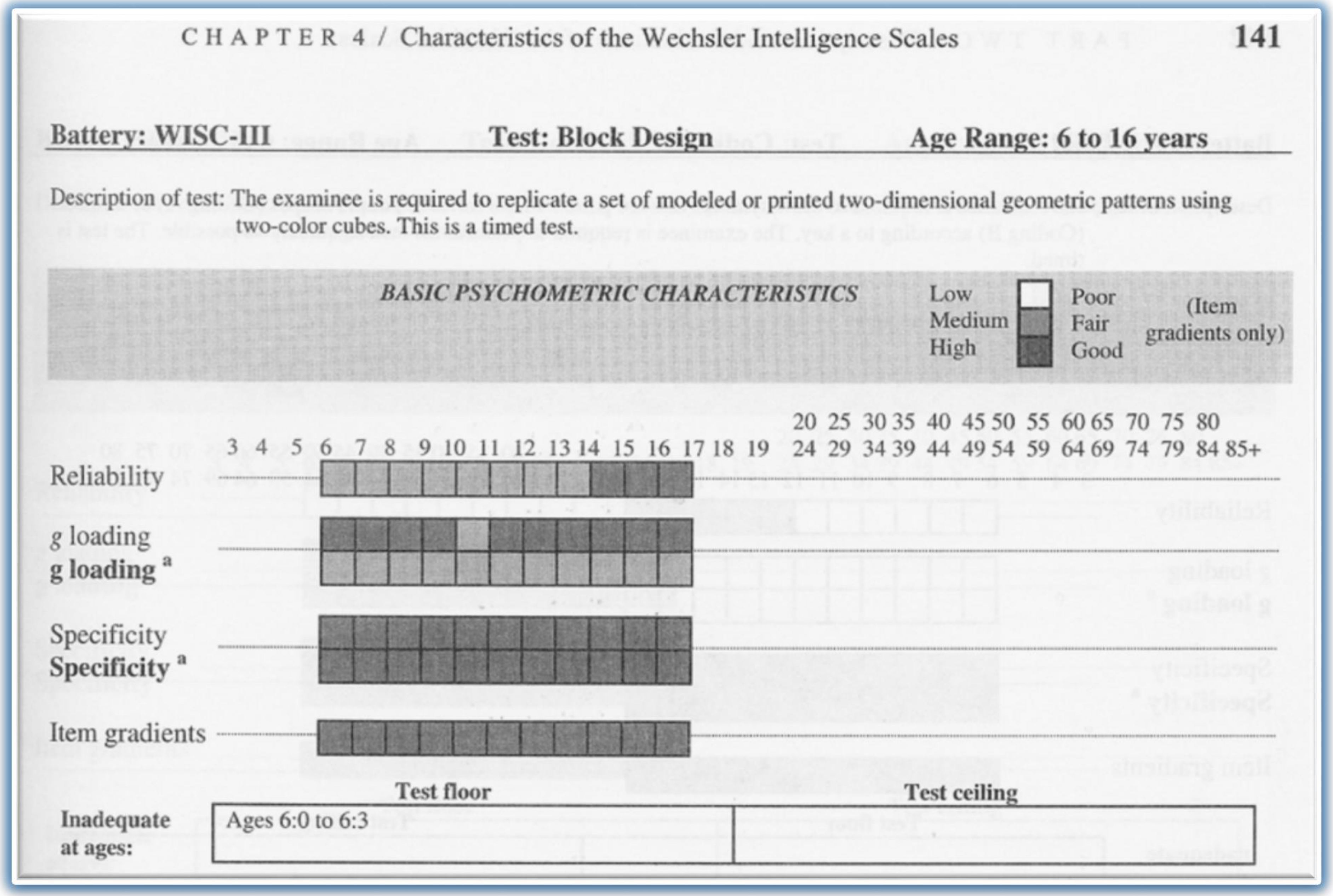


FIGURE 4.1 A Conceptual Model of the Variables Considered in Test Interpretation (WISC-III Picture Completion Example)

Note: There are additional narrow abilities in the domains of *Gc* and *Gv* that are not included in this figure; the rectangle represents the total score variance of the WISC-III Picture Completion test; the italicized terms represent the test characteristic information that is presented for the Wechsler Scales in Table 4.2 and in the Wechsler Scale summary pages.

Sample ITDR summary page from McGrew & Flanagan (1997)



Battery: WISC-III **Test: Block Design** **Age Range: 6 to 16 years**

Description of test: The examinee is required to replicate a set of modeled or printed two-dimensional geometric patterns using two-color cubes. This is a timed test.

BASIC PSYCHOMETRIC CHARACTERISTICS

Inadequate at ages:	**Test floor**	**Test ceiling**
	Ages 6:0 to 6:3	

Sample ITDR summary page

Gf-Gc CLASSIFICATIONS (Broad:stratum II / *Narrow:stratum I*)

Visual Processing (*Gv*): The ability to generate, perceive, analyze, synthesize, manipulate, transform, and think with visual patterns and stimuli (Empirical: strong).

- *Spatial Relations* (SR): Ability to rapidly perceive and manipulate visual patterns or to maintain orientation with respect to objects in space (probable).
- *Visualization* (Vz): Ability to mentally manipulate objects or visual patterns and to "see" how they would appear under altered conditions (possible).

OTHER VARIABLES THAT MAY INFLUENCE TEST PERFORMANCE

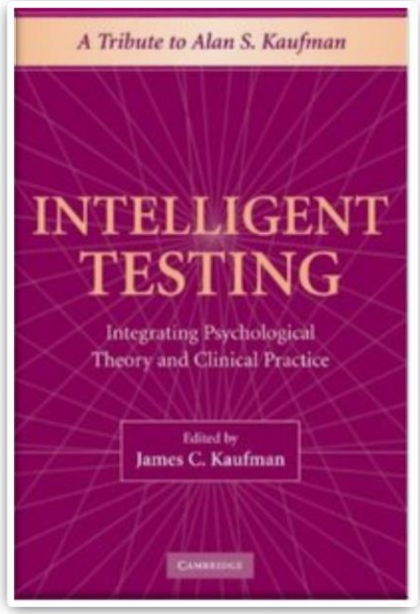
Background and Environmental

Individual and Situational

- Reflectivity/impulsivity
- Field dependence/independence
- Flexibility/inflexibility
- Planning
- Ability to perform under time pressure

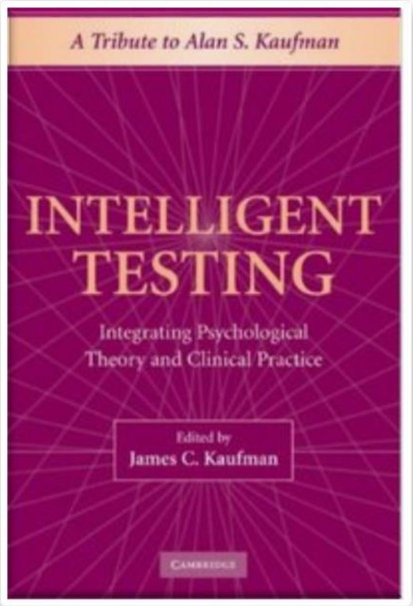
Degree of Linguistic Demand (columns) / Degree of Cultural Loading (rows)

	L	M	H
L		■	
M			
H			



The intent of the intelligent testing model was and remains to "bring together empirical data, psychometrics, clinical acumen, psychological theory, and careful reasoning to build an assessment of an individual leading to the derivation of an intervention to improve the life circumstances of the subject" (Reynolds, 2007, p. 1133) – in Fletcher-Janzen (2009)

Intelligent Testing: Bridging the Gap between Classical and Romantic Science in Assessment (Elaine Fletch-Janzen, 2009)



-The gold standard for clinical-psychometric test interpretation

-Incorporates both quantitative and qualitative analysis

-The first system of test interpretation that followed scientific principles and at the same tame overtly sought to reduce inappropriate use of obtained test scores

-Demands a very high standard of clinical expertise

-The central point of intelligent testing is that the clinician's judgement regarding the patient is the central point

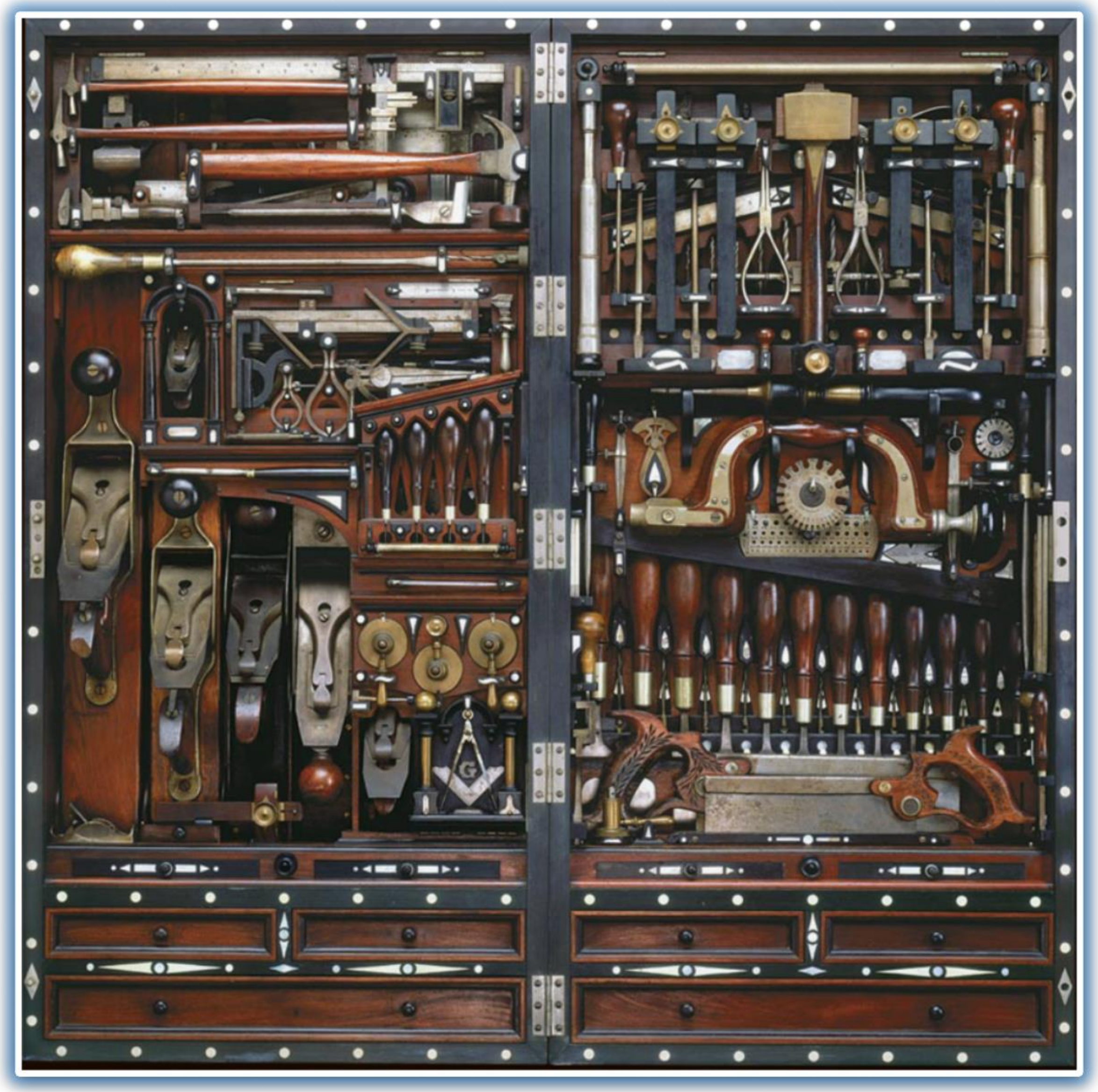
“ Tests do not think for themselves, nor do they directly communicate with patients. Like a stethoscope, a blood pressure gauge, or an MRI scan, a psychological test is a dumb tool, and the worth of the tool cannot be separated from the sophistication of the clinician who draws inferences from it and then communicates with patients and professionals”

Meyer et al. (2001). Psychological testing and psychological assessment. American Psychologist

If you give a monkey a Stradivarius violin and you get bad music……

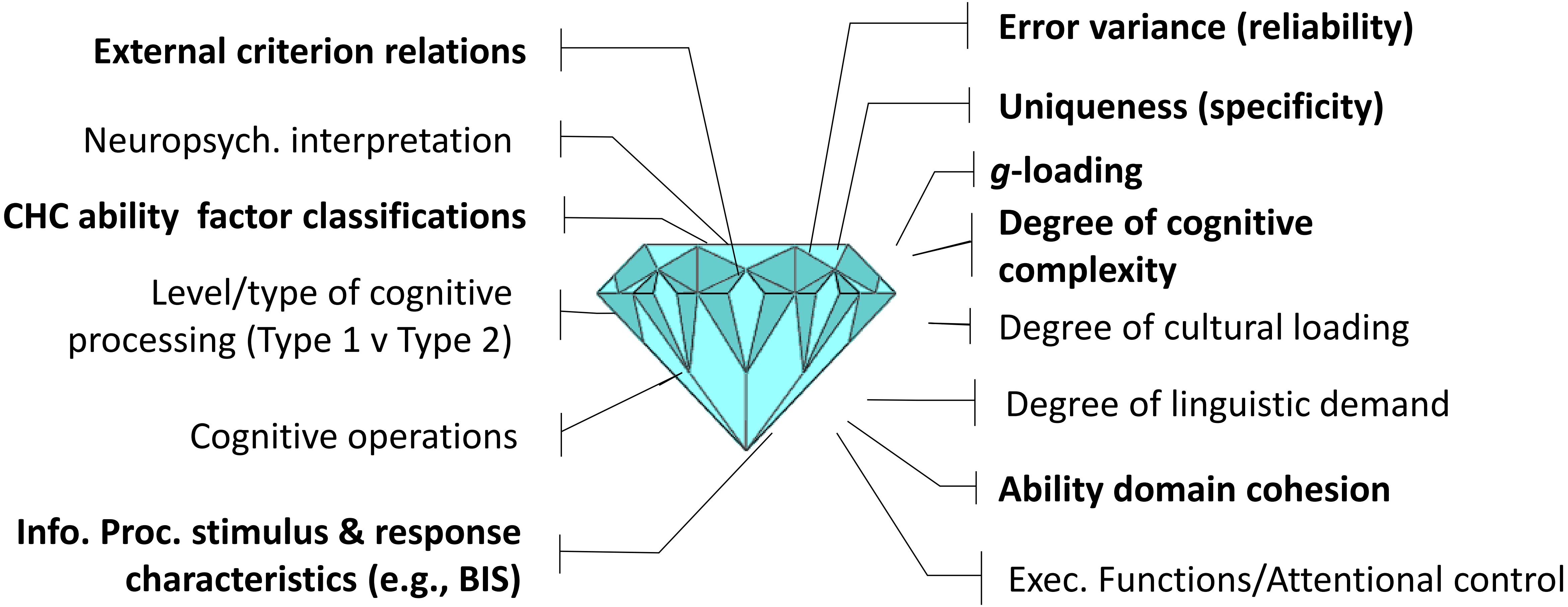
You don’t blame the violin !!!!

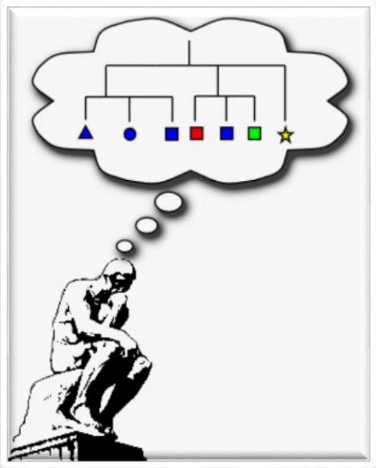
We are the instrument !!!!



"Intelligent" intelligence testing and interpretation requires … knowing thy instruments

An "intelligent" clinician understands and "romances the stones (tests)" which have different and multiple facets



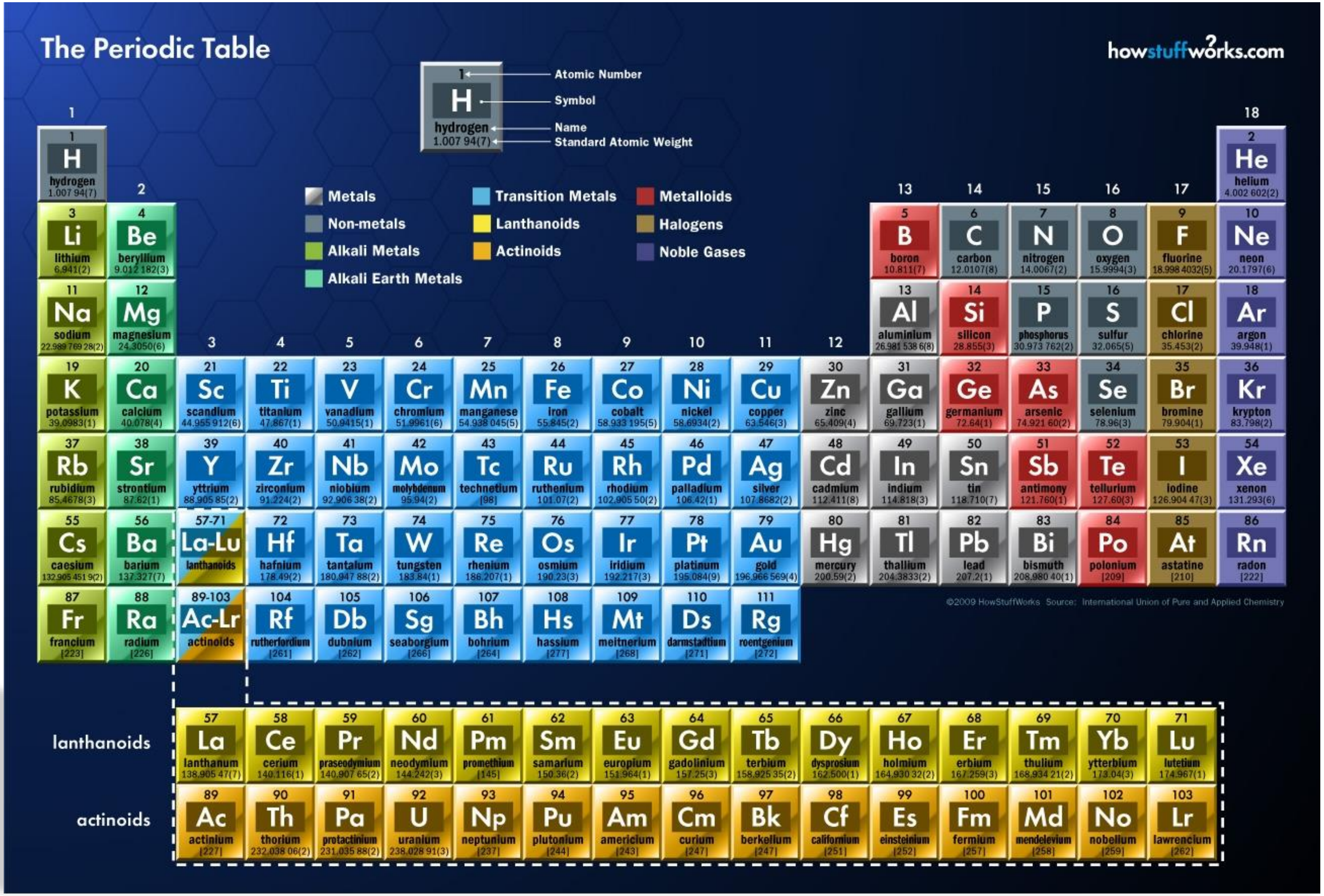


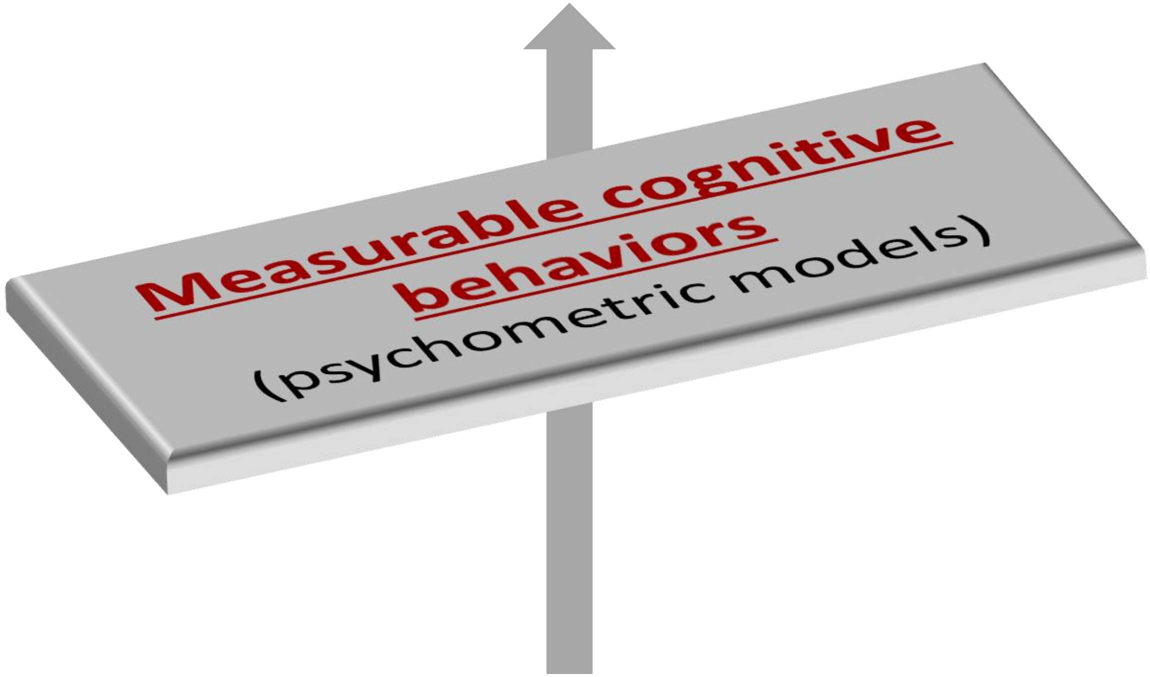
The importance of taxonomies and classification in science

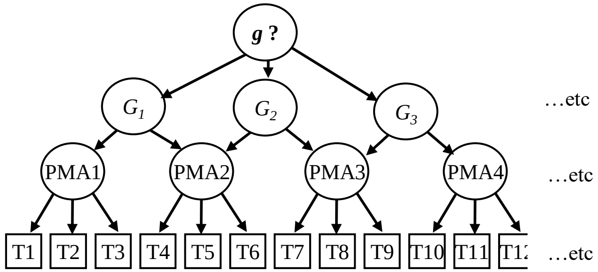
...most disciplines have a common set of terms and definitions (i.e., a standard nomenclature) that facilitates communication among professionals and guards against misinterpretations. In chemistry, this standard nomenclature is reflected in the Table of Periodic Elements. Carroll (1993a) has provided an analogous table for intelligence.....

(Flanagan & McGrew, 1998)

A Good Taxonomy







(Consensus Cattell-Horn-Carroll Hierarchical Three-Stratum Model)

The Cattell-Horn-Carroll (CHC) model is the contemporary consensus taxonomy of human cognitive abilities

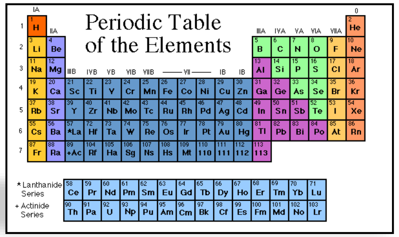
The verdict is unanimous re: the importance of Carroll’s (1993) work

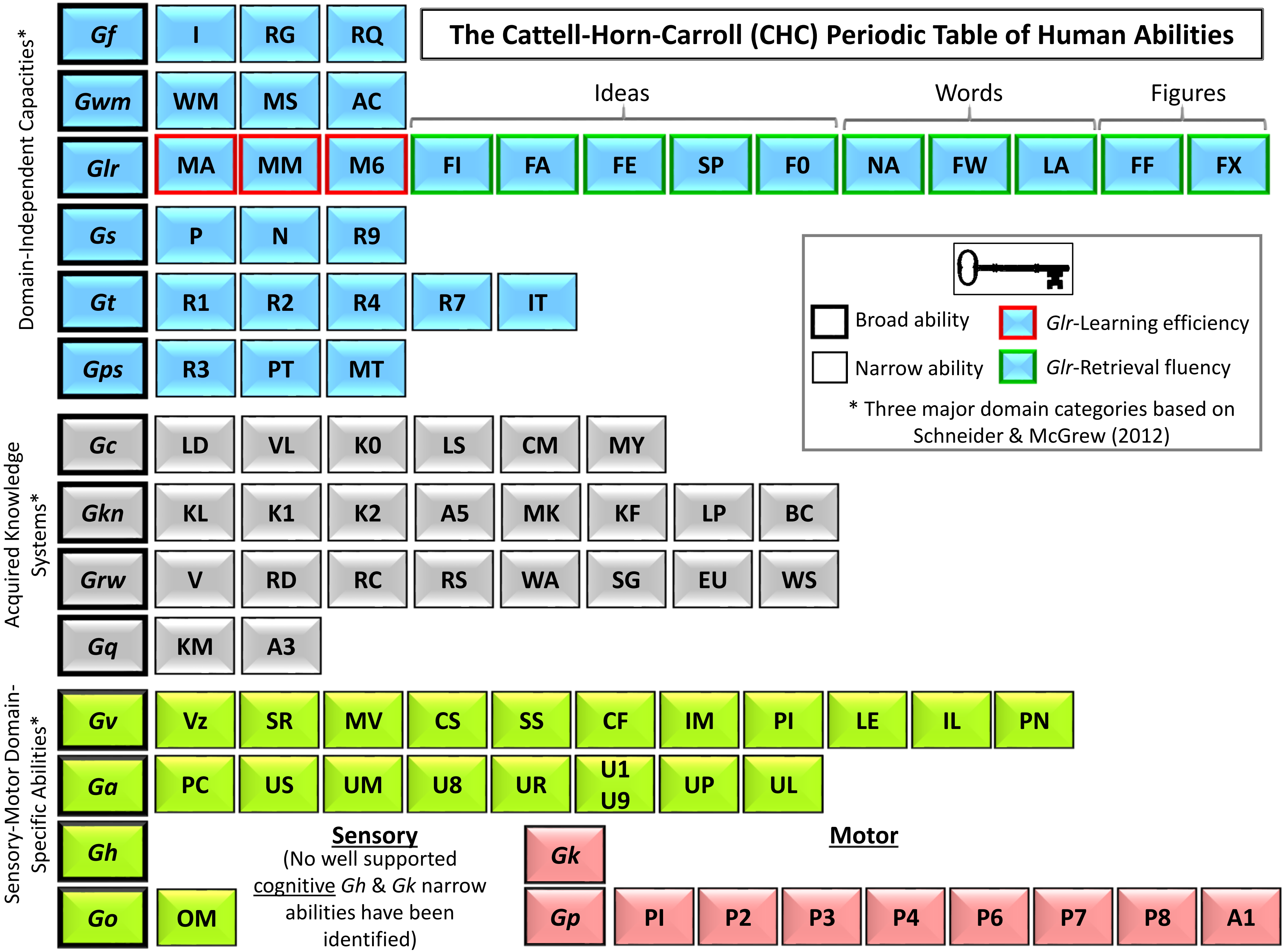
Richard Snow (1993):

“John Carroll has done a magnificent thing. He has reviewed and reanalyzed the world’s literature on individual differences in cognitive abilities…no one else could have done it… it defines the **taxonomy** of cognitive differential psychology for many years to come.”

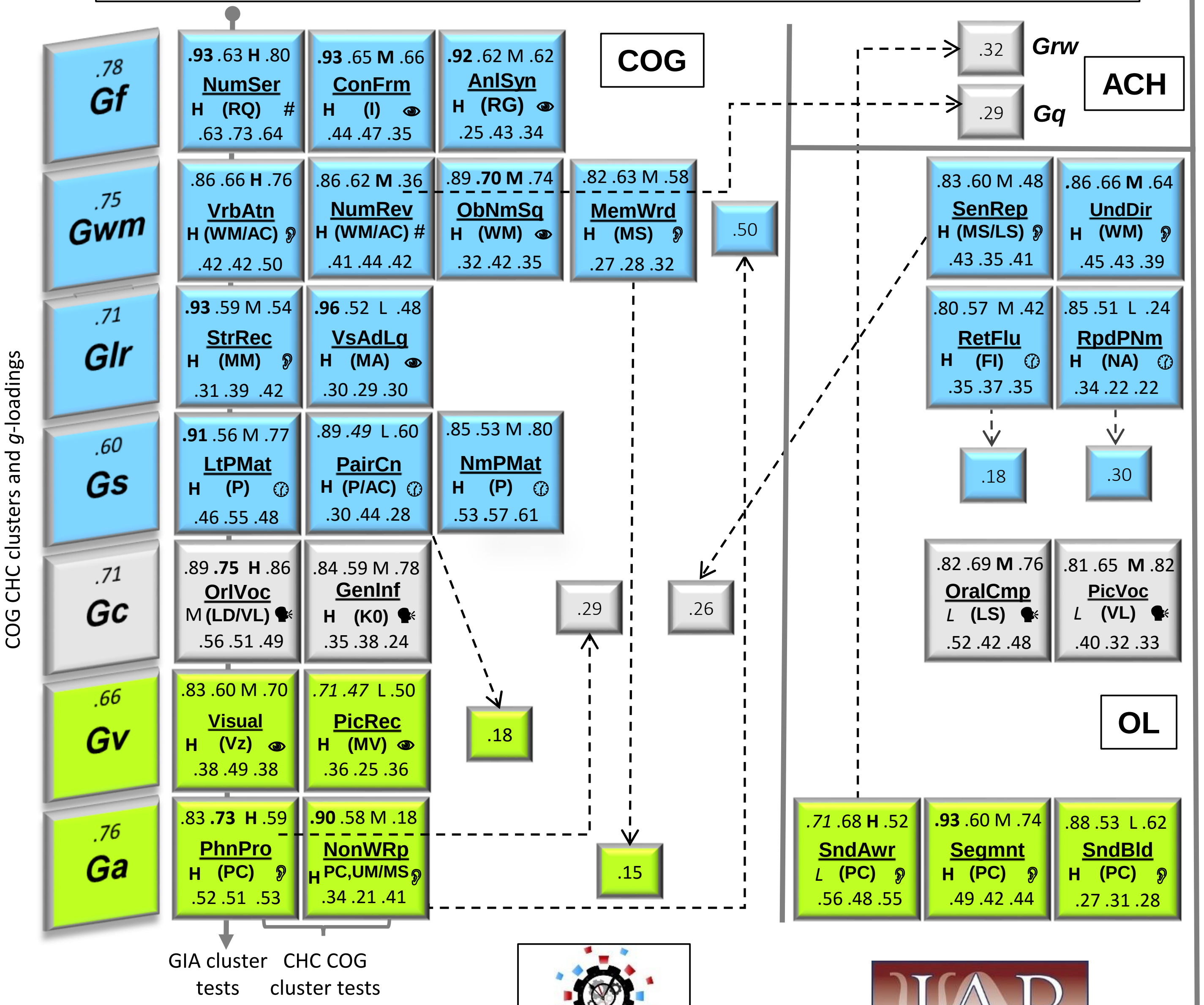
John Horn (1998):

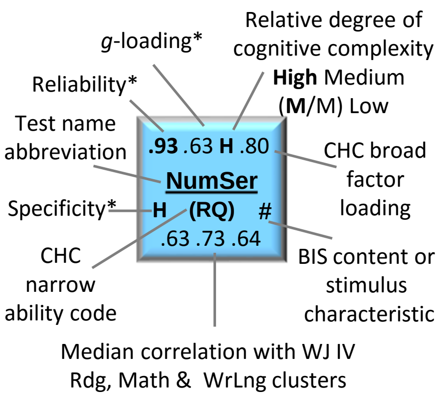
A “tour de force summary and integration” that is the “definitive foundation for current theory” (p. 58). Horn compared Carroll’s summary to “**Mendelyev’s first presentation of a** periodic table of elements in chemistry” (p. 58).




The Cattell-Horn-Carroll (CHC) Periodic Table of Human Abilities
Domain-Independent Capacities*
Gf I RG RQ
Gwm WM MS AC
Ideas
Words
Figures
Glr MA MM M6 FI FA FE SP F0 NA FW LA FF FX
Gs P N R9
Gt R1 R2 R4 R7 IT
Gps R3 PT MT
Broad ability
Narrow ability
Glr-Learning efficiency
Glr-Retrieval fluency
* Three major domain categories based on Schneider & McGrew (2012)
Acquired Knowledge Systems*
Gc LD VL K0 LS CM MY
Gkn KL K1 K2 A5 MK KF LP BC
Grw V RD RC RS WA SG EU WS
Gq KM A3
Sensory-Motor Domain-Specific Abilities*
Gv Vz SR MV CS SS CF IM PI LE IL PN
Ga PC US UM U8 UR U1 U9 UP UL
Gh
Sensory
(No well supported cognitive Gh & Gk narrow abilities have been identified)
Motor
Gk
Go OM
Gp PI P2 P3 P4 P6 P7 P8 A1

The WJ IV Cattell-Horn-Carroll (CHC) periodic table of COG/OL test elements: Ages 6 to 19



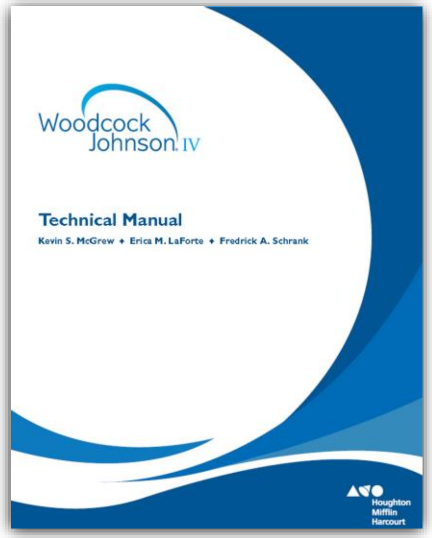


[* **high**, med, *low* – as per Kaufman (1979) & McGrew & Flanagan (1998)]

.29 (Secondary CHC factor loading)

Information based on analysis of the WJ IV 6-19 year old norm sample

- **Reliability:** The degree to which a test score is free from errors of measurement. Test score precision.
- **Specificity:** The portion of a test's score variance that is reliable and unique to the test.
- ***g*-loading:** A test's loading on the first unrotated factor or component in factor or principal component analysis.
- **Cognitive complexity:** The relative degree of cognitive information processing load (e.g., resource demands on working memory, attentional control, executive functions) demanded by a test.
- **CHC narrow ability code**: (see back)
- **BIS content characteristic**:
  Verbal # Quant.-numeric
  Auditory Figural-visual
  Speed-fluency

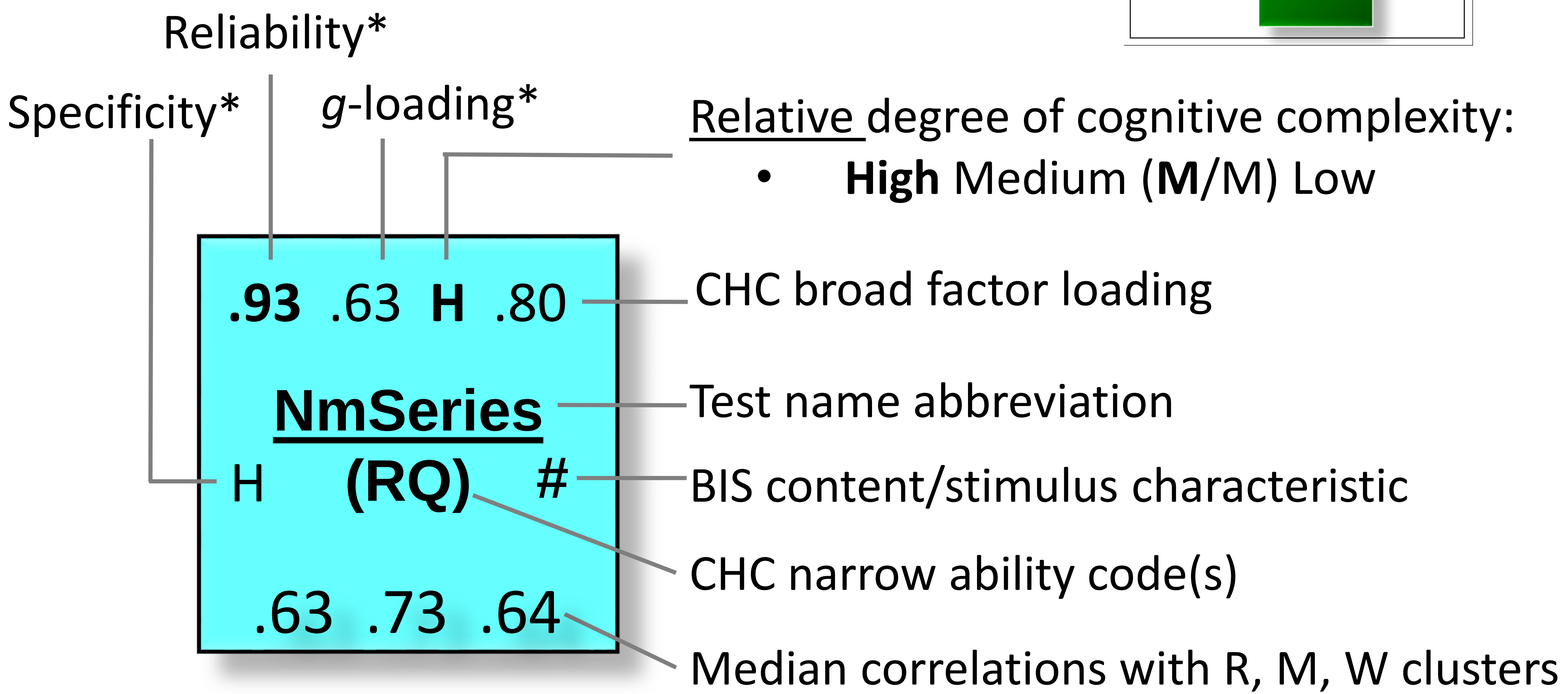


The MindHub

Additional resources available at www.themindhub.com (*MindHub*TM)

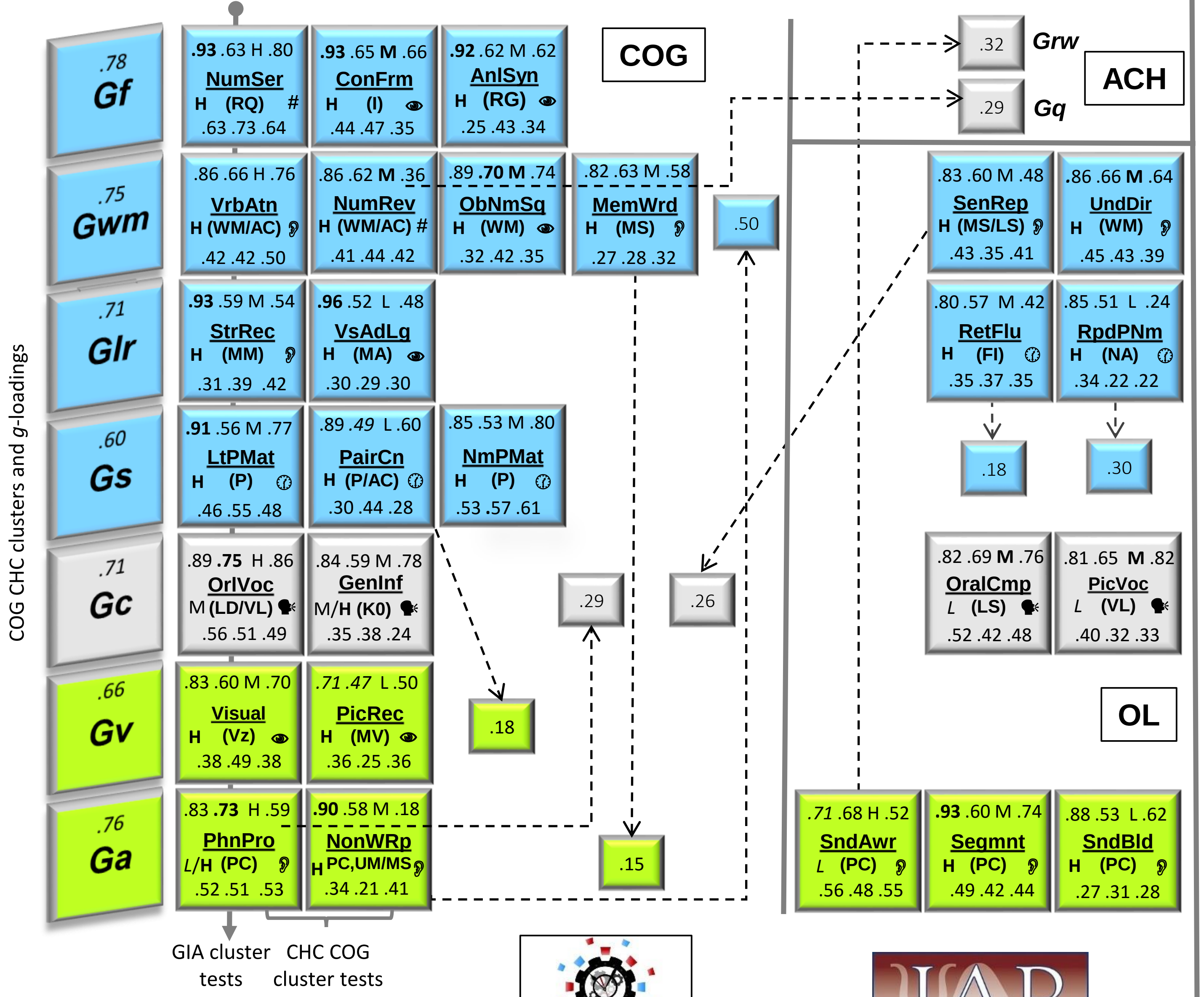
IAP Institute for Applied Psychometrics

All information based on analysis of WJ IV norm data from ages 6 thru 19



[* **high**, med, *low* – as per Kaufman (1979) & McGrew & Flanagan (1998)]

The WJ IV Cattell-Horn-Carroll (CHC) periodic table of COG/OL test elements: Ages 6 to 19



Additional resources available at
www.themindhub.com (*MindHub*™)

WISC-V related measures

Matrix Reasoning (I)
Figure Weights (RQ)
Picture Concepts (I)
Arithmetic (RQ; Gq)

Digit Span (MS,WM)
Letter-Number Seq. (WM)
Picture Span (WM/MS; *Gv*-MV?)
Arithmetic (Gwm-WM)

Naming Speed Literacy (NA)
Naming Speed Quantity (NA)
Immediate Symbol Translation (MA)
Delayed Symbol Translation (MA)
Recognition Symbol Translation (MA)

Coding (R9/MA?)
Symbol Search (P/R9; *Gv*-SS?)
Cancellation (P/R9)

Similarities (VL/LD)
Vocabulary (VL)
Information (K0)
Comprehension (LD/K0)

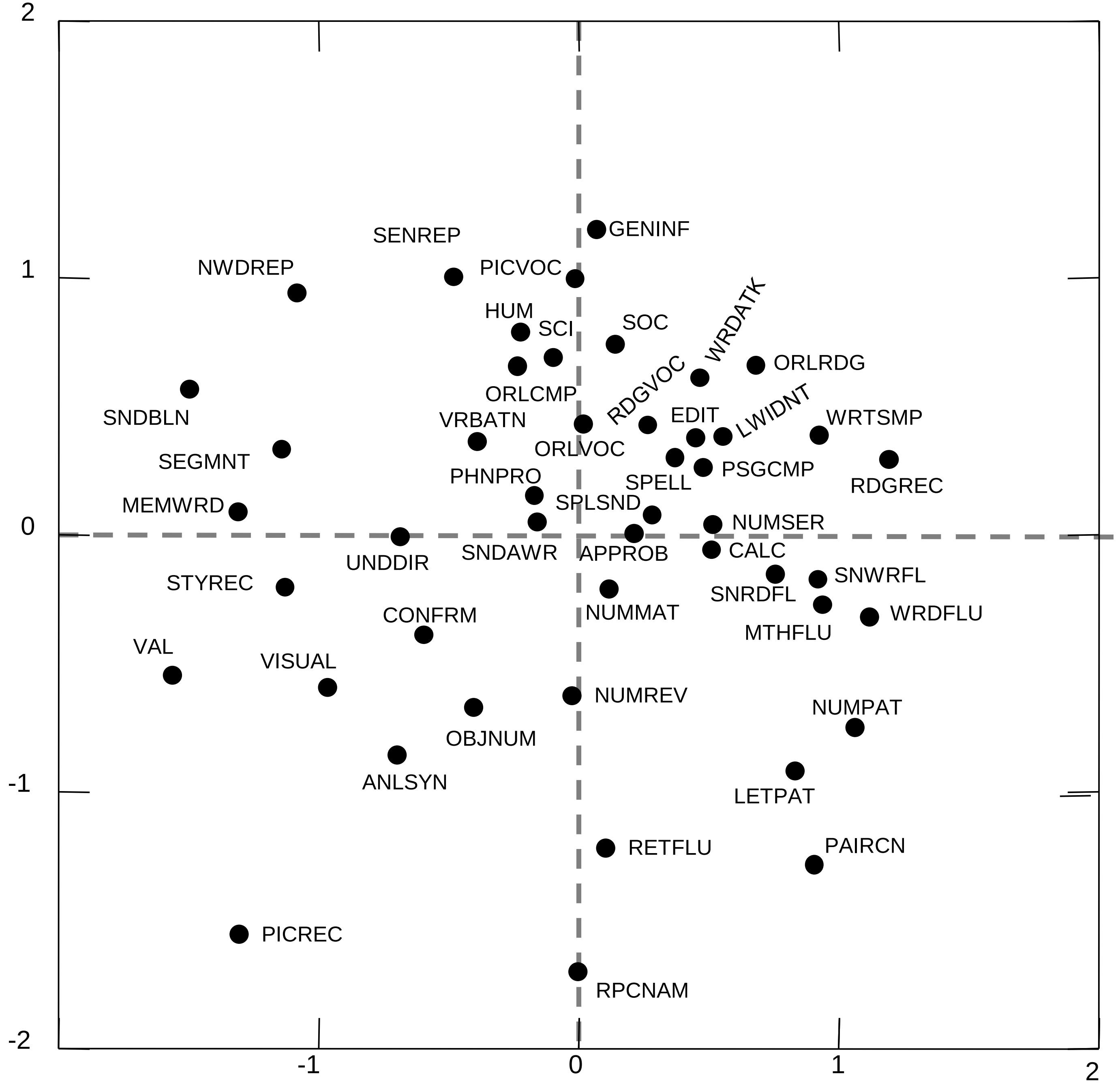
Block Design (Vz)
Visual Puzzles (Vz/SR?)

No *Ga* tests

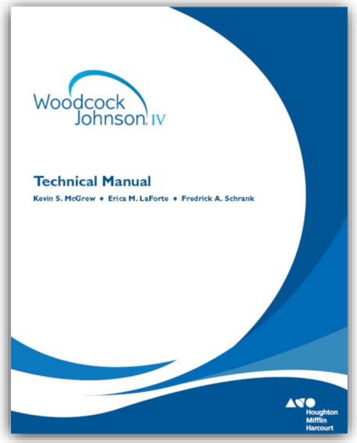
WISC-V tests & tentative CHC classifications (based on multiple sources)

Italic font designates Canivez, Watkins & Dombrowski's (2015) conclusion that Gf and Gv are not separate factors-instead combine as perceptual reasoning

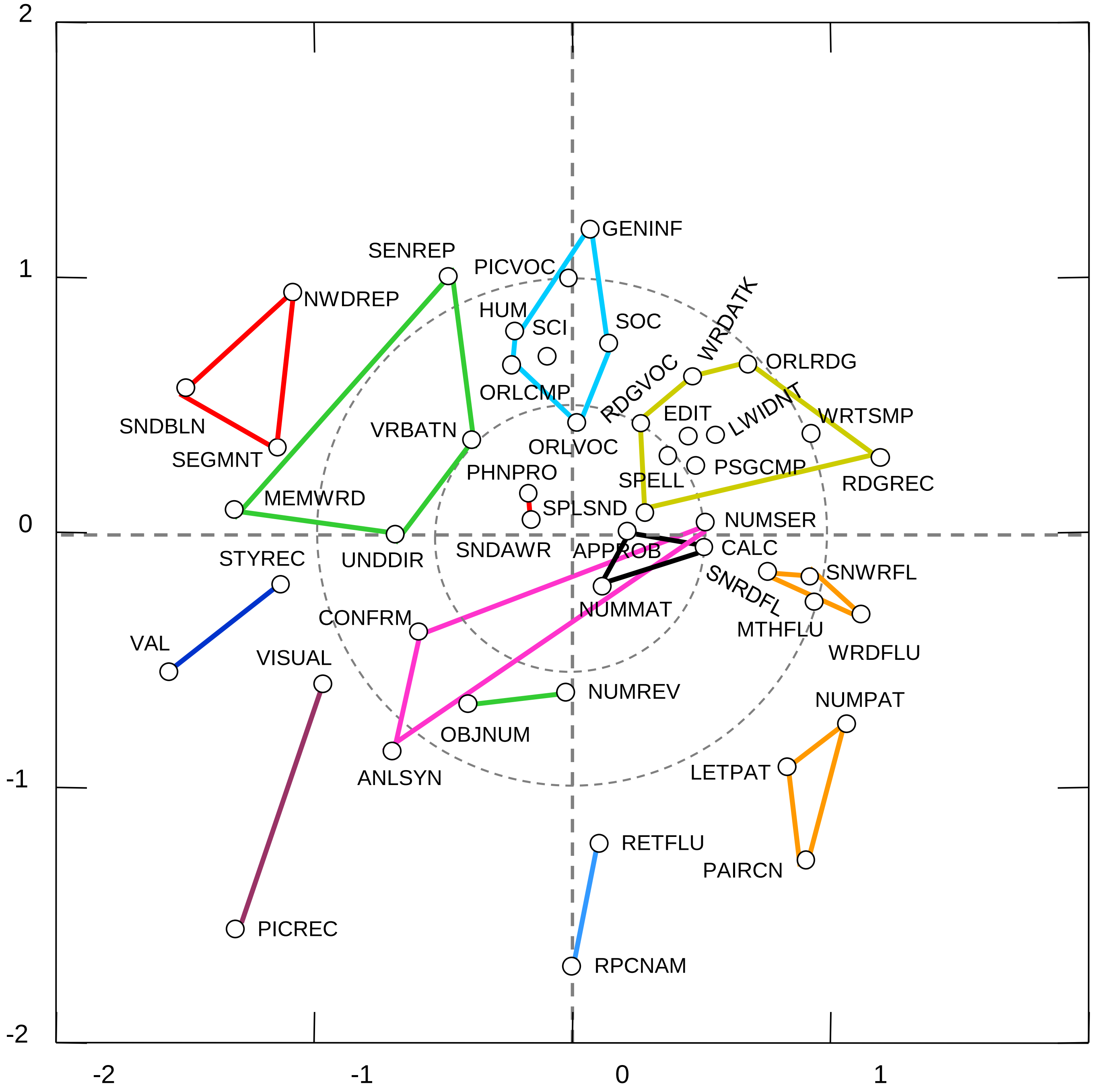
Exploratory MDS of WJ IV norm subjects ages 6-19



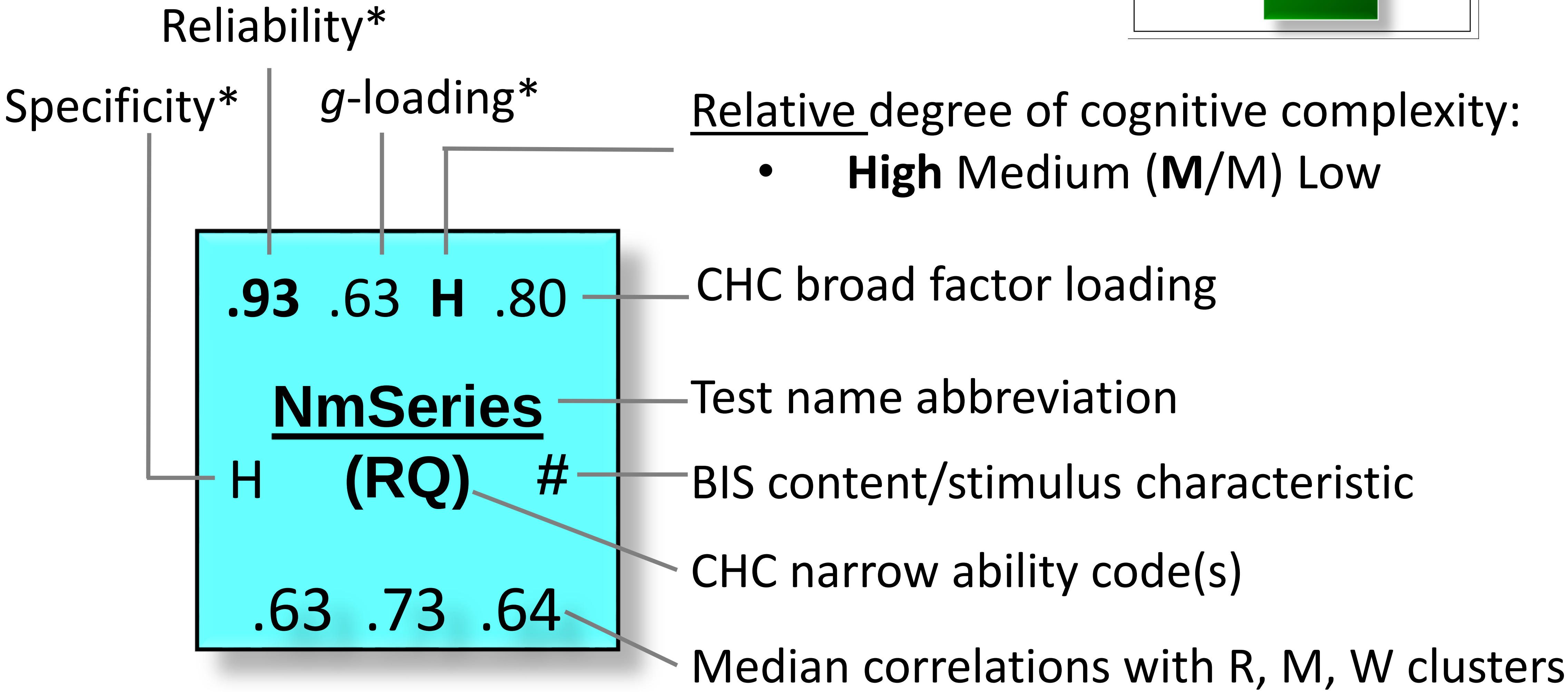
WJ IV test 2D MDS (Ages 6 to 19; n = 4,082)



www.iapsych.com/mimap.pdf



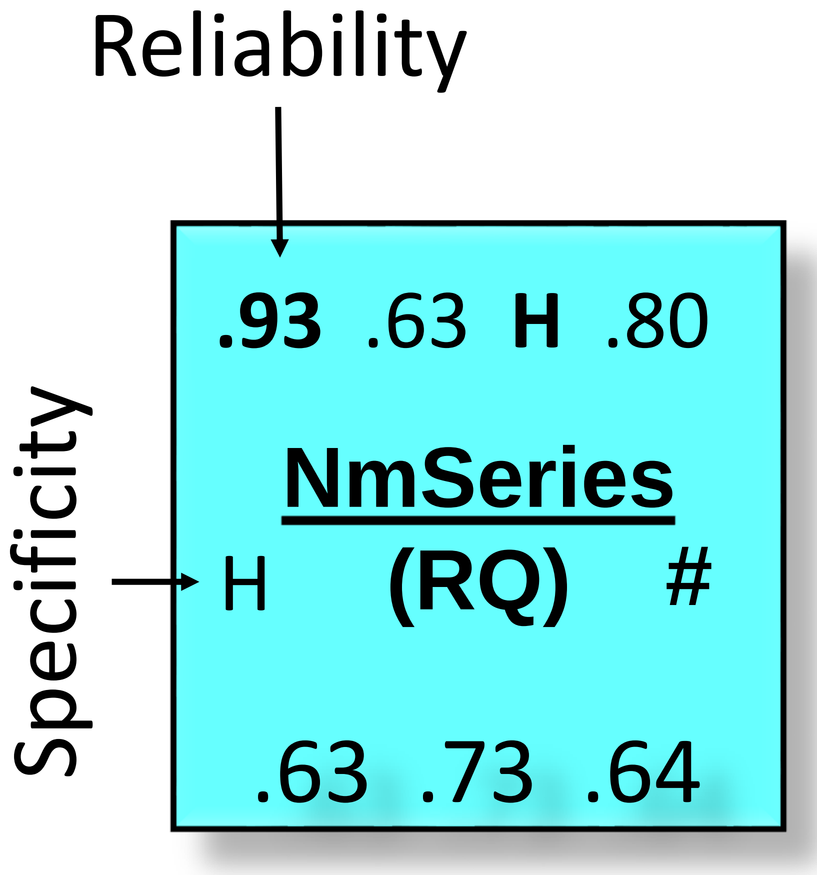
All information based on analysis of WJ IV norm data from ages 6 thru 19

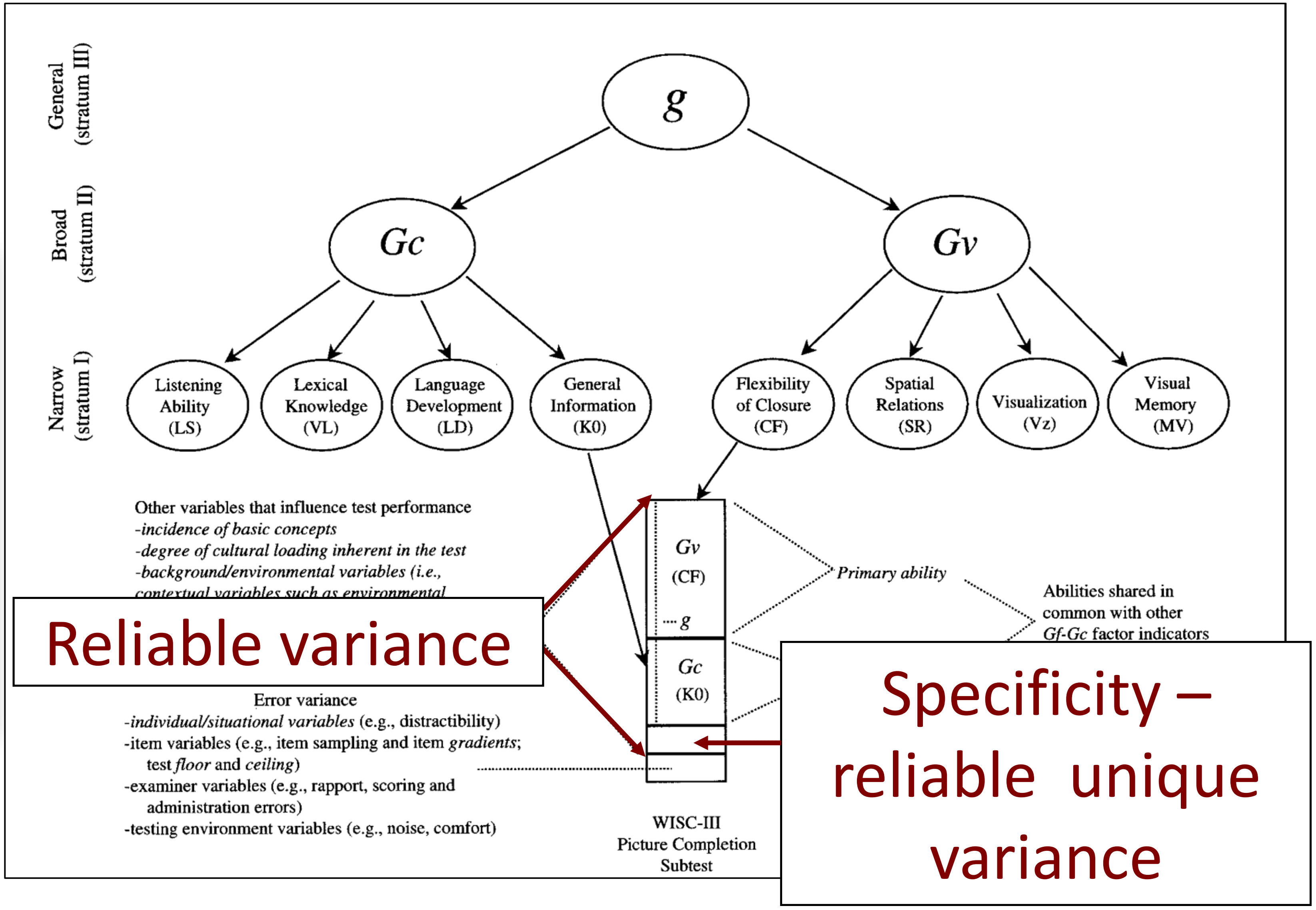


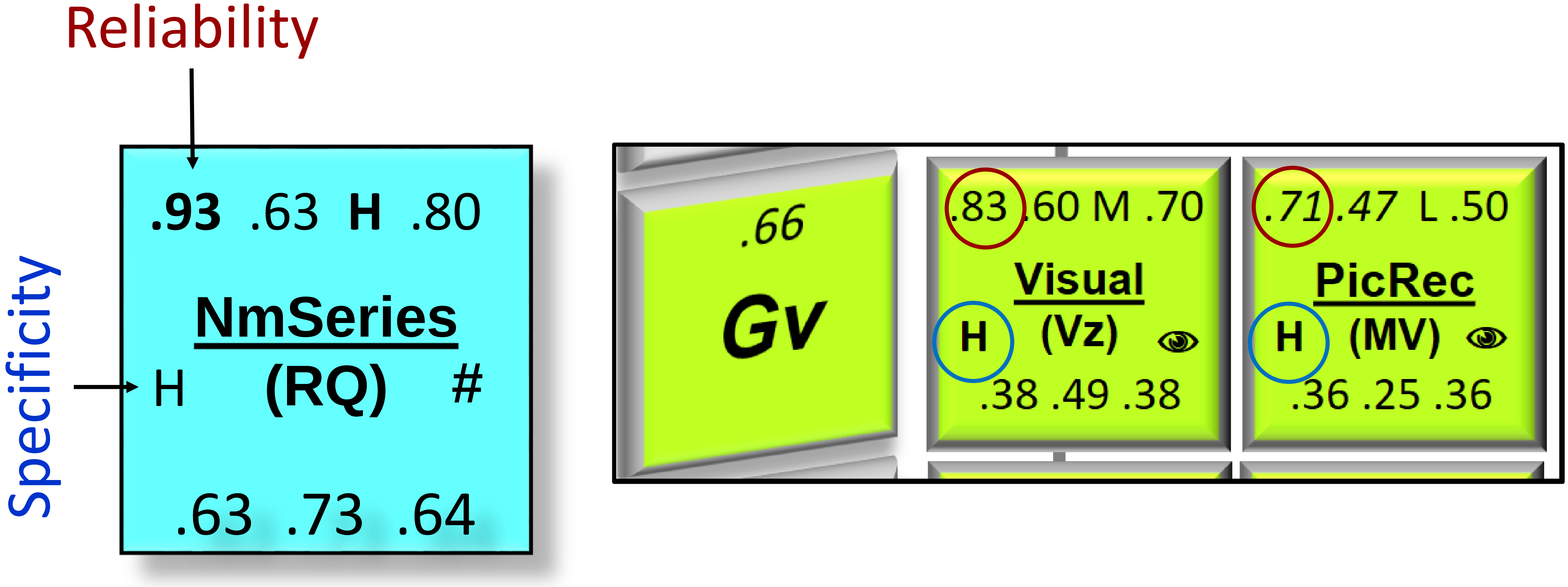
[* **high**, med, *low* – as per Kaufman (1979) & McGrew & Flanagan (1998)]

<u>Reliability</u>	The degree to which a test score is free from errors of measurement. Test score precision.	Important for making accurate educational and/or diagnostic decisions.
High	Coefficients of .90 or above.	Test scores are sufficiently reliable and can be used to make diagnostic decisions.
Medium	Coefficients from .80 to .89 inclusive.	Test scores are moderately reliable and can be used to make <u>screening</u> decisions or can be combined with other tests to form a composite with "high" reliability.
Low	Coefficients below .80.	Test scores are not sufficiently reliable and cannot be used to make important screening or diagnostic decisions. Need to be combined with other tests to form a composite with "medium" or "high" reliability.

<u>Specificity</u>	The portion of a test's score variance that is reliable and unique to the test.	
High	A test's unique reliable variance is equal to or above 25% of the total test variance and it exceeds error variance (1-reliability).	A test with high specificity may be interpreted as measuring an ability distinct within a battery of tests.
Medium	When a test meets only one of the criteria for High.	A test with medium specificity should be interpreted cautiously as measuring an ability distinct within a battery of tests).
Low	When a test does not meet either of the criteria for High.	A test with low specificity should not be interpreted as representing a unique ability but may prove useful in interpretation when it is considered as part of a composite or cluster of other similar tests.


Reliability
Specificity
.93 .63 H .80
NmSeries
H (RQ) #
.63 .73 .64

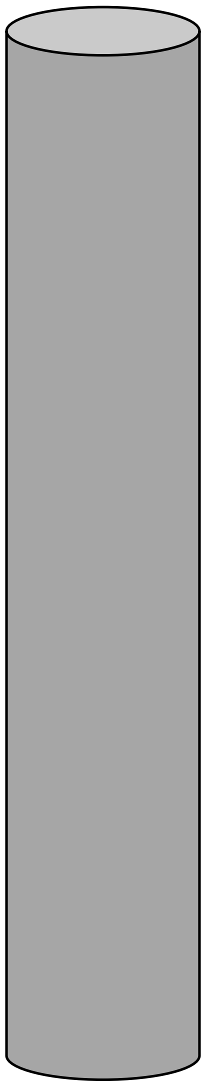

General (stratum III)
Broad (stratum II)
Narrow (stratum I)
g
Gc
Gv
Listening Ability (LS)
Lexical Knowledge (VL)
Language Development (LD)
General Information (K0)
Flexibility of Closure (CF)
Spatial Relations (SR)
Visualization (Vz)
Visual Memory (MV)
Other variables that influence test performance
-incidence of basic concepts
-degree of cultural loading inherent in the test
-background/environmental variables (i.e.,
Reliable variance
Gv (CF)
g
Gc (K0)
Primary ability
Abilities shared in common with other Gf-Gc factor indicators
Specificity – reliable unique variance
Error variance
-individual/situational variables (e.g., distractibility)
-item variables (e.g., item sampling and item gradients; test floor and ceiling)
-examiner variables (e.g., rapport, scoring and administration errors)
-testing environment variables (e.g., noise, comfort)
WISC-III Picture Completion Subtest



Reliability
Specificity
.93 .63 H .80
NmSeries
H (RQ) #
.63 .73 .64
.66
Gv
.83 .60 M .70
Visual
H (Vz)
.38 .49 .38
.71 .47 L .50
PicRec
H (MV)
.36 .25 .36

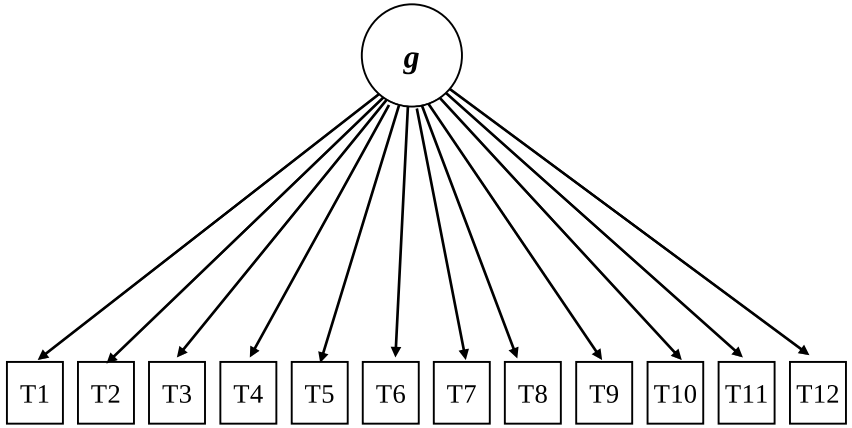
***g*-loading**	Each test's loading on the first unrotated factor or component in principal factor or component analysis with all other tests from a specific intelligence battery.	Important indicator of the degree to which a test of an individual battery measures general intelligence. Aids in determining the extent to which a test score can be expected to vary from other scores within a profile.
High	General factor or g loading of .70 or higher.	Tests with high g loadings are not expected to vary greatly from the mean of the profile and are considered good indicators of general intelligence.
Medium	A loading of .51 to .69.	Tests with medium g loadings may vary from the mean of the profile as tests with this classification are considered fair indicators of general intelligence.
Low	A loading of .50 or lower.	Tests with low g loadings can be expected to vary from the mean of the profile as tests with this classification are considered poor indicators of general intelligence.

High *g*



IQ test battery subtest *g*-loadings or saturation

General intelligence (*g*) →



(1a) Spearman's general Factor model

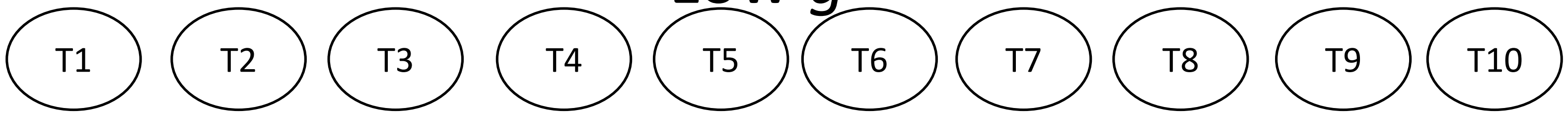
Intelligence test battery test *g* (general intelligence) *loadings (weights)*

Derived from factor analysis

Think of a general intelligence pole that is saturated with <u>more</u> *g-ness* (like magnetism) at the top and <u>less</u> *g-ness* at the bottom

Factor analysis orders the tests on the pole based on their saturation of *g-ness*

Low *g*



Subtests

First (unrotated) principal component for **WJ IV COG & WISC-IV tests** (*n*=173)

	g	*h2*
Arithmetic	0.81	0.66
Phonological Processing	**0.81**	**0.66**
Vocabulary	0.80	0.64
Oral Vocabulary	**0.80**	**0.64**
Information	0.79	0.62
Concept Formation	**0.78**	**0.61**
Matrix Reasoning	0.75	0.56
Similarities	0.74	0.55
Verbal Attention	**0.73**	**0.53**
Block Design	0.71	0.50
General Information	0.71	0.50
Number Series	**0.70**	**0.49**
Numbers Reversed	**0.69**	**0.48**
Comprehension	0.69	0.48
Letter-Number Sequencing	0.68	0.46
Digit Span	0.65	0.42
Object-Number Sequencing	**0.64**	**0.41**
Picture Concepts	0.63	0.40

	g	*h2*
Visual-Auditory Learning	**0.62**	**0.38**
Nonword Repetition	**0.62**	**0.38**
Symbol Search	0.62	0.38
Analysis-Synthesis	**0.61**	**0.37**
Number-Pattern Matching	**0.59**	**0.35**
Story Recall	**0.58**	**0.34**
Pair Cancellation	**0.58**	**0.34**
Visualization	**0.55**	**0.30**
Picture Recognition	**0.49**	**0.24**
Letter-Pattern Matching	**0.48**	**0.23**
Coding	0.47	0.22
Cancellation	0.42	0.18

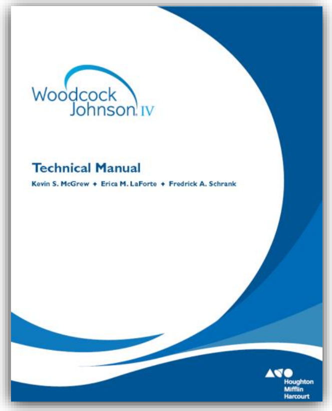
g-loading

.93 .63 **H** .80

NmSeries

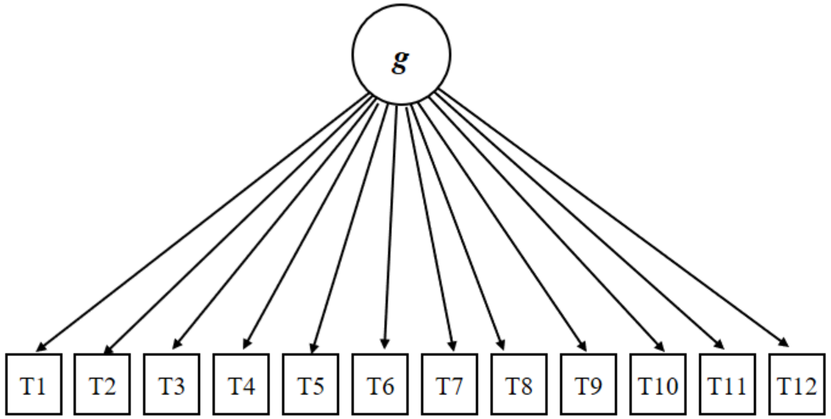
H **(RQ)** **#**

.63 .73 .64

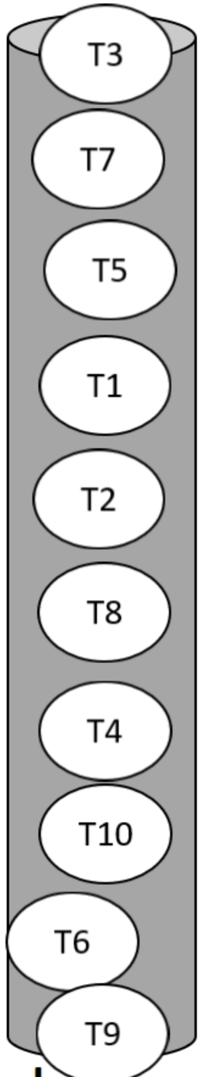


IQ test battery subtest *g*-loadings or saturation

General intelligence (*g*) →



(1a) Spearman's general Factor model



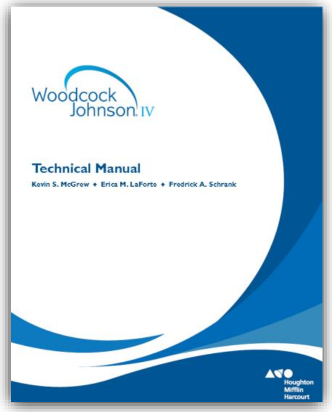
CHC narrow factor classification

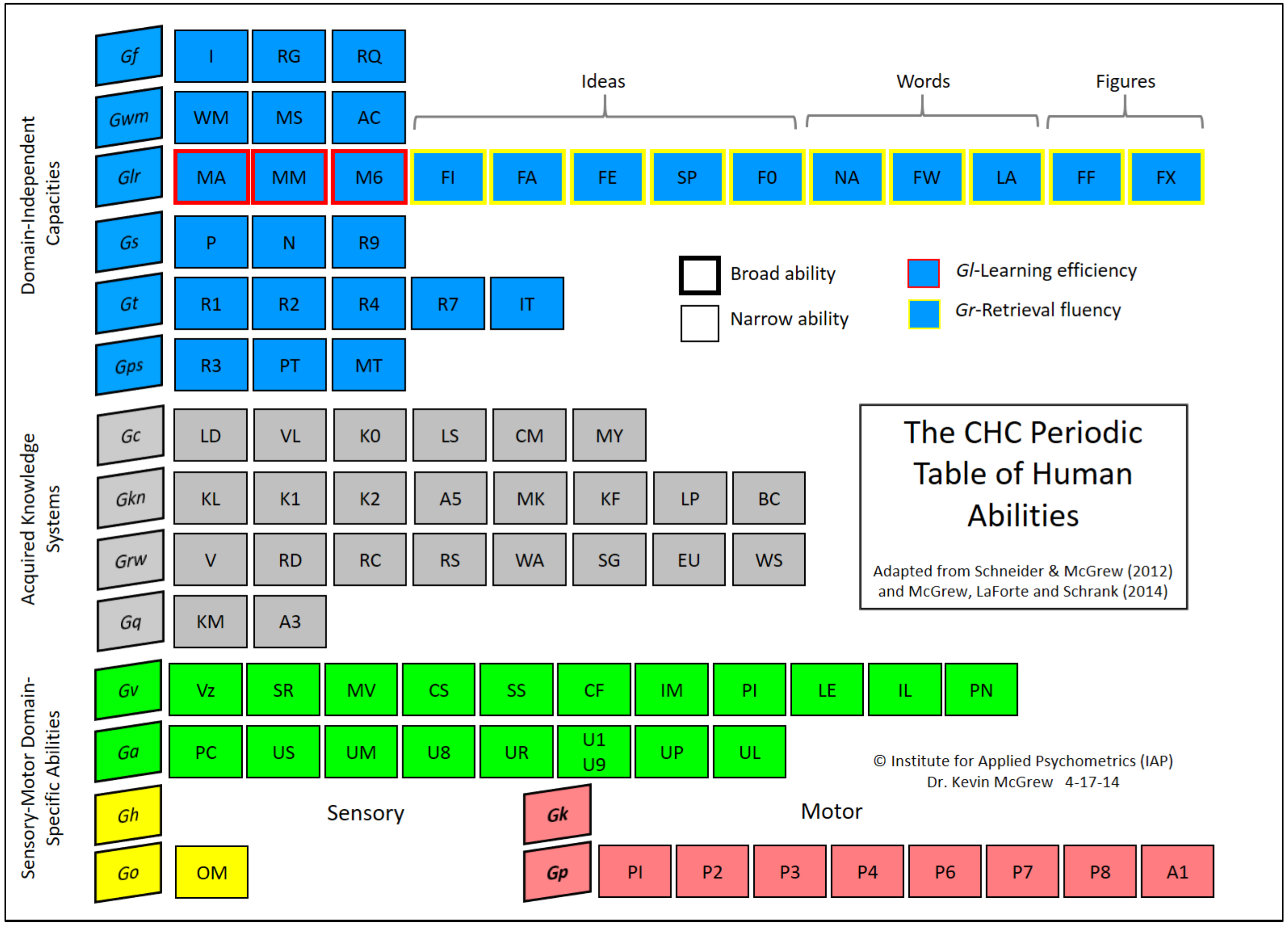
.93 .63 **H** .80

NmSeries

H **(RQ)** #

.63 .73 .64



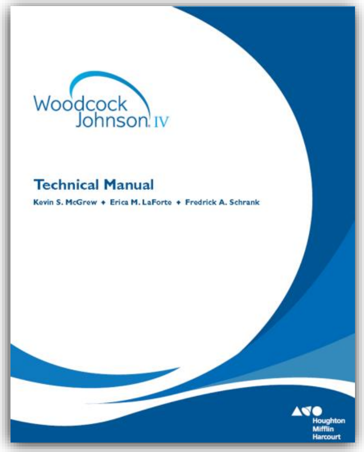


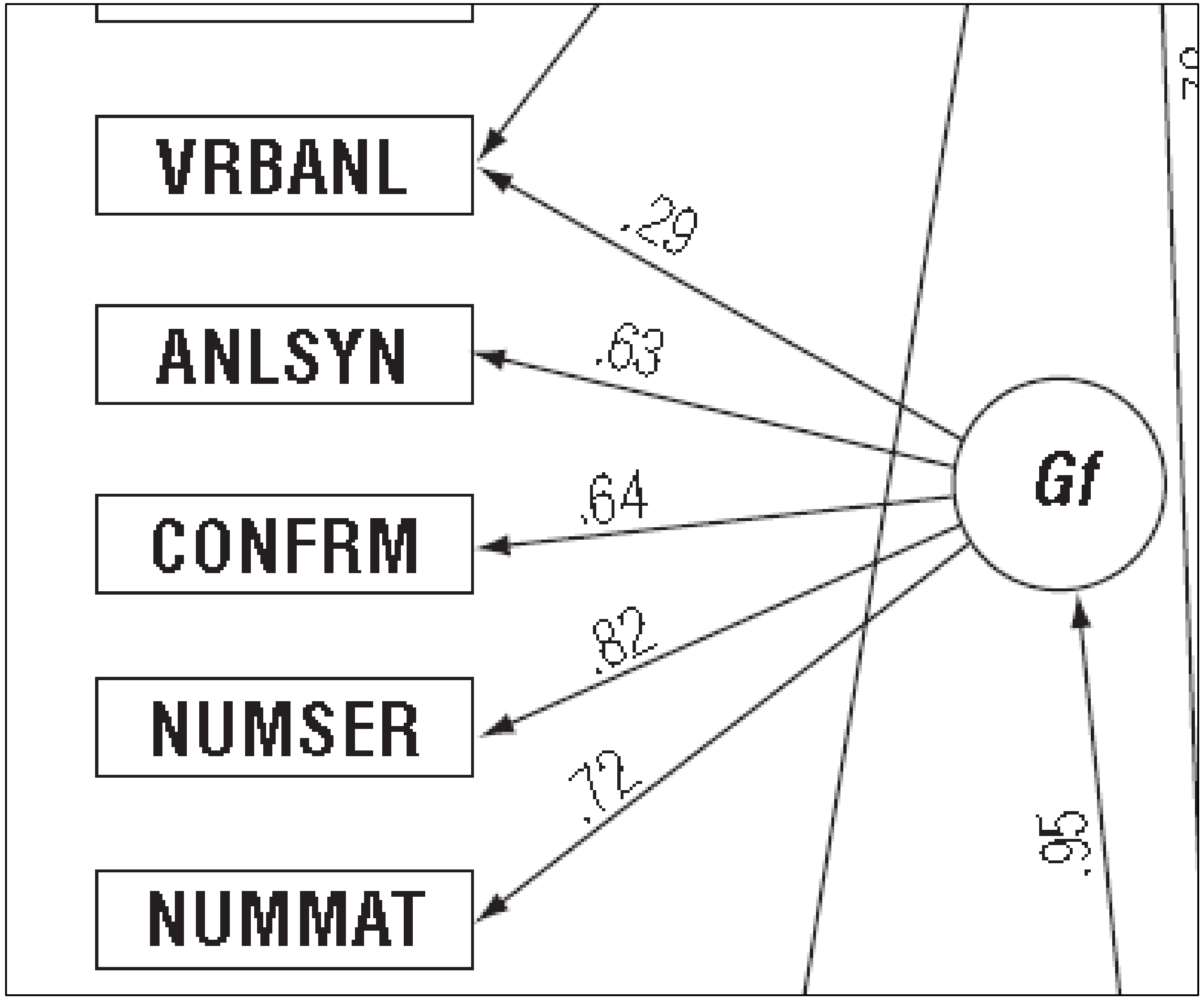
.93 .63 **H** .80 ← CHC broad factor loading (average)

NmSeries

H **(RQ)** **#**

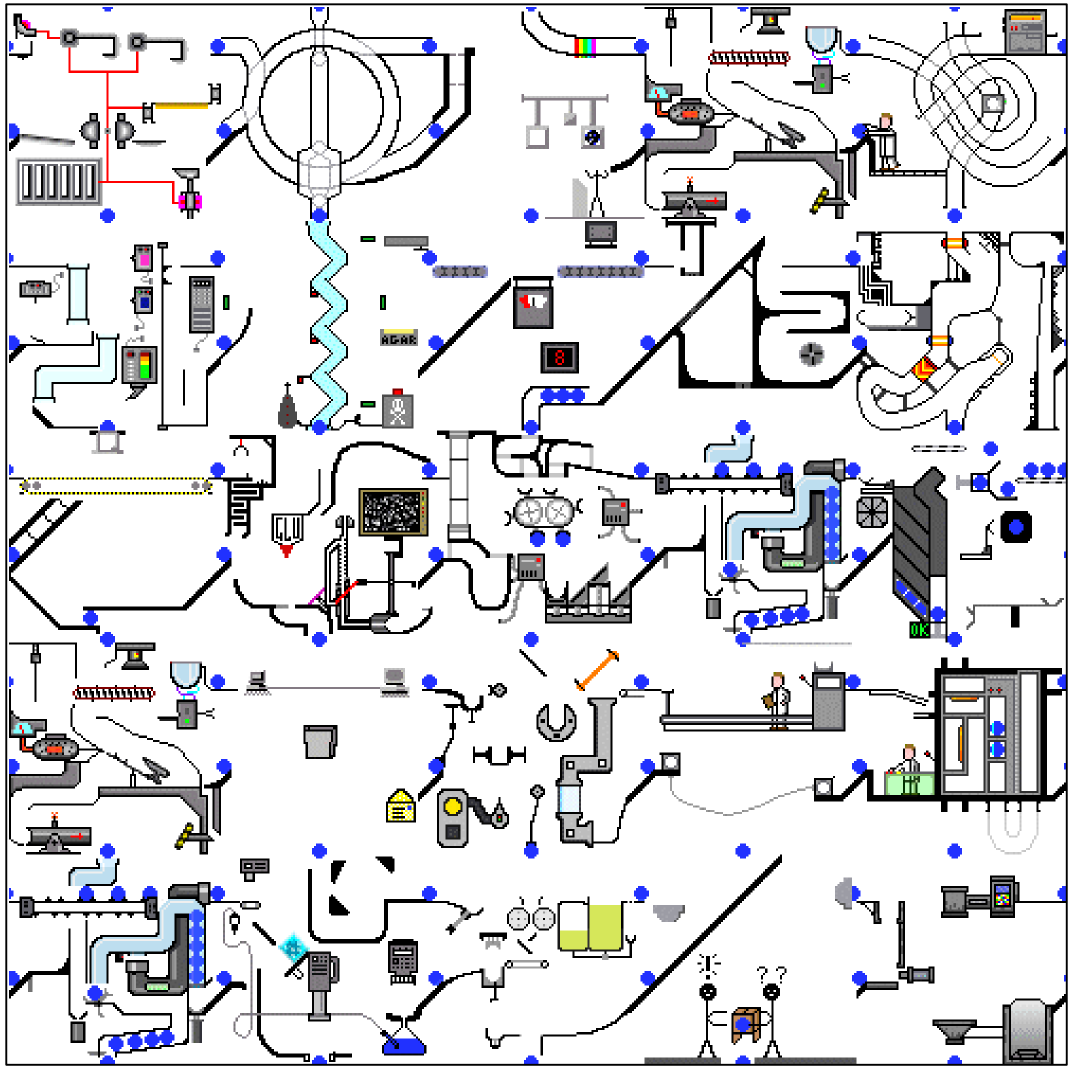
.63 .73 .64





Ages 9-13 in technical manual

What is (relational) cognitive complexity?



Journal of Educational Psychology
1983, Vol. 75 No. 4, 603–618

Cognitive Variables in Series Completion

Thomas G. Holzman
Georgia State University

James W. Pellegrino
University of California, Santa Barbara

Robert Glaser
University of Pittsburgh

The cognitive determinants of number series completion performance were studied by presenting a systematic set of problems to college adults and to average- and high-IQ elementary-school children. In each group a combination of process and content-knowledge variables accounted for more than 70% of the variance in solution difficulty. Solution difficulty was most affected by the amount of information to be coordinated in working memory while assembling and applying the pattern description rule for the sequence. Adults could effectively coordinate more information than children, but IQ levels did not differ on this component ability. Skill in dealing with unusual, hierarchical relations and arithmetic computation also affected performance and discriminated between age and IQ levels. Comparisons with results from other types of rule-induction tasks suggested some general abilities of importance to rule induction.

PSYCHOLOGICAL SCIENCE

Research Article

How Many Variables Can Humans Process?

Graeme S. Halford,[1] Rosemary Baker,[1] Julie E. McCredden,[1] and John D. Bain[2]

[1]*University of Queensland, Brisbane, Australia, and* [2]*Griffith University, Brisbane, Australia*

BEHAVIORAL AND BRAIN SCIENCES (1998) **21**, 803–865
Printed in the United States of America

Processing capacity defined by relational complexity: Implications for comparative, developmental, and cognitive psychology

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www.etl.go.jp/etl/ninchi/stevep@etl.go.jp/welcome.html

Two major classes of cognitive complexity theories (Bertling, 2012)

- Empirical: Post-hoc purely data-driven theories (e.g., Marshalek, Lohman & Snow, 1983)
  - *g*-loadings
  - Proximity to center of MDS spatial maps

- Cognitive theories: Working memory theories and the constraints placed on reasoning (e.g., *Gf*). Increasing processing demands results in an increase (demand/load) on cognitive resources

Two types of cognitive theories regarding cognitive complexity

Load placed on working memory by a task

- Focus is on the sheer number of elements or element relations in a task

Relational Complexity theory (RC): The relational complexity of a task (e.g., Birney et al., 2006); Halford, 1993; Halford et al., 1988; Just & Carpenter, 1992)

- Focus is on the complexity of the interrelated elements (pieces of information) that need to be processed in parallel

Example of task with high relational cognitive complexity (RC)

Another example is provided by Sweller (1993), who analysed the following problem: *Suppose five days after the day before yesterday is Friday. What day of the week is tomorrow?* Despite our expertise in reasoning about days of the week, this problem is frustratingly difficult. The reason is that, especially in the first sentence, numerous elements are related to each other and cannot be considered meaningfully in isolation. These relations have to be at least partially processed in order to segment the statement into subproblems that can be processed serially. The processing load is felt most keenly when we try to plan this procedure.

More on relational cognitive complexity (RC) theory

The processing load (demand on resources) imposed by interacting components of a task can be captured with the concept or *relational complexity* (Bertling, 2012; Birney et al., 2006; Halford et al., 1998)

- The key is the number of interacting variables (elements; arguments) that must be represented in parallel to implement the process
- Conceptually RC is similar to the number of factors in an experimental design

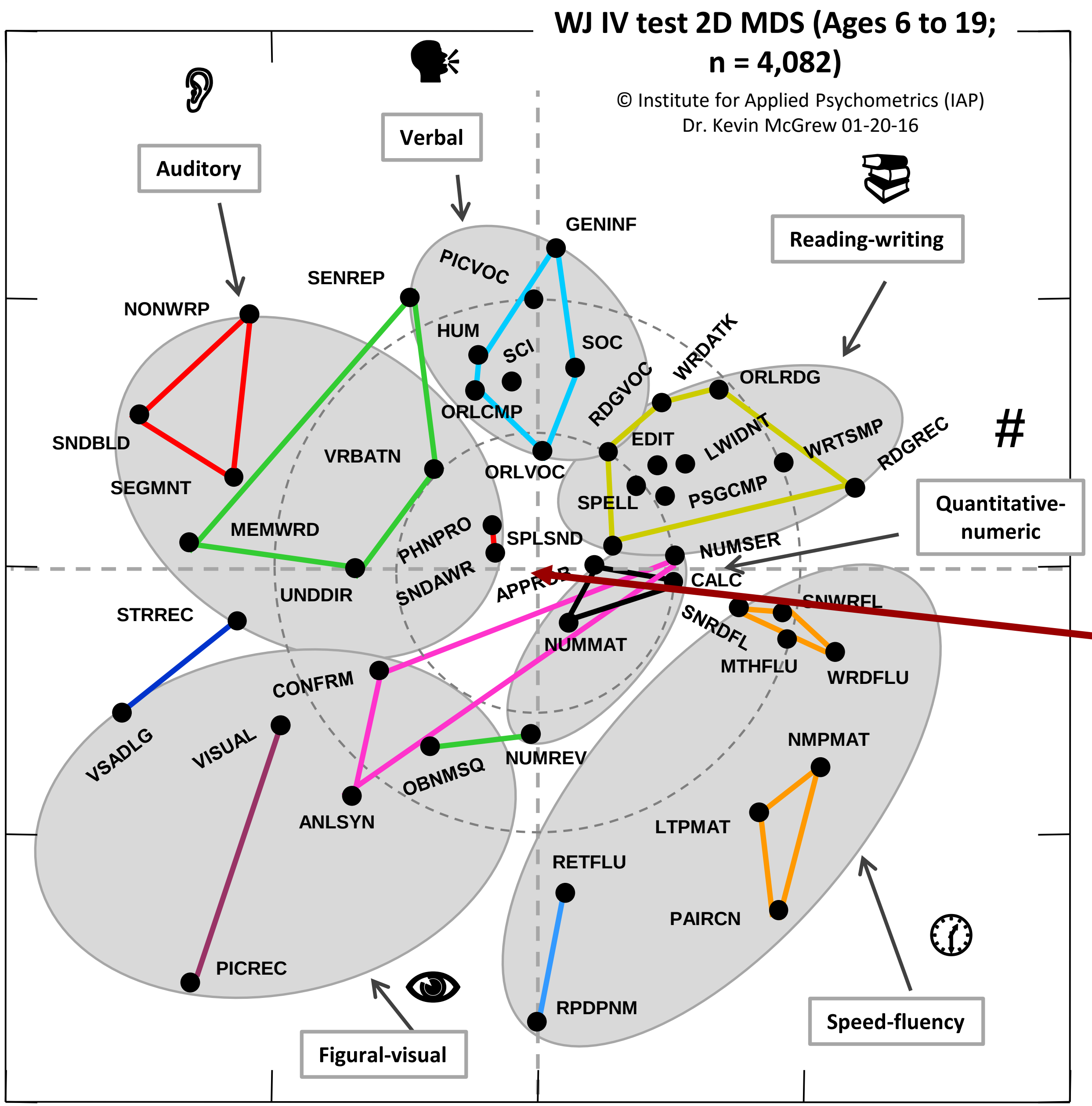
More on relational cognitive complexity (RC) theory

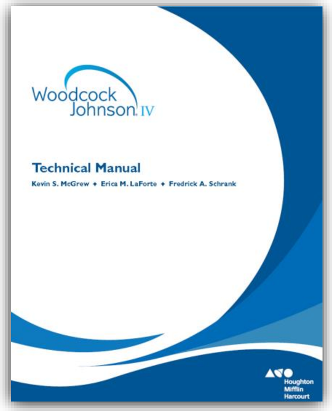
Processing complexity

- May depend on executive functions.
- The strategy used by a person may differ across people or within the same person at different times
- The optimal strategy may not be the one that is best theoretically or as generated by an artificial intelligence (AI) algorithm
- Individuals operate in ways that are different from theoretically optimal algorithms

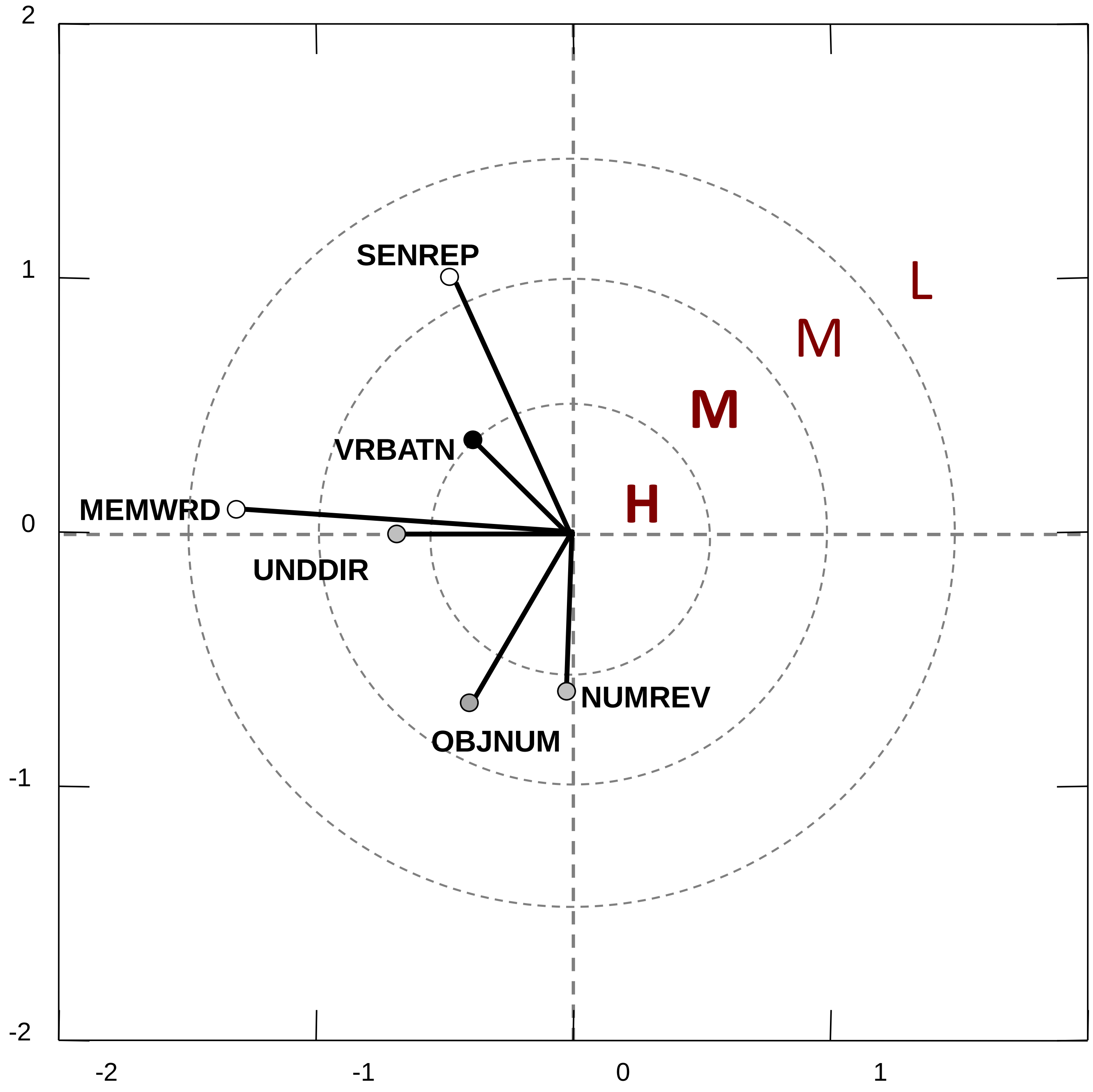
WJ IV cognitive complexity design approach based on work of Lohman & Larkin (2011)

- Increase the information processing demands of the tests within a specific narrow CHC domain.
- Design tests that place greater demands on:
  - Cognitive information processing (cognitive load)
  - Greater allocation of key cognitive resources (working memory or attentional control)
  - The involvement of more cognitive control or executive functions





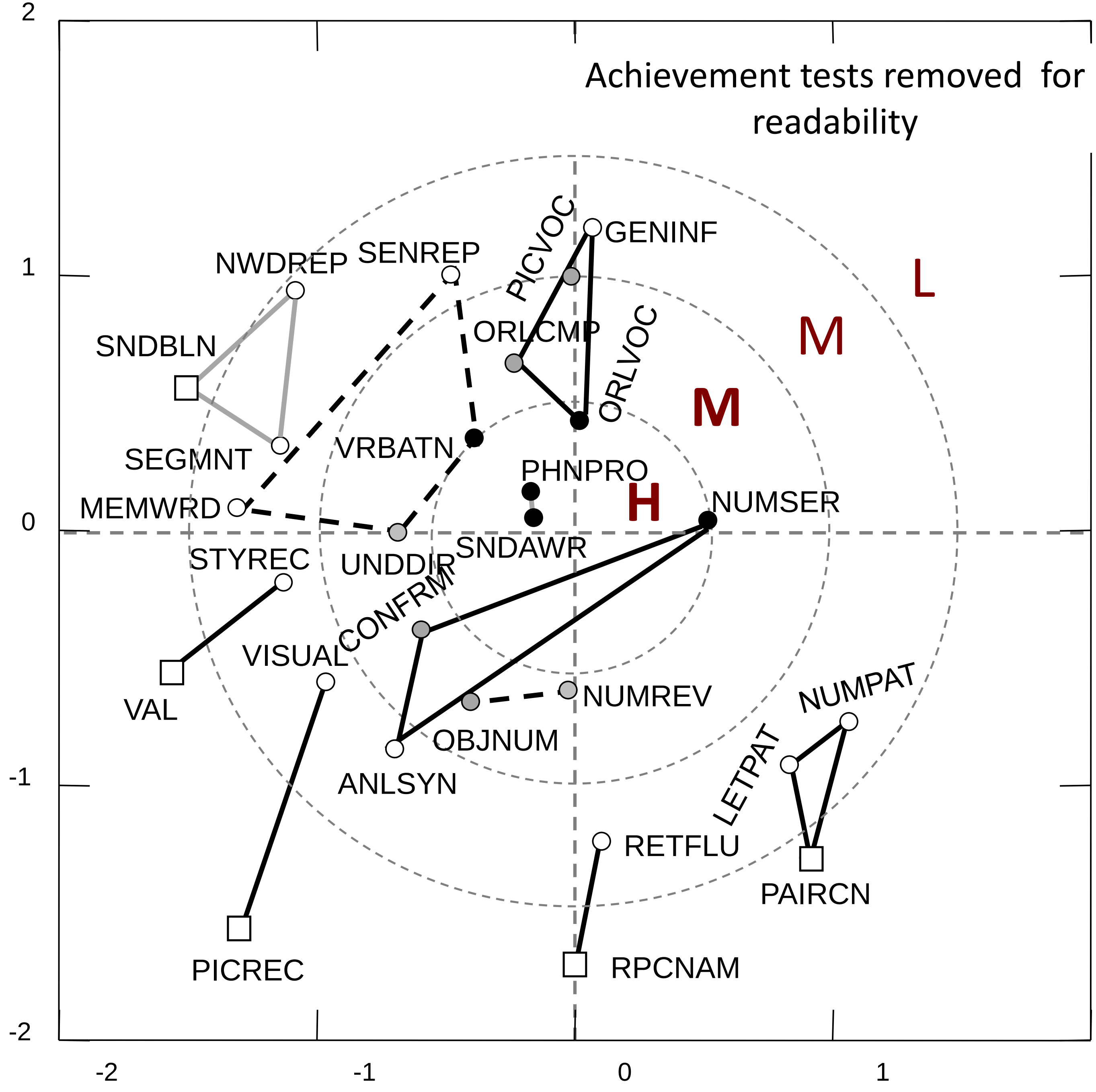
Tests closest to the center are considered more cognitively complex



Cognitive complexity interpretation aid

Gwm tests

- **H** = High
- **M =** Moderate
- M = Low Mod.
- L = Low

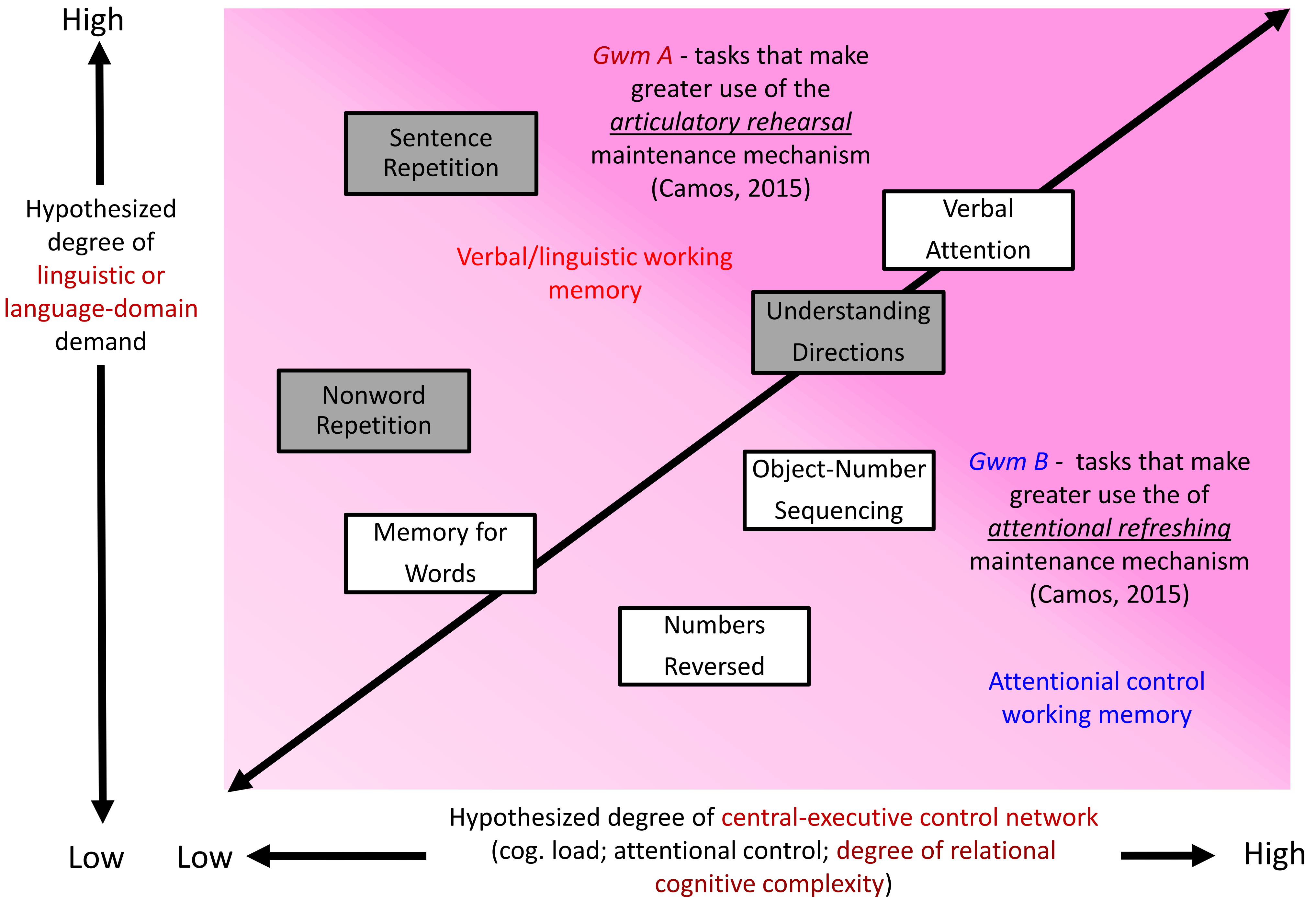


Cognitive complexity by CHC domain interpretation aid

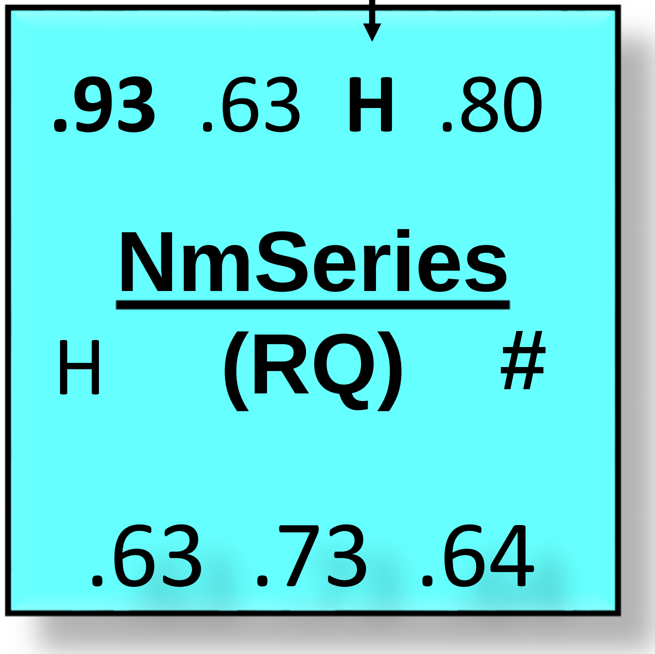
- **H** = High
- **M =** Moderate
- M = Low Mod.
- L = Low

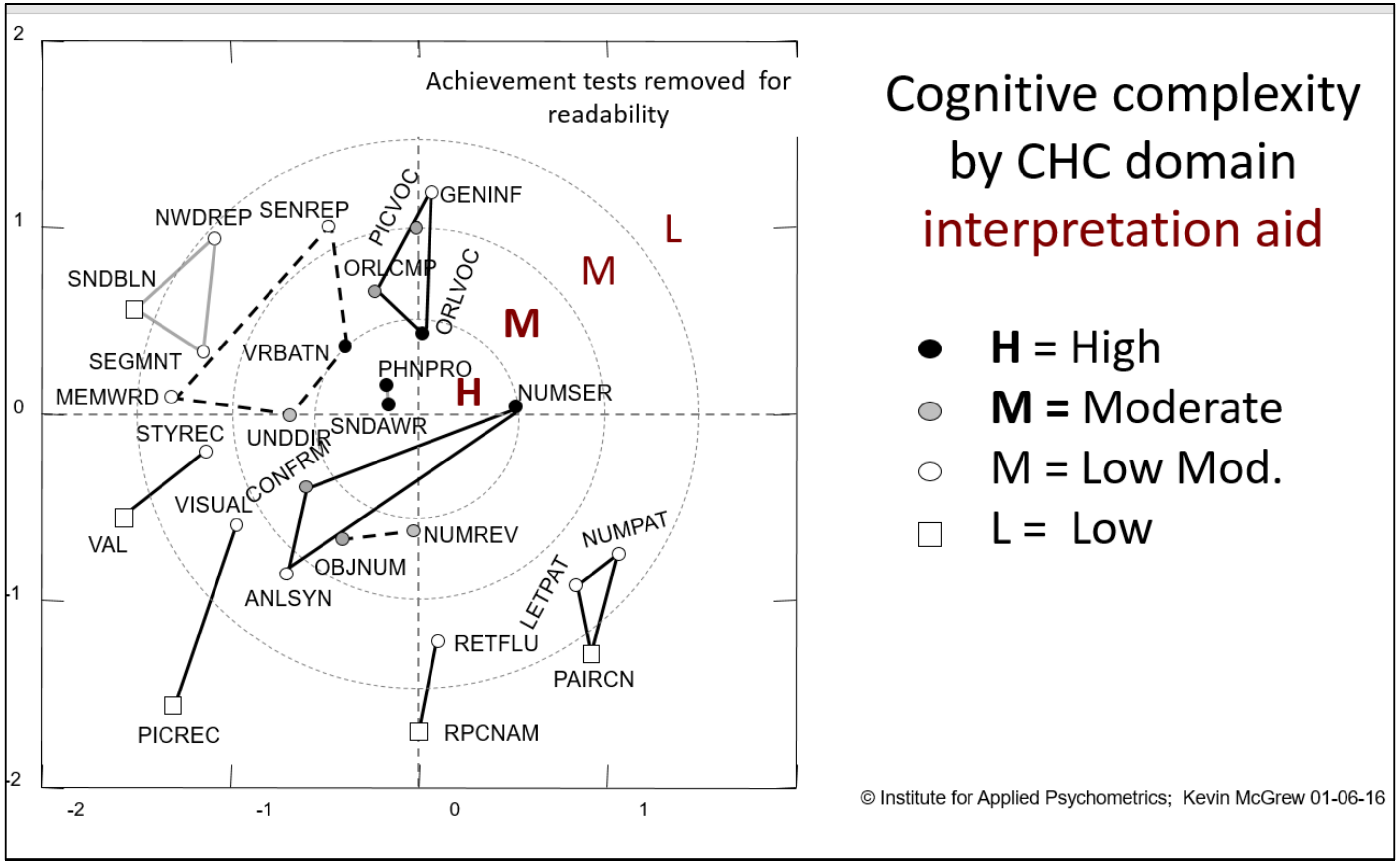
Distances between tests intended to reflect relative hypothesized differences (not quantified) along two axis

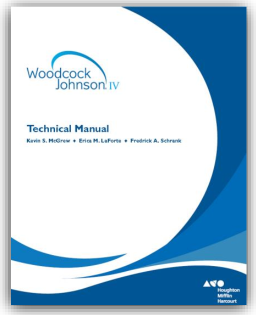
Linguistic/language dimension classifications based on inspection of correlations with other WJ IV tests of *Gc* and *Ga* and Flanagan & Ortiz (2015) linguistic demand classifications



Cognitive complexity

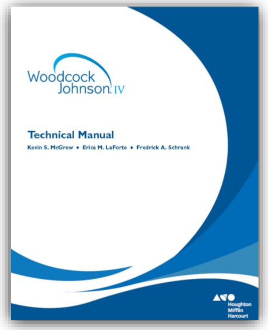


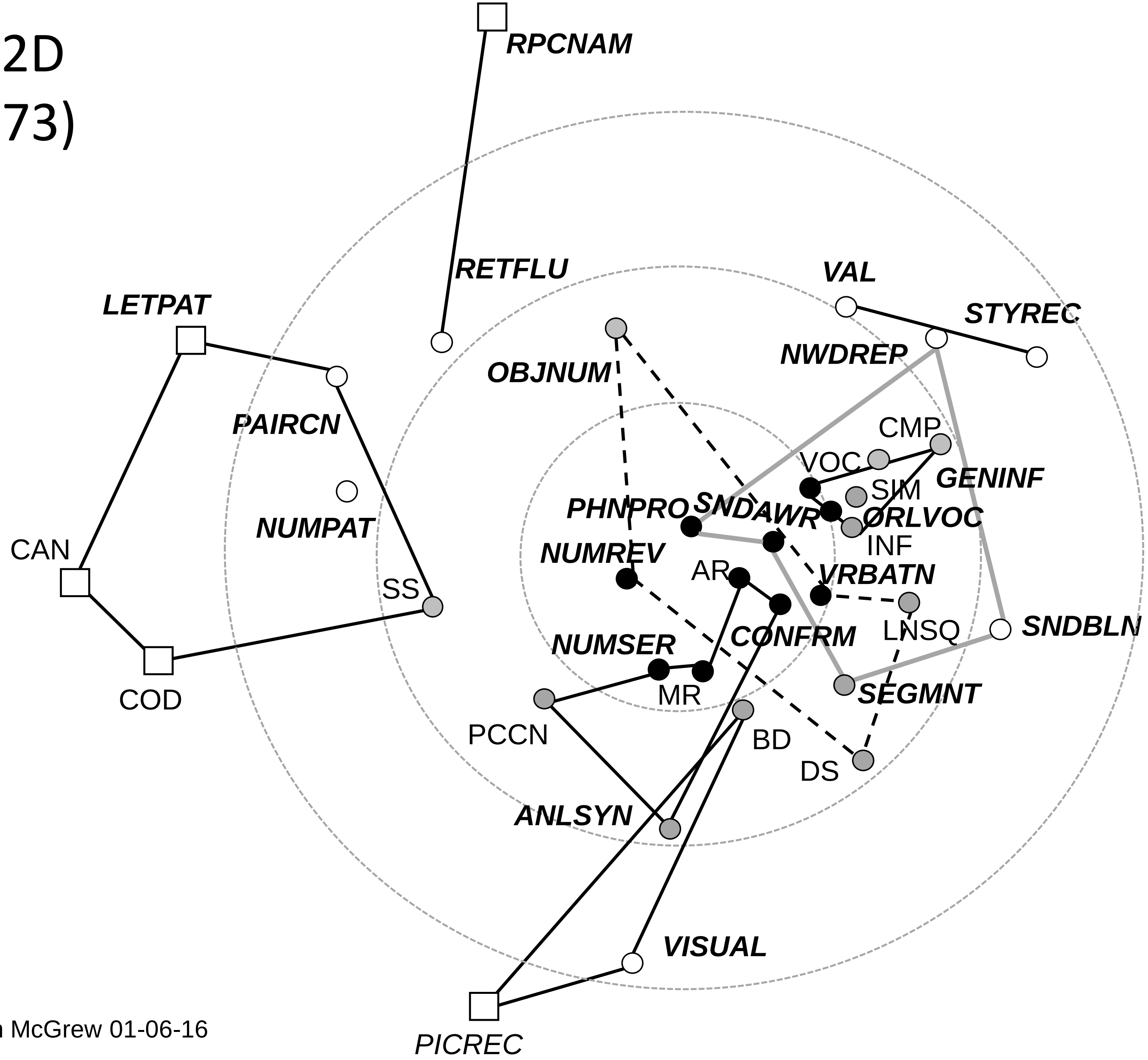


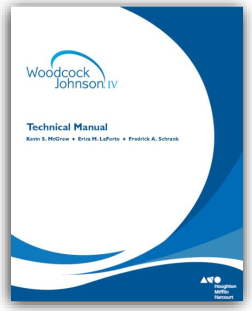


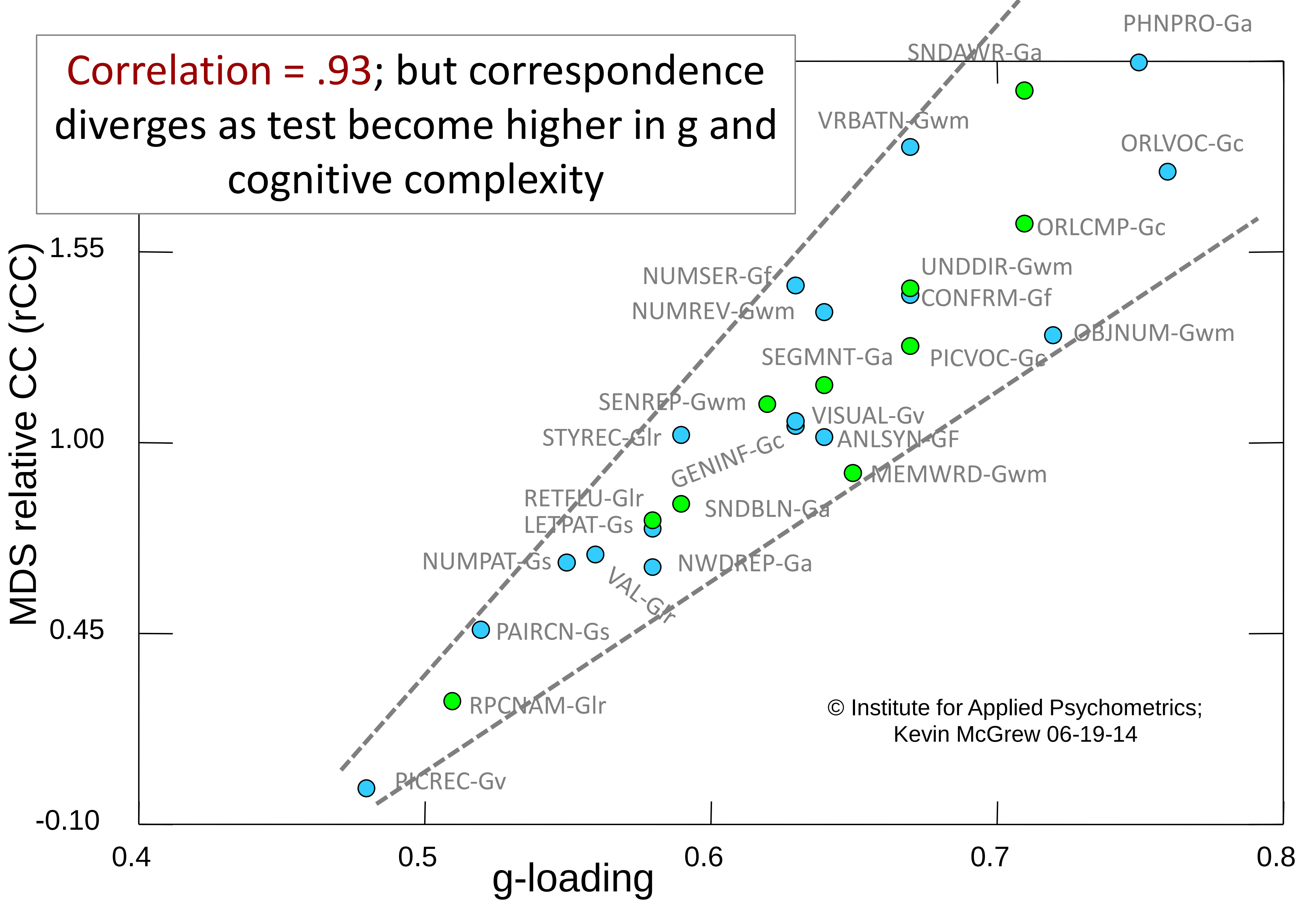
WJ IV and WISC-IV 2D MDS solutions (n=173)

- ● **H** = High
- ◐ **M** = Moderate (grey circle)
- ○ M = Low Mod.
- □ L = Low









Relationship between *g-loadings* and MDS-based relative cognitive complexity (rCC) for WJ IV COG and OL tests

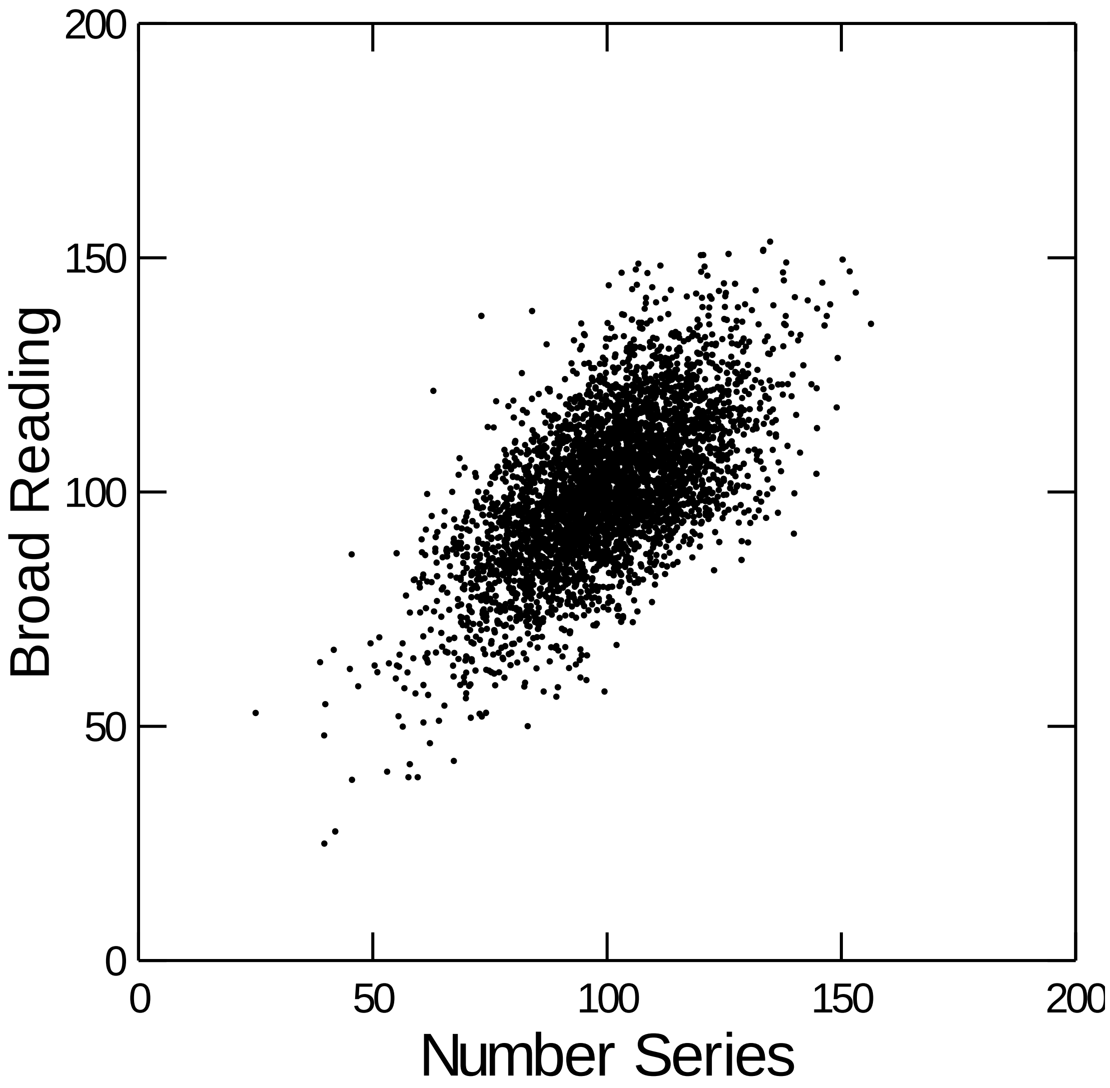
.93 .63 **H** .80

NmSeries

H **(RQ)** #

.63 .73 .64

Median test correlations with R, M, & W clusters for ages 6-19 (not reported in technical manual)



For example, correlation of Number Series with Broad Reading cluster

External criterion relations validity

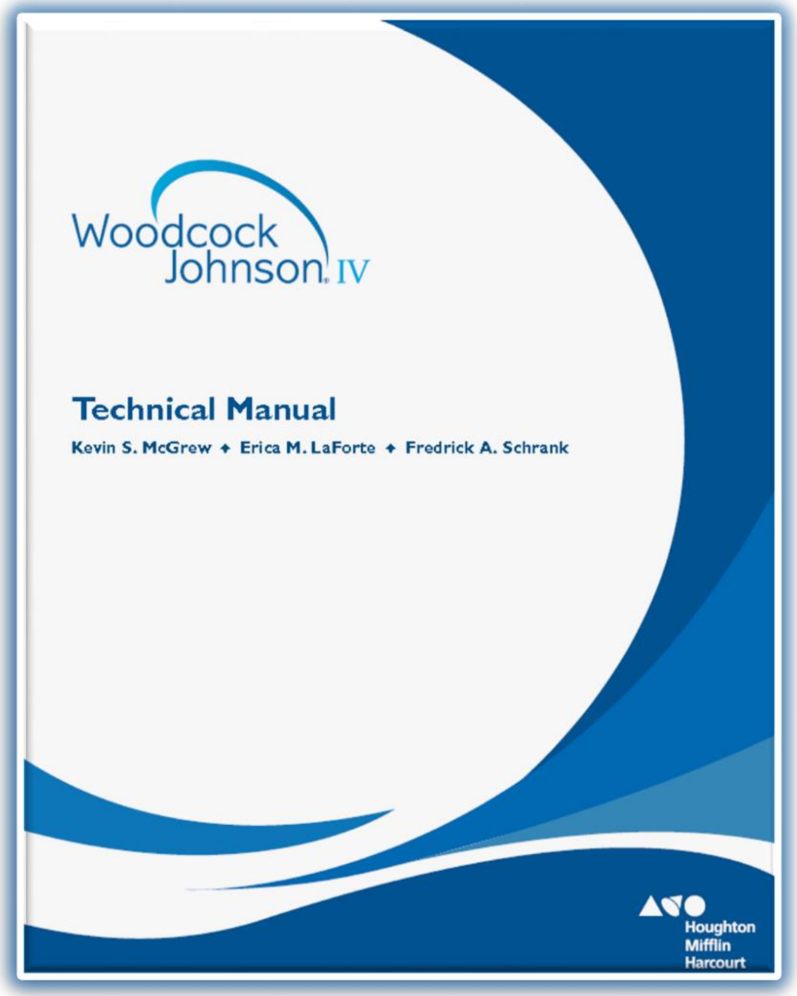
.93 .63 **H** .80

<u>NmSeries</u>

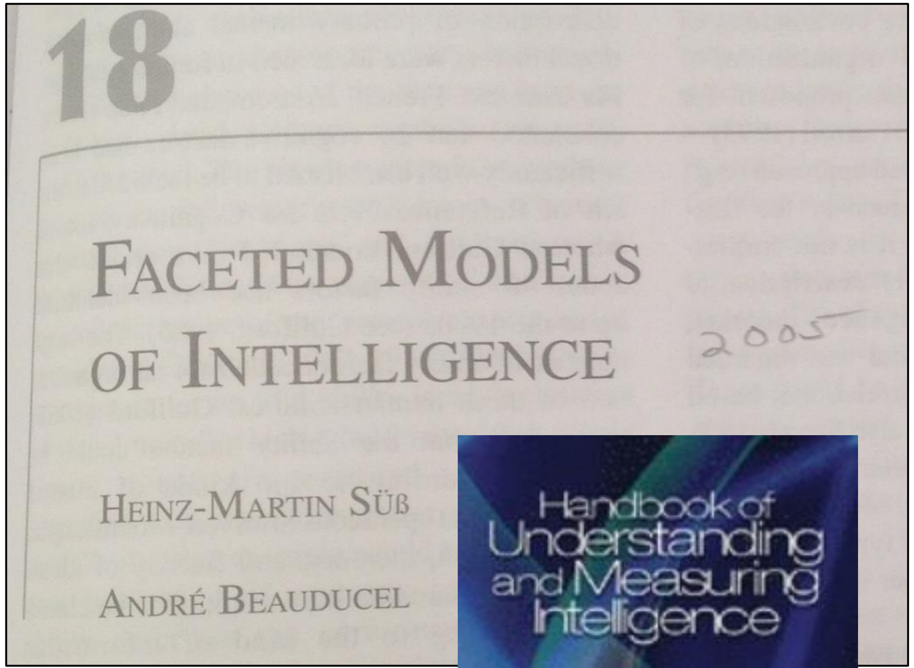
H **(RQ)** #

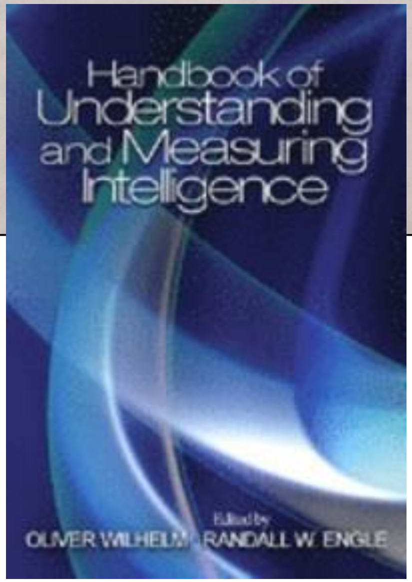
.63 .73 .64 ←

Median correlation with WJ IV reading, math, and written language achievement clusters (ages 6-19)



Auditory has recently been proposed to be added





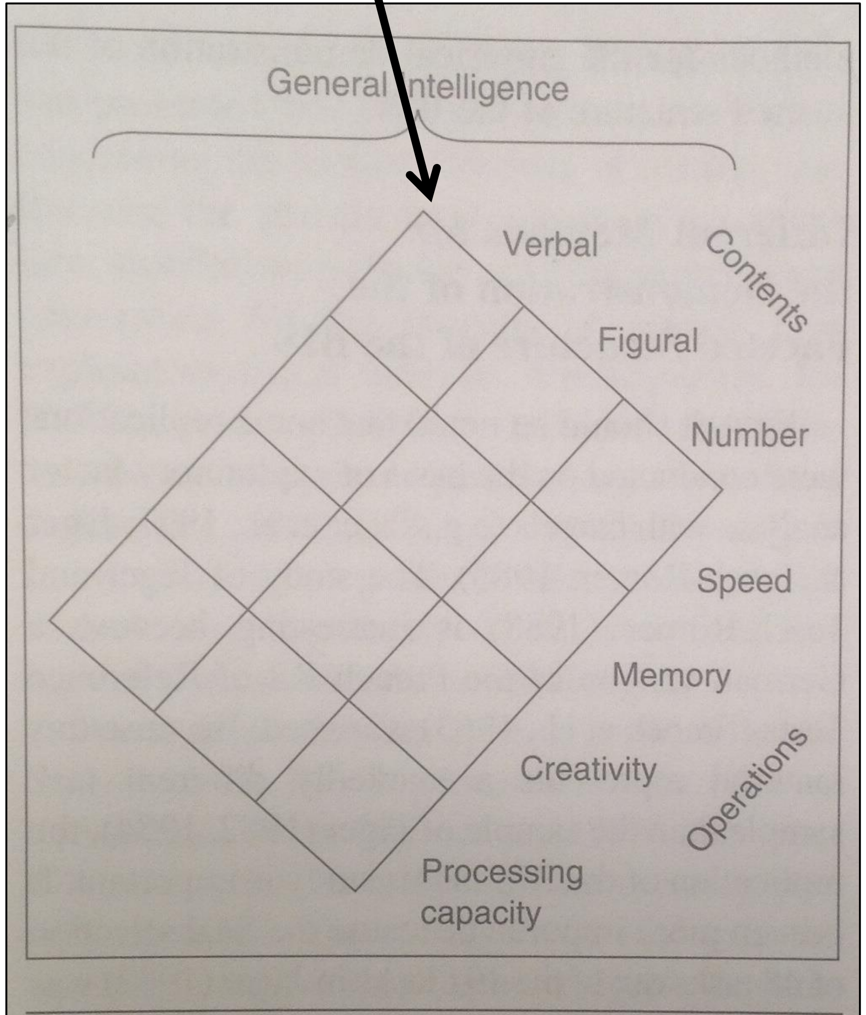


Figure 18.3 The Berlin Model of Intelligence Structure (BIS)

Faceted models of intelligence

European Journal of Psychological Assessment, Vol. 18, Issue 2, pp. 97–112

Fluid and Crystallized Intelligence and the Berlin Model of Intelligence Structure (BIS)

André Beauducel[1] and Martin Kersting[2]

ELSEVIER

Intelligence 30 (2002) 261–288

INTELLIGENCE

Working-memory capacity explains reasoning ability—and a little bit more

Heinz-Martin Süß*, Klaus Oberauer, Werner W. Wittmann,
Oliver Wilhelm, Ralf Schulze

Cognitive operations and content dimensions

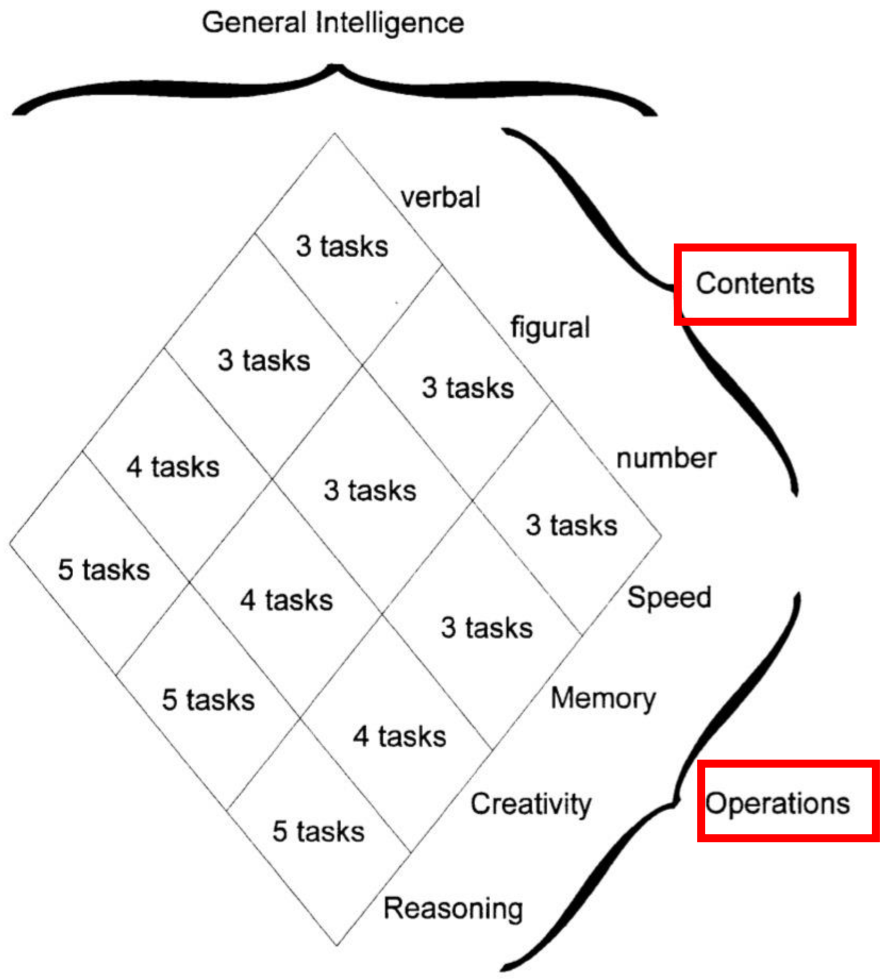


Fig. 1. The BIS. Four functional abilities are cross-classified with three content abilities. General intelligence represents the integral of all operational and content-related abilities, respectively.

Learning and Individual Differences 40 (2015) 27–40

Contents lists available at ScienceDirect

Learning and Individual Differences

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

Auditory intelligence: Theoretical considerations and empirical findings

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[b] Department of Aviation and Space Psychology, DLR German Aerospace Center, Hamburg, Germany

A R T I C L E I N F O

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Musical training
BIS model

A B S T R A C T

In the last few years, auditory intellectual abilities have received increased attention in different fields of research. However, most intelligence models have yet to include an auditory factor. This paper aimed to replicate the general auditory factor and examined whether and how the hierarchical and faceted Berlin Intelligence Structure model (BIS; Jäger, 1982) should be extended by adding an auditory dimension. Two studies included 126 students (Study 1) and a heterogeneous group of 175 adults (Study 2). Participants took a broad auditory intelligence test and the BIS test and provided a self-report of musical training. Confirmatory factor analyses revealed two separate auditory content factors: nonverbal and speech. Auditory nonverbal ability was clearly distinct from academic intelligence, whereas auditory speech ability could be completely subsumed under verbal reasoning. We suggest that auditory ability – as represented by auditory nonverbal tests – needs to be added to the BIS as an additional content dimension.

There has been an explosion of research on auditory abilities since Carroll's (1993) seminal work (Schneider & McGrew, 2012). A wide-ranging collection of *Ga* characteristics have been related to disorders of reading, speech, and language. For example, *Ga* abilities are now recognized as playing a pivotal scaffolding role in the development of language and general cognitive abilities (Conway, Pisoni, & Kronenberger, 2009).

The BIS intelligence framework (2016)

Stimulus Content

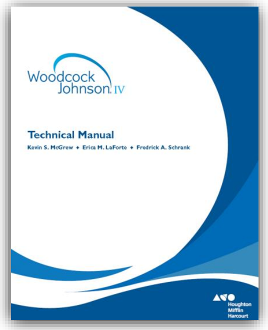
Cognitive Operations

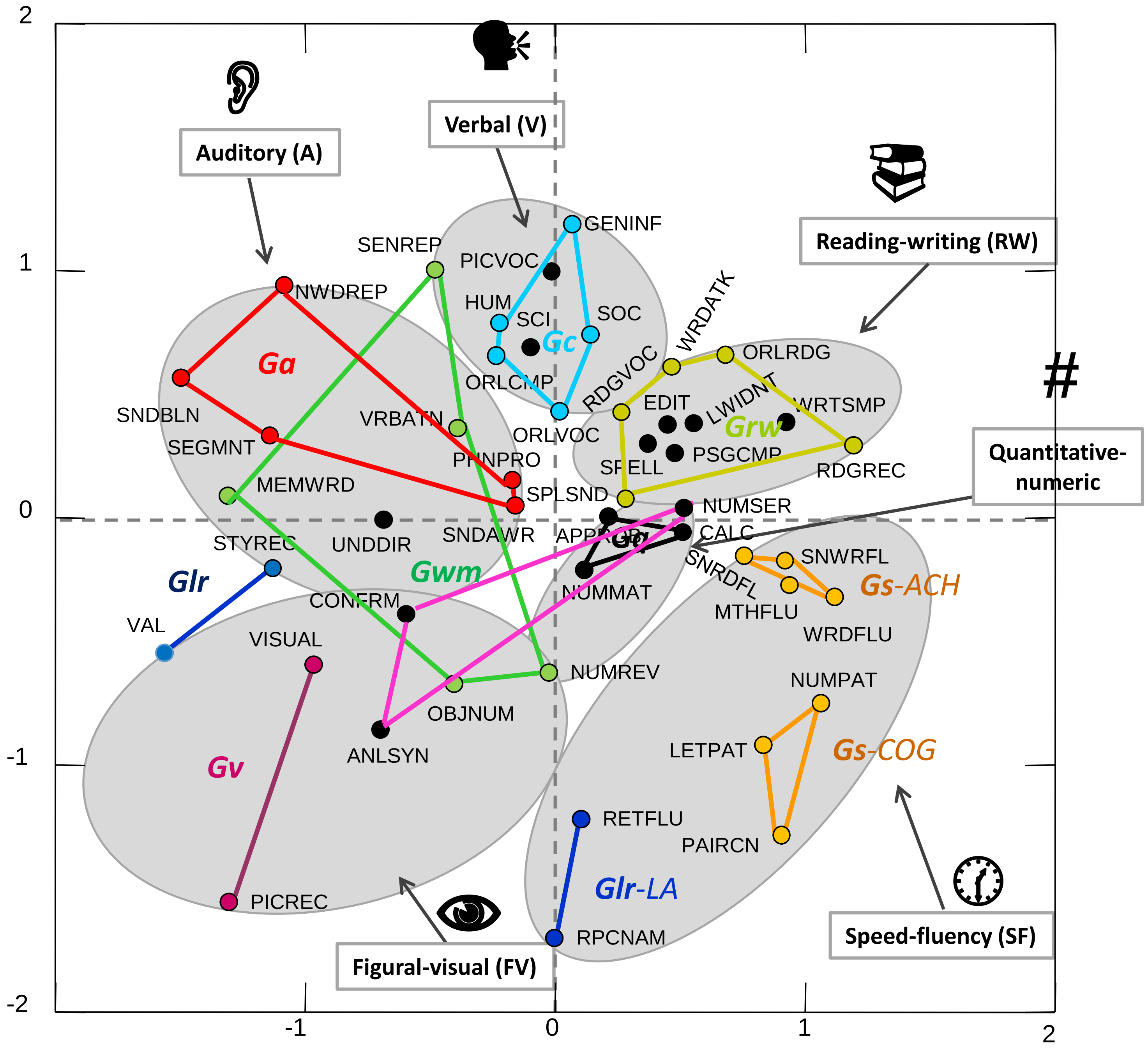
	Verbal	**Auditory**	Figural	Numeric
Reasoning				
Creativity				
Memory				
Speed				

Another perspective:

BIS framework: The stimulus content dimension

Ages 6-19

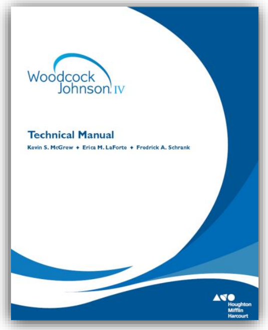


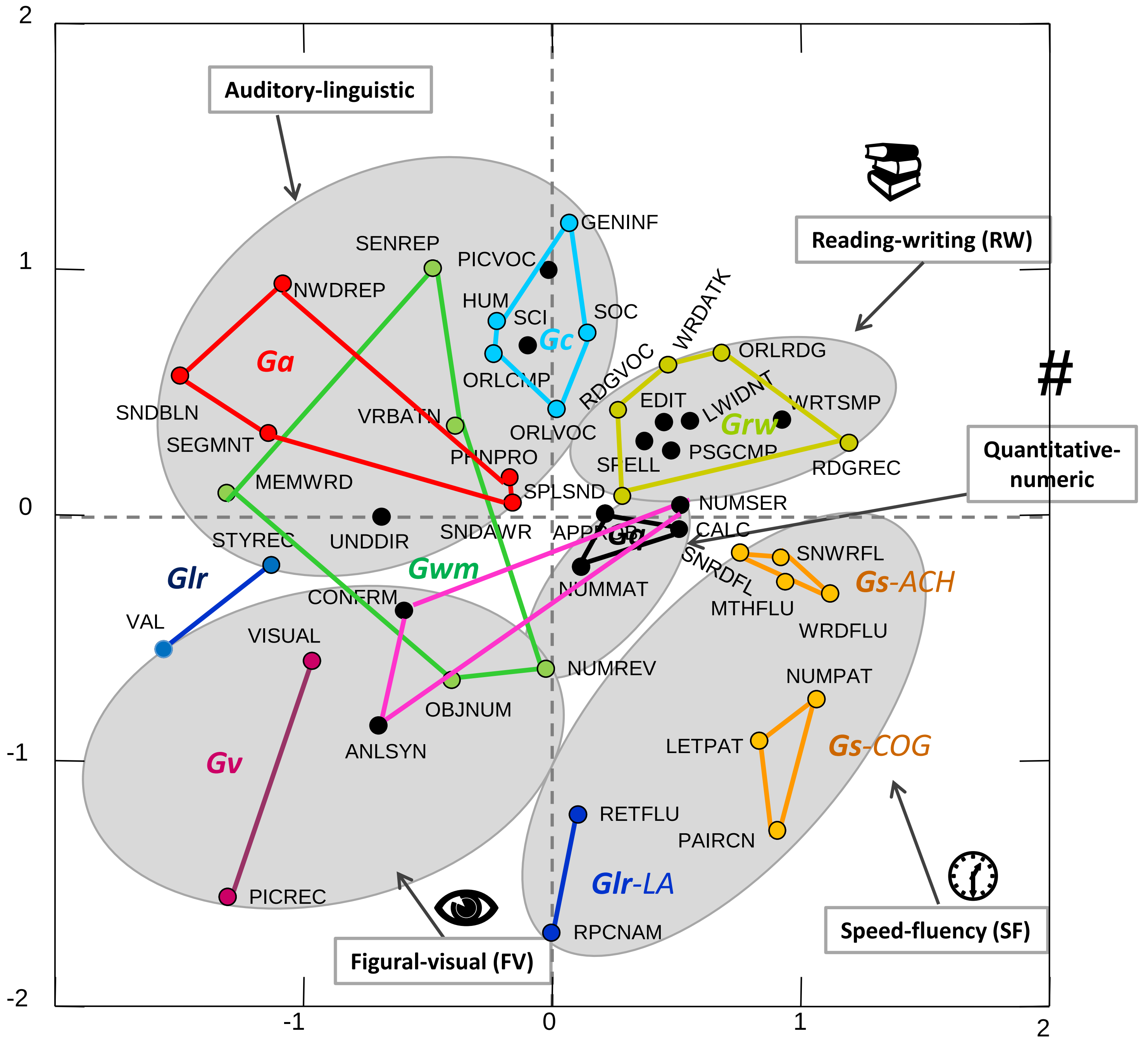


Another perspective:

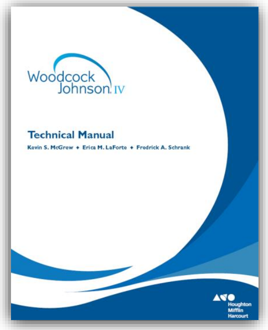
BIS framework: The stimulus content dimension

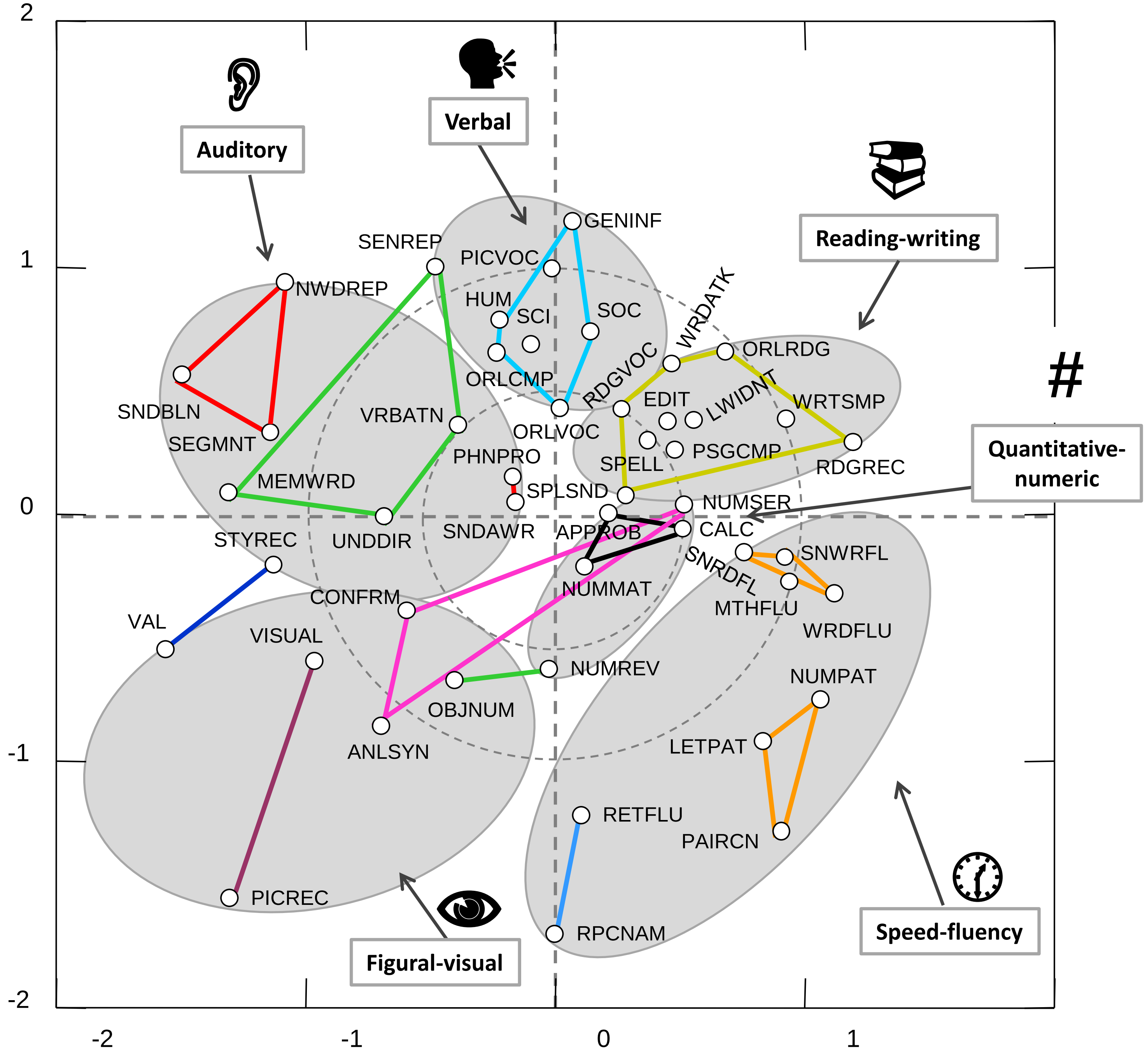
Ages 6-19





WJ IV test 2D MDS (Ages 6 to 19; n = 4,082)





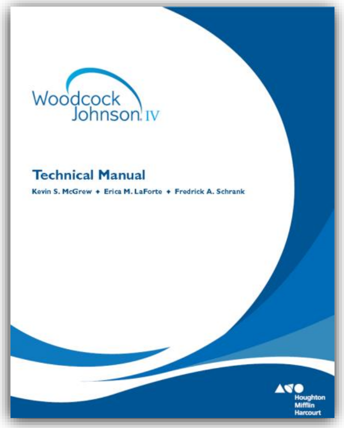
.93 .63 **H** .80

NmSeries

H **(RQ)** #

.63 .73 .64

BIS content/stimulus characteristic

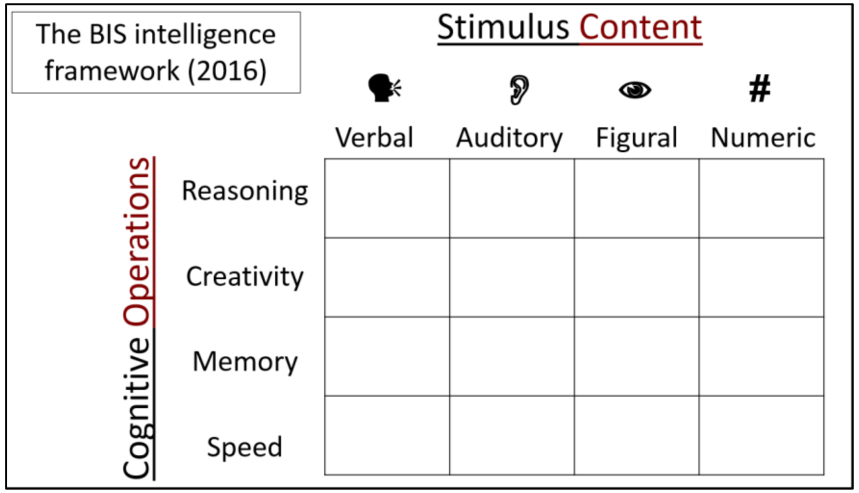


The BIS intelligence framework (2016)

Stimulus Content

Cognitive Operations

	Verbal	Auditory	Figural	# Numeric
Reasoning				
Creativity				
Memory				
Speed				



The BIS intelligence framework (2016)
Stimulus Content
Verbal
Auditory
Figural
#
Numeric
Cognitive Operations
Reasoning
Creativity
Memory
Speed

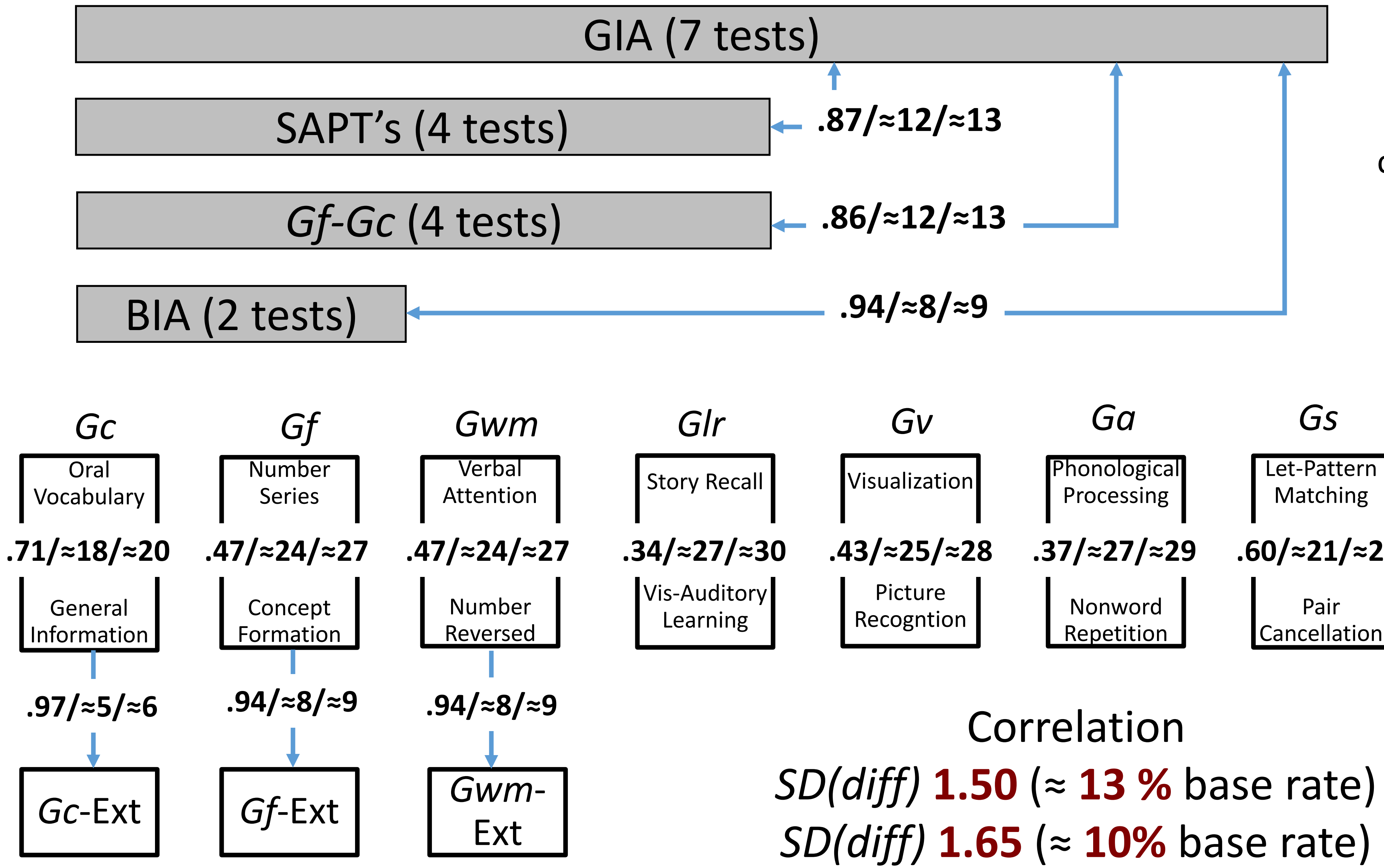
.78
Gf
.93 .63 H .80
NumSer
H (RQ) #
.63 .73 .64
.93 .65 M .66
ConFrm
H (I)
.44 .47 .35
.92 .62 M .62
AnlSyn
H (RG)
.25 .43 .34

How to evaluate the unusualness (base rate) of WJ IV cluster or test score differences

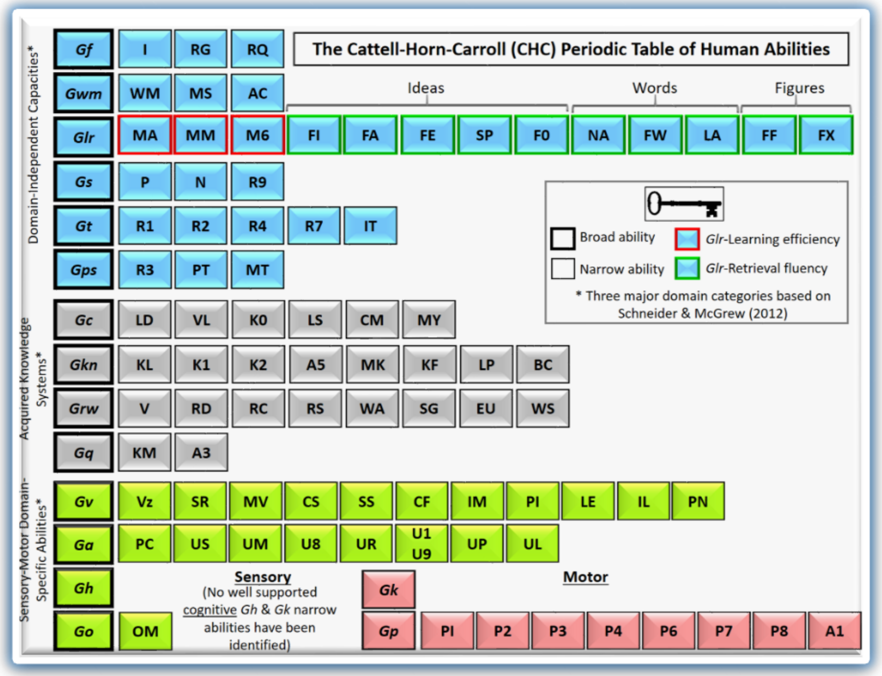
Kevin McGrew, PhD.
Educational/School Psychologist
Director
Institute for Applied Psychometrics (IAP)

It's a pleasure when you use the correct measure

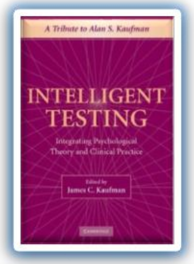
Select WJ IV COG cluster/test score significance values (ages 6-19) *



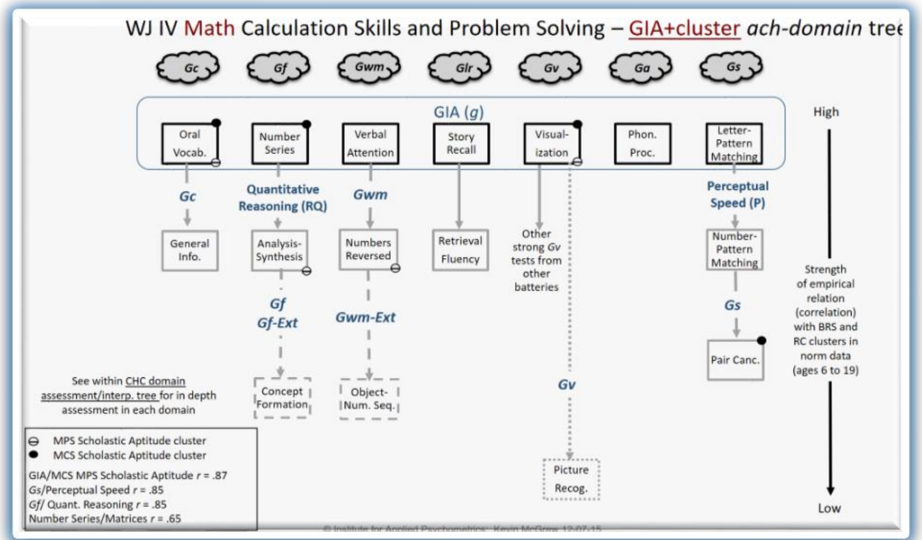
* Rounded values calculated in WJ IV norm data (ages 6 to 19)



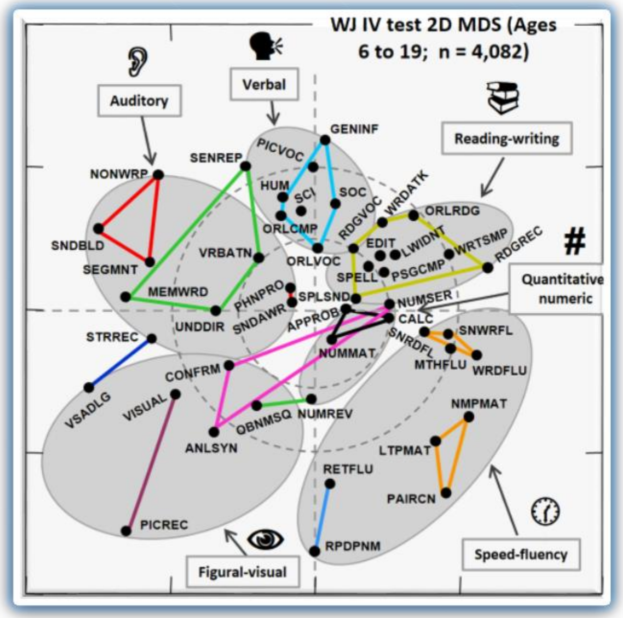
The Cattell-Horn-Carroll (CHC) Periodic Table of Human Abilities
Domain-Independent Capacities*
Acquired Knowledge Systems*
Sensory-Motor Domain-Specific Abilities*
Gf I RG RQ
Gwm WM MS AC
Ideas Words Figures
Glr MA MM M6 FI FA FE SP FO NA FW LA FF FX
Gs P N R9
Gt R1 R2 R4 R7 IT
Gps R3 PT MT
Gc LD VL K0 LS CM MY
Gkn KL K1 K2 A5 MK KF LP BC
Grw V RD RC RS WA SG EU WS
Gq KM A3
Gv Vz SR MV CS SS CF IM PI LE IL PN
Ga PC US UM U8 UR U1 U9 UP UL
Gh
Go OM
Sensory
(No well supported cognitive Gh & Gk narrow abilities have been identified)
Motor
Gk
Gp PI P2 P3 P4 P6 P7 P8 A1
Broad ability
Narrow ability
Glr-Learning efficiency
Glr-Retrieval fluency
* Three major domain categories based on Schneider & McGrew (2012)



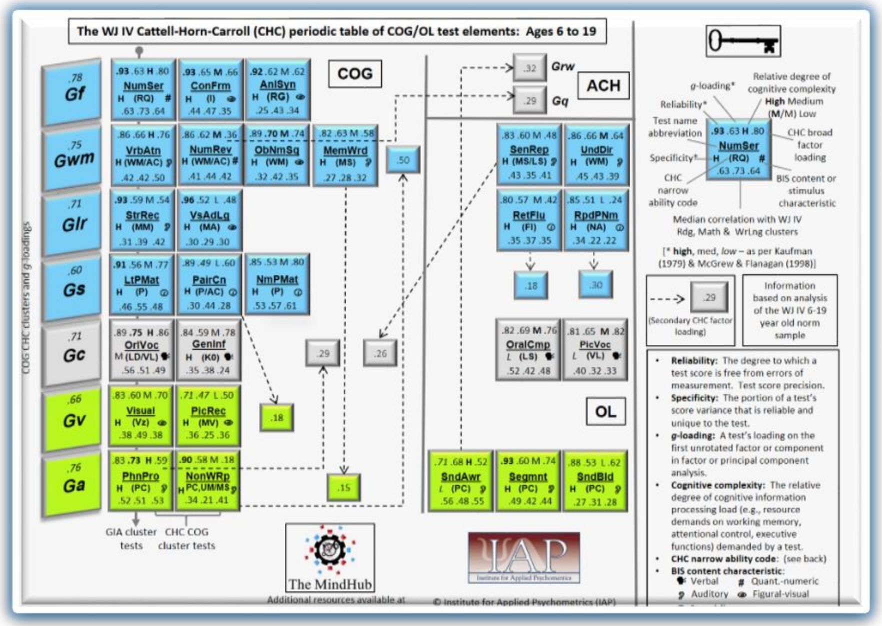
A Tribute to Alan S. Kaufman
INTELLIGENT TESTING
Integrating Psychological Theory and Clinical Practice



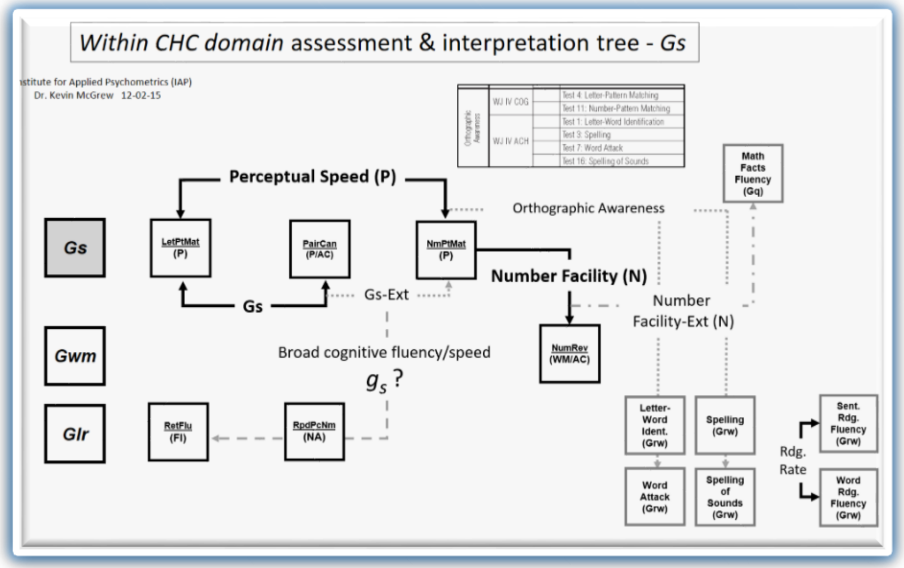
WJ IV Math Calculation Skills and Problem Solving – GIA+cluster ach-domain tree
Gc Gf Gwm Glr Gv Ga Gs
GIA (g)
Oral Vocab.
Number Series
Verbal Attention
Story Recall
Visual-ization
Phon. Proc.
Letter-Pattern Matching
Gc
Quantitative Reasoning (RQ)
Gwm
Perceptual Speed (P)
General Info.
Analysis-Synthesis
Numbers Reversed
Retrieval Fluency
Other strong Gv tests from other batteries
Number-Pattern Matching
Gf
Gf-Ext
Gwm-Ext
Gs
Concept Formation
Object-Num. Seq.
Pair Canc.
Gv
Picture Recog.
See within CHC domain assessment/interp. tree for in depth assessment in each domain
MPS Scholastic Aptitude cluster
MCS Scholastic Aptitude cluster
GIA/MCS MPS Scholastic Aptitude r = .87
Gs/Perceptual Speed r = .85
Gf/ Quant. Reasoning r = .85
Number Series/Matrices r = .65
High
Strength of empirical relation (correlation) with BRS and RC clusters in norm data (ages 6 to 19)
Low



WJ IV test 2D MDS (Ages 6 to 19; n = 4,082)
Auditory
Verbal
Reading-writing
#
Quantitative numeric
Figural-visual
Speed-fluency
GENINF
PICVOC
SENREP
NONWRP
HUM
SCI
SOC
WRDATK
ORLRDG
RDGVOC
LWIDNT
WRTSMP
RDGREC
EDIT
PSGCMP
SPELL
SNDBLD
SEGMNT
VRBATN
ORLCMP
ORLVOC
MEMWRD
PHNPRO
SPLSND
NUMSER
SNDAWR
UNDDIR
APPROB
CALC
SNWRFL
STRREC
CONFRM
NUMMAT
SNRDFL
MTHFLU
WRDFLU
VSADLG
VISUAL
OBNMSQ
NUMREV
NMPMAT
ANLSYN
LTPMAT
RETFLU
PAIRCN
PICREC
RPDPNM



The WJ IV Cattell-Horn-Carroll (CHC) periodic table of COG/OL test elements: Ages 6 to 19
Gf Gwm Glr Gs Gc Gv Ga
COG
ACH
OL
Grw
Gq
NumSer ConFrm AnlSyn
VrbAtn NumRev ObNmSq MemWrd
StrRec VsAdLg
LtPMat PairCn NmPMat
OrlVoc GenInf
Visual PicRec
PhnPro NonWRp
SenRep UndDir
RetFlu RpdPNm
OralCmp PicVoc
SndAwr Segmnt SndBld
GIA cluster tests
CHC COG cluster tests
The MindHub
IAP
© Institute for Applied Psychometrics (IAP)



Within CHC domain assessment & interpretation tree - Gs
Institute for Applied Psychometrics (IAP)
Dr. Kevin McGrew 12-02-15
Gs
Gwm
Glr
Perceptual Speed (P)
LetPtMat (P)
PairCan (P/AC)
NmPtMat (P)
Gs
Gs-Ext
Number Facility (N)
Number Facility-Ext (N)
NumRev (WM/AC)
Orthographic Awareness
Math Facts Fluency (Gq)
Broad cognitive fluency/speed
g_s ?
RetFlu (FI)
RpdPcNm (NA)
Letter-Word Ident. (Grw)
Spelling (Grw)
Word Attack (Grw)
Spelling of Sounds (Grw)
Rdg. Rate
Sent. Rdg. Fluency (Grw)
Word Rdg. Fluency (Grw)

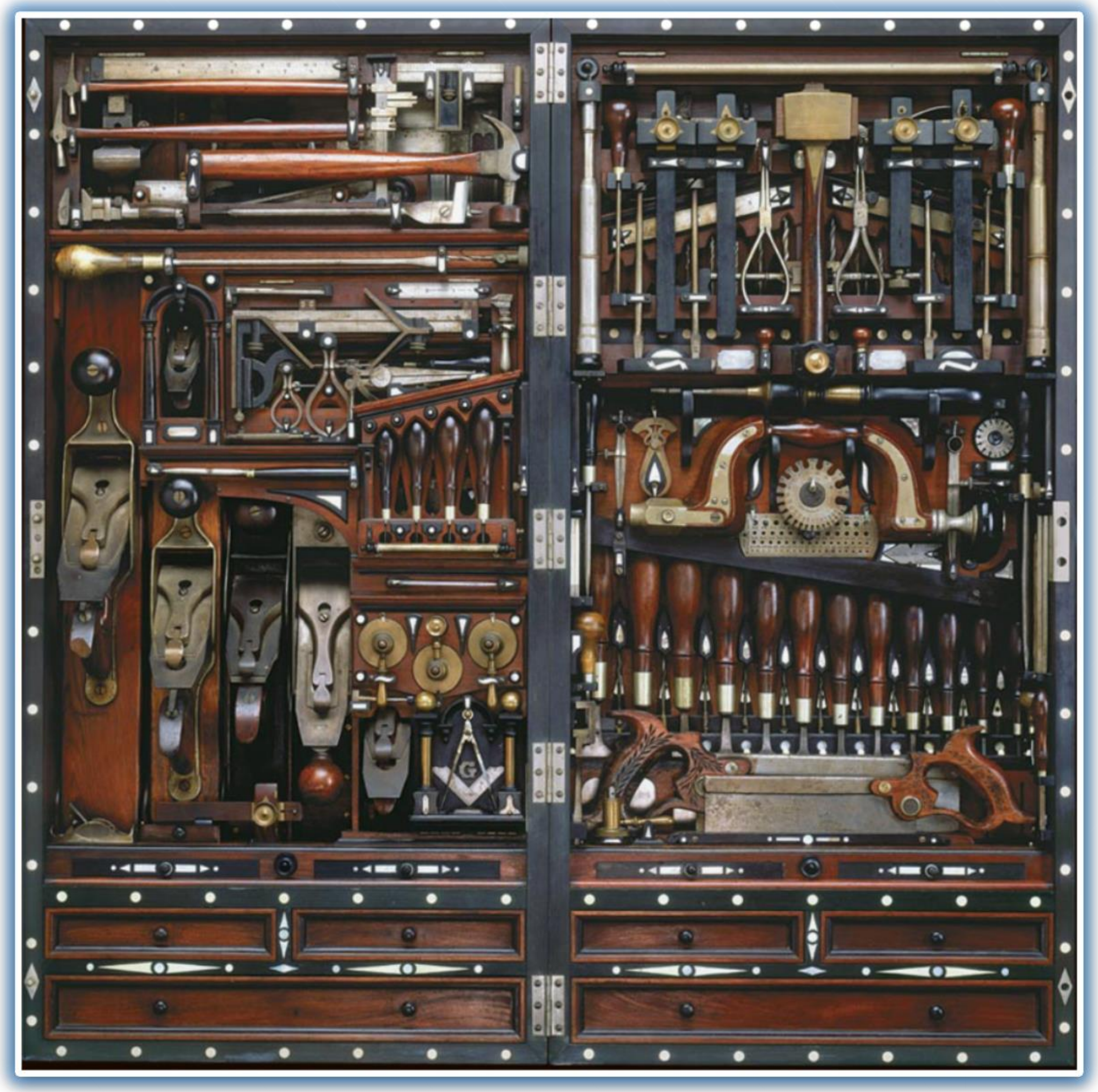
School Psychology Quarterly, Vol. 9, No. 3, 1994, pp. 209-221

Intelligence *is* Important, Intelligence *is* Complex

Timothy Z. Keith
Alfred University

....and....."intelligent" intelligent testing is complex....and important

We are the instrument !!!!



In the remainder of this presentation I will model “intelligent” intelligence test interpretation for the WJ IV COG+OL

Will provide you with some aids and templates to organize thinking and test data

Not to be used as cookbooks