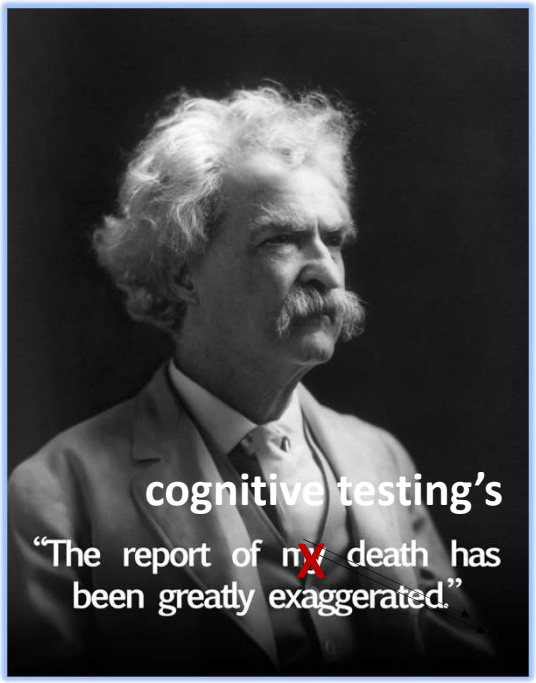


Dr. Kevin S. McGrew

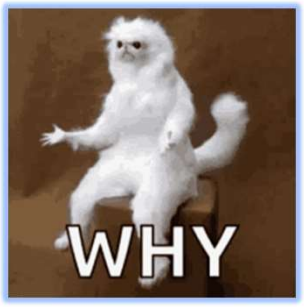
Educational Psychologist
Director
Institute for Applied Psychometrics

Research Professor (adjunct)
Institute on Community Integration
University of Minnesota

1

Research Is Needed To Bridge CHC Theories and Intelligence Testing Practices in Education

Kevin S. McGrew
Institute for Applied Psychometrics



We need cognitive-achievement **causal/explanatory** models

The **WHY & HOW**

Presentation at 2023 ISIR conference (7-29-23; Berkley, CA)

2

For more information visit
www.themindhub.com or follow me on Twitter

@iqmobile

My current potential conflicts of interest

Woodcock Johnson IV

Instituto Ayrton Senna

3

Journal of Intelligence

CHC PNA paper

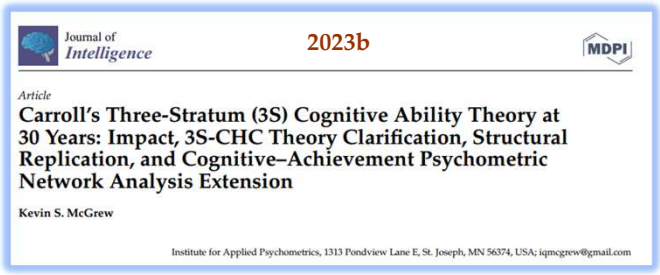

Journal of Intelligence 2023a MDPI

Article

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

Kevin S. McGrew [1,*], W. Joel Schneider [2], Scott L. Decker [3] and Okan Bulut [4]

Carroll @30 paper


Journal of Intelligence 2023b MDPI

Article

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

Kevin S. McGrew

Institute for Applied Psychometrics, 1313 Pondview Lane E, St. Joseph, MN 56374, USA; iqmcgrew@gmail.com

This is an "open access" journal!!!

OPEN ACCESS

4

This presentation will cover the 3 major topics below

A. The premature death knell for intelligence testing in SP: **Full Scale IQ v CHC composite scores. SP is "stuck on *g*"**

B. A contemporary *g*-less network model of intelligence: The future? (McGrew et al., 2023)

1. Implications for **WJ IV COG test and cluster interpretation**

C. Using CHC COG→ACH network models to understand the complex system of cognitive and achievement behaviors (McGrew, 2023). **"Beyond *g*"**

D. B& C =

5

The extant **research evidence** on IQ test interpretation has **not** yet provided strong convincing support for widespread use of these practices in **education**:

- Individual subtest analysis
- Actuarial prediction from cognitive subtest profiles
- The long-term stability of cognitive subtest profiles
- Cognitive test score-based interventions (i.e., aside from *g*, no robust ATI's)
- The diagnostic accuracy of the pattern of strengths and weakness (PSW) approach to SLD diagnosis **(but look for Flanagan & Schneider, 2023 [R&R] paper re "buffer zones")**

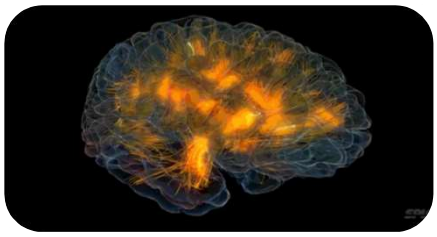
6

Research evidence or pragmatic/administrative requirements indicate that cognitive tests are a **useful (but, at times, controversial & harmful) practice in such areas as:**

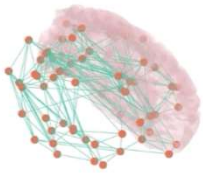
- Diagnosis of intellectual disability (ID)
- Gifted?
- Forensic and legal settings
- Neuropsychology and cognitive neuroscience
- Research on the human brain
- Intelligence & cognitive psychology theoretical research
- Selective referral-focused testing
- Service eligibility decisions (e.g., SSI)
- …..

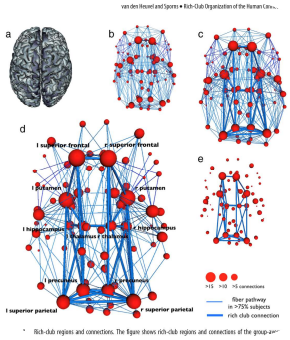
7

Intelligent behavior originates in the brain



The brain is a complex dynamic network system





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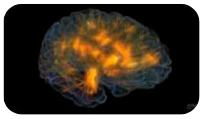
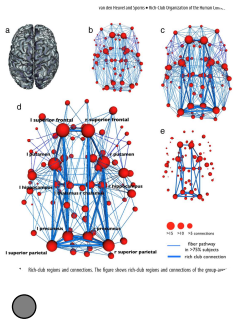
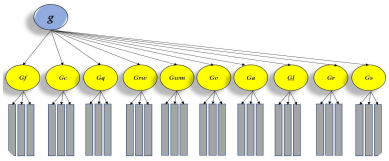




Pop quiz question

Draw a line from the top set of figures (the gray dot) to the one at the bottom(A, B, or C) that "best" represents the target

A



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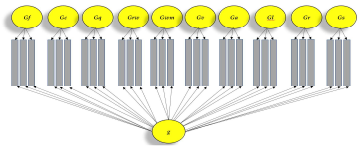
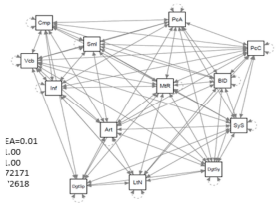


C

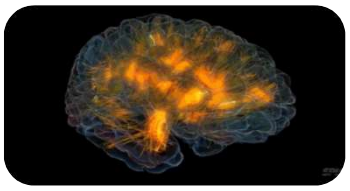


9

Thinking about intelligence a different (and better) way

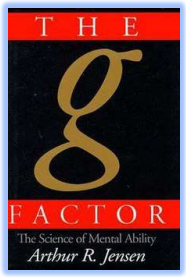
Lessons from the complex *emergent behavior* from the animal kingdom (e.g., birds, ants, fish, dogs, etc) and contemporary *network science* and *cognitive neuroscience*

Can a statistical-like index (e.g., g, Full Scale IQ) explain this complex behavior?



10

Fact: Psychometric or statistical *g* is the **most robust replicated finding in (most?) all of psychology (over 100+ years of research)**

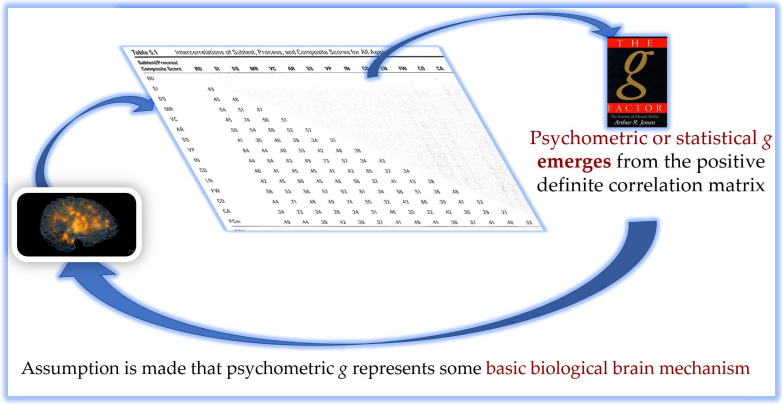


Fact: Psychometric or statistical *g* is the **most *single* powerful predictor of educational and other life outcomes in all of psychology**

11

Answer

Example of **circular reasoning** in the **conflation** of psychometric and theoretical *g*



12

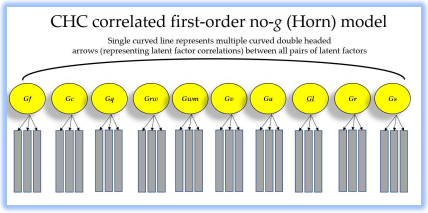
The **conflation of psychometric and theoretical *g*** demonstrates the **circular reasoning fallacy**

That is, a strong psychometric *g* factor is extracted from the positive definite correlation matrix among subtests in an IQ test battery…therefore, by inference, it represents (**without question**) some variant **of Spearman's original theoretical *g* construct of mental energy**…thus, **proving the preeminent importance of the extracted *g*-factor reported in the IQ test structural research study**

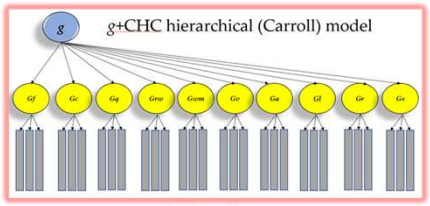
Most all SP structural intelligence testing research and practice (to date) has a huge **elephant in the room**

13

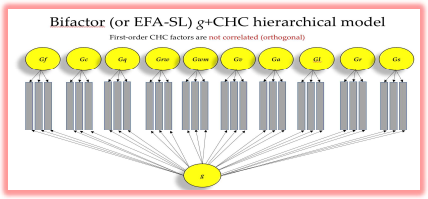
The **three** dominant **psychometric *g*** statistical models for **cognitive-achievement** research in **school psychology** research



no-*g*



Mixed *g*



***g*-centric**

14

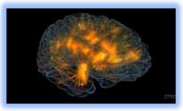
The **conflation of psychometric and theoretical *g*** is endemic in SP IQ test structural research

- Recent WISC-V structural publications by both prominent ***g*-centric** and **mixed-*g*** SP research groups found **liberal** mention of some type of **general intelligence (*g*)** entity (typically between **31 and 58 times**) in the respective publications
- One of these WISC-V pubs referenced some variant of *g* **over 170 times!**

- Frequently a myriad of *g* terms is used with the **reader left to infer, from the surrounding context or reference citations, if the authors are referring to theoretical or psychological *g* or psychometric or statistical *g*—or perhaps both.**
  - I have also committed the same error in much of my past research

15

Theoretical or psychological *g*, **after 100+ years of research**, is still:




Trends in Cognitive Sciences

Opinion

Network Neuroscience Theory of Human Intelligence

Aron K. Barbey


Intelligence

A new beginning of intelligence research. Designing the playground

John Protzko, Roberto Colom


Intelligence

Is there a "g-neuron"? Establishing a systematic link between general intelligence (g) and the von Economo neuron

Oliver J. Bruton

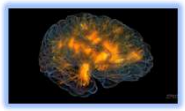
Enigmatic (Barbey, 2018)

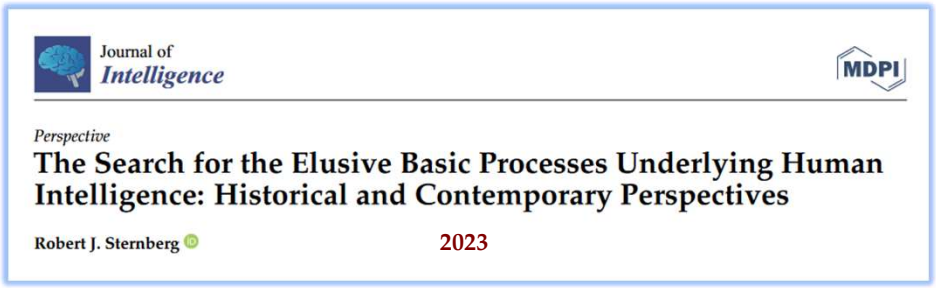
Far from the **mystical energy idea**…but far from a **foundational understanding what it is** (Protzko & Colom, 2021a)

A **black hole** (Bruton, 2021)

16

Theoretical or psychological *g*, **after 100+ years of research**, is still:





Journal of *Intelligence*

MDPI

Perspective

The Search for the Elusive Basic Processes Underlying Human Intelligence: Historical and Contemporary Perspectives

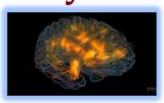
Robert J. Sternberg

2023

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

17

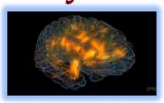
Theoretical or psychological *g*, **after 100+ years of research…**

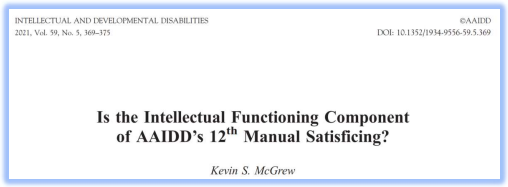


More accurately, we have **no cumulative robust evidence** for a **theoretical/psychological brain-based *g*-mechanism**

18

Theoretical or psychological *g*, **after 100+ years of research…**





INTELLECTUAL AND DEVELOPMENTAL DISABILITIES
2021, Vol. 59, No. 5, 369–375

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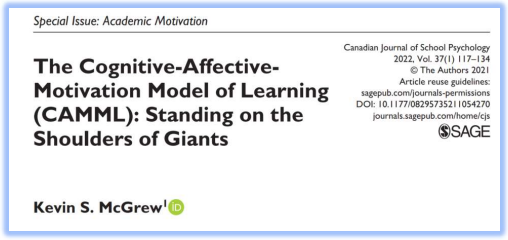
DOI: 10.1352/1934-9556-59.5.369

Is the Intellectual Functioning Component of AAIDD's 12th Manual Satisficing?

Kevin S. McGrew



Special Issue: Academic Motivation

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

Canadian Journal of School Psychology
2022, Vol. 37(1) 117–134
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Kevin S. McGrew[1]

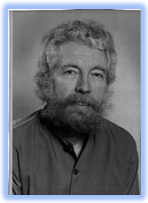
The **Loch Ness Monster of psychology,** especially school psychology

(McGrew, 2021a, 2021b)

19

Let's compare evidence in support of the ***g* construct as an *ability* *vs* broad CHC stratum II constructs as *abilities***

20



Types of Supporting Evidence for Distinct CHC abilities (John "no-*g*" Horn; Horn, 1991; Horn & Knoll, 1997)

- Structural
- Neurocognitive
- Developmental
- Heritability
- Achievement

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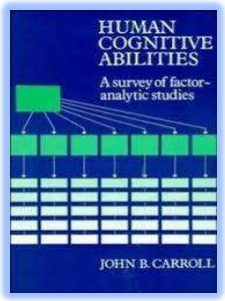
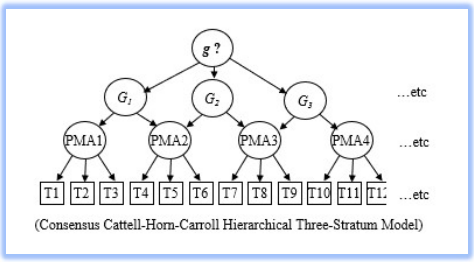
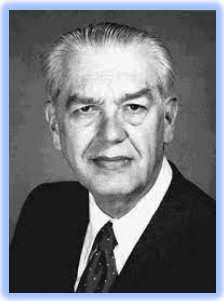
Structural - evidence of individual differences; factor analysis studies







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Developmental - evidence of change in abilities from infancy to old age

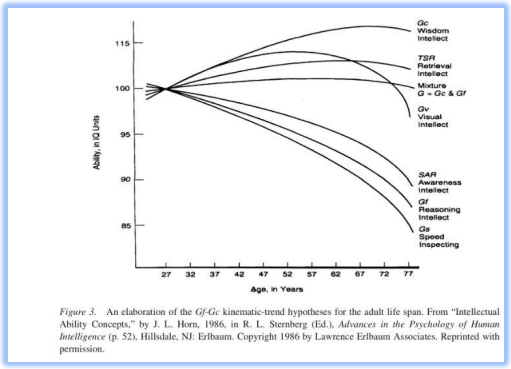
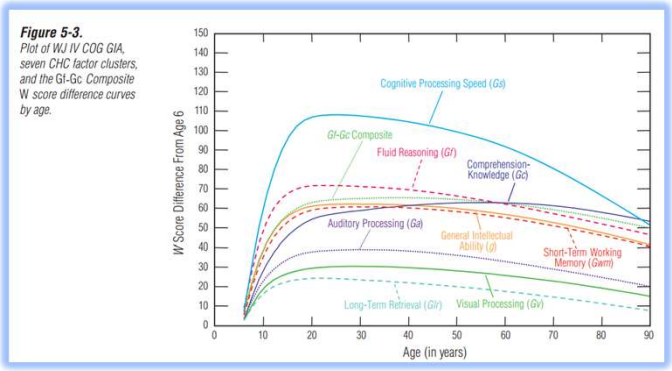


Figure 3. An elaboration of the *Gf-Gc* kinematic-trend hypotheses for the adult life span. From "Intellectual Ability Concepts," by J. L. Horn, 1986, in R. L. Sternberg (Ed.), *Advances in the Psychology of Human Intelligence* (p. 52), Hillsdale, NJ: Erlbaum. Copyright 1986 by Lawrence Erlbaum Associates. Reprinted with permission.



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Neurocognitive - evidence of relations to indicators of physiological and neurological functioning

Trends in Cognitive Sciences **(2018)**

Opinion

Network Neuroscience Theory of Human Intelligence

Aron K. Barbey[1,2,3,4,5,6,*,@]

An enduring aim of research in the psychological and brain sciences is to understand the nature of individual differences in human intelligence, examining the stunning breadth and diversity of intellectual abilities and the remarkable neurobiological mechanisms from which they arise. This Opinion article surveys recent neuroscience evidence to elucidate how general intelligence, *g*, emerges from individual differences in the network architecture of the human brain. The reviewed findings motivate new insights about how network topology and dynamics account for individual differences in *g*, represented by the Network Neuroscience Theory. According to this framework, *g* emerges from the small-world topology of brain networks and the dynamic reorganization of its community structure in the service of system-wide flexibility and adaptation.

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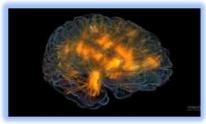
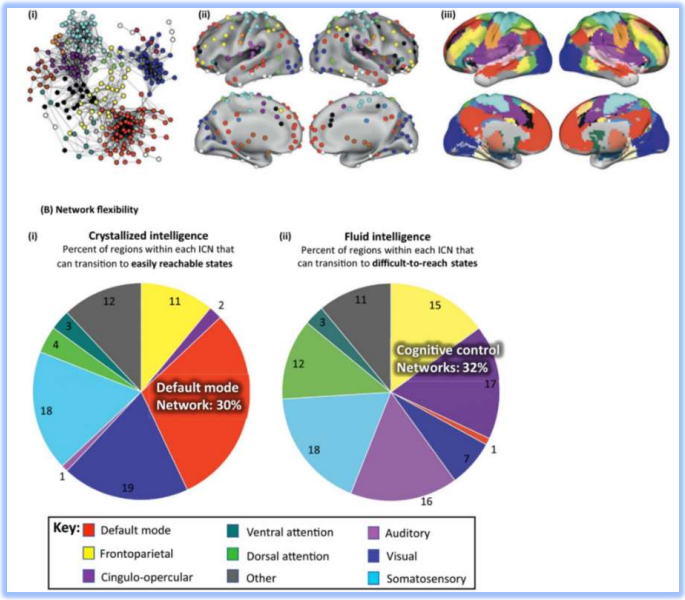


Cognitive neuroscience network theories



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Neurocognitive - evidence of relations to indicators of physiological and neurological functioning

Cognitive Abilities are Associated with Specific Conjunctions of Structural and Functional Neural Subnetworks

To appear in: *NeuroImage*

Received date: 9 November 2022
Revised date: 19 July 2023
Accepted date: 31 July 2023

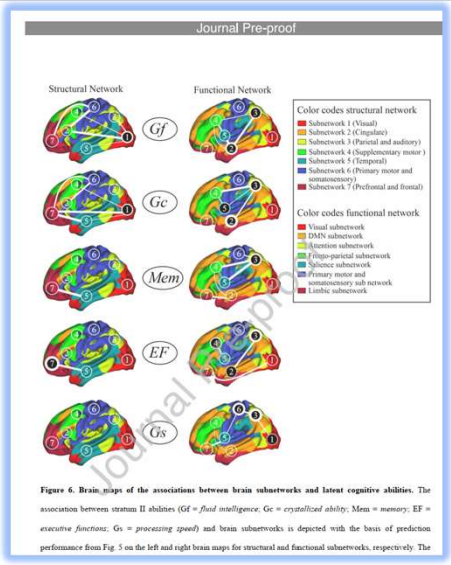
Please cite this article as: Daniel Kristanto , Andrea Hildebrandt , Werner Sommer , Changsong Zhou , Cognitive Abilities are Associated with Specific Conjunctions of Structural and Functional Neural Subnetworks, *NeuroImage* (2023), doi: https://doi.org/10.1016/j.neuroimage.2023.120304

Structural networks were identified using machine-learning graph neural network by clustering anatomical brain properties measured in **838 individuals enrolled in the WU-Minn Young Adult *Human Connectome Project***. **Functional networks** were adapted from seven Resting State Networks

We then analyzed the results of **15 cognitive tasks and estimated five latent abilities:** fluid reasoning **(Gf)**, crystallized intelligence (**Gc**), memory (**Mem**), executive functions (**EF**), and processing speed (**Gs**).

26

Neurocognitive - evidence of relations to indicators of physiological and neurological functioning



- All cognitive abilities were associated with several **interacting brain subnetworks**
- **Brain subnetworks** likely involved in different cognitive abilities
- The findings suggest that the **distinct *stratum II abilities* are associated with different combinations of brain subnetworks**

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Heritability - evidence of relations among persons related biologically in different degrees

"the **different intelligences** appear to stem **from separate genetic and environmental determiners**...[and] **different sets of genes determine structures and functions of the brain** and that these different structures and functions support cognitive abilities" (Horn & Knoll, 1997; p. 81).

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Heritability - evidence of relations among persons related biologically in different degrees

Intelligence 95 (2022) 101689

Contents lists available at ScienceDirect

Intelligence

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

The genetics of specific cognitive abilities

Francesca Procopio [a,1,*], Quan Zhou [b,1], Ziye Wang [a,b], Agnieska Gidziela [a,b], Kaili Rimfeld [a,c], Margherita Malanchini [a,b], Robert Plomin [a]

[a] Social, Genetic & Developmental Psychiatry Centre, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom
[b] School of Biological and Chemical Sciences, Queen Mary University of London, London, United Kingdom
[c] Department of Psychology, Royal Holloway, University of London, Egham, Surrey

ARTICLE INFO

Keywords:
Specific cognitive ability
Intelligence
meta-analysis
Twin study
Heritability

ABSTRACT

Most research on individual differences in performance on tests of cognitive ability focuses on general cognitive ability (g), the highest level in the three-level Cattell-Horn-Carroll (CHC) hierarchical model of intelligence. About 50% of the variance of g is due to inherited DNA differences (heritability) which increases across development. Much less is known about the genetics of the middle level of the CHC model, which includes 16 broad factors such as fluid reasoning, processing speed, and quantitative knowledge. We provide a meta-analytic review of 747,567 monozygotic-dizygotic twin comparisons from 77 publications for these middle-level factors, which we refer to as specific cognitive abilities (SCA), even though these factors are not independent of g. Twin comparisons were available for 11 of the 16 CHC domains. The average heritability across all SCA is 56%, similar to that of g. However, there is substantial differential heritability across SCA and SCA do not show the developmental increase in heritability seen for g. We also investigated SCA independent of g (SCA.g). A surprising finding is that SCA.g remain substantially heritable (53% on average), even though 25% of the variance of SCA that covaries with g has been removed. Our review highlights the need for more research on SCA and especially on SCA.g. Despite limitations of SCA research, our review frames expectations for genomic research that will use polygenic scores to predict SCA and SCA.g. Genome-wide association studies of SCA.g are needed to create polygenic scores that can predict SCA profiles of cognitive abilities and disabilities independent of g.

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Heritability - evidence of relations among persons related biologically in different degrees

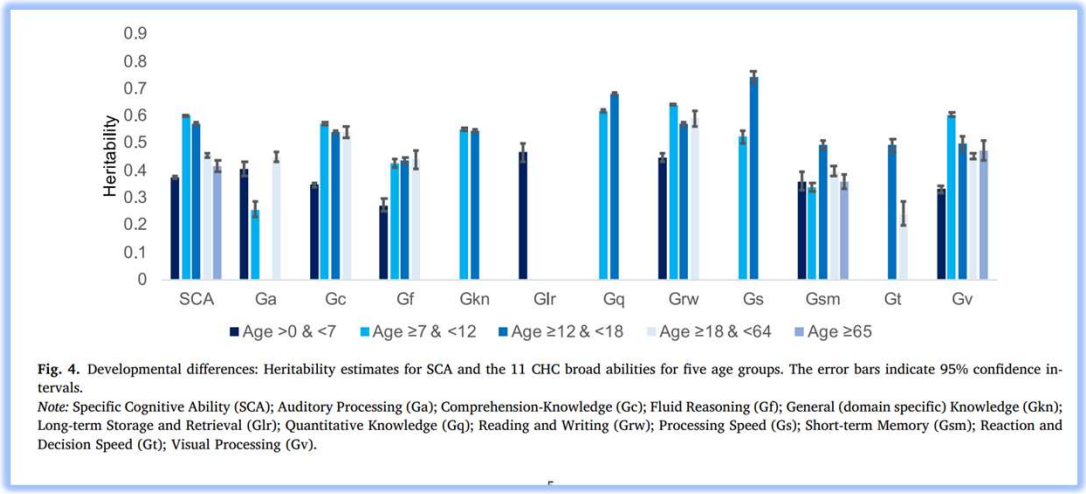


Fig. 4. Developmental differences: Heritability estimates for SCA and the 11 CHC broad abilities for five age groups. The error bars indicate 95% confidence intervals.
Note: Specific Cognitive Ability (SCA); Auditory Processing (Ga); Comprehension-Knowledge (Gc); Fluid Reasoning (Gf); General (domain specific) Knowledge (Gkn); Long-term Storage and Retrieval (Glr); Quantitative Knowledge (Gq); Reading and Writing (Grw); Processing Speed (Gs); Short-term Memory (Gsm); Reaction and Decision Speed (Gt); Visual Processing (Gv).

30

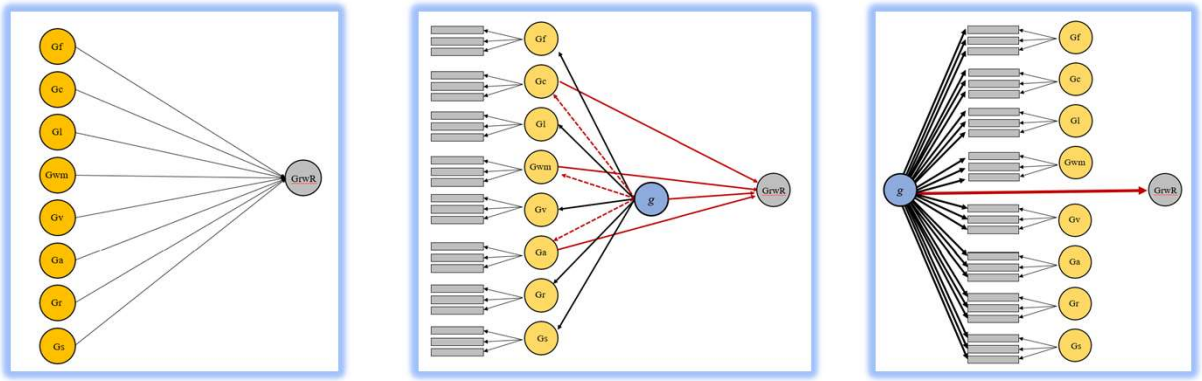
Heritability - evidence of relations among persons related biologically in different degrees

- **Two recent large sample twin studies** (one of which is a **meta-analysis of a total of 863,041 twin comparisons**)
- Confirm Horn's opinion that **CHC broad specific cognitive abilities demonstrate differential heritability and heritability as strong (or stronger) than psychometric *g***, even after psychometric *g* heritability is statistically removed

(Malanchini et al., 2020, Zhou, Wang, Gidziela, Rimfeld, Malanchini and Plomin, 2022)

31

Achievement/outcome - evidence of predictions of school performance and occupational levels



32

Achievement/outcome - evidence of predictions of school performance and occupational levels

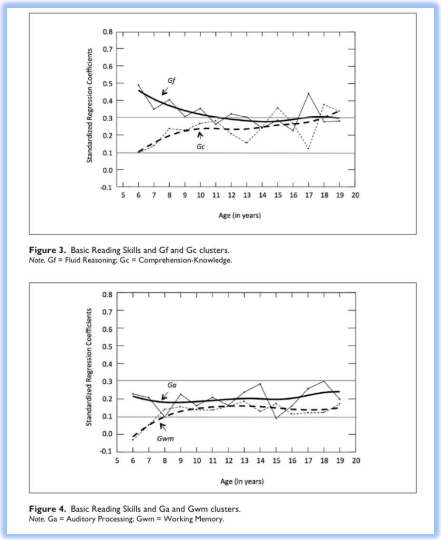


Figure 3. Basic Reading Skills and Gf and Gc clusters.
Note. Gf = Fluid Reasoning; Gc = Comprehension-Knowledge.

Figure 4. Basic Reading Skills and Ga and Gwm clusters.
Note. Ga = Auditory Processing; Gwm = Working Memory.

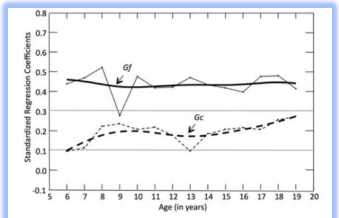


Figure 2. Math calculation skills and the relations to the fluid reasoning (Gf) and comprehension-knowledge (Gc) clusters [Colour figure can be viewed at wileyonlinelibrary.com]

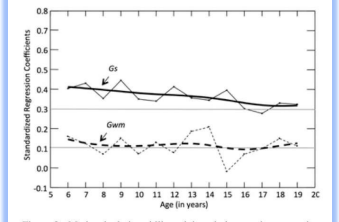
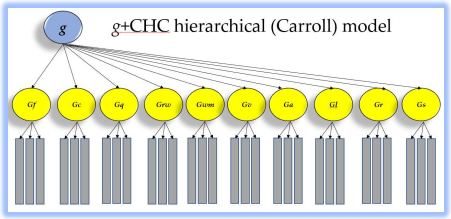
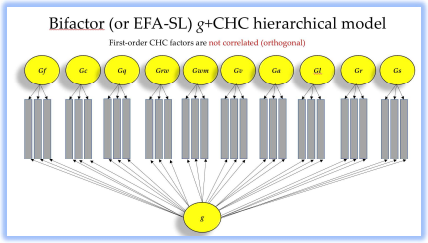


Figure 3. Math calculation skills and the relations to the processing speed (Gs) and short-term working memory (Gwm) clusters

33





Being "**stuck on *g***" increases the probability of **harmful impact** for certain groups

The **historical reality** is the intelligence (***g* - IQ score**) has **multiple negative historical roots**

Conflating psychological and psychometric *g* tends to promote (imply) the inaccurate, negative and harmful notion of "**biological determination and the immutability of intelligence**"(Holden & Hart, 2022)

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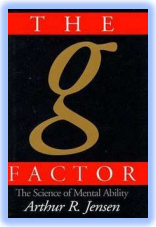
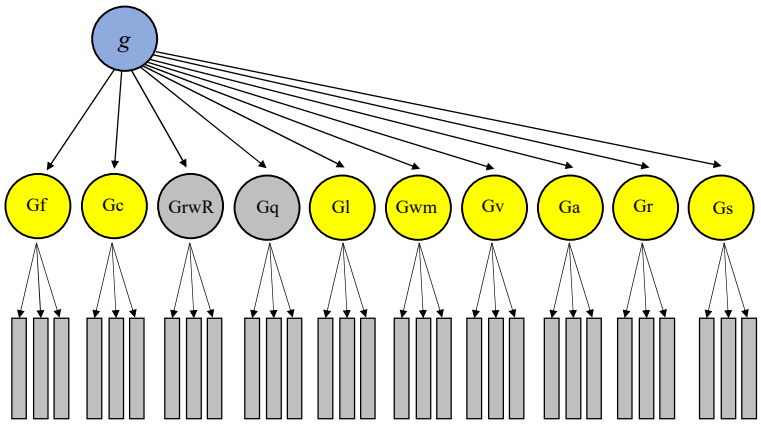
To *g*…or not to *g*



We (SP) have been (and are) "**stuck on *g***"

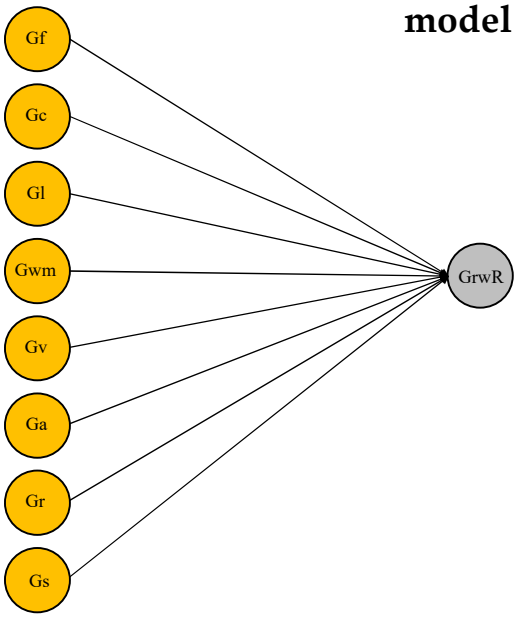
35

The classic hierarchical (Carroll) *g* model (mixed g)



36

No-*g* (Horn model) multiple regression or path analysis model studies



Multiple regression studies using the WJ-R, WJ III and WJ IV standardization samples provide **evidence supporting the developmental importance of specific CHC broad scores in the prediction of reading, writing, and math achievement in grade-school children** (Cormier et al. 2017a, 2017b; Cormier et al. 2016; Evans et al. 2002; Floyd et al. 2003, 2008; McGrew & Hessler 1995; McGrew & Knopik 1993).

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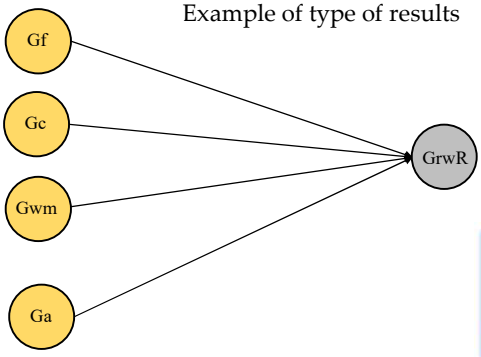
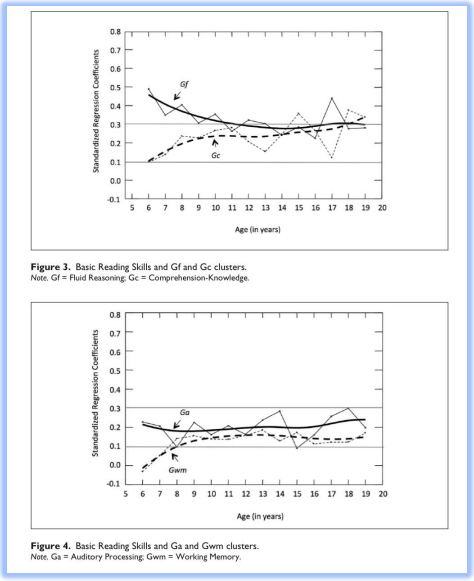
No-*g* multiple regression or path analysis model studies

Example of type of results

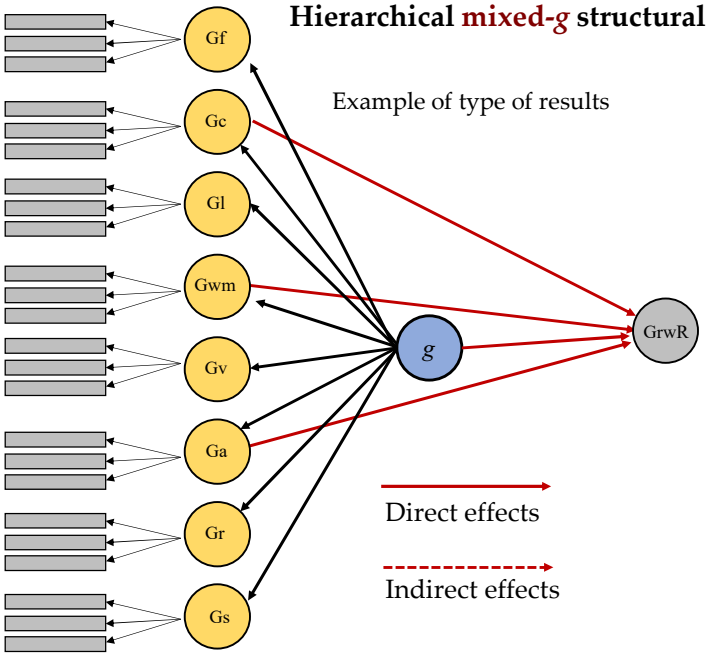


- **Multiple CHC broad abilities** are related to school achievement
- CHC ability X ACH ability X developmental (age) **interactions**



38

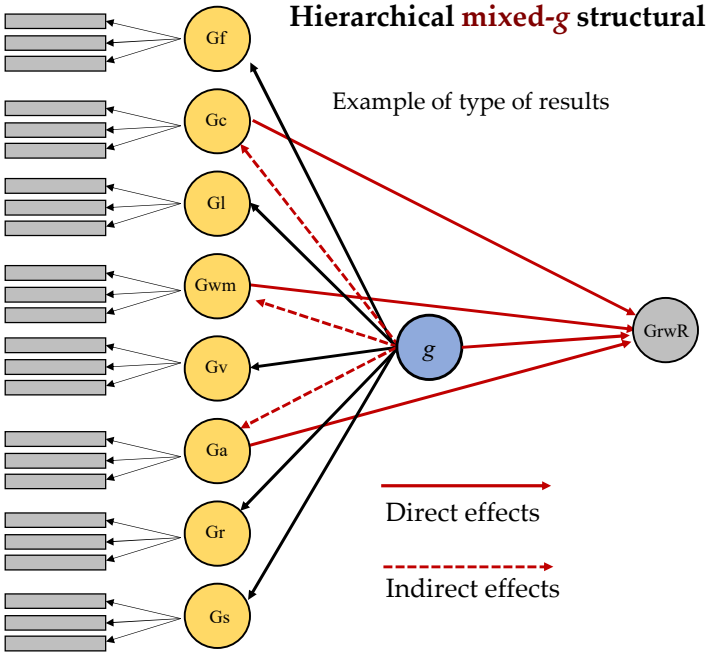
Hierarchical mixed-*g* structural equation modeling (SEM) studies



An extensive number of WJ-R, WJ III and WJ IV ***g*+specific abilities studies completed by Keith, Reynolds, and colleagues** (e.g., Caemmerer et al. 2018, 2020; Floyd et al. 2003, 2007, 2008, 2009; Hajovsky et al. 2014; Keith 1999; Keith and Dunbar 1984; Keith and Reynolds 2010, 2018; McGrew et al. 1997; Meyer and Reynolds 2017; Niileksela et al. 2016; Reynolds et al. 2013; Reynolds and Keith 2017; Reynolds and Turek 2012; Taub et al. 2008; Vanderwood et al. 2002)

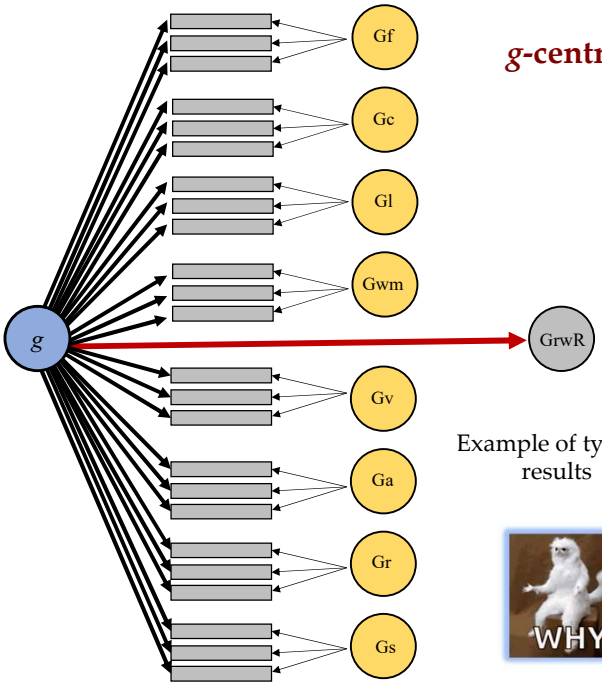
39

Hierarchical mixed-*g* structural equation modeling (SEM) studies



- Psychometric *g* has direct and indirect effects (meditated by broad CHC abilities) on ach
- Some broad CHC abilities have direct effects on ach **above and beyond *g***

40



***g*-centric**

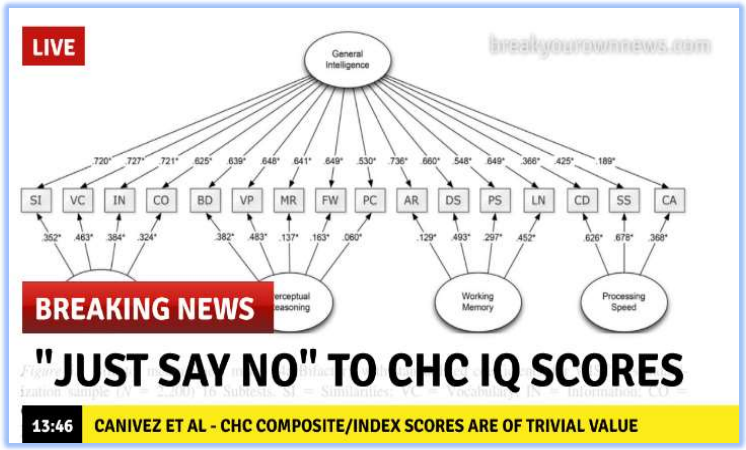
Example of type of results

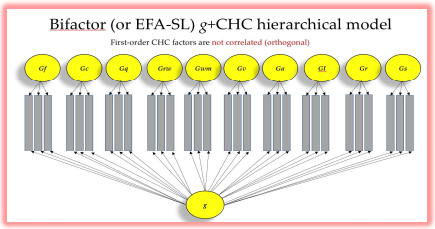
CHC broad ability scores are considered nothing more than a **minor nuisance (i.e., left over trivial residual sources of variance after psychometric *g* is accounted for)** and should **be avoided in test interpretation** (McGill et al., 2018).

"The primary interpretation of subscale scores [composite CHC scores] may be misguided as….**many of these scores** are not adequately located by popular IQ tests and, even when located, often ***lack sufficient unique reliable variance for confidant clinical interpretation***" (Farmer et al., 2021; emphasis added)

41

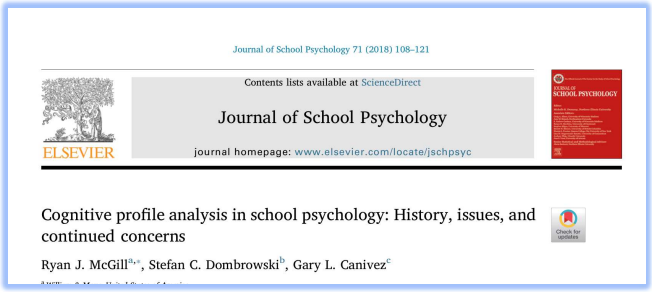
In case you missed it from the school psychology literature or social media from the ***g*-centric** researchers





***g*-centric**

42



Journal of School Psychology 71 (2018) 108–121

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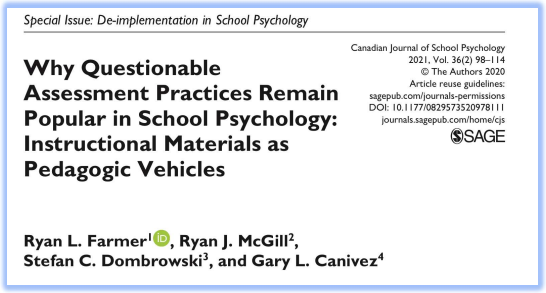
Cognitive profile analysis in school psychology: History, issues, and continued concerns

Ryan J. McGill[a,*], Stefan C. Dombrowski[b], Gary L. Canivez[c]



Special Issue: De-implementation in School Psychology

Why Questionable Assessment Practices Remain Popular in School Psychology: Instructional Materials as Pedagogic Vehicles

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Ryan L. Farmer[1], Ryan J. McGill[2], Stefan C. Dombrowski[3], and Gary L. Canivez[4]

SCHOOL PSYCHOLOGY REVIEW
https://doi.org/10.1080/2372966X.2021.1960126

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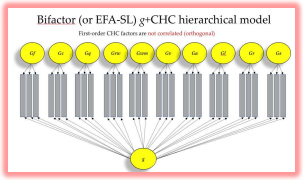
Beyond the Rhetoric of Evidence-Based Assessment: A Framework for Critical Thinking in Clinical Practice

Stefan C. Dombrowski[a], Ryan J. McGil[b], Ryan L. Farmer[c], John H. Kranzler[d], and Gary Canivez[e]

[a]Rider University; [b]William & Mary; [c]Oklahoma State University; [d]University of Florida; [e]Eastern Illinois University



***g*-centric**

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The **Wheel of Issues** with the ***g*-centrists** ("just say no to CHC composite score interpretation") research and message

SP's "big fish in small pond" mindset

The rusty linchpin - omega hierarchical subscale

The elephant in the room – conflation of psychological and psychometric *g*

The law of the instrument problem – give a child a hammer….

Beyond *g* – "You can't handle the truth"

The echo chamber

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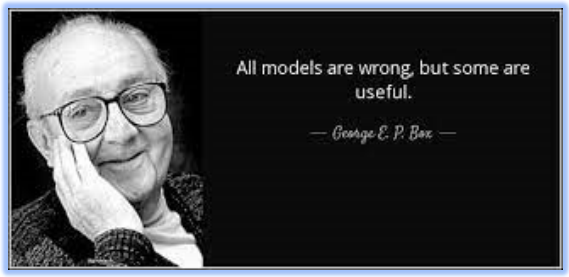
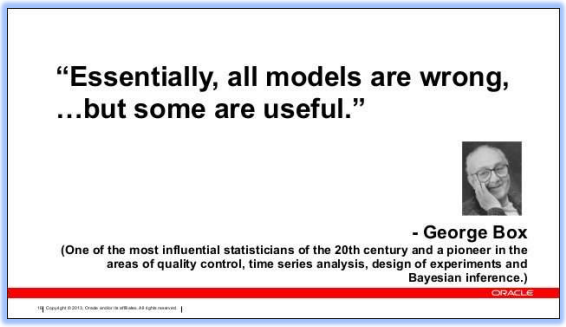
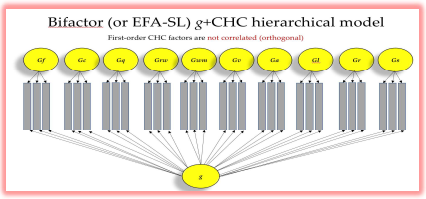
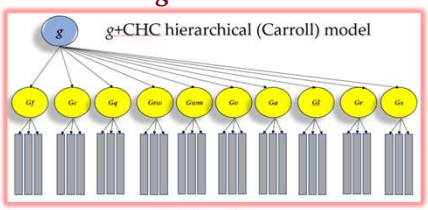


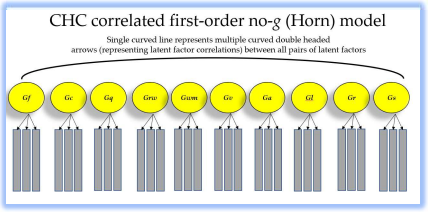




g-centric

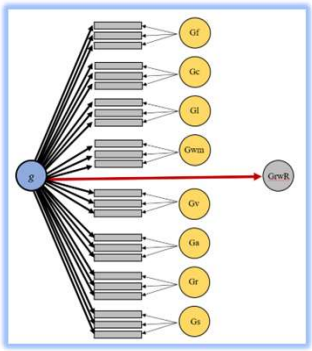


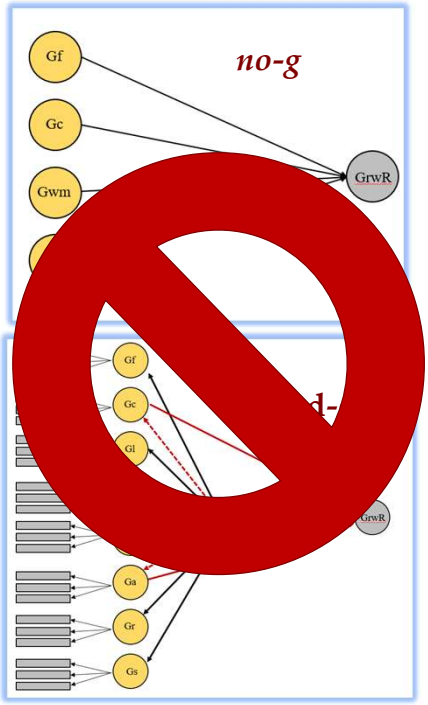
Mixed *g*



no-*g*

45





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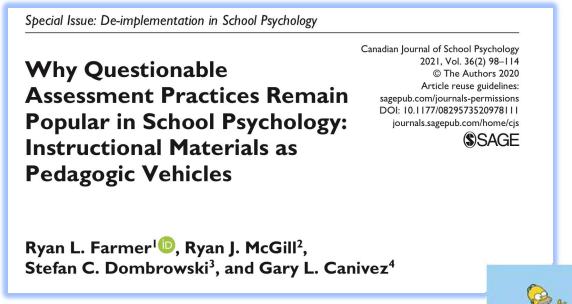
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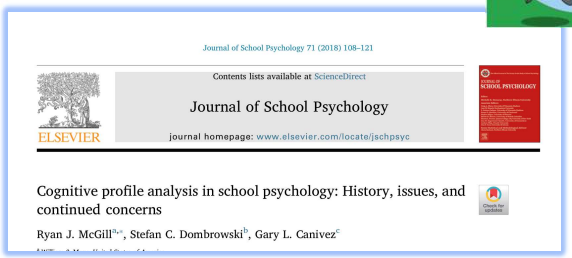
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Cognitive profile analysis in school psychology: History, issues, and continued concerns

Ryan J. McGill[b,*], Stefan C. Dombrowski[b], Gary L. Canivez[c]

In their recent IQ test DI SP journal article, **Farmer et al. (2021)** includes **13 references** that include at least one member of the ***g*-centric SP research group** while concurrently including **NO** references to any of **the mixed-g SP research.**

The **McGill et al. (2018)** paper is a **primary source for arguing against the incremental value of CHC broad ability scores** above and beyond *g* or full scale scores. The McGill et al. (2018) paper includes **34 references** that include at least one member of the ***g*-centric** SP research group, but only **3 references** that include a member of the **mixed-*g*** SP research group

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[a]Rider University; [b]William & Mary; [c]Oklahoma State University; [d]University of Florida; [e]Eastern Illinois University

In the Dombrowski et al. (2021) IQ DI article, the authors cite **19 references** that include at least one member of the ***g*-centric** SP research group, but, again, **0 references** to research by the **mixed-*g*** SP research group

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Most school psychology intelligence testing research suffers from the "**big fish in the small pond effect**"

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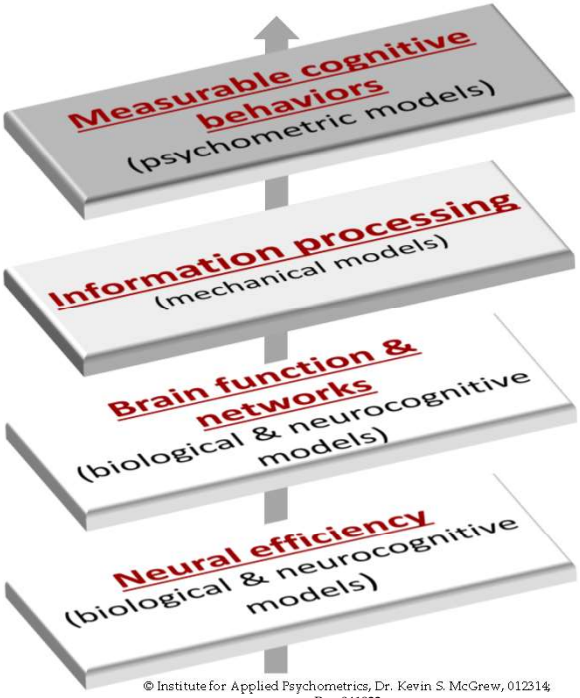
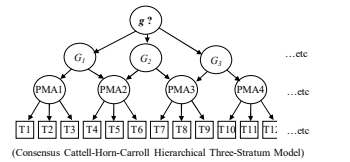
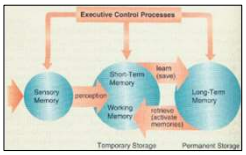
Intelligence Testing Related Research: Levels of theoretical reductionism and explanation

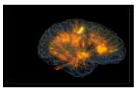
(Adapted from conceptual distinctions of Earl Hunt, 2011)

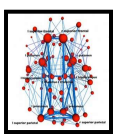


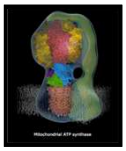


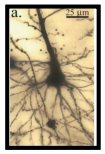
(Consensus Cattell-Horn-Carroll Hierarchical Three-Stratum Model)





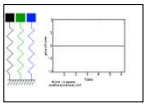






-Human Connectome
-Functional brain networks
(Bressler & Menon, 2010)
-"Rich club" network hubs
-P-FIT model
-Network neuroscience research

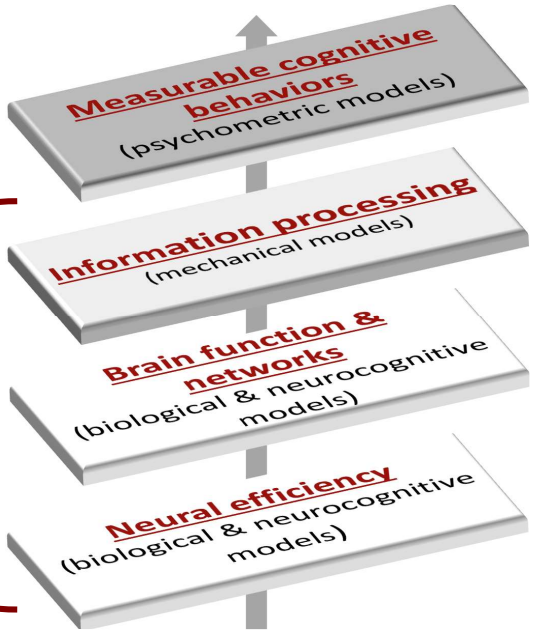
-rate of neural oscillations
-neural synchronization
-brain metabolism
-Reaction-time/temporal *g*
-ERP's (e.g., ABR)
-**mitochondrial functioning**
-**von Economo neuron (*g*-neuron)**



50

Almost all of SP's intelligence researchers are stuck on psychometric models (esp. **psychometric *g***)

SP intelligence testing research is like the **Titanic**…it has taken on major water by ignoring **mainstream psychology intelligence and cognitive psychology** research



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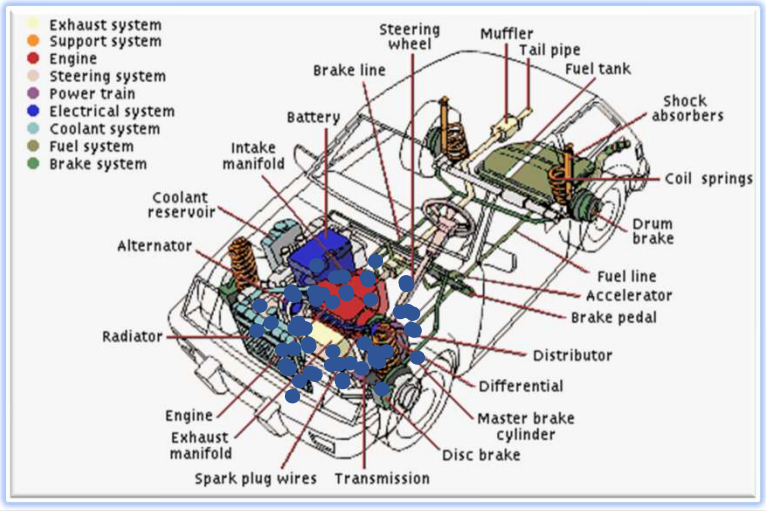


What are the 6 engine systems?

Internal combustion gasoline-powered engines require six systems: **fuel, exhaust, ignition, combustion, cooling, and lubrication**. Apr 19, 2021

Where is horsepower **in** the engine?

52

Thinking about intelligence a different way: Learning from birds, ants, fish and dogs

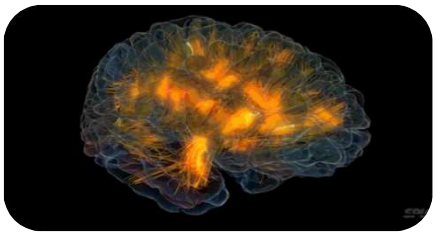
What is the underlying causal ***g*-type** mechanism for this complex behavior?

53

Emergence – Emergent property models

https://www.youtube.com/watch?v=jaPgOkO5lzY

54



"What we call general intelligence [*g*] is a **by-product** of the operation of a **complex system**. General intelligence [**psychometric *g***] is an ***index* of the efficiency of the brain in carrying out cognitive processing**" (Detterman et al., 2016; p. 203).

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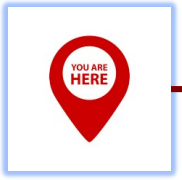
If psychologists are going to use and interpret intelligence tests, and rely on reporting a full scale or global IQ score, shouldn't we, **at a minimum**, understand **what are (and are not) the likely causal mechanisms** of intelligence… and **what does an IQ score mean**?

56



A. **The premature death knell** for intelligence testing in SP: **Full Scale IQ v CHC composite scores. SP is "stuck on *g*"**

B. **A contemporary *g*-less network model of intelligence:** The future? (McGrew et al., 2023)

   1. Implications for **WJ IV COG test and cluster interpretation**

C. **Using CHC COG→ACH network models** to understand the complex system of cognitive and achievement behaviors (McGrew, 2023). **"Beyond *g*"**

D. **B& C =**

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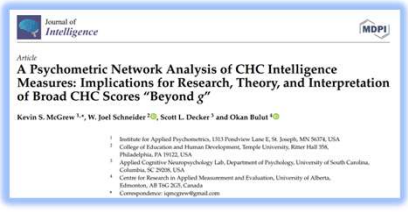
Network analysis of intelligence test data and **network (emergent property) intelligence theories** are here!



Journal of Intelligence — MDPI

Article

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

Kevin S. McGrew [1,*], W. Joel Schneider [2], Scott L. Decker [3] and Okan Bulut [4]

[1] Institute for Applied Psychometrics, 1313 Pondview Lane E, St. Joseph, MN 56374, USA
[2] College of Education and Human Development, Temple University, Ritter Hall 358, Philadelphia, PA 19122, USA
[3] Applied Cognitive Neuropsychology Lab, Department of Psychology, University of South Carolina, Columbia, SC 29208, USA
[4] Centre for Research in Applied Measurement and Evaluation, University of Alberta, Edmonton, AB T6G 2G5, Canada
* Correspondence: iapsygrew@gmail.com

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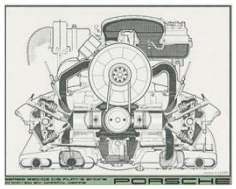
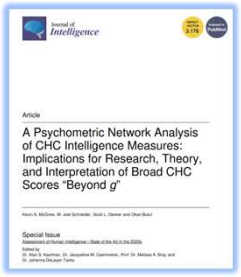
2.4.2. The Potential of Psychometric Network Models of Intelligence Tests

Modern network-based models of intelligence (e.g., process overlap theory; dynamic mutualism) (Protzko and Colom 2021a, 2021b; van der Maas et al. 2019) eschew the assumption that the positive manifold among cognitive ability tests is due to latent unobserved common causes. Instead, network models (and psychometric network analysis methods, PNA) are based on the assumption that the positive definite nature of cognitive ability test correlations is the result of the non-linear interaction of multiple biological and psychological factors, sans the invocation of underlying latent common cause explanatory traits or factors (Hampshire et al. 2012; van der Maas et al. 2019). Much like the quantitative horsepower index of an automobile engine is an *emergent property* metric that reflects the by-product of the complex interaction of multiple engine systems (e.g., fuel, exhaust, ignition, combustion, cooling, lubrication, etc.), modern network cognitive ability theories postulate that psychometric *g* is the result of, and not the cause of, the positive manifold between IQ tests (Conway et al. 2021; Fried 2020; Hampshire et al. 2012; Kan et al. 2019; Kovacs and Conway 2016, 2019). Borsboom et al. (2021), Jones et al. (2018), Neal and Neal (2021), and Robinaugh et al. (2016) provide excellent overviews of PNA, from which we borrow extensively in our description below.





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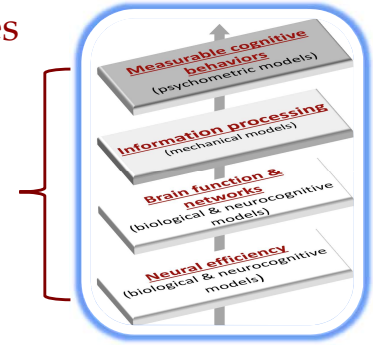
There are several **different network theories**, all that do **NOT** include a **latent *g*-factor or mechanism**

Interconnected (causal interaction) models

- **Dynamic mutualism** (van der Mass et al.)
- Wired intelligence (Savi et al.)
- Cognitive network neuroscience theories (Barbey et al.)

Sampling models

- **Process Overlap Theory** (Conway & Kovacs)



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Important new network theories for SP to become familiar with

Process Overlap Theory (POT)

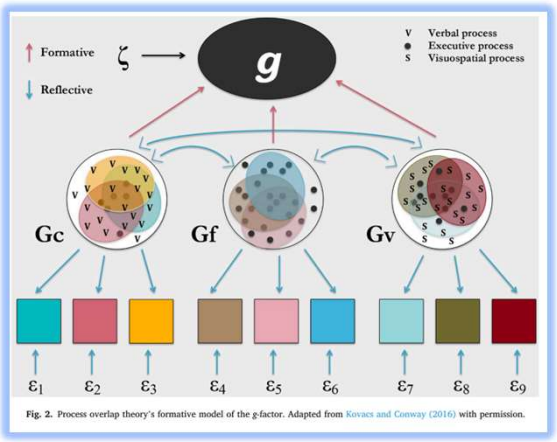

Fig. 2. Process overlap theory's formative model of the g-factor. Adapted from Kovacs and Conway (2016) with permission.

Dynamic mutualism (cog-ach mutualism)

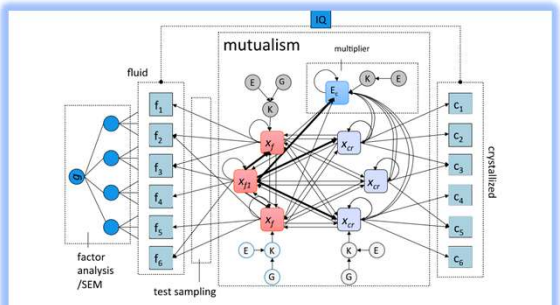

Figure 5-1. The unified model of general intelligence includes test sampling, reciprocal effects (both mutualistic and multiplier), and central cognitive variables (such as working memory capacity, x_{fl}). The x_f and x_c nodes represent fluid and crystalized cognitive abilities in the intelligence network. The f_i and c_i represent test scores for these abilities, the sum of which is IQ. The *g*-factor can be extracted using factor analysis on f (and c) tests.

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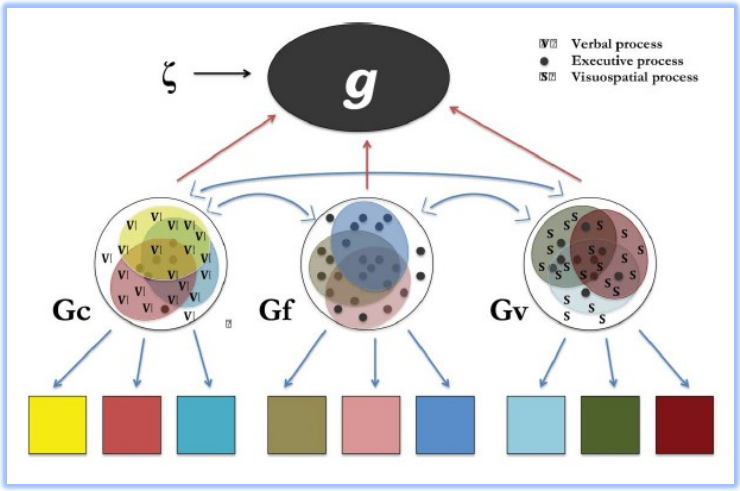
Process Overlap Theory: A Unified Account of the General Factor of Intelligence

Kristof Kovacs & Andrew R. A. Conway

Pages 151-177 | Published online: 02 Aug 2016

- POT explains positive manifold or *psychometric* g but dismisses *psychological* g.
- Process Overlap Theory (POT) postulates that domain-general executive processes, located primarily in the prefrontal cortex and partly in the parietal cortex, are the main reason for the emergence of positive manifold or g (Kovacs & Conway, 2016).
- POT proposes that domain-general executive processes overlap with domain-specific cognitive processes more than the domain-specific cognitive processes overlap with one another and that any cognitive task requires a number of domain-general and domain-specific cognitive processes.

(slide borrowed from Dr. Dawn Flanagan)



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Intelligence 88 (2021) 101567

Contents lists available at ScienceDirect

Intelligence

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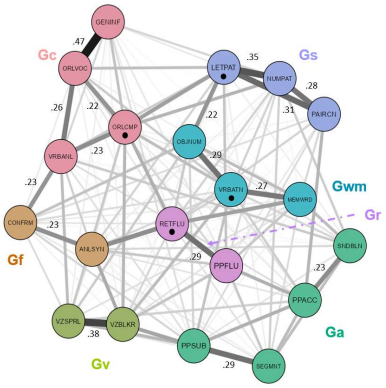
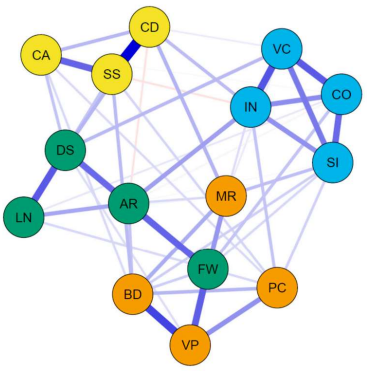
Evolving networks of human intelligence

Alexander O. Savi [a,*], Maarten Marsman [b], Han L.J. van der Maas [b]

…**network** (*g-less*) theories will dominate the twenty first





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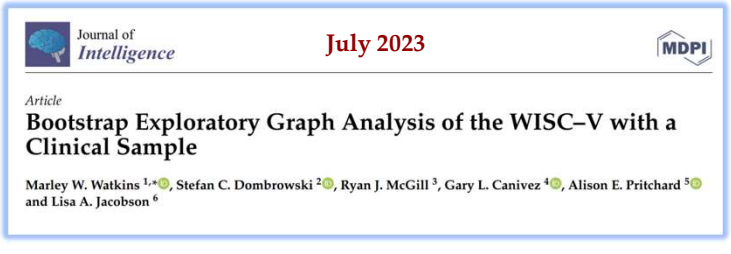


Journal of *Intelligence*

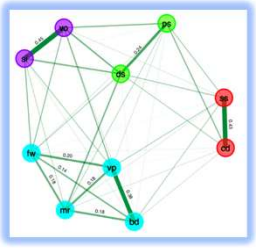
July 2023

MDPI

Article

Bootstrap Exploratory Graph Analysis of the WISC–V with a Clinical Sample

Marley W. Watkins [1,*], Stefan C. Dombrowski [2], Ryan J. McGill [3], Gary L. Canivez [4], Alison E. Pritchard [5] and Lisa A. Jacobson [6]



I'm happy to see that the ***g*-centric SP researchers are now attempting to use no-*g* psychometric network analysis methods**

EGAs have been supported by statistical simulations and productively applied to data from intelligence tests. As a result, McGrew and colleagues (McGrew et al. 2023) have recently called for the greater use of these methods to aid in the understanding of the psychological structure of commercial ability measures. However, EGAs have yet to be employed with WISC–V data, which is a glaring omission given the prominent role of the test and its progenitors in the realm of intellectual assessment research and practice. Accordingly, this study employed EGAs to investigate the structure of the 10 WISC–V primary subtests in a large clinical sample.

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Interestingly, these historically ***g*-centric SP** researchers do not reference their extensive body of ***g*-centric** research (that has led to the "just say no to broad CHC composite scores") or use the term **general intelligence or *g*** in this paper. The closest reference was commenting on how EGA/PNA methods removed the **"general variance"**

0.05. As expected, the resulting four factors were highly correlated, with a mean of 0.67 and a standard deviation of 0.07. Partial correlations, as applied in the EGA, removed the general variance that would otherwise be extracted in a second-order factor analysis. In

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Brief description of study **sample** and **measures**

- **Sample** – WJ IV norm subjects ages 9-19 (n = 3,258)
- **Measures** – Selected the **"best" CHC measures** (test or subtests) from WJ IV and ECAD (full-age range norm versions) based on review of CFA findings across WJ-R, WJ III and WJ IV
  - **Goal** – use the **best qualitatively different narrow ability measures for each CHC domain**
    - **Example** – After Oral Vocabulary (VL) and General Information (K0) were selected, OL Picture Vocabulary (VL) not selected as it would be too similar to Oral Vocabulary (VL). Therefore, OL Oral Comprehension (LS) was selected instead

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Visualization subtests

Phonological Processing subtests

WJ IV Measure	Abbreviation	CHC broad domain
Analysis-Synthesis	ANLSYN	Gf
Concept Formation	CONFRM	Gf
Verbal Analogies	VRBANL	Gc/Gf
General Information	GENINF	Gc
Oral Comprehension	ORLCMP	Gc
Oral Vocabulary	ORLVOC	Gc
Block Rotation	VZBLKR	Gv
Spatial Relations	VZSPRL	Gv
Phon. Proc. - Word Access	PPACC	Ga
Phon. Proc. - Substition	PPSUB	Ga
Segmentation	SEGMNT	Ga
Sound Blending	SNDBLN	Ga
Phon. Proc. - Word Fluency	PPFLU	Gr
Retreival Fluency	RETFLU	Gr
Object-Number Sequencing	OBJNUM	Gwm
Memory for Words	MEMWRD	Gwm
Verbal Attention	VRBATN	Gwm
Letter-Pattern Matching	LETPAT	Gs
Number-Pattern Matching	NUMPAT	Gs
Pair Cancellation	PAIRCN	Gs
Number Series	NUMSER	Gq
Applied Problems	APPROB	Gq
Calculation	CALC	Gq

What measures or broad CHC domains would you predict to be most **central** to a CHC intelligence network?

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Primary 20 variable CHC PNA model (n = 3,258)

Apriori selection of measures to best represent primary **CHC theoretical domains**

Gl tests and Number Series (Gf) test excluded

Most **central** measures in network

Most **central** single measure in network

Do these central measures share common cognitive processes?

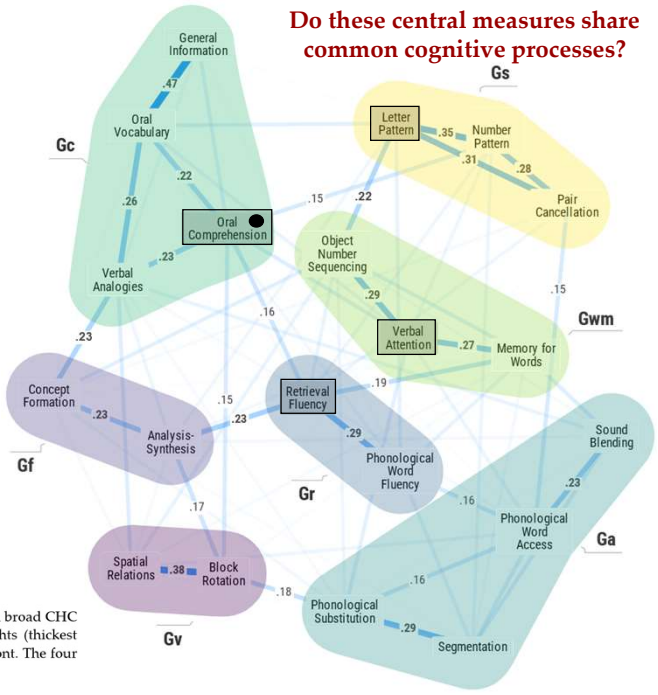

Figure 1. Weighted undirected network structure of 20 select WJ IV measures of seven broad CHC ability domains in the primary network model. *Note.* Numbers are the edge weights (thickest lines) greater than or equal to .15. Edge weights greater than or equal to .20 in bold font. The four most central nodes are enclosed in gray boxes (see manuscript text).

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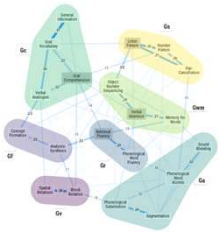

Support for **emergent property (*g*-less) CHC network theory**

- Validity of **Gc, Gf, Ga, Gwm, Gr, Gs & Gq broad abilities** supported
- Support for cleaving Glr into **Gl and Gr**
- Is **not possible** to provide differential support for any **specific emergent network theory** (e.g., process overlap theory; dynamic mutualism, wired intelligence) from these analyses

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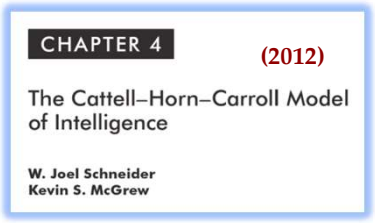
Implications for WJ IV test & cluster interpretations



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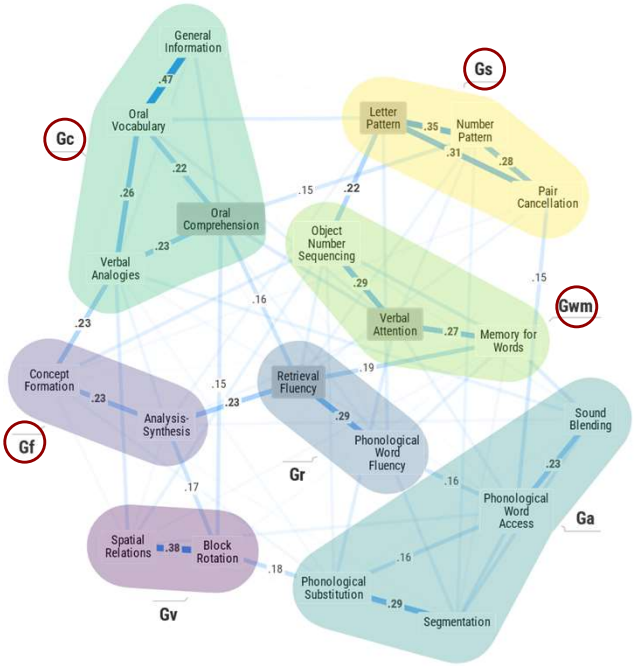
Implications for WJ IV test & cluster interpretations

- Clear Support for **Comprehension-Knowledge (Gc), Fluid Reasoning (Gf), Processing Speed (Gs), and Working Memory (Gwm) tests or clusters**
- **Numbers Reversed & Number Series** excluded apriori—extant lit supports there CHC classifications



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Implications for WJ IV test & cluster interpretations

- Perhaps the WJ III Gv cluster **should have been retained** instead of creating the Visualization Test
- The **Visualization test** (mdn rel. = .85**)** can be interpreted as **proxy for broad Gv** instead of Visualization + Picture Recognition cluster (mdn rel. = .86). Typical SR/Vz ***r* = .60**. – Visualization test is a **"mini-me"** cluster

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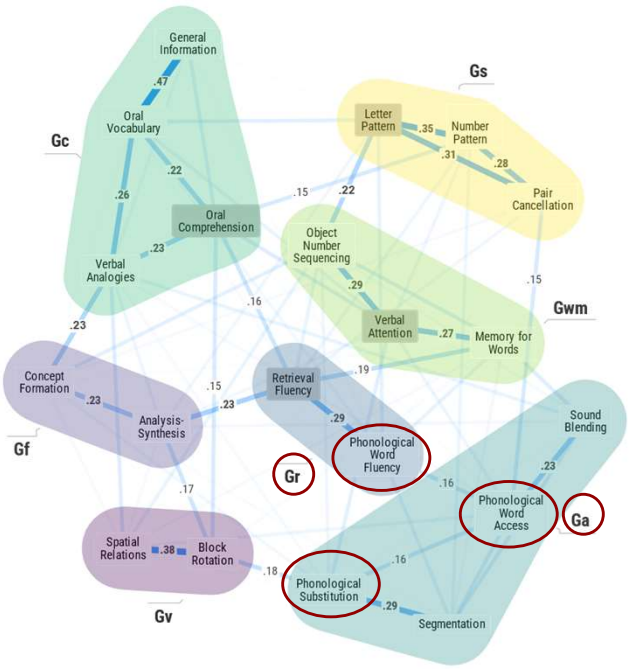
Implications for WJ IV test & cluster interpretations

- The **WJ IV Phonological Processing test is factorially complex (Ga and Gr)** and may be a good pragmatic predictor, but should be **interpreted cautiously as a "pure" indicator of Ga**



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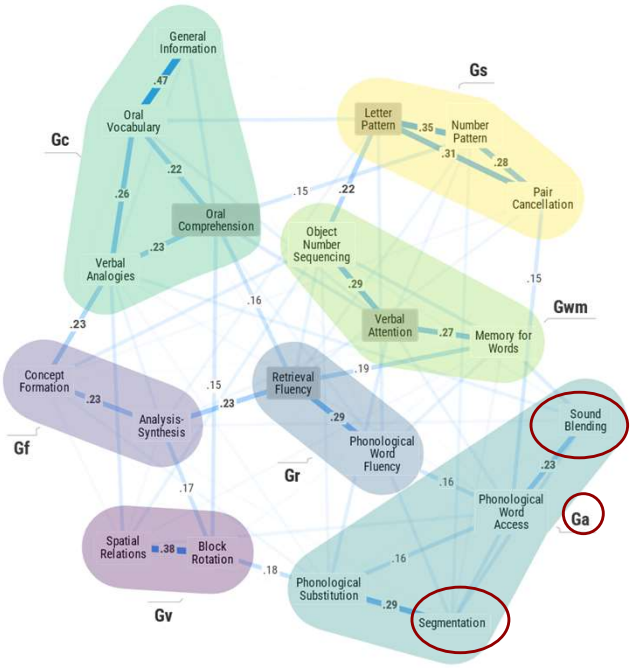
Implications for WJ IV test & cluster interpretations

- **The best Ga cluster in the WJ IV is the Phonetic Coding cluster from the Oral Language Battery**



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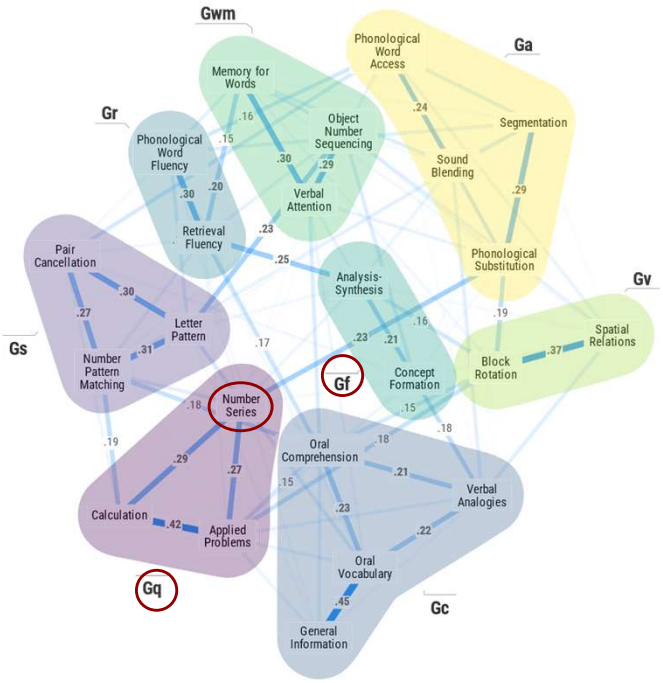
Secondary "boundary specification" 23 variable CHC PNA model (included *Gq* measures)

Implications for WJ IV test & cluster interpretations

- **Number Series has noticeable connection with Gq** (mixed Gf-RQ Gq-KM issue raised).
- Gf cluster might be impacted (low) for kids **lacking in foundational math achievement skills?**
- If low, follow-up with **Analysis-Synthesis**



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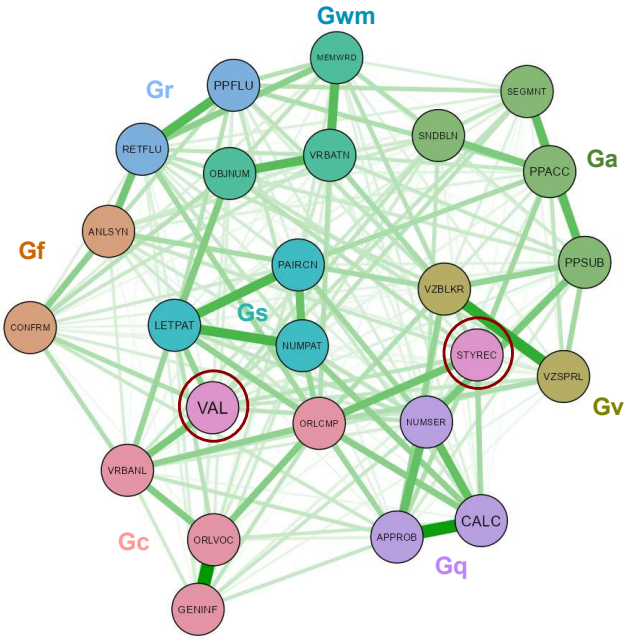
Secondary "boundary specification" 25 variable CHC PNA model (included *Gq* and *Gl* measures)

Implications for WJ IV test & cluster interpretations

- **Glr cluster (VAL+STYREC) not strong cluster. STYREC** is likely best indicator of Gl. VAL is a more questionable Gl measure. **Supplement Story Recall with another measure** of free recall memory (M6), meaningful memory (MM), or associative memory (MM) from another battery?
- Best proxy of **Gr** is WJ IV **Oral Language Speed of Lexical Access** cluster (Schneider & McGrew, 2018)



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The **complexity of listening comprehension** tasks is captured well by Osada (2004, p. 63):

The process of listening comprehension is **highly complex**. The knowledge and skills necessary for listening comprehension must be all utilized **simultaneously**. However, our **processing space is limited**. Before we can sort out what has we just heard, the speech **disappears**. What is worse, we cannot get the speech repeated. We **must comprehend the text as we listen** to it, **retain** the information in memory, **integrate** it with what follows, and **continually adjust our understanding** of what we hear in the light of prior knowledge and incoming information. Given this **heavy processing load,** listeners may **lose concentration quickly** and sometimes give up listening all together.

(McGrew et al., 2023)

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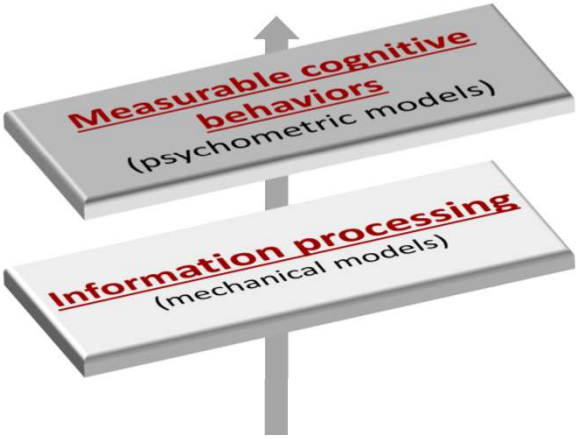

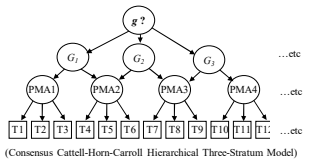

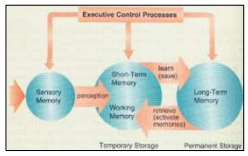

What about CHC **information processing** models, which suggest **causal relations** between cognitive abilities?

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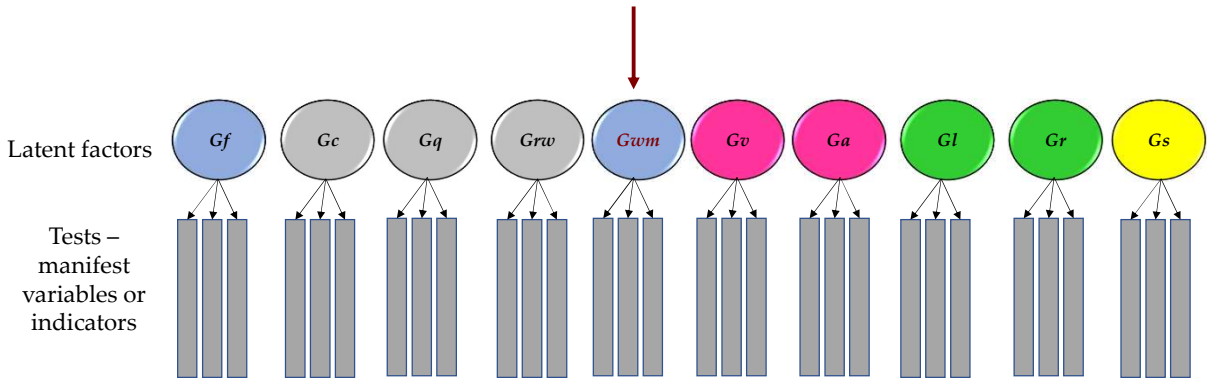
Remember that **working memory (Gwm)** is **NOT** an **individual differences trait-like construct** (McGrew, 2005, 2009)



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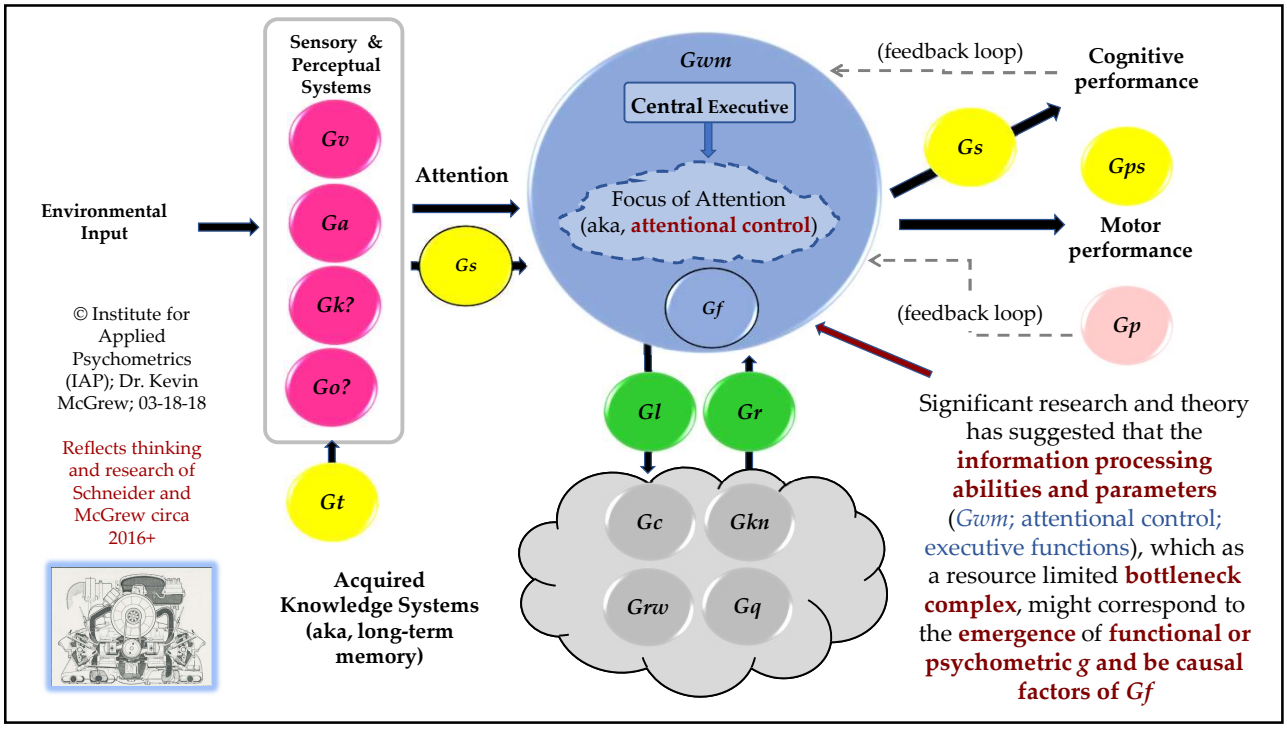

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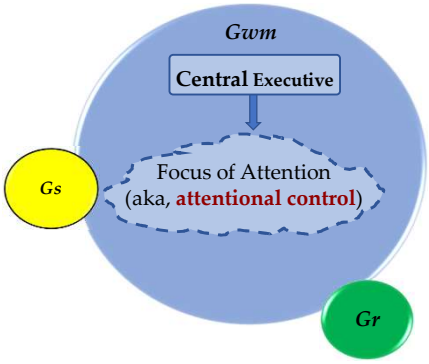
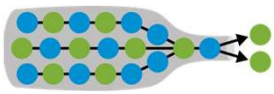


Often referred to as the **working memory- attentional control(Gwm-AC) system/complex**

(Burgoyne et al. 2022; Conway & Kovacs, 2015; Conway et al., 2021;Holdern & Hart, 2022; **Hunt, 2011**)

The **Gwm-AC complex** is a **resource limited (constrained)** system: The information "**bottleneck**"



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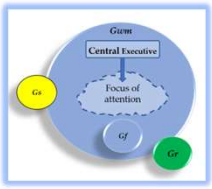

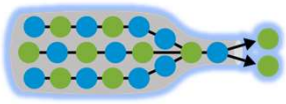

Cognitive processing/efficiency or attentional control/working memory complex may be most central component of intellectual functioning

Whatever the terms, be they working memory, retrieval fluency, attentional control, cognitive control, executive functioning, top-down control processes, executive attention, processing speed, etc., the extant broad CHC abilities SEM research consistently suggests that the CHC parameters of cognitive processing or Gwm-AC efficiency are crucial to higher-level cognition typically operationally defined as psychometric *g* or Gf (De Alwis et al. 2014; Demetriou et al. 2014; Fry and Hale 1996; Hunt 2011; Kail 2007; Kyllonen and Christal 1990; McGrew 2005; Neubeck et al. 2022; Schneider and McGrew 2018; Tourva and Spanoudis 2020; Unsworth et al. 2021a, 2021b). The Gwm and AC-related constructs

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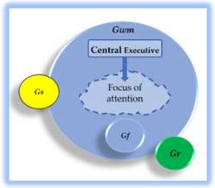
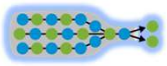
Of interest is the central role **Gwm and AC-related constructs** play in other areas of **brain network research**…





and Spanoudis 2020; Unsworth et al. 2021a, 2021b). The Gwm and AC-related constructs have also demonstrated a central role in other areas of brain network research, such as mind wandering (Bressler and Menon 2010; Kane and McVay 2012; McVay and Kane 2012; Smallwood 2010) and focused attention meditation (Lutz et al. 2008; Sedlmeier et al. 2012). These conceptually-related lines of research have demonstrated a link between measures and constructs of cognitive processing efficiency (particularly Gwm, AC, and Gs) and brain network-based models of neural efficiency (Bressler and Menon 2010). This link is also featured in the dynamic mutualism and wired intelligence models of intelligence that suggests working memory capacity may be a "central" cognitive variable or process underlying intelligence. The process overlap theory of intelligence also features multiple domain–general executive functioning, AC and Gwm-related cognitive processes in the positing of a central executive bottleneck processing explanation of psychometric *g* as an emergent property (Conway et al. 2021; Conway and Kovacs 2015). Engle and colleagues' (Burgoyne et al. 2022) AC explanation of the positive manifold is also consistent with the importance of the Gwm-AC complex.

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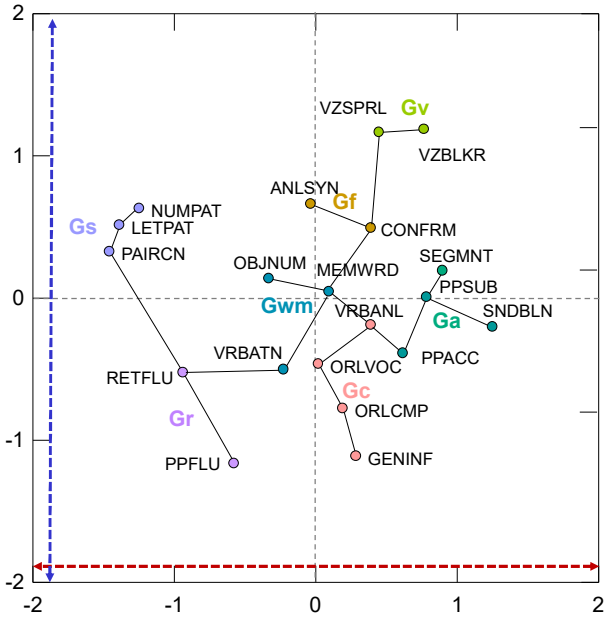
More process-dominant/ less cultural loaded (Intelligence-as-Process)

Cattell's g_f

Cattell's g_c

More product-dominant/ culturally loaded (Intelligence-as-Knowledge)



More System 1 /automatic automatized cog. processes ← Fast ---------- Slow → More System 2 / controlled deliberate cog. processes

Primary 20 variable CHC MDS+MST (as per Jones et al., 2018) supplemental model (n = 3,258)

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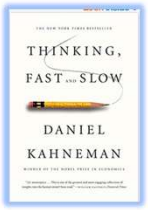
PNA suggests possible **intermediate or cognitive ability or processing dimensions we may need to recognize in understanding intelligence and intelligence test performance**

- **System 1** (automatized cog. processes) vs **System 2** (controlled deliberate cog. processes) continuum
- **Cattell g_f/ g_c** and / **Ackerman PPIK** continuums



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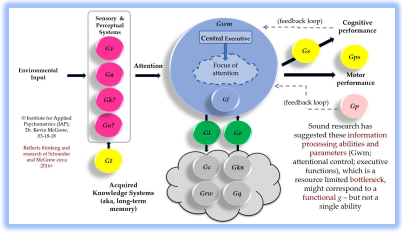
Psychometric network analysis and related theories can inform and compliment causal modeling research



PNA methods are, at face value, exploratory and descriptive—they do not directly suggest causal mechanisms in the psychological network. However, this is an upside of PNA models *when combined with substantive knowledge and network science tools*. The primary value of these descriptive models is their ability to function as a bridge to theory formation and the ability to hypothesize, and empirically test or statistically simulate, potential causal mechanisms in the network (Borsboom et al. 2021; Haslbeck et al. 2021). In contrast, classic statistical prediction models such as multiple regression provide few hints regarding possible complex causal relations between and among variables in a regression model. SEM causal models have the potential to illuminate causal relations between and among broad CHC abilities. However, currently no comprehensive CHC explanatory causal SEM-based

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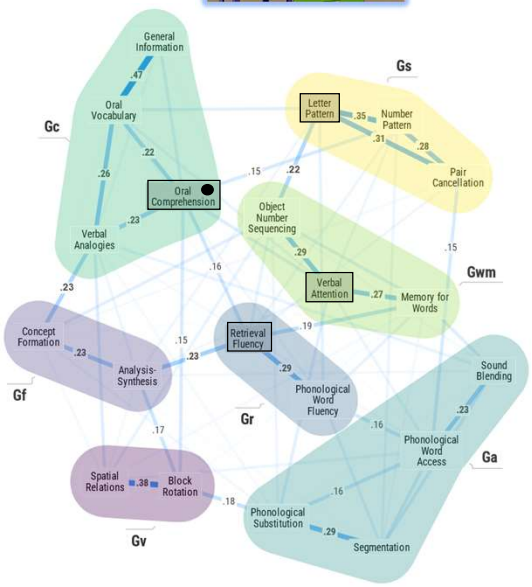
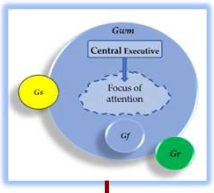
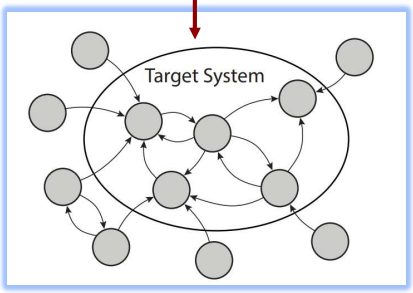
Implications for **intervention** research and efforts







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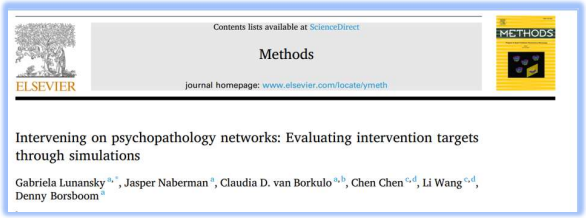
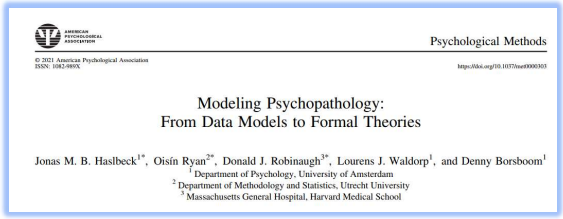
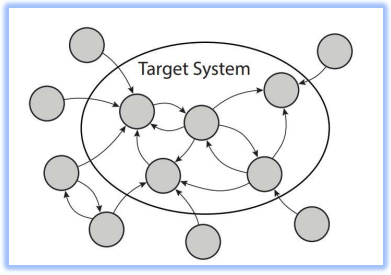
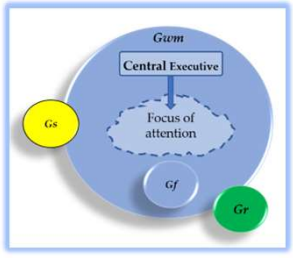
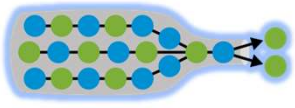






"*In silico*" intervention model research





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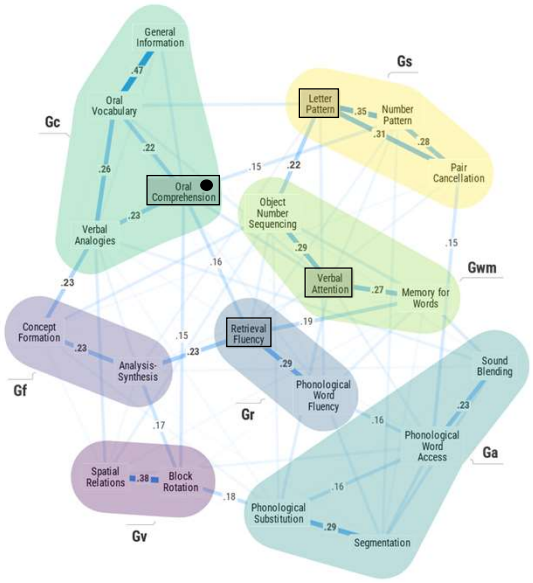
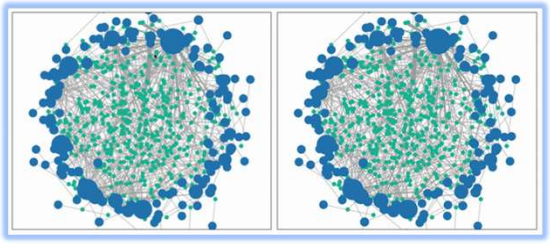
Network intervention simulations





"What if? ***"in silico"*** simulations

"*As highly central nodes go, so should go the network*" (aka, the **centrality hypothesis assumption**; Robinaugh et al., 2016)

Evaluate the potential **impact** of **changing the connectivity of the system** (Epskamp et al. 2018)

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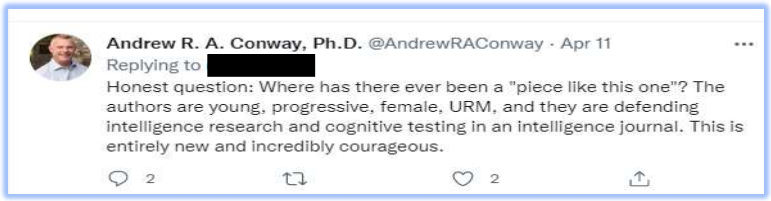
Network non-*g* dynamic modern models of intelligence have potential for helping with interventions that may help **ameliorate social inequities in education**



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Journal of *Intelligence* 2023 MDPI

Perspective

Intelligence Can Be Used to Make a More Equitable Society but Only When Properly Defined and Applied

LaTasha R. Holden [1,*] and Sara A. Hart [2,3]

[1] Department of Psychology, The University of Memphis, Memphis, TN 38152, USA
[2] Department of Psychology, Florida State University, Tallahassee, FL 32306, USA; sahart@fsu.edu
[3] Florida Center for Reading Research, Tallahassee, FL 32306, USA
* Correspondence: lholden@memphis.edu

Abstract: In the US, undeniable evidence shows that socioeconomic inequities explain a high proportion of individual differences in school achievement. Although not all countries show this same effect due to socioeconomic status, it is consistently found that social inequities lead to achievement gaps. These achievement gaps then manifest into trajectories that set some individuals on a path of lower incomes, poorer health and higher mortality, lower wellbeing, and other poor adult outcomes. Like James Flynn so handily reminded the scientific literature that achievement gaps are explainable by environmental factors, the inequities we see around the world are based on environments some children are exposed to. In his work, Flynn stated his belief that the suppression of scientific work on intelligence would continue to lead to social inequities. We wish to take this idea and move it forward. We believe that the scientific construct of intelligence plays a key role in helping create a more equitable society through science. We also believe that the poor perception of intelligence, rooted in historical realities, means that it will continue to be misunderstood, feared, and misused, limiting how effective it could be in helping to close gaps in achievement and in creating a more equitable society.

check for updates

Citation: Holden, LaTasha R., and

Keywords: intelligence; inequity; social issues

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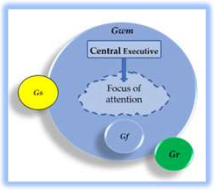

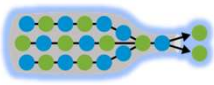

An intriguing recent suggestion, albeit likely controversial in some circles given the historical realities and track record of intelligence testing and theories with marginalized groups, is that newer non-*g* emergent property theories of intelligence might lead to better intervention research for individuals who have been marginalized by society. Holden and Hart (2021) suggest that network-based theories, particularly those that feature Gwm-AC mechanisms (process overlap theory in particular) may hold promise as a vehicle for improving, and not harming, social justice and equity practices and valued outcomes for individuals in marginalized groups. For example, *stereotype threat* (Spencer et al. 2016; Steele and Aronson 1995) has been linked to poorer outcomes in performance settings where an individual's group membership is salient, a situation that can negatively impact an individual's Gwm-AC complex, executive functions, and more deliberate controlled cognitive processing mechanisms (Holden and Hart 2021; Spencer et al. 2016). The identification of the central Gwm-AC complex and a possible System I-II cognitive processing dimension in the current study aligns with Holden and Hart's (2021) proposal that these cognitive constructs should be featured in a variety of potential interventions for learners who experience learning difficulties, and as articulated by Holden and Hart (2021), to potentially mitigate the impact of stereotype threat in certain marginalized groups. In contrast, common cause factor models that include a dominant psychometric or theoretical *g* construct hold little promise for helping individuals as a century of research has not yet found convincing evidence-based practice approaches for "moving the needle" on general intelligence. In contrast, emergent property models have "the benefit of focusing on lower order specific abilities . . . because they are real, and beyond being statistically emergent (like global IQ or *g*), they have predictive validity" (Holden and Hart 2021, p. 3).

(McGrew et al., 2023)

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A. **The premature death knell** for intelligence testing in SP: **Full Scale IQ v CHC composite scores. SP is "stuck on *g*"**

B. **A contemporary *g*-less network model of intelligence:** The future? (McGrew et al., 2023)

   1. Implications for **WJ IV COG test and cluster interpretation**

C. **Using CHC COG→ACH network models** to understand the complex system of cognitive and achievement behaviors (McGrew, 2023). **"Beyond *g*"**

D. **B& C =**

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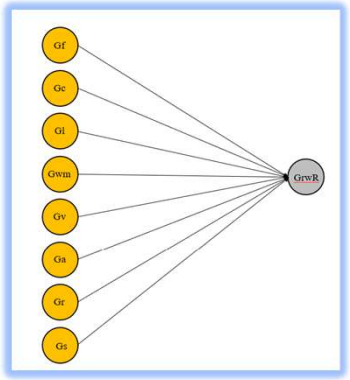

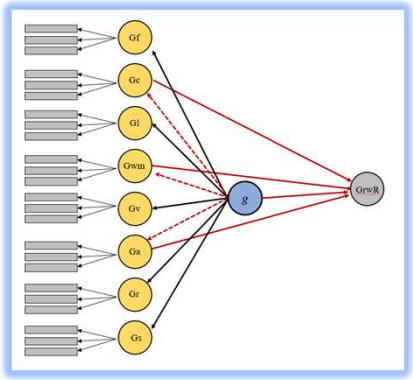

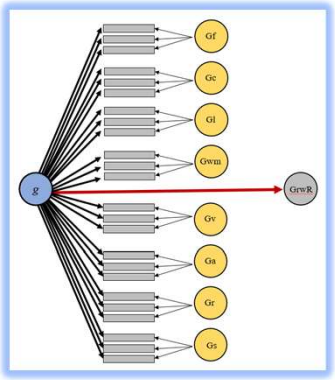

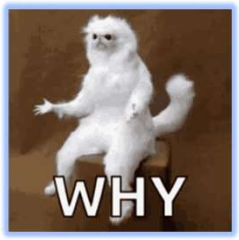

These models, although important, do not help us better understand the **WHY and HOW**

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WJ III Test Name	TM CHC	O2 g	O1 Grw	O1 Gc	O1 Gl [1]	O1 Gsc [2]	O1 Gf	O1 Gsa [2]	O1 Gwm [1]	O1 Gq	O1 Gv	O1 Ga
		Factors										
Word Attack	Grw	0.62	0.58									
Spelling of Sounds	Grw	**0.70**	0.46									0.30
Spelling	Grw	0.65	0.32									
Letter–Word Identification	Grw	**0.74**	0.32									
Editing	Grw	**0.70**	0.22									
Writing Samples	Grw	0.67	0.14									
Picture Vocabulary	Gc	0.65		0.65								
Verbal Comprehension	Gc	**0.86**		0.45								
General Information	Gc	**0.82**		0.34								
Academic Knowledge	Gc	**0.83**		0.26								
Reading Vocabulary	Grw	**0.81**		0.20								
Story Recall	Gl	**0.82**		0.14								
Oral Comprehension	Gc	0.66		0.14								
Passage Comprehension	Grw	0.68		0.08								
Memory for Names	Gl	0.57			0.48							
Visual–Auditory Learning	Gl	**0.70**			0.44							
Picture Recognition	Gv	0.44			0.23							
Visual Closure	Gv	0.25			0.16							
Pair Cancellation	Gs	0.42				0.79						
Visual Matching	Gs	0.48				0.68						
Decision Speed	Gs	0.39				0.64						
Cross Out	Gs	0.51				0.57						
Retrieval Fluency	Gr	0.54				0.25						
Concept Formation	Gf	**0.73**					0.54					
Understanding Directions	Gsw	**0.81**				0.22	0.40					
Reading Fluency	Grw	0.66				0.38		0.47				
Math Fluency	Gq	0.50				0.46		0.37		0.33		
Rapid Picture Naming	Gr	0.43				0.43		0.25				
Writing Fluency	Grw	0.58				0.27		0.25				
Memory for Words	Gwm	0.57							0.50			
Numbers Reversed	Gwm	0.58							0.40			
Memory for Sentences	Gwm	0.66		0.14					0.37			
Auditory Working Memory	Gwm	**0.70**							0.37			
Calculation	Gq	0.59								0.42		
Number Series [3]	Gf	**0.73**								0.39		
Number Matrices [3]	Gf	**0.72**								0.38		
Applied Problems	Gq	**0.76**								0.34		
Analysis-Synthesis	Gf	**0.73**					0.18			0.20		
Spatial Relations	Gv	0.50									0.52	
Block Rotation	Gv	0.49									0.39	
Planning	Gv	0.38									0.29	
Sound Blending	Ga	0.56										0.58
Auditory Attention	Ga	0.42				0.23						0.41
Incomplete Words	Ga	0.48										0.34
Sound Patterns–Voice	Ga	0.49										0.20
Sound Awareness	Ga	**0.83**										

The combined exploratory–confirmatory analyses of 46 WJ III tests in the age 14–19 norm sample produced **robust factor results consistent with Carroll's (2003) analyses.**

Carroll was pleased with these findings when we jointly interpreted the EFA-SL results during our May 2003 working session in Alaska.

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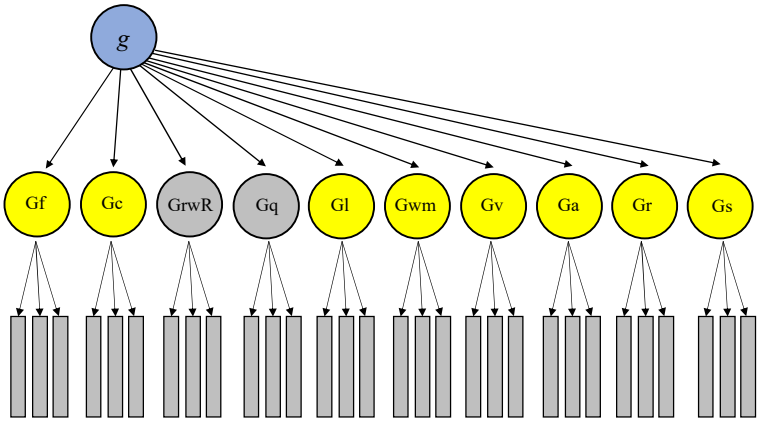
WJ III (ages 14-19; *n* = 1600+) Norm Data Analysis Supported Carroll *g*+CHC model



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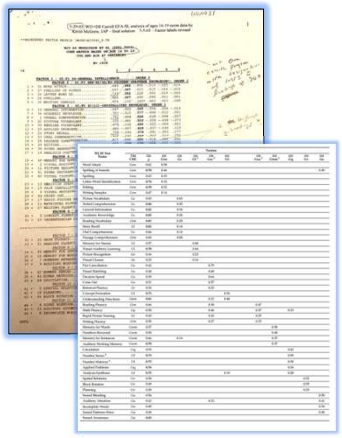
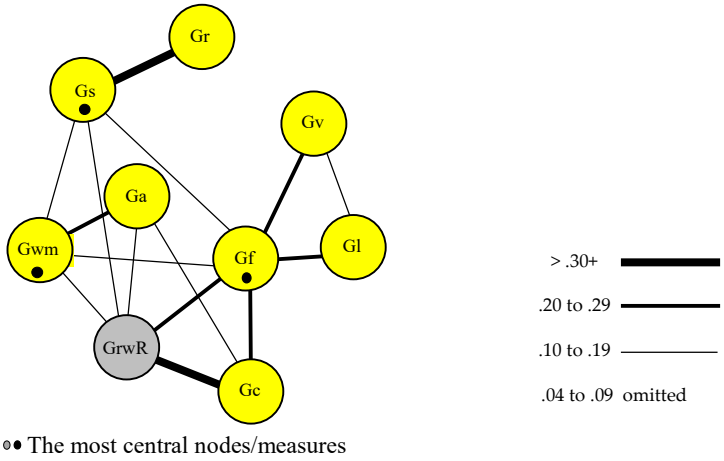
Carroll Recommended More Higher-Stratum Research Designs: A CHC Cognitive-Achievement Psychometric Network Analysis





●● The most central nodes/measures

From CHC Structural Research to Cognitive-Achievement Network Analysis Research

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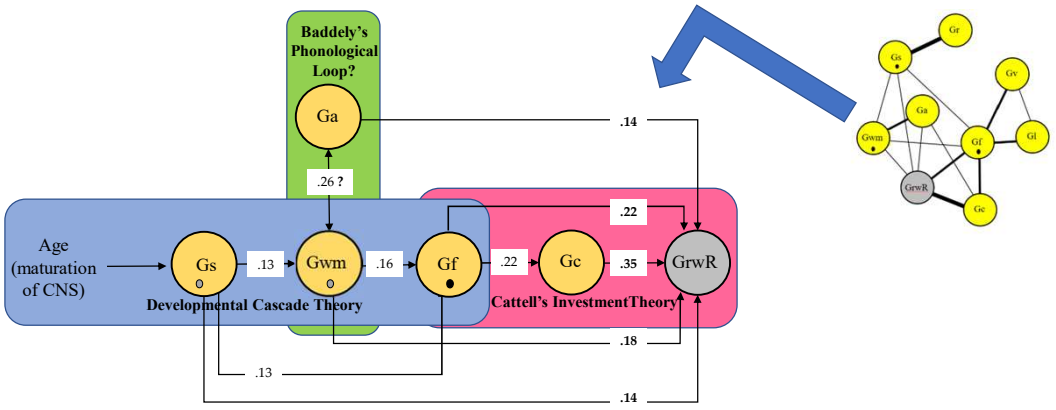
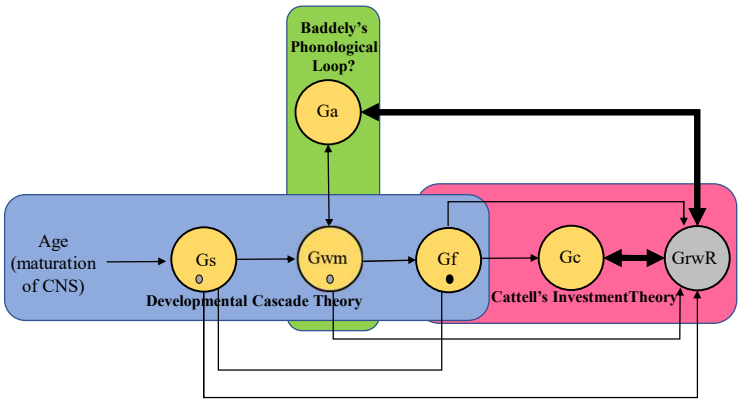
PNA models have exploratory→causal potential when married with substantive and theoretical knowledge

CHC cognitive-reading composite variables (and partial weights) organized as per the developmental cascade and Cattell's investment theories



●● The most central nodes/measures = The "target system"

98



Cognitive-achievement mutualism – many of these paths may be bidirectional (Peng, 2022; Peng & Kievit, 2020)

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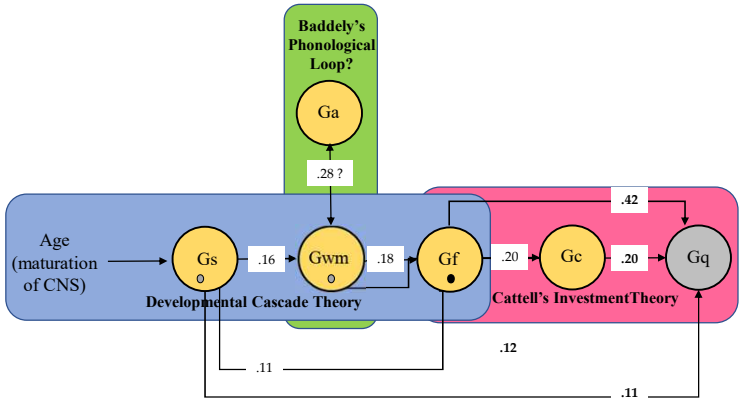
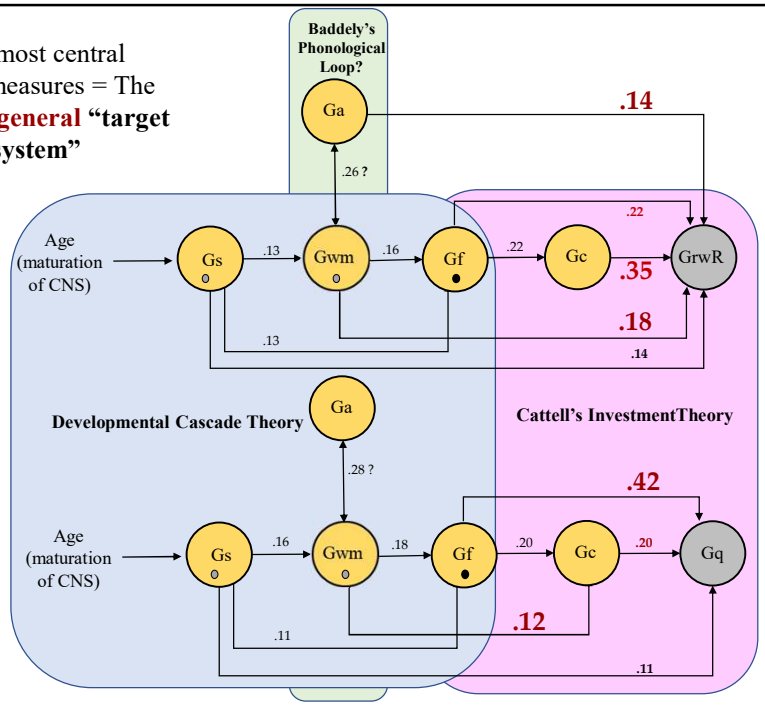
CHC cognitive-**math** composite variables (and partial weights) organized as per the **developmental cascade** and **Cattell investment theories**



●● The most central nodes/measures = The **"target system"**

100

- The most central nodes/measures = The **domain-general "target system"**



Note larger **red font values**

Academic **domain-specific** cognitive processes?

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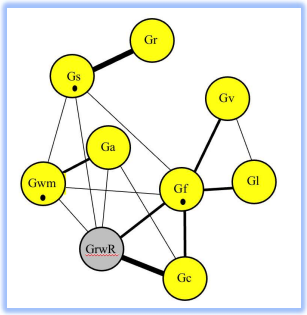
PNA of CHC tests or factor analyses derived broad CHC scores can serve as a **new lens** by which to **identify potential key levers** for understanding relations between cognitive abilities, intellectual functioning, and school achievement



- Cross-sectional PNA methods **do not directly suggest** causal mechanisms in the psychological network.
- The primary value of these **descriptive** models is their ability to function as a **BRIDGE to theory formation and the ability to hypothesize, and empirically test or statistically simulate (*in silico*), potential causal mechanisms in the network** (Borsboom et al. 2021; Haslbeck et al. 2021).

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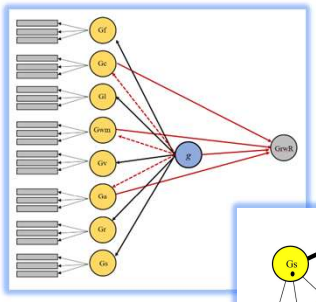
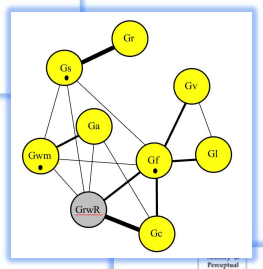
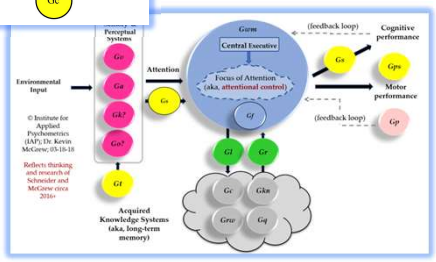
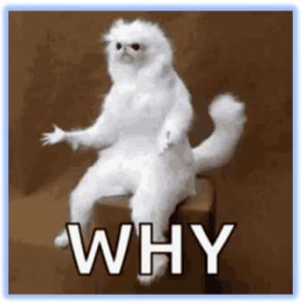






PNA models of cognitive abilities can assume a **pivotal role in improving CHC cognitive–achievement relations SEM modeling research**



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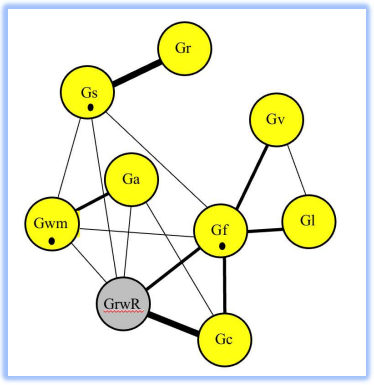

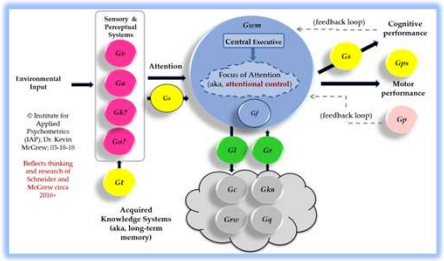

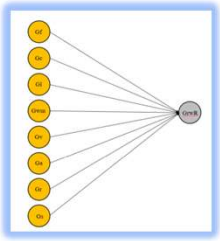

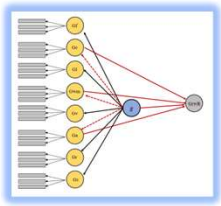

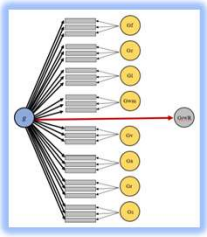

"The PNA methodology and results demonstrate how this relatively new methodology can complement factor analysis by providing a framework for identifying and empirically evaluating **cognitive–achievement causal relations and mechanisms**, with an eye toward **improved cognitive intervention research** ***[,new and more useful diagnostic approaches to learning disorders]*** **and theory formation**" (McGrew, 2023, p. 26)

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Final Thought

Research Is Needed To Bridge CHC Theories and Intelligence Testing Practices in Education

We believe Haslbeck et al.'s (2021) proposed framework for advancing theory construction in psychopathology could be adapted for intelligence research. In this framework, formal theory construction will likely require a division of labor between researchers steeped in intelligence test measurement, psychometrics, and psychometric-derived intelligence descriptive taxonomies (e.g., CHC theory) and intelligence or cognitive science theoretical researchers who can focus more on the generation, evaluation, and refinement of formal theories of intelligence and cognitive functioning. Clearly, the lengthy historical chasm between proposed intelligence testing score diagnostic and interpretation systems and evidence-based interventions will likely persist until a genuine rapprochement occurs between these two general categories of intelligence researchers. We hope the current paper






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Use a proposed **rapprochement bifurcated *g*** model of intelligence test interpretation model

Use psychometric *g* (full scale IQ score) for **pragmatic/administrative decision-making …only if you MUST**

Recognize that the best available evidence and research, based on over 100+ years of research, suggests **removing the psychometric *g* (statistical abstraction) *constraint*** will allow us to **benefit from what we do know (and don't know) regarding broad CHC ability constructs and their measures**

Its ok to interpret ***valid*** **CHC broad ability scores as they represent known human cognitive abilities**

Such a model **has equity/diversity implications** for intelligence testing in SP (Holden & Hart, 2023)

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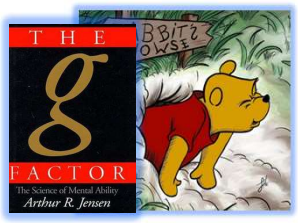
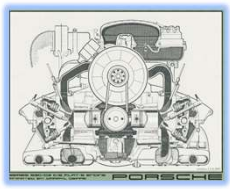
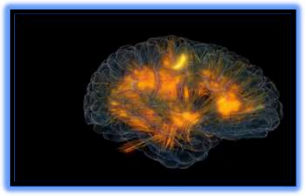
Stuck on…or stuck by…*g*







- All there is is *g*
  - Beyond *g*
    - **Instead of *g***

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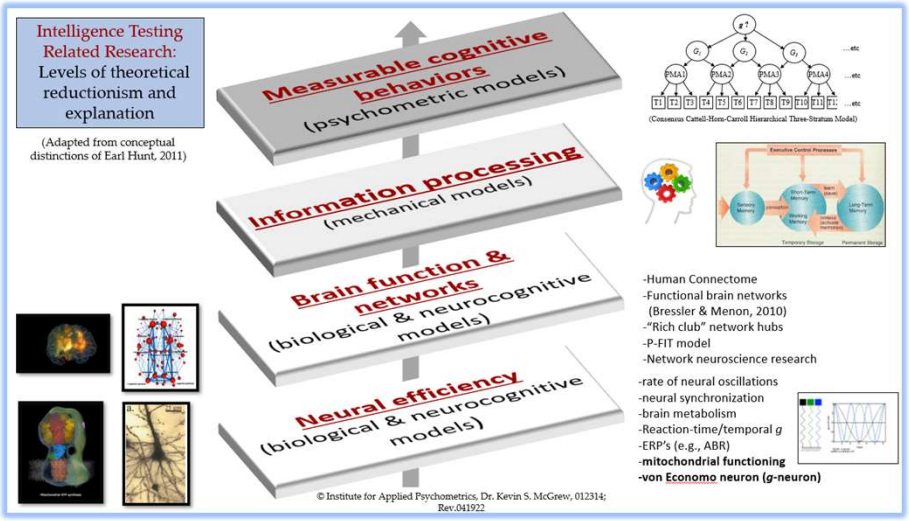
If school psychologists are going to use and interpret intelligence tests, and rely on reporting a full scale or global IQ score, shouldn't we, **at a minimum**, understand **what are (and are not) the likely causal mechanisms** of intelligence… and **what does an IQ score mean**?



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Important new network theories for SP to become familiar with

Process Overlap Theory (POT)

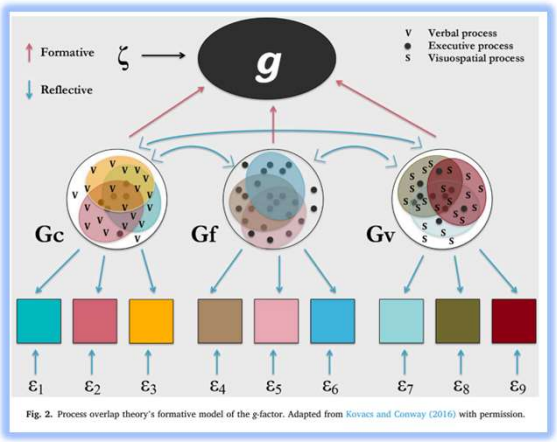

Fig. 2. Process overlap theory's formative model of the *g*-factor. Adapted from Kovacs and Conway (2016) with permission.

Dynamic mutualism (cog-ach mutualism)

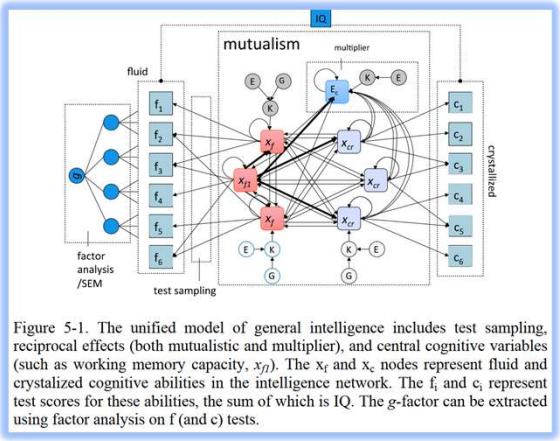

Figure 5-1. The unified model of general intelligence includes test sampling, reciprocal effects (both mutualistic and multiplier), and central cognitive variables (such as working memory capacity, x_{fl}). The x_f and x_c nodes represent fluid and crystalized cognitive abilities in the intelligence network. The f_i and c_i represent test scores for these abilities, the sum of which is IQ. The *g*-factor can be extracted using factor analysis on f (and c) tests.

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