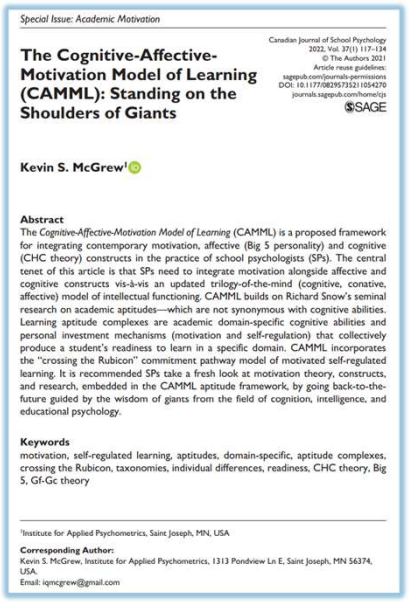
If you have time prior to the podcast, I recommend reading this journal article (available at download link)

http://iapsych.com/kmpubs/mcgrew2022.pdf



Special Issue: Academic Motivation

Canadian Journal of School Psychology
2022, Vol. 37(1) 117–124
© The Author(s) 2021
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/08295735211054270
journals.sagepub.com/home/cjs
SAGE

The Cognitive-Affective-Motivation Model of Learning (CAMML): Standing on the Shoulders of Giants

Kevin S. McGrew[1]

Abstract

The *Cognitive-Affective-Motivation Model of Learning* (CAMML) is a proposed framework for integrating contemporary motivation, affective (Big 5 personality) and cognitive (CHC theory) constructs in the practice of school psychologists (SPs). The central tenet of this article is that SPs need to integrate motivation alongside affective and cognitive constructs vis-à-vis an updated trilogy-of-the-mind (cognitive, conative, affective) model of intellectual functioning. CAMML builds on Richard Snow's seminal research on academic aptitudes—which are not synonymous with cognitive abilities. Learning aptitude complexes are academic domain-specific cognitive abilities and personal investment mechanisms (motivation and self-regulation) that collectively produce a student's readiness to learn in a specific domain. CAMML incorporates the "crossing the Rubicon" commitment pathway model of motivated self-regulated learning. It is recommended SPs take a fresh look at motivation theory, constructs, and research, embedded in the CAMML aptitude framework, by going back-to-the-future guided by the wisdom of giants from the field of cognition, intelligence, and educational psychology.

Keywords

motivation, self-regulated learning, aptitudes, domain-specific, aptitude complexes, crossing the Rubicon, taxonomies, individual differences, readiness, CHC theory, Big 5, Gf-Gc theory

[1]Institute for Applied Psychometrics, Saint Joseph, MN, USA

Corresponding Author:
Kevin S. McGrew, Institute for Applied Psychometrics, 1313 Pondview Ln E, Saint Joseph, MN 56374, USA.
Email: iqmcgrew@gmail.com

1

www.themindhub.com



Sources for more information

http://www.iqscorner.com/

IQ's Corner

(Over 10 million served since 2005→current)



https://tinyurl.com/mwephzbf



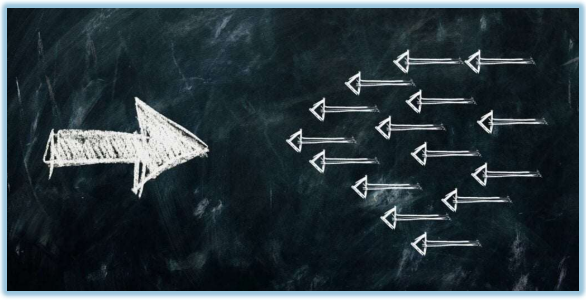
@iqmcgrew



@iqmcgrew.bsky.social

2

Potential conflicts of interest (COI)



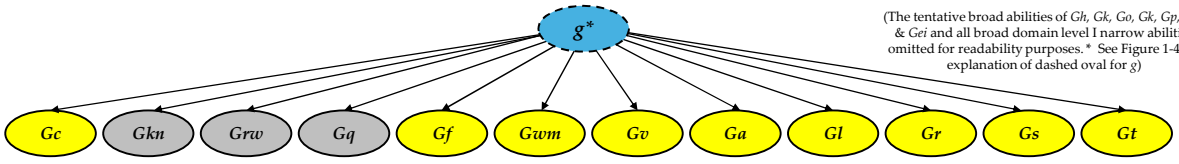
Woodcock Johnson IV

(Sales-based royalties $ - ending 2027?)

WJ V WOODCOCK JOHNSON®

(No sales-based royalties 2025+)

3



(The tentative broad abilities of *Gh, Gk, Go, Gk, Gp, Gps* & *Gei* and all broad domain level I narrow abilities omitted for readability purposes.* See Figure 1-4 for explanation of dashed oval for *g*)

Comprehension-knowledge (Gc): The depth and breadth of declarative and procedural knowledge and skills valued by one's culture. Comprehension of language, words, and general knowledge developed through experience, learning and acculturation.	***Visual-spatial processing (Gv):*** The ability to use mental imagery, store images in primary memory, or perform visual-spatial analysis or mental transformation of images in the "mind's eye."
Domain-specific knowledge (Gkn): The depth, breadth, and mastery of specialized declarative and procedural knowledge typically acquired through one's career, hobby, or other passionate interest. The *Gkn* domain is likely to contain more narrow abilities than are currently listed in the CHC model.	***Auditory processing (Ga):*** The ability to perceive, discriminate, and manipulate sounds and information received through the ears. Includes the processing of auditory information in primary memory and/or the activation, restructuring, or retrieval of information from semantic-lexical memory based on phonemes.
Reading and writing (Grw): The depth and breadth of declarative and procedural knowledge and skills related to written language or literacy.	***Learning efficiency (Gl):*** The ability and efficiency to learn, store, and consolidate new information in long-term memory. (Called long-term storage in WJ V).
Quantitative knowledge (Gq): The depth and breadth of declarative and procedural knowledge related to mathematics. The *Gq* domain is likely to contain more narrow abilities than are currently listed in the CHC model.	***Retrieval fluency (Gr):*** The rate and fluency at which individuals can produce and retrieve verbal and nonverbal information or ideas stored in long-term memory.
Fluid reasoning (Gf): The use of deliberate and controlled focused attention to solve novel "on the spot" problems that cannot be solved solely by using prior knowledge (previously learned habits, schemas, or scripts). Reasoning that depends minimally on learning and acculturation.	***Processing speed (Gs):*** The ability to control attention to automatically and fluently perform relatively simple repetitive cognitive tasks. Attentional fluency.
Short-term working memory (Gwm): The ability to encode, maintain, and/or manipulate auditory or visual information in primary memory (while avoiding distractions) to solve multiple-step problems. The mind's mental "scratchpad" or "workbench."	***Reaction and decision speed (Gt):*** The speed at which very simple perceptual discriminations or decisions can be made.

CHC theories broad abilities and definitions

4

IQ test scores are fallible predictors

For any **given IQ test score**, half of the individuals with that score will obtain achievement scores **at or below** their IQ score. Conversely, and frequently not recognized, is that for any given IQ test score, half of the individuals will obtain achievement standard scores ***at or above*** their IQ score

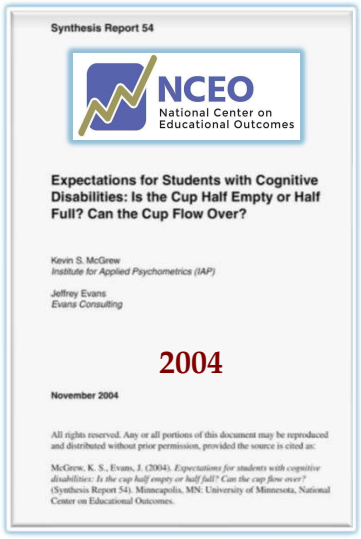
(note – regression to the mean phenomenon ignored in this example)

- Given the best IQ-achievement test **correlation of .70**….
- Approximately **50% of the shared achievement variance is accounted for**
- **When predicting achievement scores with IQ-ACH correlation of .70, *SEest*** for .70 = 15 x SQRT (1-r ^{2}) = ±10.7 or approximately **±11 (range of 22 standard score ACH points)**

(McGrew & Evans, 2004)

5

IQ test scores are fallible predictors


Synthesis Report 54

NCEO National Center on Educational Outcomes

Expectations for Students with Cognitive Disabilities: Is the Cup Half Empty or Half Full? Can the Cup Flow Over?

Kevin S. McGrew
Institute for Applied Psychometrics (IAP)

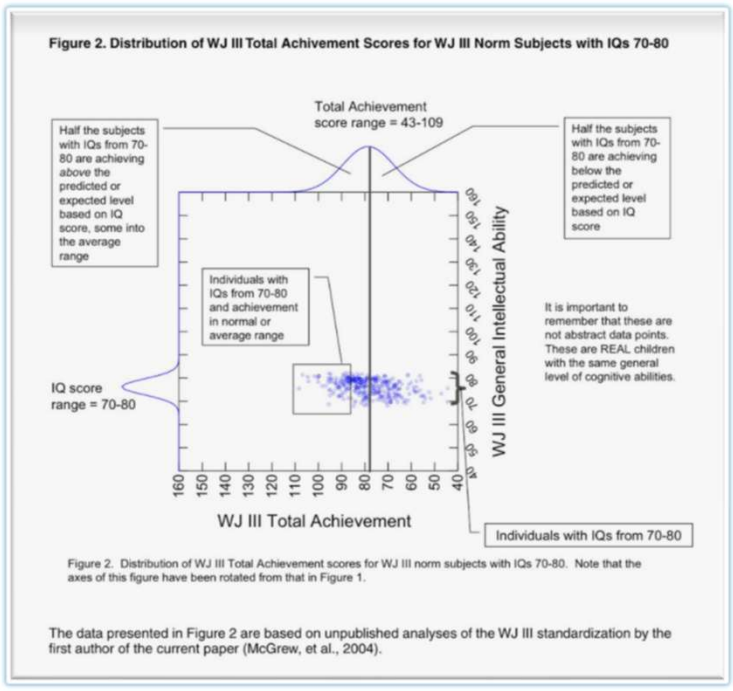
Jeffrey Evans
Evans Consulting

2004

November 2004

All rights reserved. Any or all portions of this document may be reproduced and distributed without prior permission, provided the source is cited as:

McGrew, K. S., Evans, J. (2004). *Expectations for students with cognitive disabilities: Is the cup half empty or half full? Can the cup flow over?* (Synthesis Report 54). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.



6

Going Beyond IQ

Sternberg's Triarchic Theory of Intelligence

Intelligence as three interacting abilities.

1. **Analytical / Componential**
   - Analyze, evaluate, compare, judge.
   - Closest to IQ.
   - Metacomponents, performance components, knowledge-acquisition.
2. **Creative / Experiential**
   - Handle novelty, invent, discover.
   - Automatize familiar tasks.
3. **Practical / Contextual**
   - Street smarts — adapt to, shape, or select environments.

Later Successful Intelligence: balance the three; capitalize on strengths; compensate for weaknesses.

Greenspan's Model of Personal Competence

Broader human functioning; intelligence is one part.

1. **Physical Competence**
   - Motor skills, health,
   - physical/organ functioning
2. **Affective Competence**
   - Temperament, character,
   - socio-emotional adaptation
3. **Academic Competence**
   - Conceptual intelligence + language —
   - abstract thinking, closest to IQ.
4. **Everyday Competence**
   - Practical intelligence (daily living, adaptive skills) +
   - Social intelligence (people, social situations, interpersonal demands)

Snow's Model of Aptitude Trait Complexes

Aptitude Trait Complexes = readiness for a situation; person–situation transaction

1. **Physical & Psychomotor**
   - Physical abilities
   - psychomotor abilities
   - sensory-perceptual abilities
2. **Cognitive**
   - Declarative knowledge and procedural skills
3. **Conative**
   - Motivations and volitional controls —
   - goal commitment, effort, action control.
4. **Affective:**
   - Temperament traits, characteristic moods, personality traits

Aptitude complexes: people assemble combinations of these resources to meet a specific situation's affordances and constraints.

Similarities:
- All three go beyond single-factor IQ
- Cognitive/conceptual/analytical overlap across models
- Physical + affective appear in both Greenspan and Snow

Unique emphases:
- Sternberg — Creative intelligence and internal processing components
- Greenspan — Distinct Social intelligence and overall personal competence (often used in ID / adaptive behavior)
- **Snow** — Included Conative domain (motivation + volition) and dynamic person-situation aptitude complexes

7

Two Conceptualizations of Aptitude

European fitness-for-situation vs. American psychometric potential.

European Conceptualization

From Latin aptitudo / aptus = fitness, suitability

1. **Core meaning**
   Aptitude = readiness or fitness for a particular situation, task, or role. Person-situation fit.
2. **Scope**
   Plural aptitudes — domain-specific dispositions (languages, music, math, crafts). Not limited to cognition; can include motivation, temperament, and physical fitness.
3. **Development**
   Latent potential that can change with experience, instruction, and opportunity. Not a fixed inborn ceiling.
4. **Use in education**
   Often judged through demonstrated mastery of a shared curriculum. Binet's original aim was to identify who needed help, not to rank a single inherited IQ.

American Conceptualization

20th-century psychometric narrowing

1. **Core meaning**
   Aptitude ≈ innate or relatively stable cognitive potential — how much a person can learn.
2. **Scope**
   Often treated as general mental ability or a few cognitive factors (verbal, quantitative, spatial). Equated with IQ, SAT, GATB, ASVAB-type tests.
3. **Stability**
   Commonly viewed as a person property that travels across situations and sets an upper limit on school learning ("the aptitude myth").
4. **Use in education**
   Used to predict, select, track, and sort — college admissions, military classification, job placement. Aptitude tests vs. achievement tests (potential vs. already learned).

Bridge note: Snow, Corno, and colleagues (2002) argued for restoring the original meaning: **aptitude as readiness in a situation, assembled from cognitive, conative, and affective resources (aptitude complexes)** — not a single inherited IQ score.

8

The CAMML Model (McGrew, 2022):
All Relevant Learning Variables are "Cooked in the Same Pot (Brain)"



Snow and Farr (1987)

"The general improvement of instruction ultimately requires a whole person view that integrates cognitive, conative, and affective aspects of learning, and individual differences therein."

Protzko and Colom (2021)

"All the relevant variables preceding ostensible behavior are cooked in the same pot (the brain)."

McGrew (2022)

"It is recommended SPs take a fresh look at motivation theory, constructs, and research, embedded in the CAMML aptitude framework, by going back-to-the-future guided by the wisdom of giants from the field of cognition, intelligence, and educational psychology." [i.e., the cognitive, conative, affective "trilogy-of-the-mind"]

9

Cattell's Investment Hypothesis
How Fluid Intelligence (g_f) is Invested to Build Crystallized Intelligence (g_c)



Societal Investment



Culture, schools, curriculum, and institutions that define what knowledge is valued and provide shared learning opportunities for an entire generation.

Family Investment



Home environment, parental education, resources, encouragement, and everyday intellectual stimulation that shape early and ongoing learning.

Personal Investment



The individual's motivations, self-beliefs, interests, conative traits, personality traits, etc.

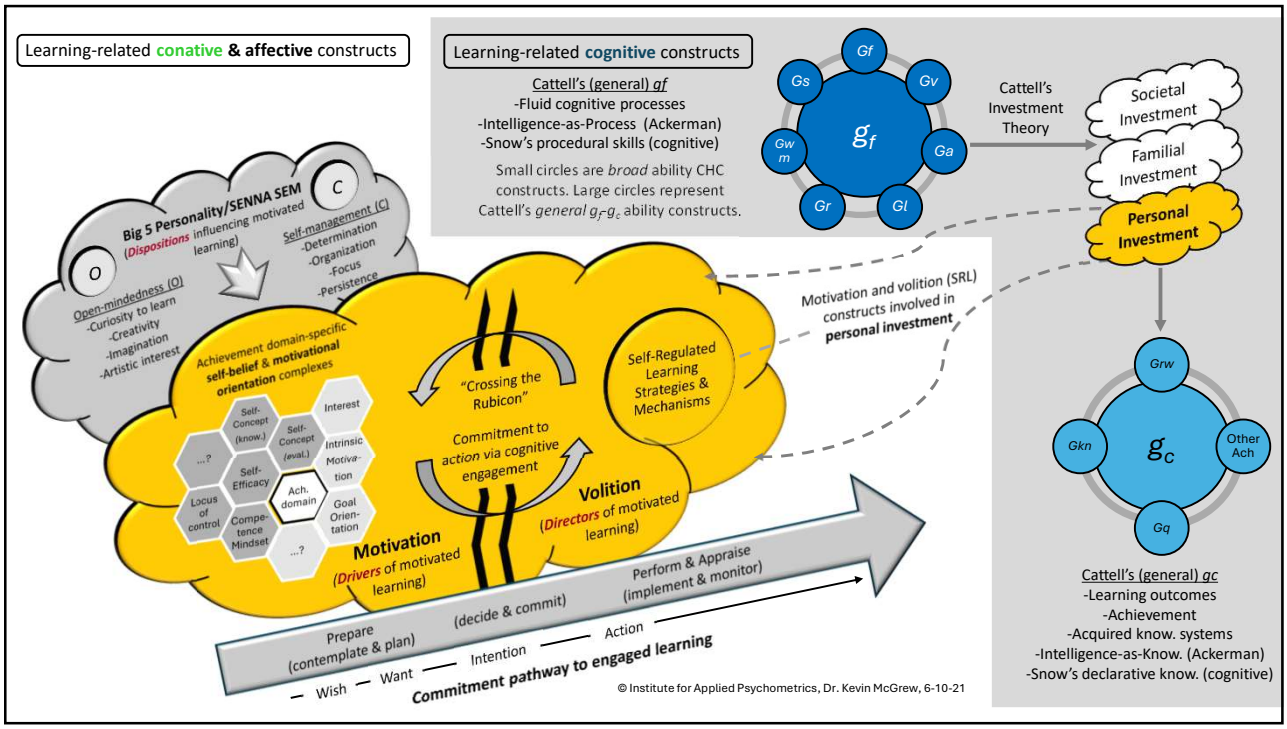
Personal investment mechanisms are individual differences characteristics.



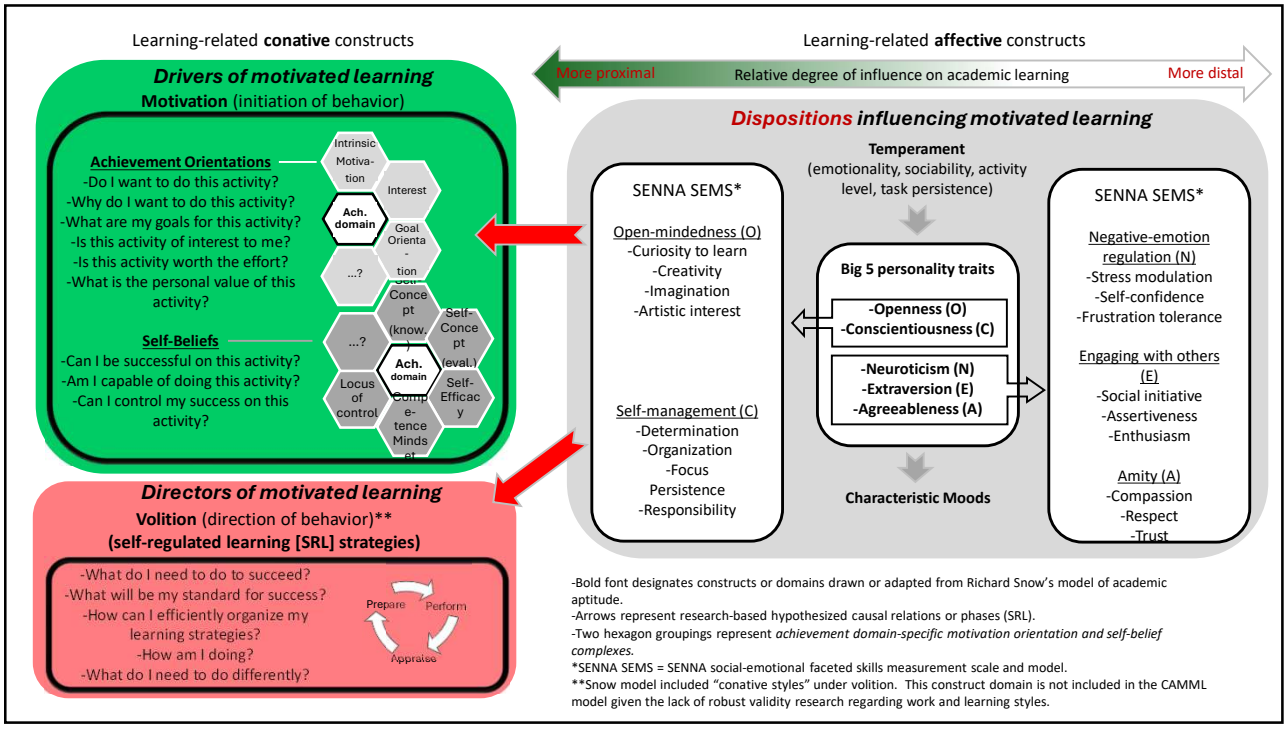


g_c is the accumulated return on g_f invested across these three sources.

10



11



-Bold font designates constructs or domains drawn or adapted from Richard Snow's model of academic aptitude.
-Arrows represent research-based hypothesized causal relations or phases (SRL).
-Two hexagon groupings represent *achievement domain-specific motivation orientation and self-belief complexes.*
*SENNA SEMS = SENNA social-emotional faceted skills measurement scale and model.
**Snow model included "conative styles" under volition. This construct domain is not included in the CAMML model given the lack of robust validity research regarding work and learning styles.

12

Assessing Social-emotional Skills using SENNA: Development, Psychometrics and Validity

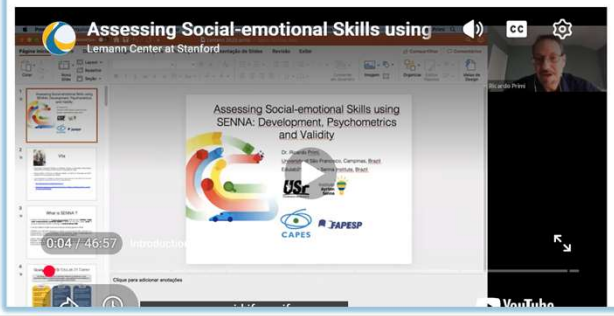


For more information on the SENNA Social-Emotional Big 5 organized facets and scales (video by Dr. Ricardo Primi)

https://lemanncenter.stanford.edu/events/assessing-social-emotional-skills-using-senna-development-psychometrics-and-validity

Date: Wednesday, June 3, 2020 - 9:00am to 10:20am

Quarter: Spring 2020



13

Definition of CAMML motivation and volition (SRL) constructs

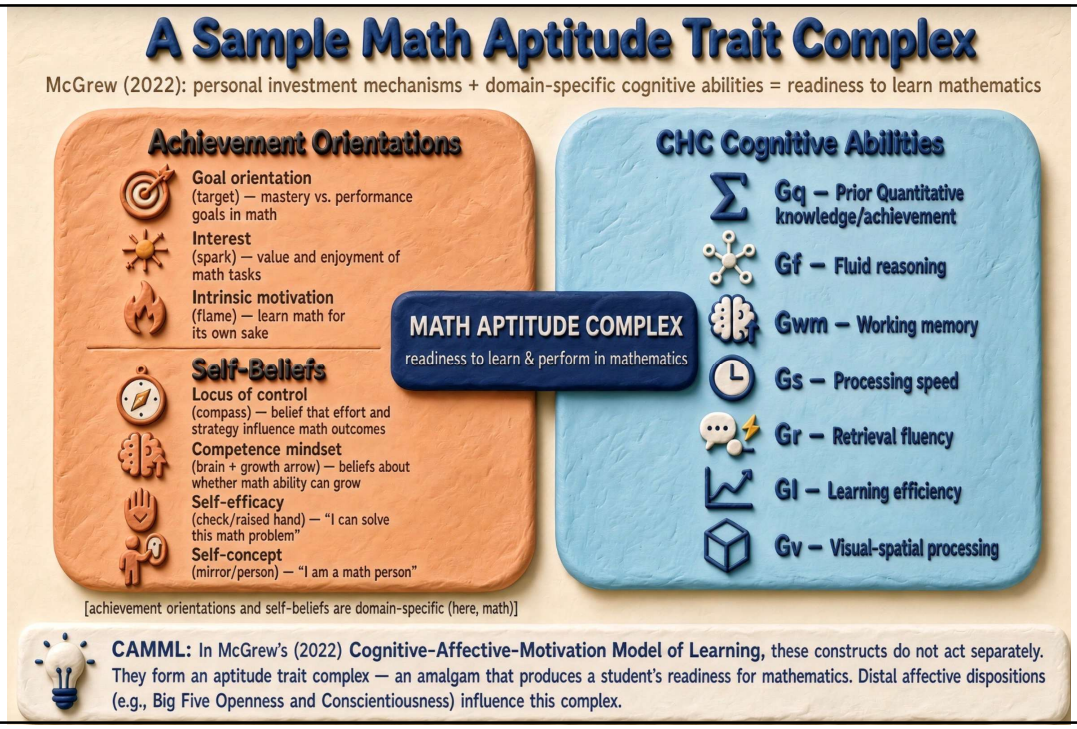
Achievement Orientations	
Academic Goal Orientation	A student's set of academic achievement motivation domain-specific beliefs reflecint the reasons why they approach and engage in academic learning tasks. A *performance* goal orientation reflects a concern for personal ability, a normative social comparison with others, preoccupation with the perception of others, and a need to avoid looking incompetent. A *learning or mastery* goal orientation reflects a focus on task completion and understanding, learning, mastery, solving problems, and developing new skills.
Intrinsic Motivation	A student's engagement in an academic domain-specific activity due to interest and enjoyment of the activity (e.g., performing the activity for the sake of doing it—for the enjoyment, fun or pleasure, satisfying curiosity), not because the activity will produce a reward, gain, or result in the avoidance of a negative consequence.
Academic Interests	A student's relatively stable or enduring academic domain-specific predisposition, positive affective orientation, or preference for certain specific academic content or task domains. *Personal* interest reflects a relatively stable or enduring predisposition, evaluative orientation, and tendency to persevere when working on certain specific content or task domains. *Situational* interests are often "spur -of-the-moment" interests triggered by specific contexts..
Self-Beliefs	
Locus of Control	A student's academic domain-specific belief regarding he perceived causes of their success or failure. An *internal attribution* orientation is when a student perceives their success or failure as contingent on their own behavior and due to relatively unchanging personal characteristics. An *external attribution* orientation is when success or failure is perceived as under the control of others, unpredictable, and the result of luck, chance, or fate.
Competence Mindset	A student's academic domain-specific ability conception mindset. The beliefs, self-evaluation, and self-awareness (i.e., a thinking disposition) regarding their academic-related skills and abilities. The distinction between students who hold "*entity/fixed*" versus "*incremental/growth*" mindsets is of particular interest in contemporary research.

14

Academic Self-Efficacy	A student's academic domain-specific confidence (conviction) or judgement in their ability to organize, execute, and regulate performance to solve or accomplish academic problems at a designated level of skill and ability.
Academic Self-Concept	A student's academic domain-specific self-view, based on self-knowledge and evaluation of value or worth, of one's own capabilities in a specific academic domain.
Self-Regulated Learning (SRL) Strategies & Phases (Volition)[1]	
Prepatory Phase	The metacognitive processes involved in setting initial goals and activating prior domain-relevant knowledge and task relevant strategies.
Performance Phase	The metacognitive processes involved in self-awareness of personal cognition and the monitoring of various components of ones thinking during task performance. The activation of strategies for selecting, adapting, and changing cognitive strategies to reduce the relative discrepancy between immediate goals and self-generated performance feedback judgments. (The list of possible control strategies is relatively large and represents the most researched component of SRL--see table footnote.)
Appraisal Phase	The metacognitive processes in self-judging and making causal attributions regarding personal performance.

Note. The definitions in this table represent a synthesis of definitions from multiple sources of relevant literature cited in this paper. [1] Sitzman and Ely (2011), based on a comprehensive review of 15 self-regulation theories, identified a list of 16 potential SRL regulatory mechanisms. Most (n=12) are under the performance phase or SRL. An adapted set of these brief SRL definitions are available at: www.iapsych.com/MACM/srldefs.pdf.

15



16

Common Myths About IQ Test Scores



An IQ score represents a person's biological or neurocognitive-based general intelligence (g)

There is a "true IQ" for each person

Each person's IQ score is generally stable (fixed) over their lifespan

A person will generally get the same IQ score on all high quality individually administered IQ tests

A person's IQ score can accurately predict the person's current and future academic achievement - it is very good for formulating expectations

If a person has multiple IQ scores, the highest IQ score is the most accurate

17

The Search for the Elusive Basic Processes Underlying Human Intelligence



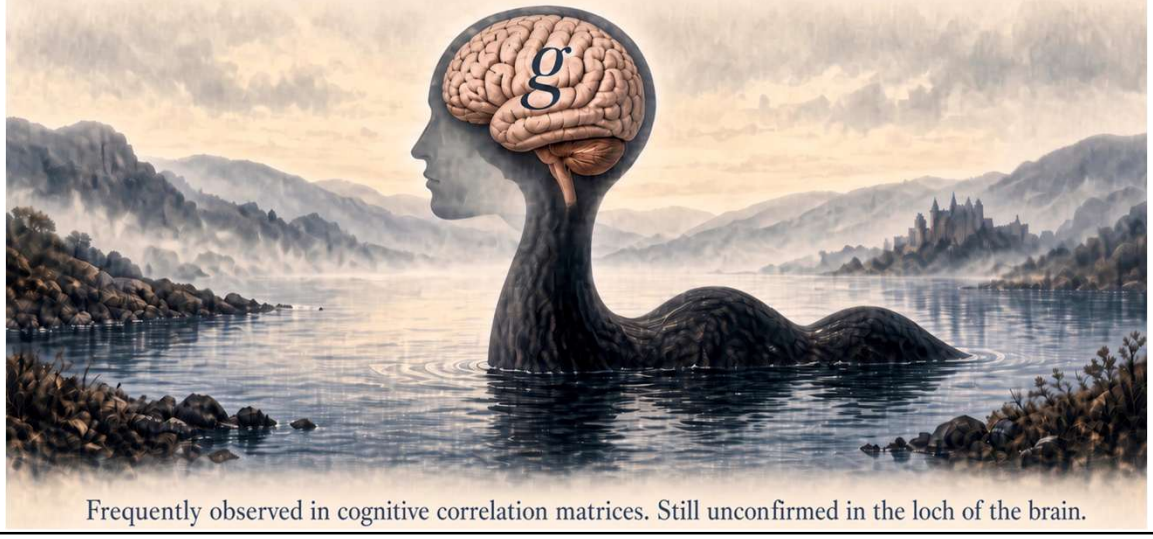
"Almost a century after Spearman's (1927) famous treatise on general intelligence, it is still *unclear what g is.*"

— *Robert J. Sternberg (2022)*

18

The *g* factor in human intelligence

is the "Loch Ness monster of psychology" (McGrew, 2021, 2022)

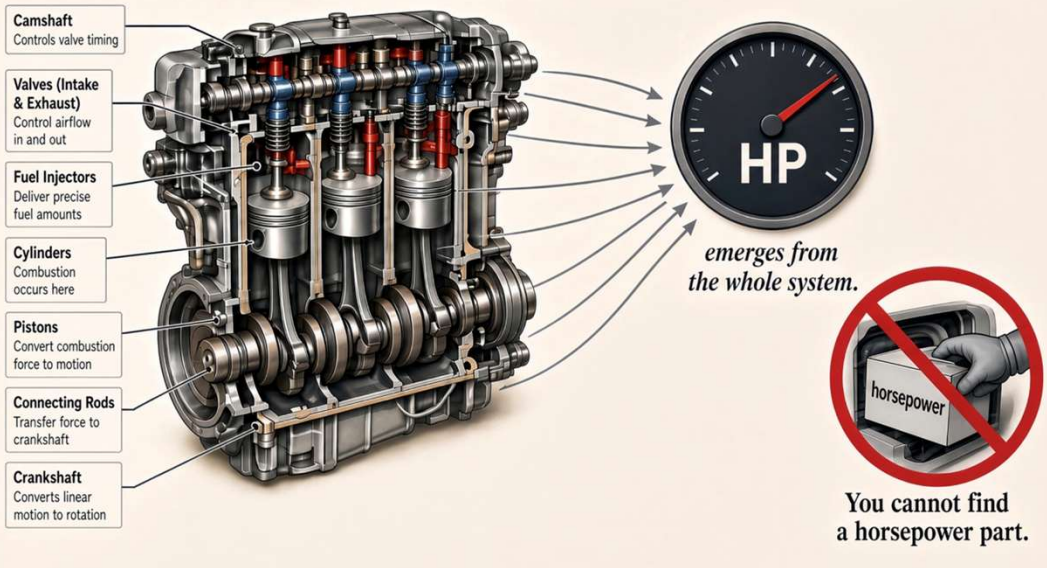


Frequently observed in cognitive correlation matrices. Still unconfirmed in the loch of the brain.

19

Horsepower is not a "thing" or "part" in the engine

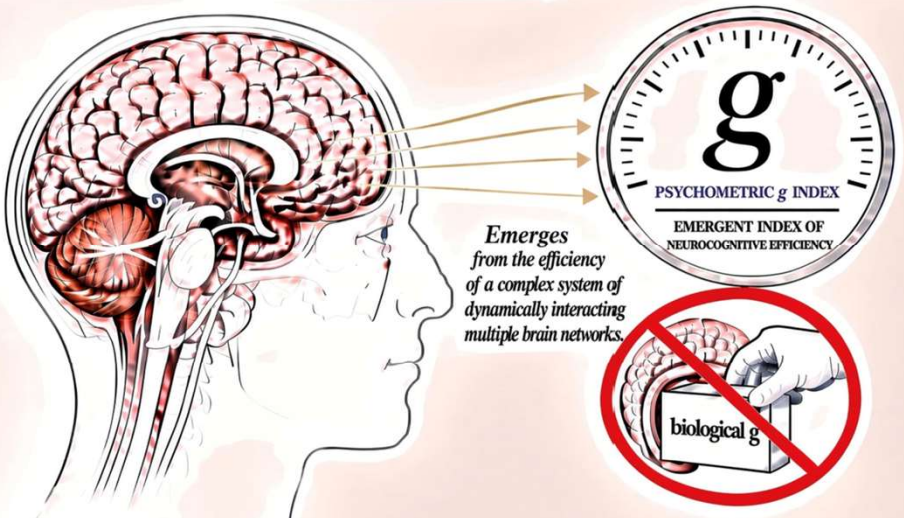
It is a practical <u>emergent property index</u> of system performance.



20

Psychometric *g* is not a "thing" or "part" in the brain

It is a practical emergent property index of neurocognitive efficiency.

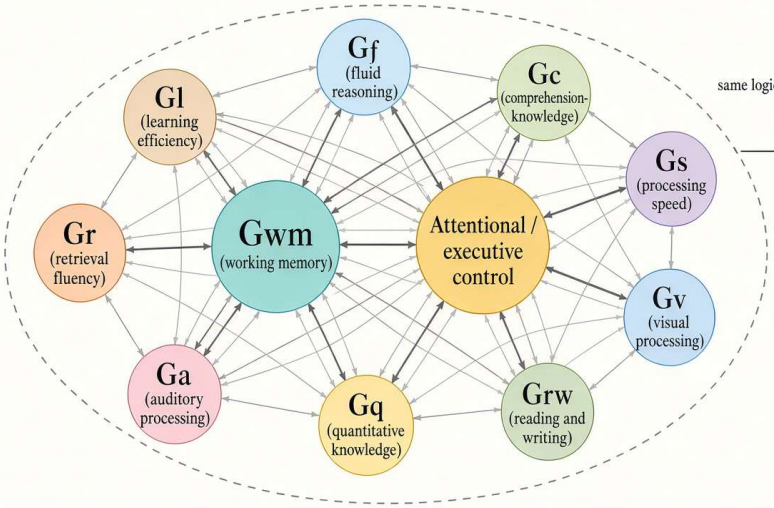


Over a century+ of research has failed to identify a biological brain *g* *mechanism.*

21

A Psychometric Network of Broad CHC Abilities

Executive control processes as central hubs from which psychometric g emerges as a property of the network



emergent psychometric *g*
statistical summary of network efficiency

same logic

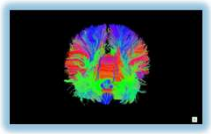


Horsepower is not a "thing" or part in the engine. It is a practical emergent property index of system performance — like psychometric *g*.

- No latent causal *g* sitting above the tests
- Positive manifold arises from overlapping processes
- Working memory and attentional control are high-centrality hubs
- Psychometric *g* is an emergent property index of the network

22





- General intelligence (represented by a **composite IQ score**) is a fallible **summary statistical (numerical)** ***index*** of the ***efficiency*** of a ***complex system of dynamically interacting multiple brain networks***
- Like the emergent statistical index of horsepower of a car engine, which does not represent a "thing" (a mechanism) in the engine, IQ reflects the ***current estimated efficiency*** of the processing of **multiple interacting cognitive abilities** measured during a **highly artificial "maximal" (vs "typical") performance structured/scaffolded experience**
- IQ or psychometric *g* should **not** be interpreted as being the result of a single brain-based entity or mystical mental energy, as **fixed,** or reflecting **biological/genetic destiny**.
- The manifestation expression of this statistical emergent property index is also influenced by other non-cognitive (**conative**) traits and **temporary states** of the individual and current **environmental** variables

(**Kevin McGrew on IQ scores**, borrowing from Detterman, 2016, and McGrew, 2023)

23

Problems with common-cause *g*-factor models of intelligence and advantages of *no-g* network models

Based on McGrew et al. (2023) and Holden and Hart (2021), Journal of Intelligence

Problems with common-cause *g* models

- Psychometric *g* is extracted from the positive manifold and regularly conflated with theoretical or biological *g*
- Models treat *g* as a latent entity "out there" that causes test scores, not as an emergent statistical index
- Factor arrows from *g* to tests imply *g* is the primary causal mechanism and the target of intervention
- Bifactor *g*-centric models treat broad CHC abilities as leftover nuisance variance after *g* is removed
- These models bar complex interactions among cognitive processes and adjacent systems
- A century of research has not isolated a unitary biological brain-based *g* mechanism
- *g*-dominated models can promote biological determinism and the idea that intelligence is immutable (Holden and Hart, 2021)

Advantages of *no-g* network models

- Explain the positive manifold without assuming a latent causal *g*
- Allow interactions among CHC ability measures instead of one-way arrows from *g* to measures
- Restore interpretive value of broad CHC scores beyond full-scale IQ
- Identify central processes such as the working memory–attentional control complex (Gwm-AC)
- Avoid conflating psychometric *g* with biological or theoretical *g*
- Offer centrality metrics that can generate intervention hypotheses

McGrew, Schneider, Decker, and Bulut (2023); Holden and Hart (2021)

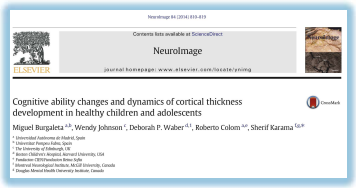
24



- **True** (common everyday meaning): Agreeing with fact, reality, or the actual situation, rather than being false or made up
- **True score** (theoretical psychometric term): In psychometric theory **(specifically Classical Test Theory),** a **true score** is **the hypothetical, error-free value** of a person's attribute or ability. It is defined mathematically as the **expected (average) score** a person would achieve if they took the exact same test **an infinite number of times without any practice or fatigue effects**
  - Can never directly measure or observe—can only estimate it through observed score and reliability calculations

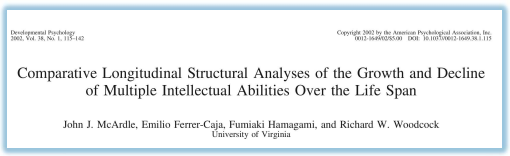
25



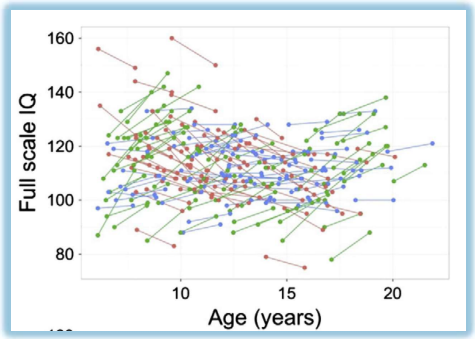

NeuroImage

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

Cognitive ability changes and dynamics of cortical thickness development in healthy children and adolescents


Comparative Longitudinal Structural Analyses of the Growth and Decline of Multiple Intellectual Abilities Over the Life Span

John J. McArdle, Emilio Ferrer-Caja, Fumiaki Hamagami, and Richard W. Woodcock
University of Virginia



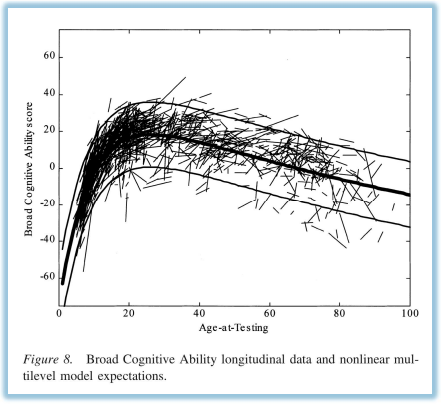


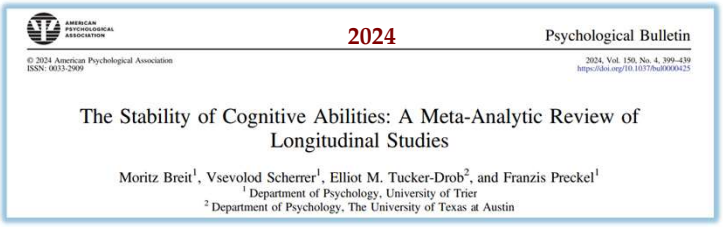
Figure 8. Broad Cognitive Ability longitudinal data and nonlinear multilevel model expectations.

26



Each person's IQ score is generally stable (fixed) over their lifespan

The scientific consensus is that the average correlation from childhood IQ tests with later adolescent and adult IQ's ranges from .60 to .80



2024 Psychological Bulletin

© 2024 American Psychological Association
ISSN: 0033-2909

2024, Vol. 150, No. 4, 399–439
https://doi.org/10.1037/bul0000425

The Stability of Cognitive Abilities: A Meta-Analytic Review of Longitudinal Studies

Moritz Breit[1], Vsevolod Scherrer[1], Elliot M. Tucker-Drob[2], and Franzis Preckel[1]
[1] Department of Psychology, University of Trier
[2] Department of Psychology, The University of Texas at Austin

Best available estimate of stability across age is ***r* = .76**

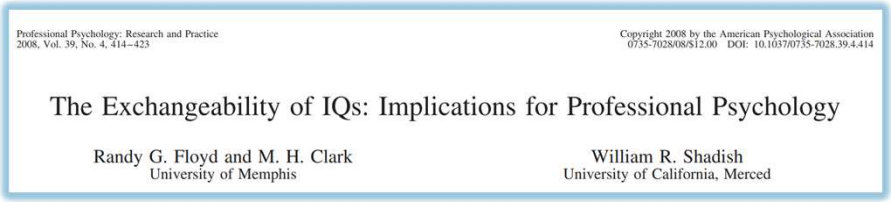
- .76 means approximately **57% shared variance**
- *SEest* for .76 = ± 9.7 or **± 10 pts – a range of 20 points!!!**

27



A person will generally get the same IQ score on all high quality individually administered IQ tests

- **IQ/IQ score exchangeability** across **10** different intelligence test battery full-scale IQs across approximately **1,000 subjects** from **six** different intelligence test validity study samples.
- **Correlation *r*** range = .69 to .93; **median *r* = .76**.
- "Psychologists can anticipate that **1 in 4 individuals** taking an intelligence test battery will receive an **IQ more than 10 points (± 10) *higher or lower* when taking another battery.**"



Professional Psychology: Research and Practice
2008, Vol. 39, No. 4, 414–423

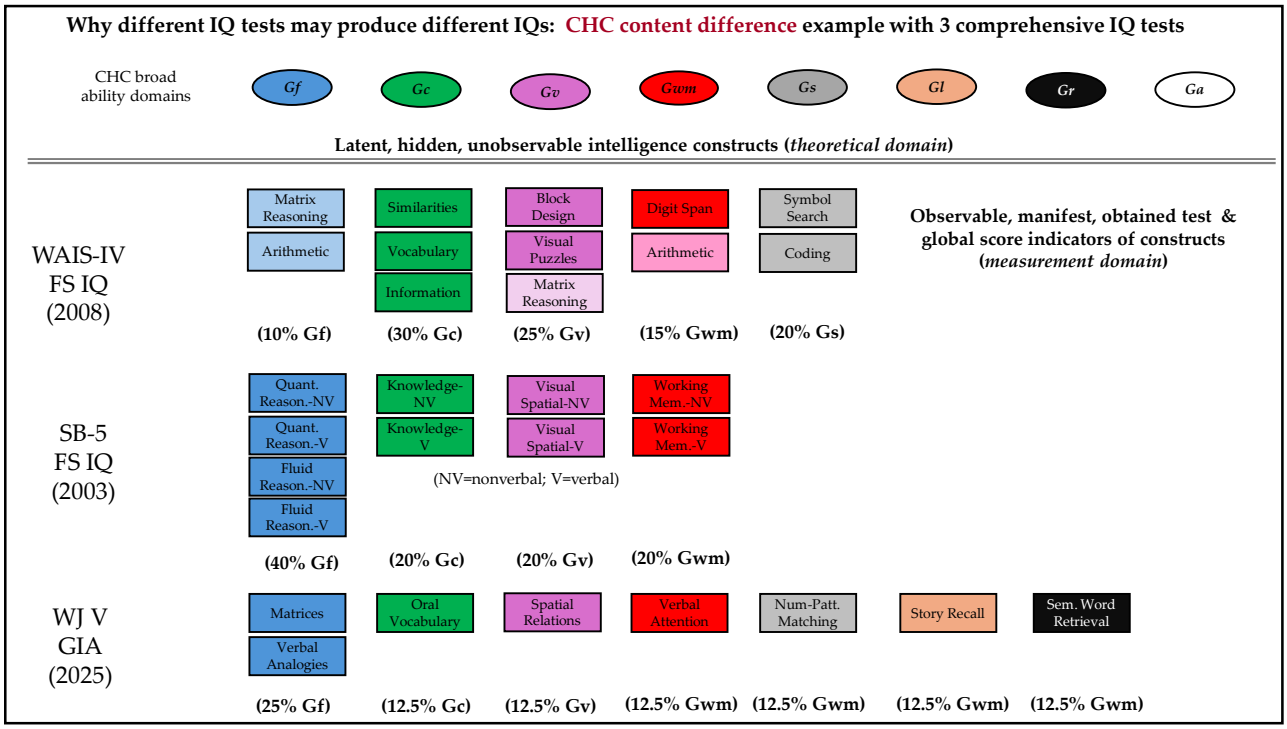
Copyright 2008 by the American Psychological Association
0735-7028/08/$12.00 DOI: 10.1037/0735-7028.39.4.414

The Exchangeability of IQs: Implications for Professional Psychology

Randy G. Floyd and M. H. Clark
University of Memphis

William R. Shadish
University of California, Merced

28


Why different IQ tests may produce different IQs: CHC content difference example with 3 comprehensive IQ tests
CHC broad ability domains
Gf
Gc
Gv
Gwm
Gs
Gl
Gr
Ga
Latent, hidden, unobservable intelligence constructs (theoretical domain)
WAIS-IV FS IQ (2008)
Matrix Reasoning
Arithmetic
Similarities
Vocabulary
Information
Block Design
Visual Puzzles
Matrix Reasoning
Digit Span
Arithmetic
Symbol Search
Coding
(10% Gf)
(30% Gc)
(25% Gv)
(15% Gwm)
(20% Gs)
Observable, manifest, obtained test & global score indicators of constructs (measurement domain)
SB-5 FS IQ (2003)
Quant. Reason.-NV
Quant. Reason.-V
Fluid Reason.-NV
Fluid Reason.-V
Knowledge-NV
Knowledge-V
Visual Spatial-NV
Visual Spatial-V
Working Mem.-NV
Working Mem.-V
(NV=nonverbal; V=verbal)
(40% Gf)
(20% Gc)
(20% Gv)
(20% Gwm)
WJ V GIA (2025)
Matrices
Verbal Analogies
Oral Vocabulary
Spatial Relations
Verbal Attention
Num-Patt. Matching
Story Recall
Sem. Word Retrieval
(25% Gf)
(12.5% Gc)
(12.5% Gv)
(12.5% Gwm)
(12.5% Gwm)
(12.5% Gwm)
(12.5% Gwm)

29