

2018

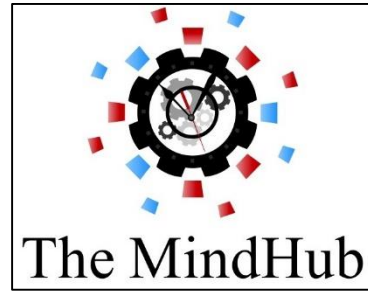
CHC Theory Revised: A Visual-Graphic Summary of Schneider and McGrew's 2018 CHC Update Chapter

Dr. Kevin S. McGrew, Director, Institute for Applied Psychometrics (IAP)
Dr. W. Joel Schneider, Associate Professor, Temple University



A MindHub™ Pub. #4. 05-18-18 v1.2





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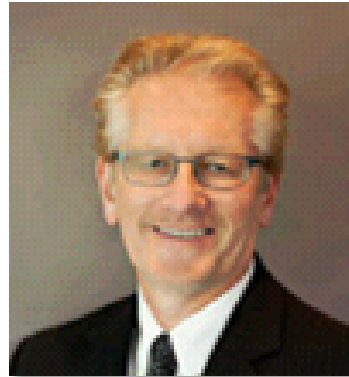
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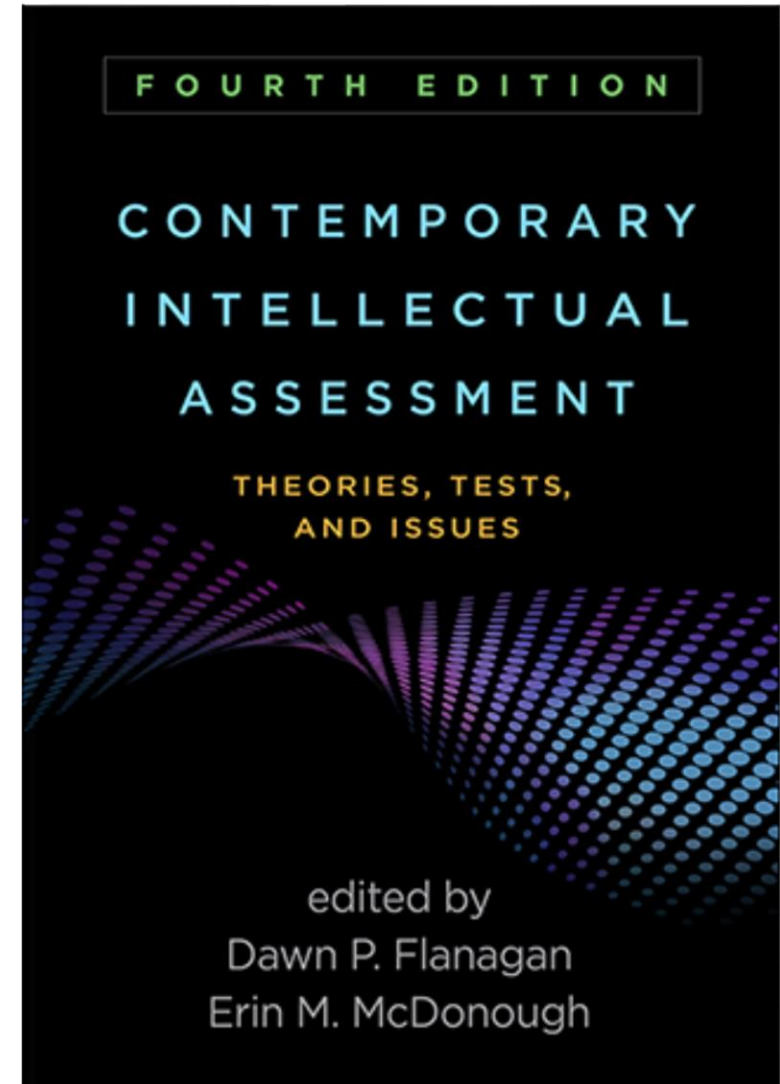
CHC Theory Revised

For the latest revisions &
refinements to CHC Theory see
our chapter in:



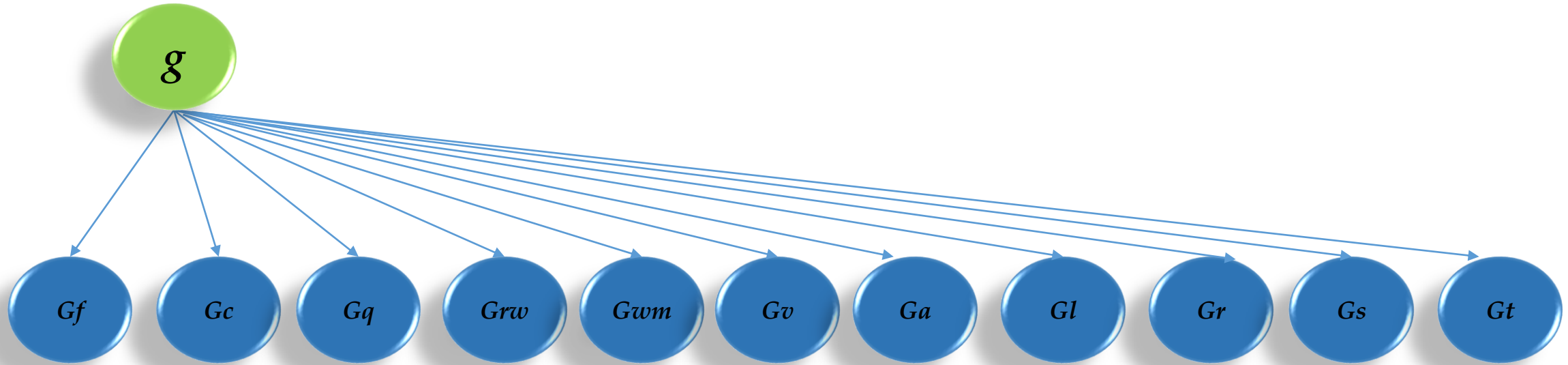
Available Sept 2018:

<https://www.guilford.com/books/Contemporary-Intellectual-Assessment/Flanagan-McDonough/9781462535781/summary>



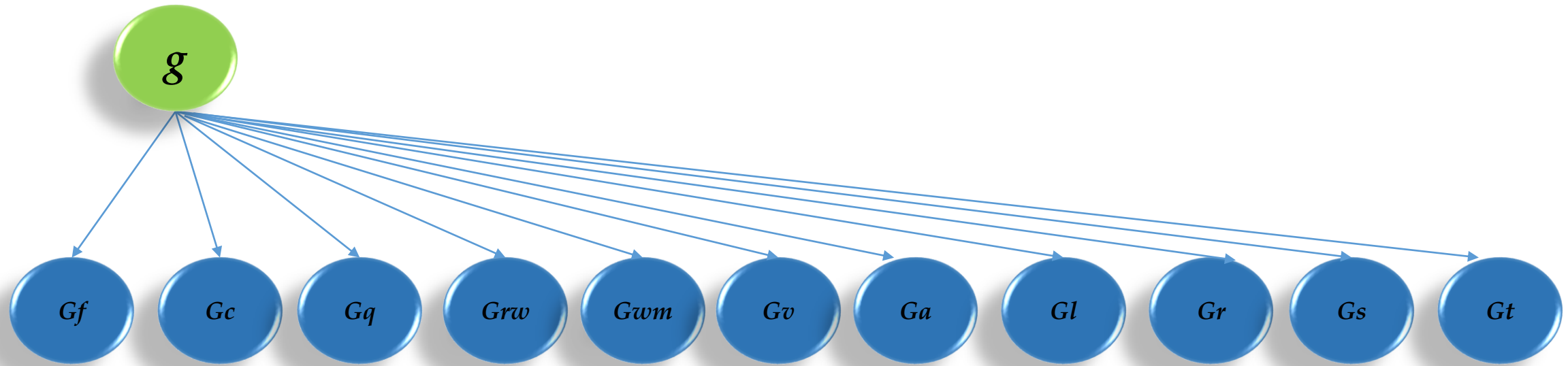
Cattell-Horn-Carroll Theory (CHC) of Cognitive Abilities

(Typical **hierarchical framework** presentation; based on Schneider & McGrew, 2018)



Tentative abilities often excluded from figures





- Gf = Fluid reasoning
- Gc = Comprehension-knowledge
- Gq = Quantitative knowledge
- Grw = Reading and writing
- Gwm = Working memory capacity
- Gv = Visual-processing
- Ga = Auditory processing
- Gl = Learning Efficiency
- Gr = Retrieval fluency
- Gs = Processing speed
- Gt = Reaction and decision speed

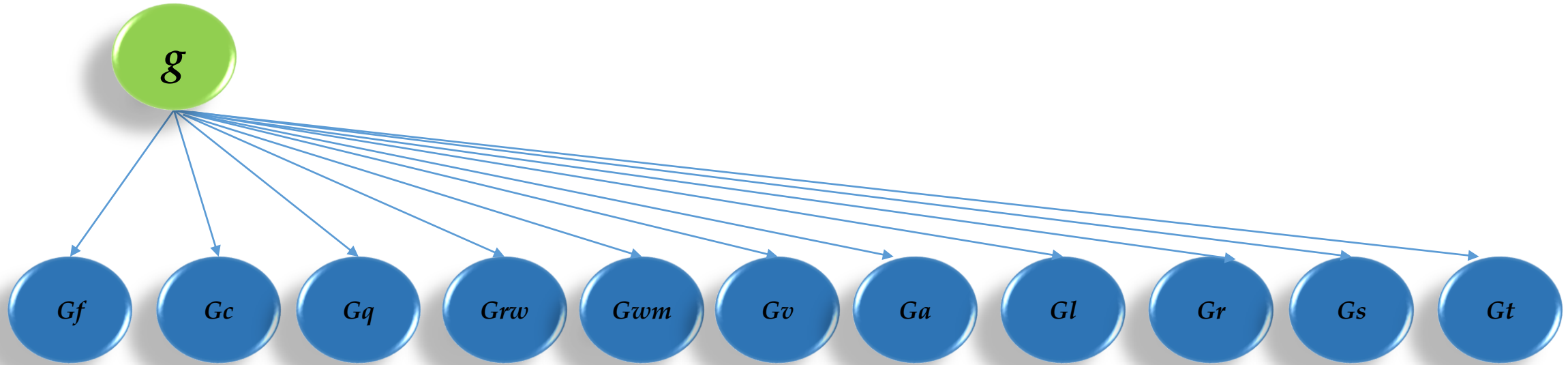
Tentative broad abilities often excluded from figures



- *Gei* = Emotional intelligence
- *Gk* = Kinesthetic abilities
- *Go* = Olfactory abilities
- *Gh* = Tactile abilities
- *Gp* = Psychomotor abilities
- *Gps* = Psychomotor speed

Cattell-Horn-Carroll Theory (CHC) of Cognitive Abilities

(Typical **hierarchical framework** presentation; based on Schneider & McGrew, 2018)



Tentative abilities often excluded from figures

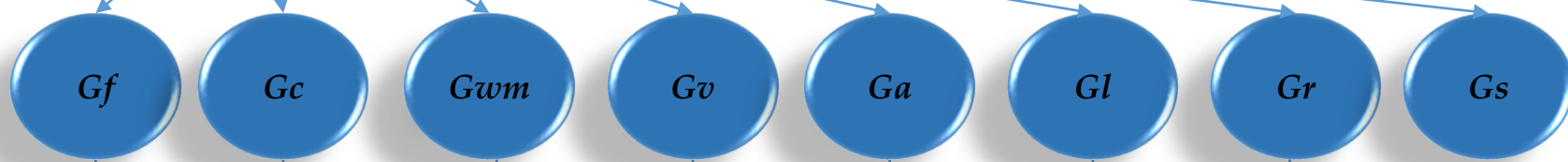


General

CHC Cognitive Abilities Measured Across Most Intelligence Tests
(plus those that should be measured)



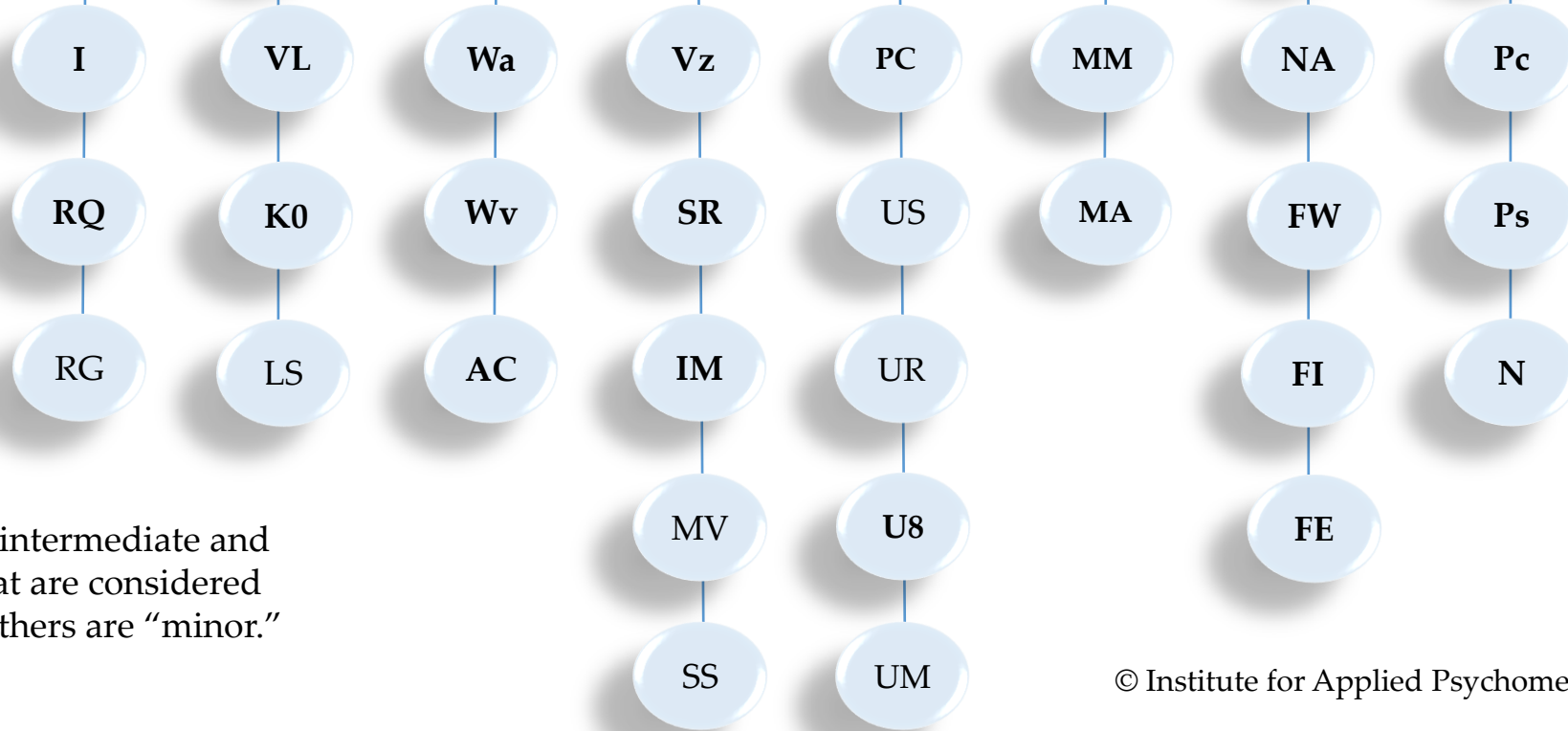
Broad



Intermediate



Narrow



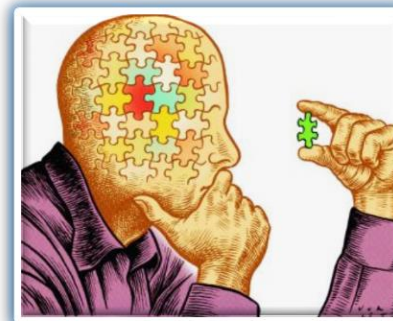
Bold font indicates intermediate and narrow abilities that are considered "major" abilities. Others are "minor."



Fluid reasoning

The use of deliberate and controlled procedures (often requiring focused attention) to **solve novel “on the spot” problems** that cannot be solved by using previously learned habits, schemas, and scripts.

- Solving unfamiliar problems (novel problem solving)
- Evident in abstract reasoning that depends less on prior learning
- **Deductive and inductive reasoning** are primary characteristics
- “Figuring things out”



Gf

I

RG

RQ

Fluid reasoning

Induction (I): The ability to observe a phenomenon and **discover the underlying principles or rules** that determine its behavior. This ability is also known as rule inference.

General Sequential Reasoning (RG): The ability to reason logically using known premises and principles This ability also is known as deductive reasoning or rule application.

Quantitative reasoning (RQ): The ability to reason with **quantities, mathematical relations, and operators.**

(Domain includes more narrow abilities not listed here)

Facets become fashionable in CHC theory

THE ORGANIZATION OF HUMAN ABILITIES¹

LLOYD G. HUMPHREYS

University of Illinois

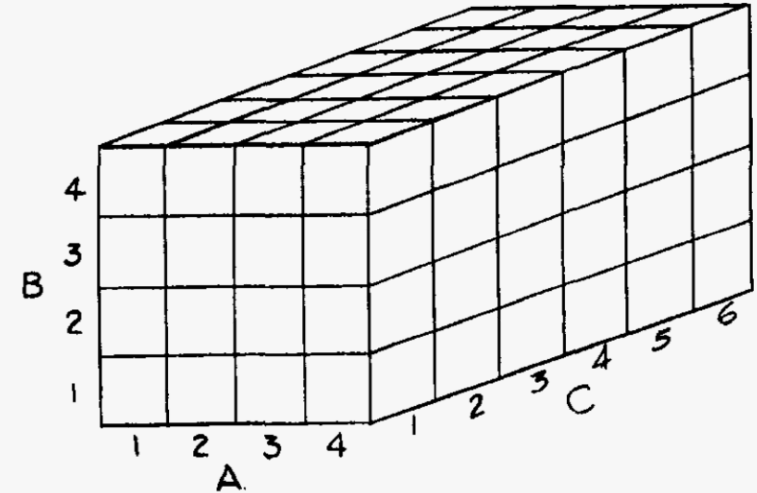
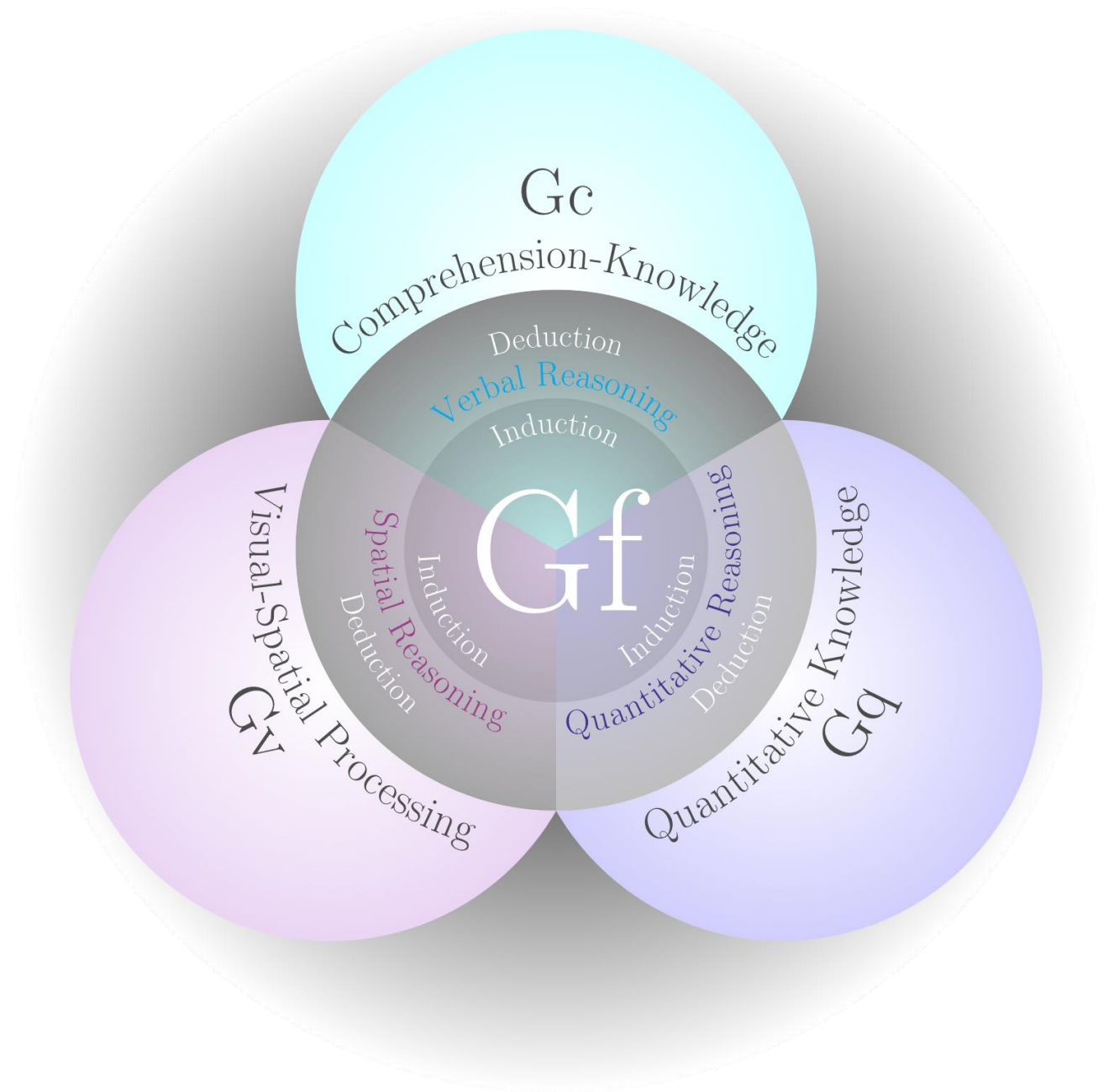
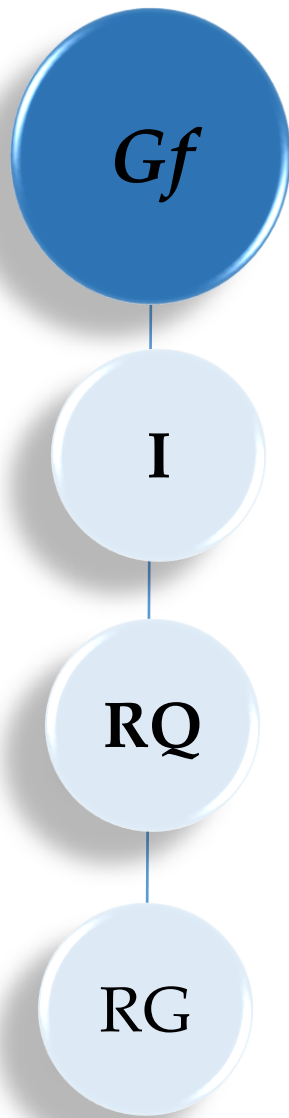


FIG. 3. Three facets creating 96 simple combinations of elements.

Facets are based on facet theory and represent **logical based** classifications of test materials as per stimulus content characteristics (e.g., verbal, numerical, figures, etc.) and are **not** to be confused with ability factors. See Humphreys (1962).





Comprehension-knowledge

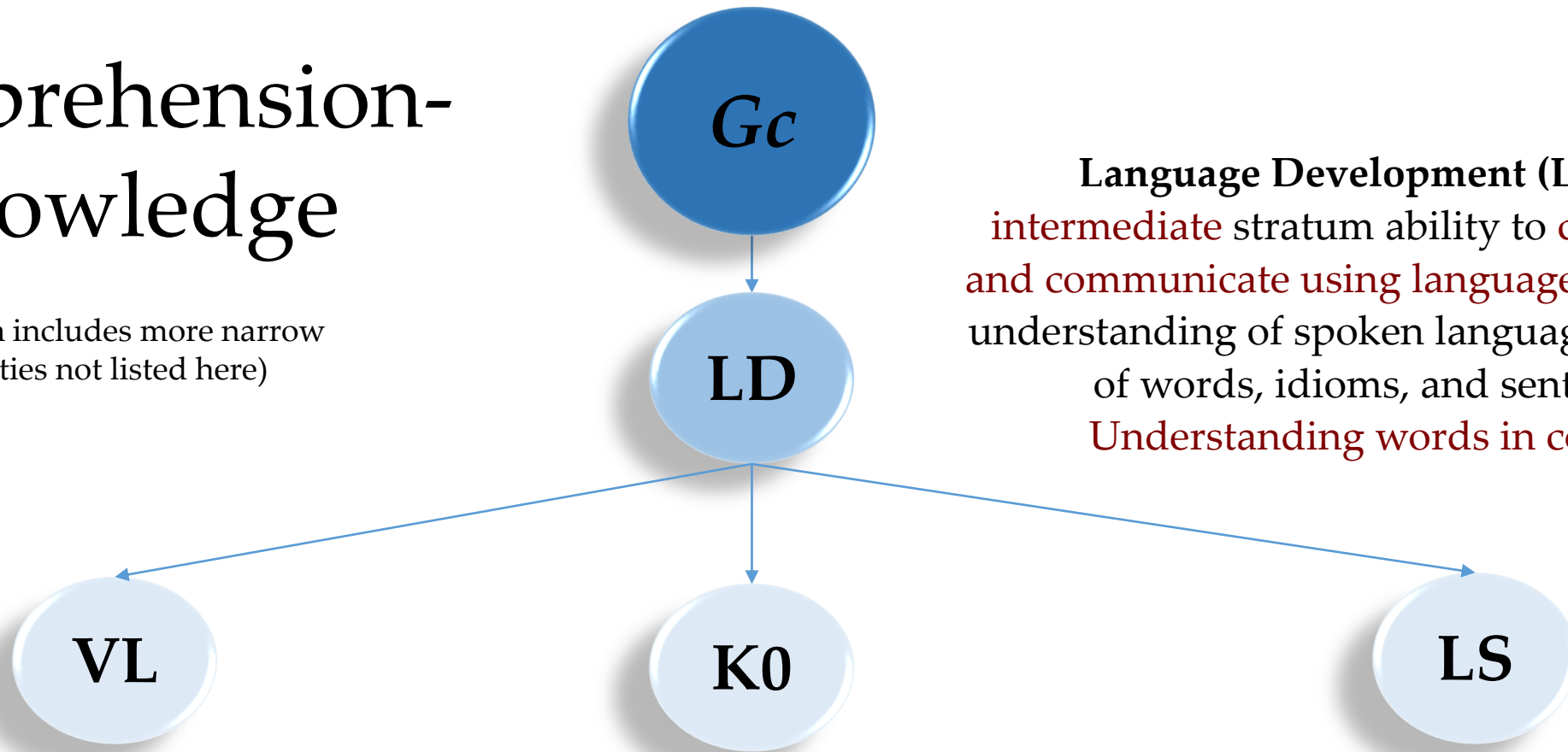
The ability to **comprehend and communicate** culturally-valued knowledge. *Gc* includes the **depth and breadth of knowledge** and skills such as language, words, and general knowledge developed through experience, learning and acculturation.

- **Acquired skills and knowledge** valued in a culture
- The degree to which a person has learned **practically useful knowledge of language, information, and concepts** specific to a culture
- Store of verbal or **language-based knowledge**



Comprehension- knowledge

(Domain includes more narrow
abilities not listed here)



Language Development (LD): An **intermediate** stratum ability to **comprehend and communicate using language**. The general understanding of spoken language at the level of words, idioms, and sentences. **Understanding words in context.**

Lexical Knowledge (VL): The knowledge of the **definitions of words** and the concepts that underlie. **Vocabulary knowledge.**

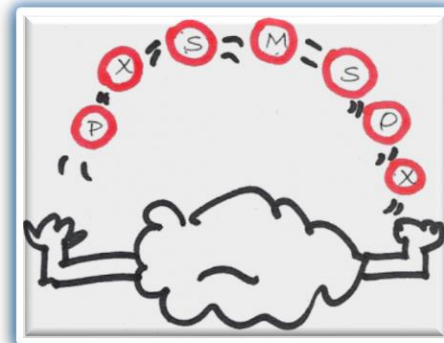
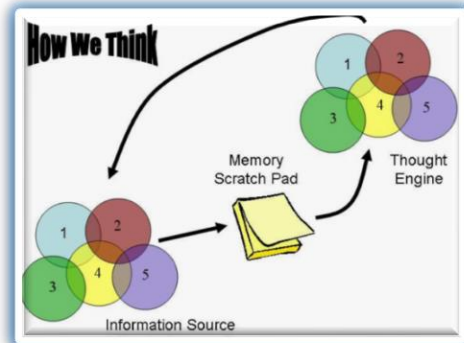
General (Verbal) Information (K0):
The breadth and depth of **knowledge that one's culture deems essential**, practical, and worthwhile for everyone to know.

Listening Ability (LS): The ability to **understand speech**.
This ability starts with comprehending single words and increases to long complex verbal statements.

Working memory capacity

The ability to maintain and manipulate information in active attention. The mind's mental "scratchpad" or "workbench."

- A limited capacity system
- Mental scratch pad or workspace
- Loses information quickly through decay of memory traces, unless individual activates other cognitive resources to maintain the information in immediate awareness



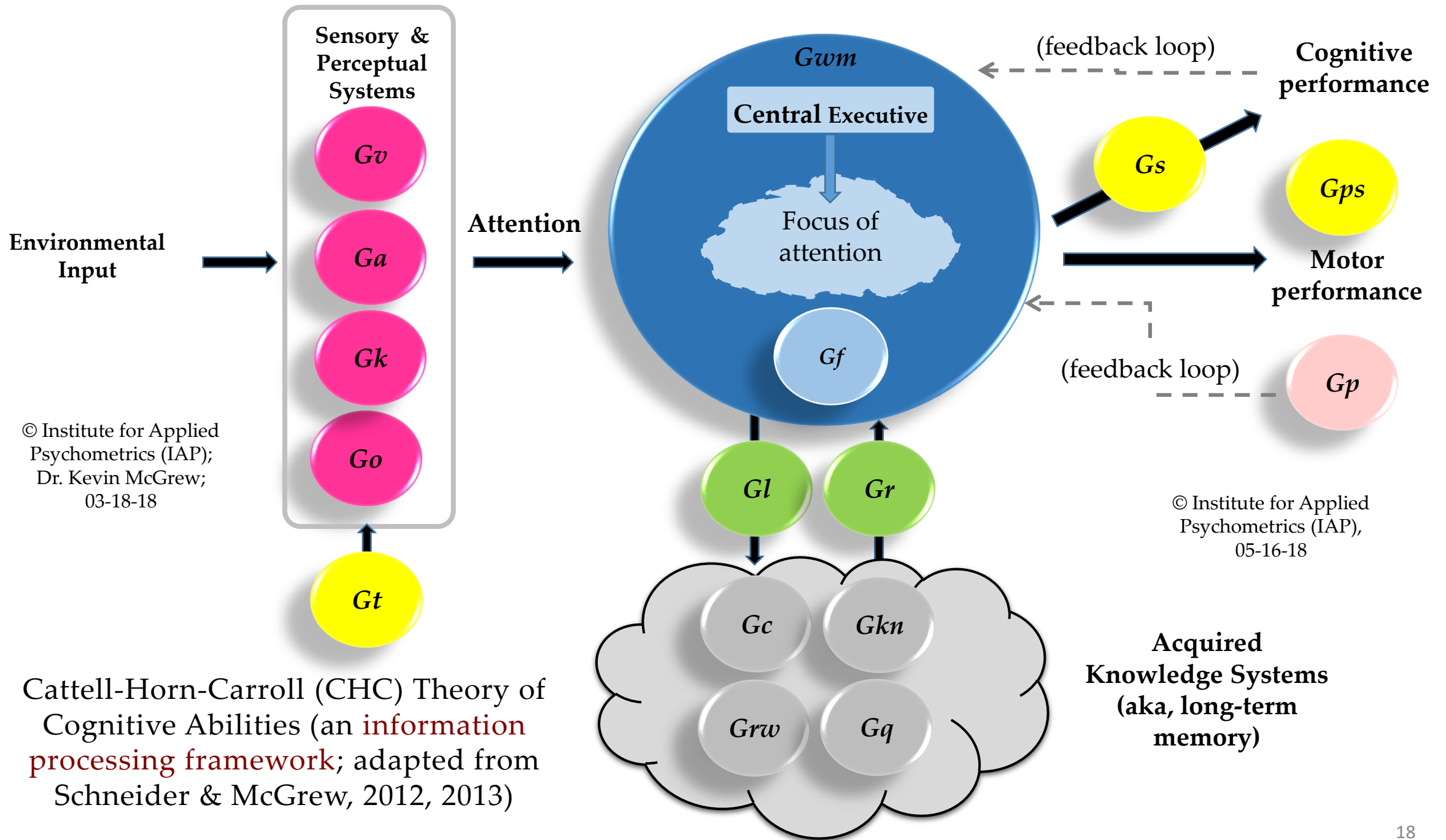


Working memory capacity

Auditory short-term storage (Wa): The ability to encode and **maintain verbal information in primary memory.**

Visual-spatial short-term storage (Wv): The ability to encode and **maintain visual information in primary memory.**

Attentional Control (AC): The ability to manipulate the spotlight of attention flexibly to focus on task-relevant stimuli and ignore task irrelevant stimuli. Sometimes referred to as spotlight or **focal attention, focus, control of attention, executive controlled attention, or executive attention.**



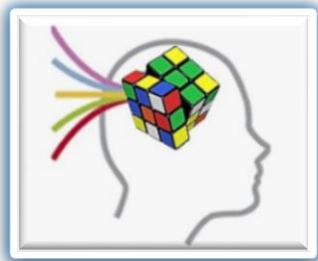


Visual processing

The ability to make use of simulated mental imagery to solve problems. Perceiving, discriminating and manipulating images in the “mind’s eye.”

- The ability to **perceive & transform visual shapes, forms, or images**
- The ability to maintain **spatial orientation** with regard to objects that may change or move through space
- Processing visual shapes or images “**in the minds eye**”
- **Visual imagination** and ability to **visualize problems**

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Gv

Vz

IM

Mv

SS

Visual processing

Visualization (Vz): The ability to perceive complex visual patterns and **mentally simulate** how they might look when transformed (e.g., rotated, changed in size, partially obscured, and so forth).

Imagery (IM): The ability to voluntarily **mentally produce very vivid images** of objects, people or events that are not actually present.

Visual memory (MV): The ability to **remember complex visual images** over short periods of time (less than 30 seconds).

Spatial scanning (SS): The ability to **quickly and accurately survey (visually explore) a wide or complicated spatial field or pattern** with multiple obstacles and identify a target configuration or identify a path through the field to a target end point.

(Domain includes more narrow abilities not listed here)

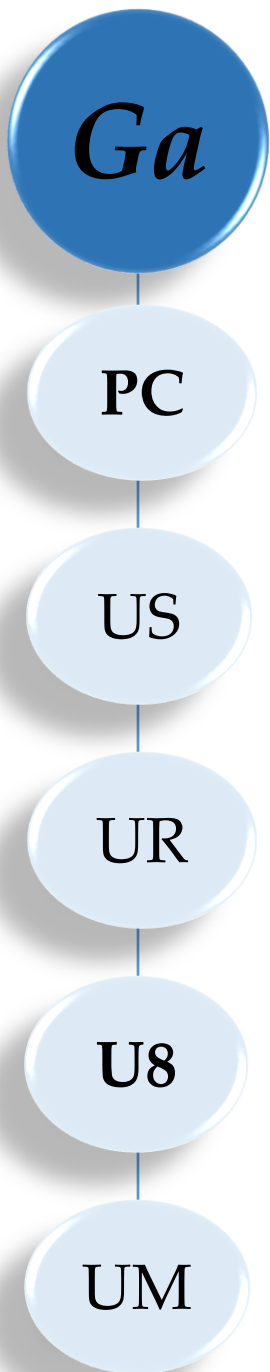
Auditory processing

The ability to discriminate, remember, reason, and work creatively (on) auditory stimuli, which may consist of tones, environmental sounds, and speech units.

- Discriminating patterns in **sounds an music**
- Processing **sounds with distracting background noise**
- Analyze, manipulate, comprehend, and synthesize **sound elements**, groups of sounds, or sound patterns
- Hearing and localizing **sounds in the environment**

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Auditory processing

Phonetic coding (PC): The ability to distinctly hear **phonemes**, blend sounds into words, and segment words into parts, sounds, or phonemes.

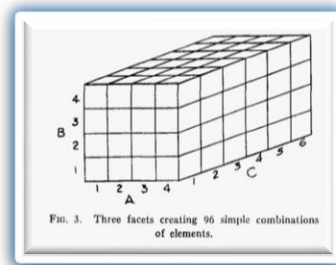
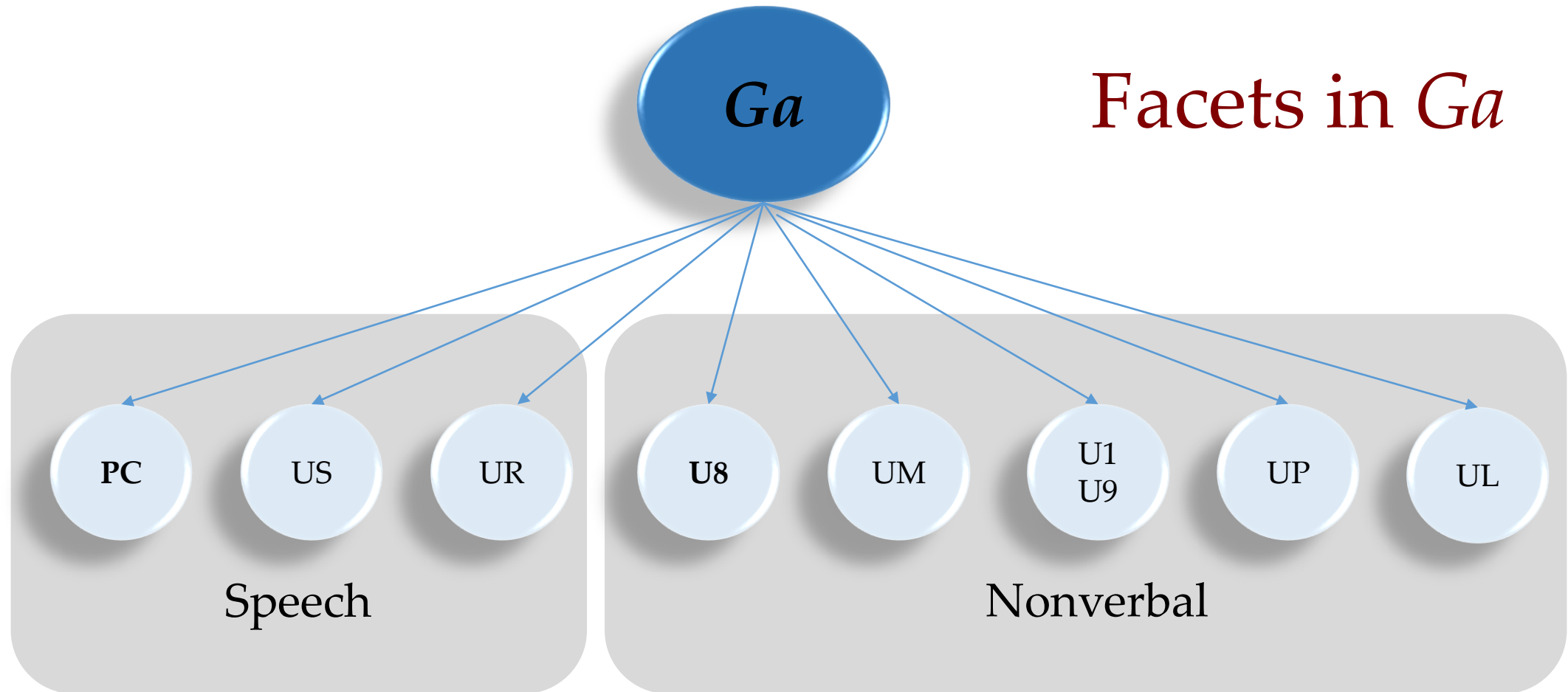
Speech sound discrimination (US): The ability to **detect and discriminate differences in speech sounds** (other than phonemes) under conditions of little or no distraction or distortion.

Resistance to auditory stimulus distortion (UR): The ability to hear words or extended speech passages correctly **under conditions of distortion or background noise**.

Maintaining and judging rhythm (U8): The ability to **recognize and maintain a musical beat**.

Memory for sound patterns (UM): The ability to retain (on a short-term basis) auditory codes such as **tones, tonal patterns, or speech sounds**.

Facets in *Ga*

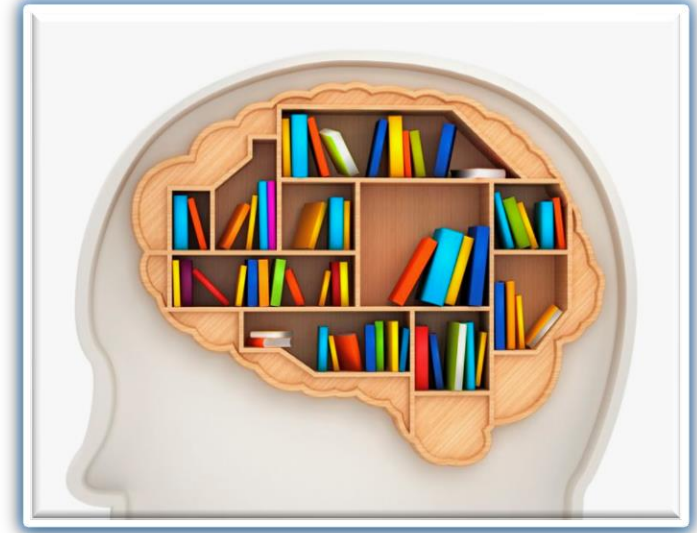
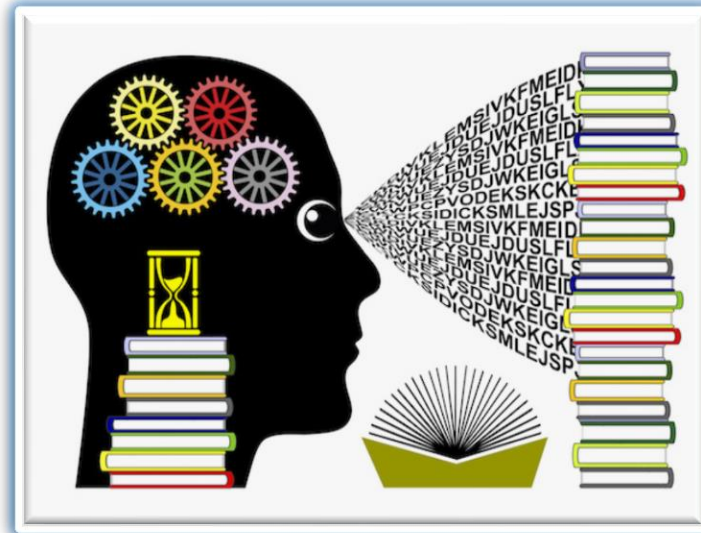
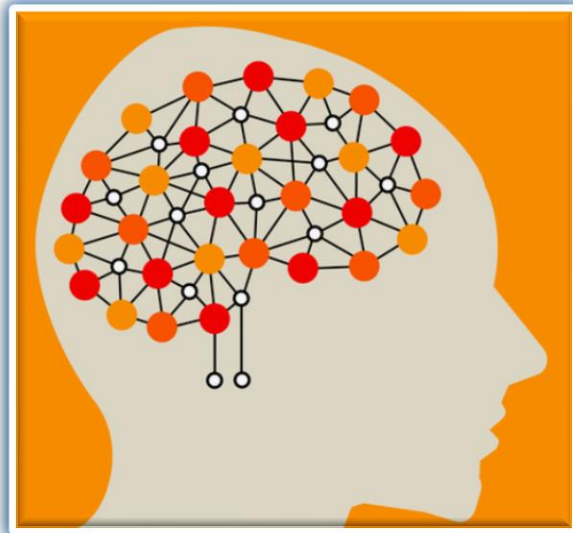


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Learning efficiency

The ability the ability to learn, store, and consolidate new information over periods of time measured in minutes, hours, days, and years.

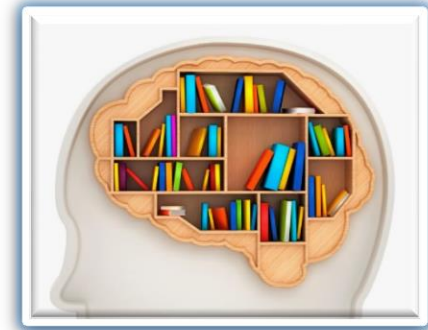
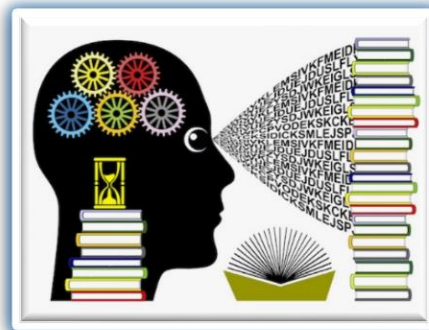




Learning efficiency

Associative memory (MA): The ability to form a link between two previously unrelated stimuli such that the subsequent presentation of one of the stimuli serves to activate the recall of the other stimuli.

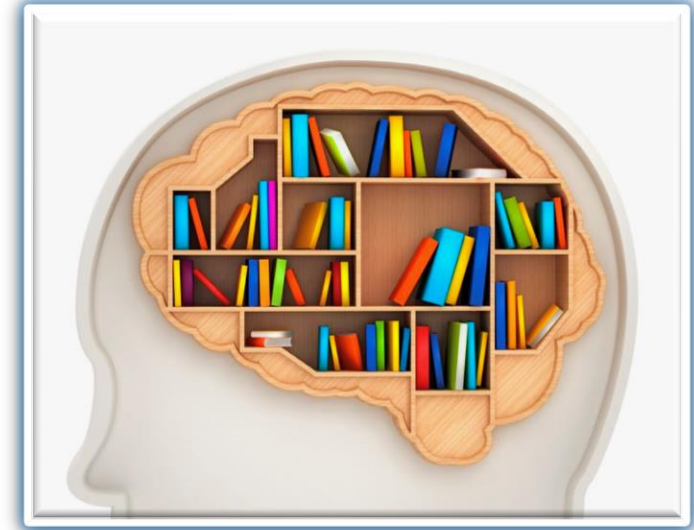
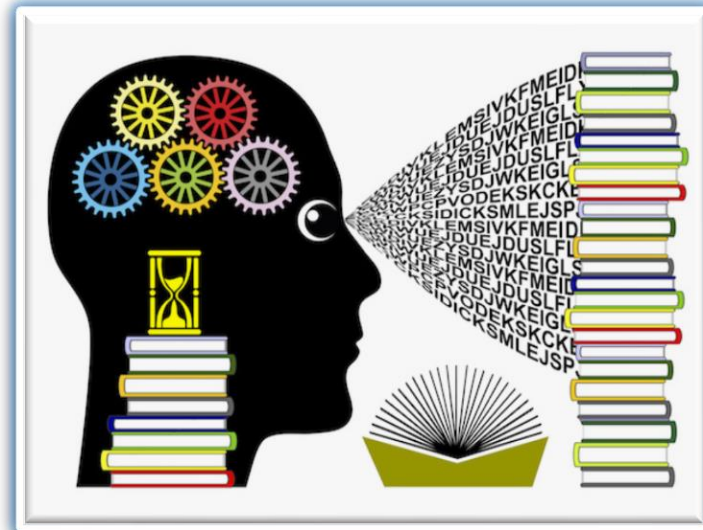
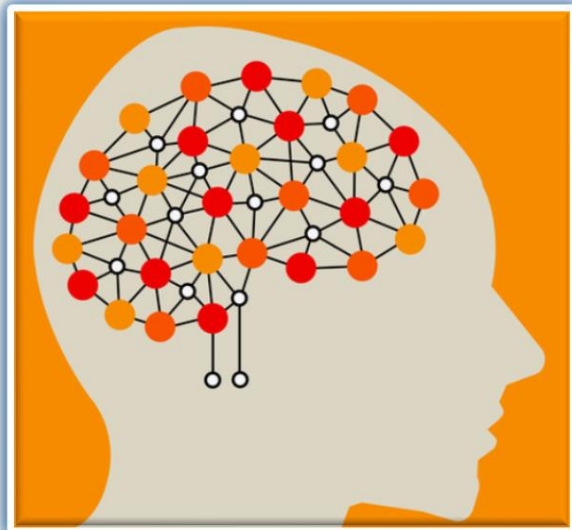
Meaningful memory (MM): The ability to remember narratives and other forms of semantically related information.



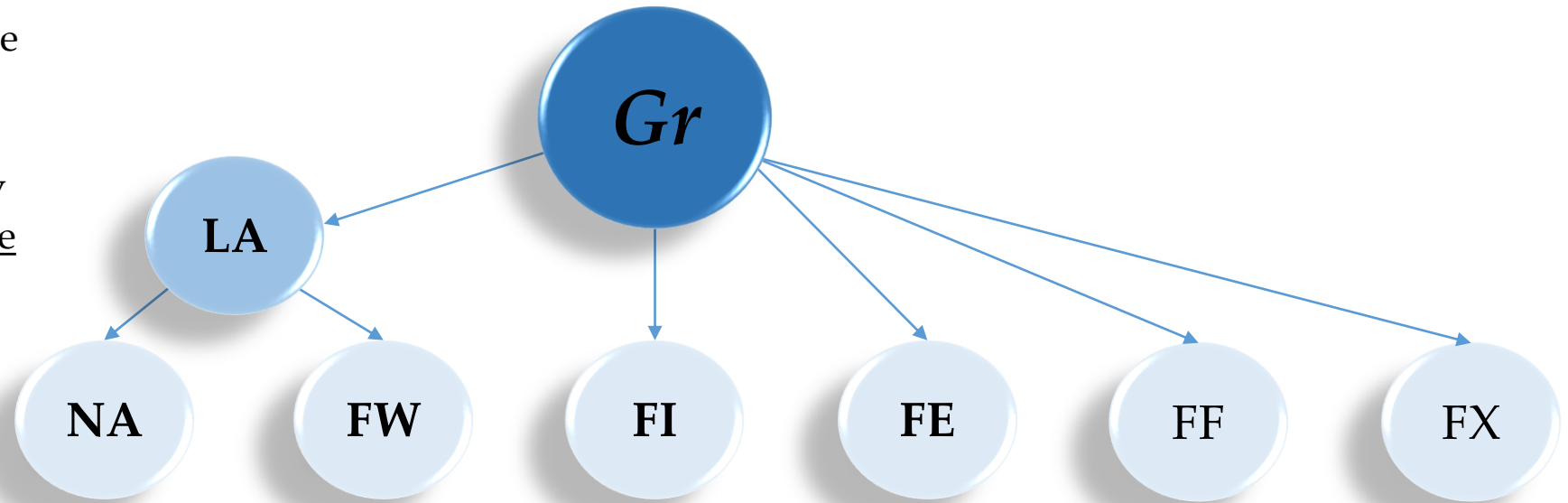


Retrieval fluency

The rate and fluency at which individuals can access information stored in long-term memory.



Speed of lexical access (LA): The ability to rapidly retrieve words from an individual's lexicon. Verbal efficiency or automaticity of lexical access. An intermediate stratum level ability.

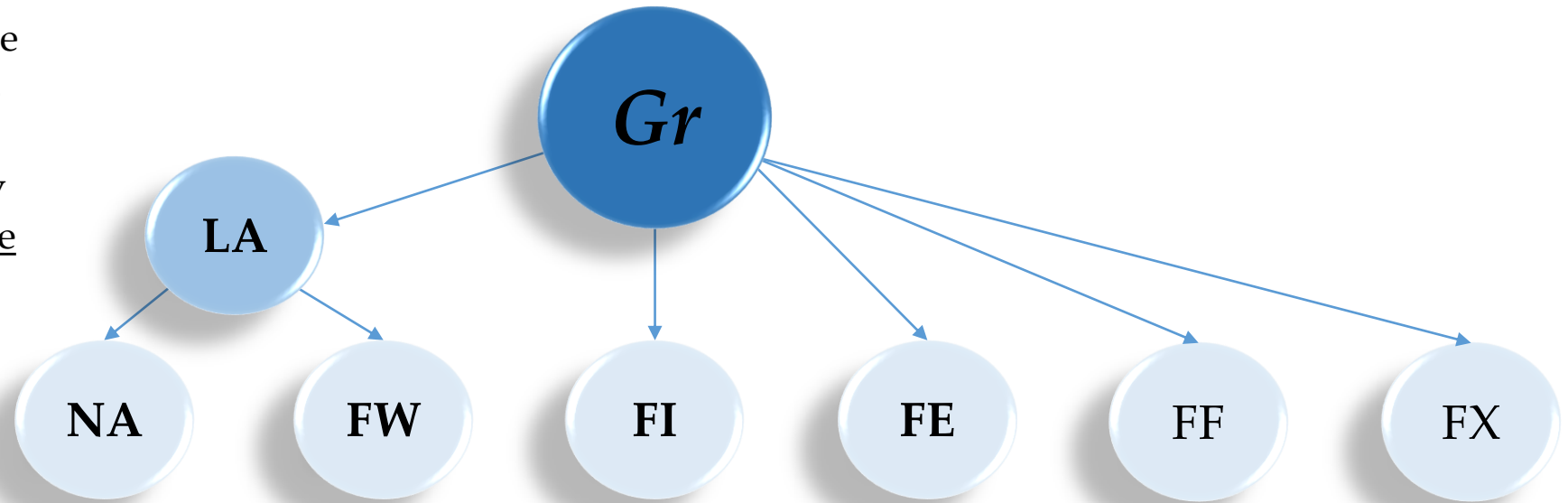


Naming facility (NA): The ability to **rapidly call objects by their names**.

Word fluency (FW): The ability to **rapidly produce words** that share a phonological (e.g., fluency of retrieval of words via a phonological cue) or semantic feature (e.g., fluency of retrieval of words via a meaning-based representation).

Ideational fluency (FI): The ability to **rapidly produce a series of ideas**, words, or phrases related to a specific condition or object.

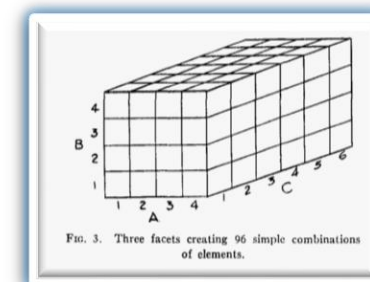
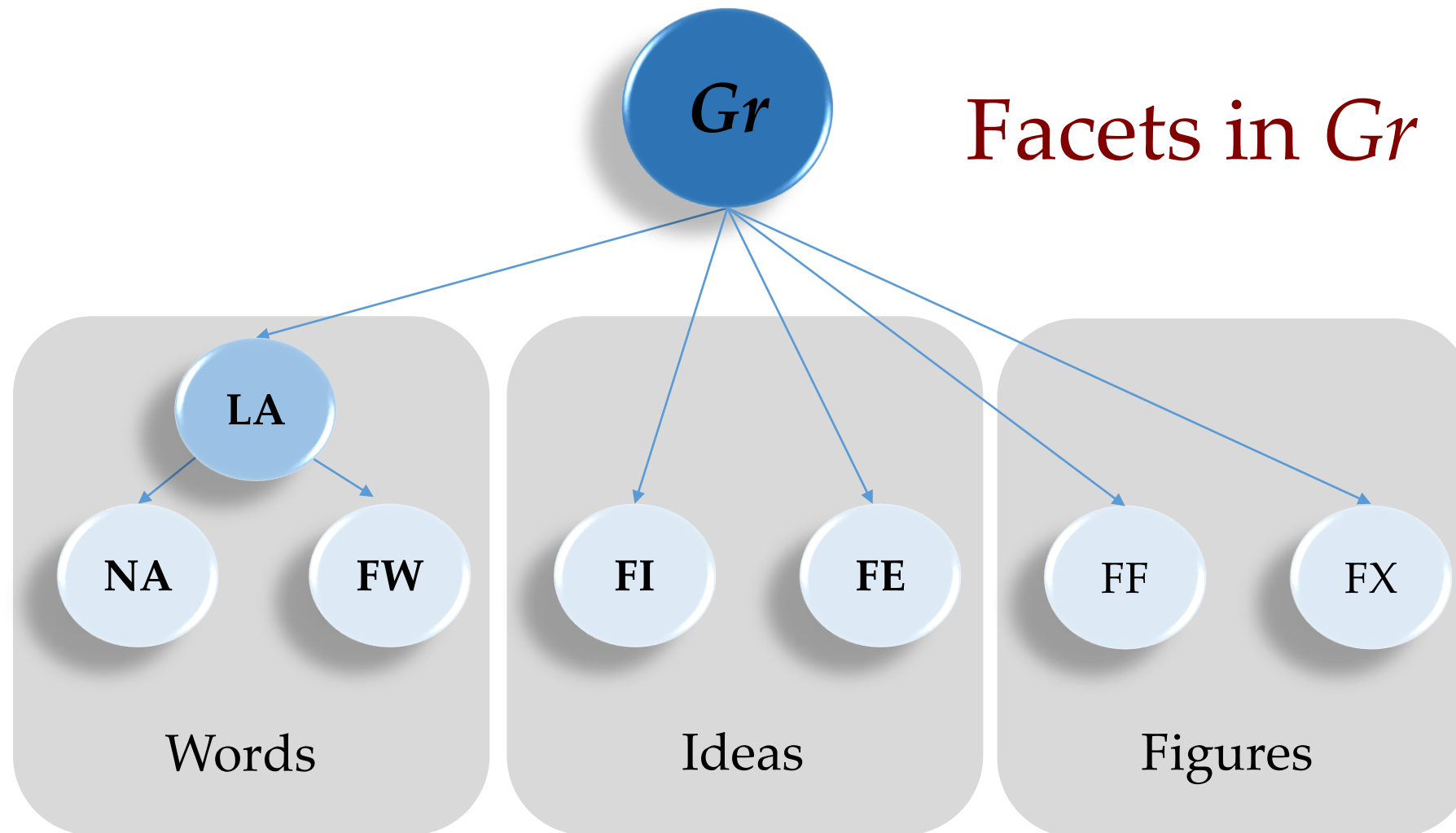
Speed of lexical access (LA): The ability to rapidly retrieve words from an individual's lexicon. Verbal efficiency or automaticity of lexical access. An intermediate stratum level ability.



Expressional fluency (FE): The ability to **rapidly think of different ways of expressing an idea.**

Figural fluency (FF): The ability to **rapidly draw or sketch as many things** (or elaborations) as possible when presented with a nonmeaningful visual stimulus (e.g., a set of unique visual elements).

Figural flexibility (FX): The ability to **rapidly draw different solutions** to figural problems.

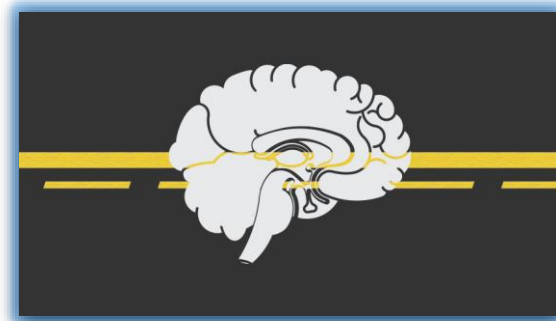


G_s

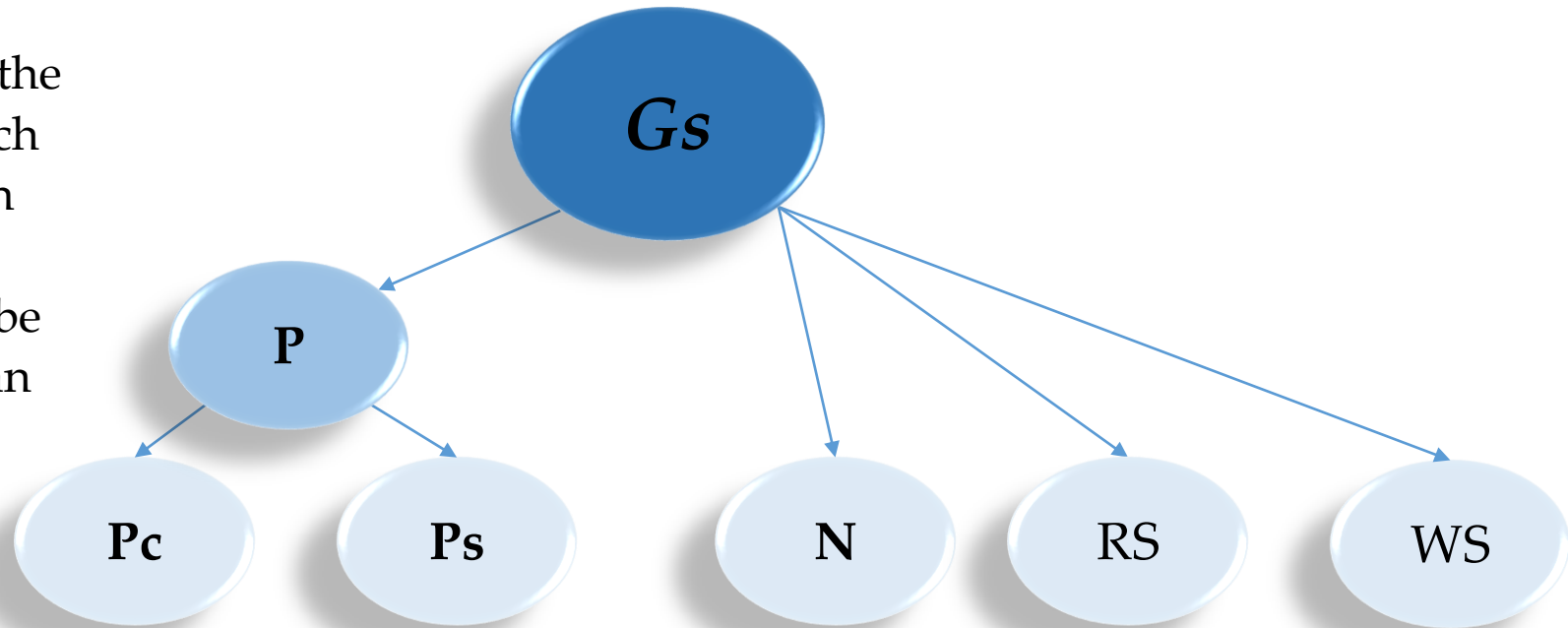
Processing speed

**The ability to control attention to automatically, quickly and fluently perform relatively simple repetitive cognitive tasks.
Attentional fluency or attentional speediness.**

- Mental speed
- Fluency of performing tasks
- Speed of executing relatively over-learned cognitive processes



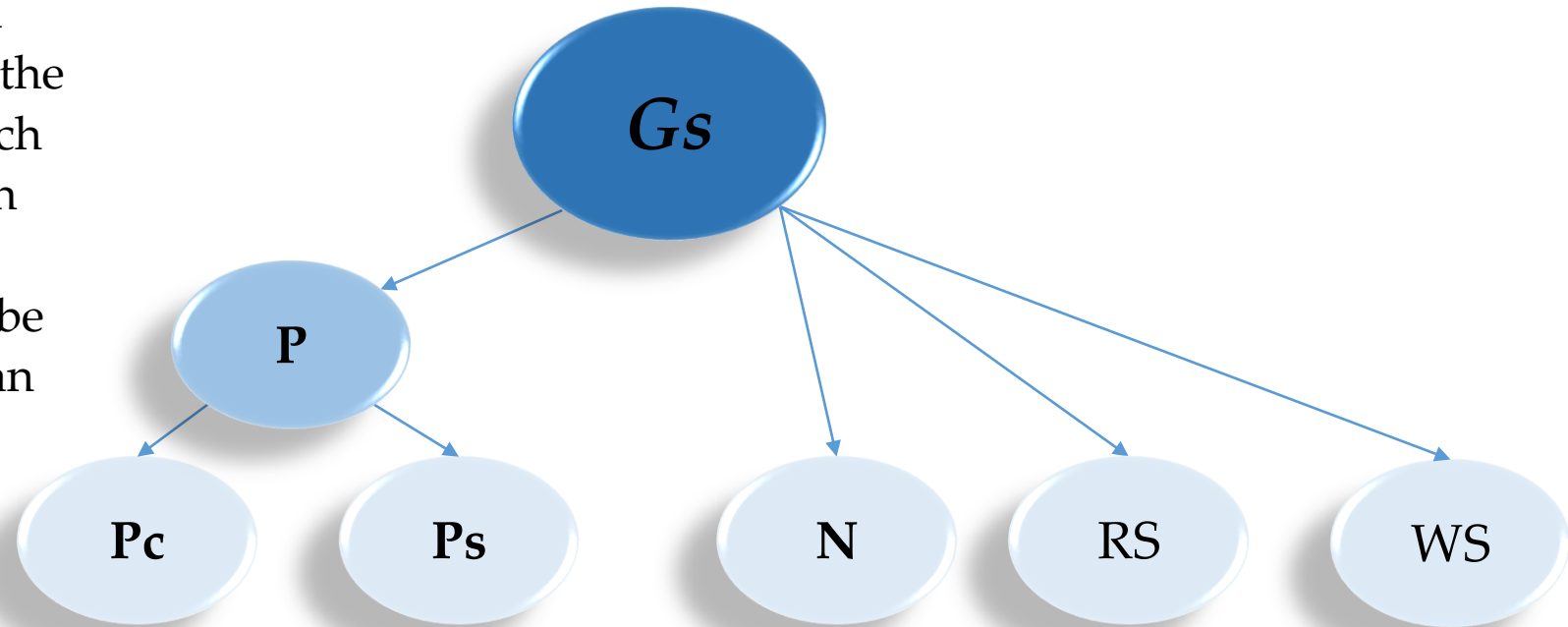
Perceptual speed (P): An intermediate stratum level ability that can be defined as the speed and fluency with which similarities or differences in visual stimuli (e.g., letters, numbers, patterns, etc.) can be searched and compared in an extended visual field.



Perceptual speed-search (Ps): The speed and fluency of **searching or scanning** an extended visual field to locate one or more simple visual patterns.

Perceptual speed-compare (Pc): The speed and fluency of **looking up and comparing** visual stimuli that are side-by-side or more widely separated in an extended visual field.

Perceptual speed (P): An intermediate stratum level ability that can be defined as the speed and fluency with which similarities or differences in visual stimuli (e.g., letters, numbers, patterns, etc.) can be searched and compared in an extended visual field.

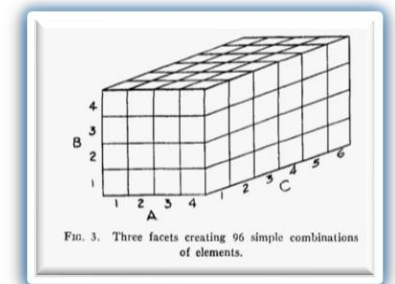
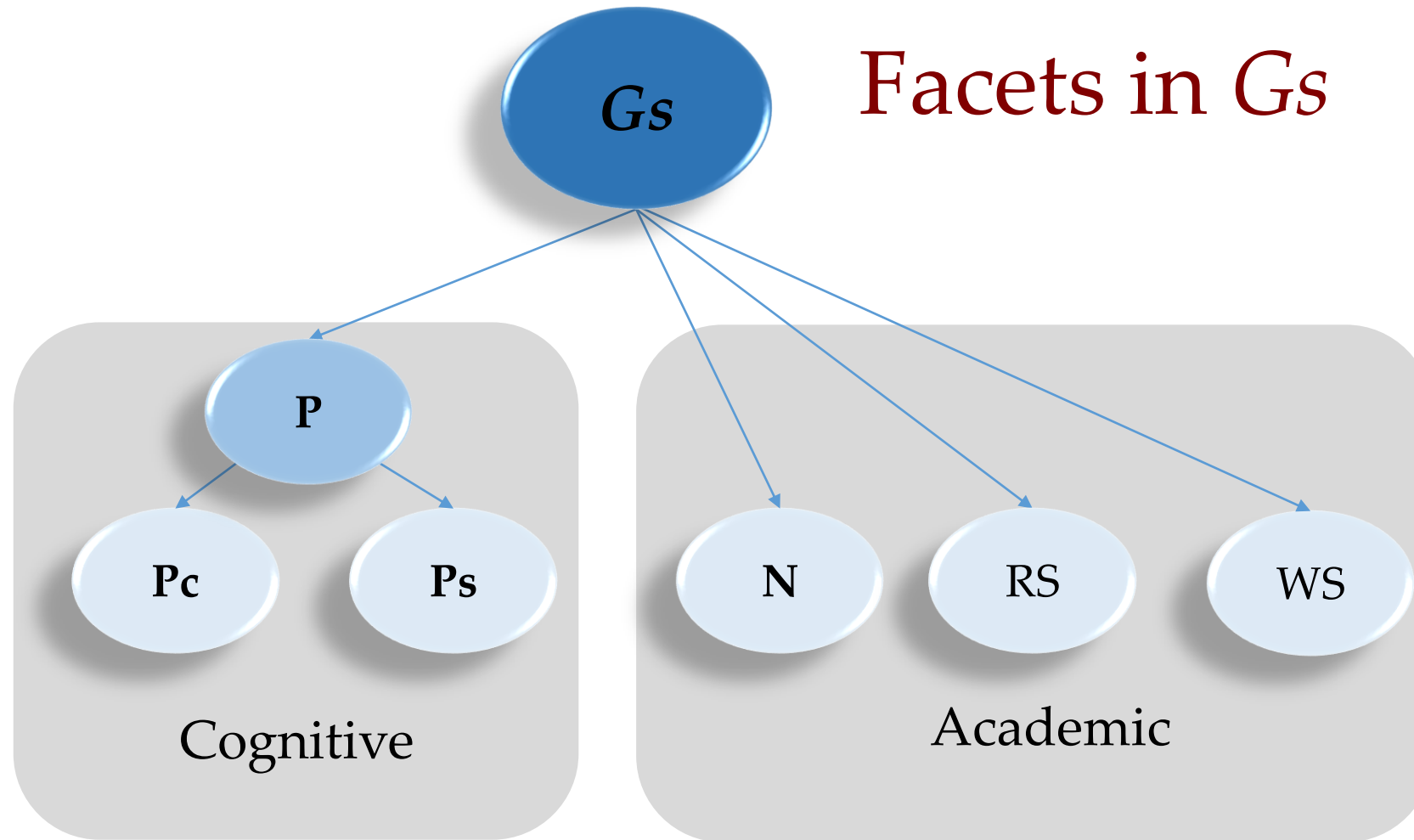


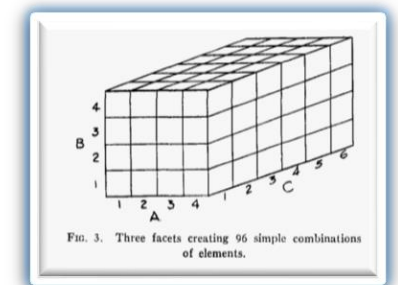
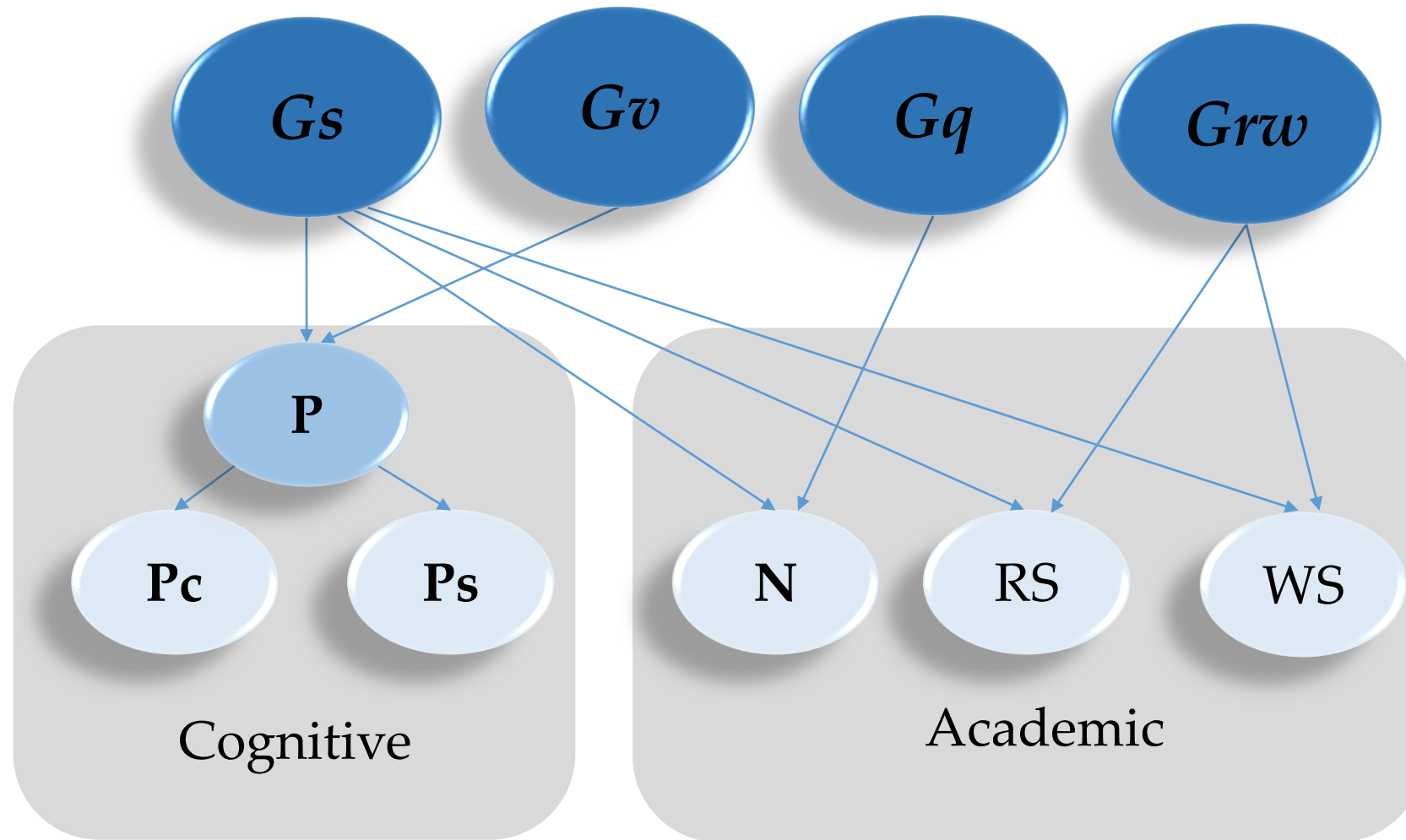
Number facility (N): The speed, fluency and accuracy in manipulating **numbers**, comparing **number patterns**, or completing **basic arithmetic**.

Reading speed (fluency) (RS): The **speed and fluency of reading** text with full comprehension. Also listed under *Grw*.

Writing speed (fluency) (WS): The **speed and fluency of generating or copying words** or sentences. Also listed under *Grw* and *Gps*.

Facets in G_s





Facets in *Gs* may actually reflect dual factor loadings

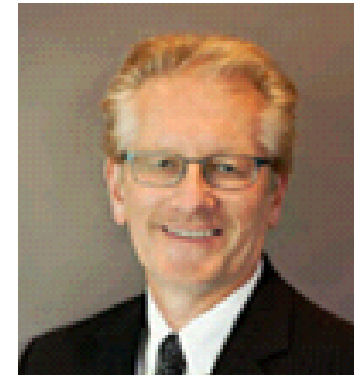
Beyond CHC: Alternative CHC frameworks

aka

The minds of Joel Schneider and Kevin McGrew unleashed

or

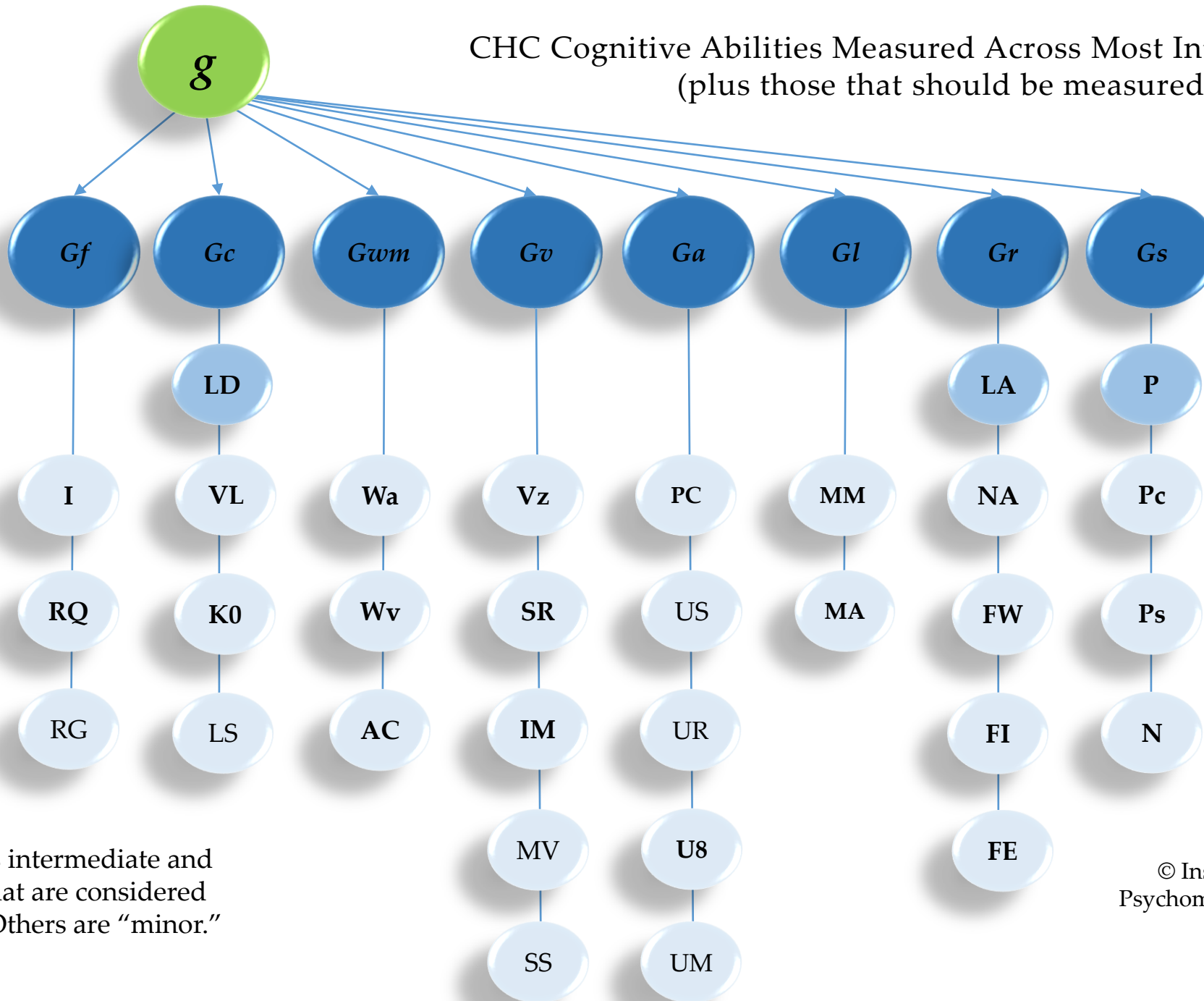
Schneider and McGrew running with scissors



General

CHC Cognitive Abilities Measured Across Most Intelligence Tests
(plus those that should be measured)

Broad
Intermediate
Narrow

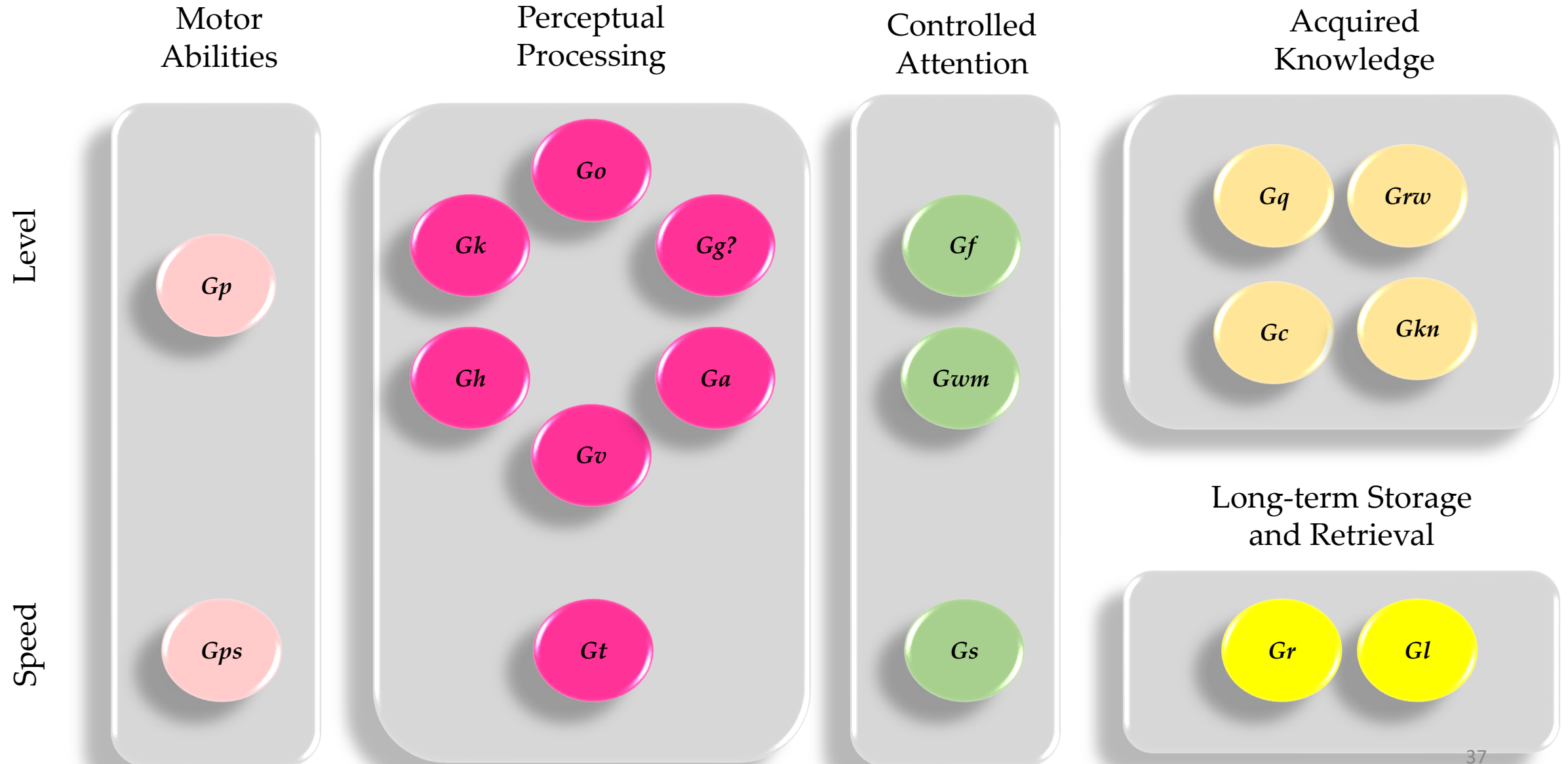


Bold font indicates intermediate and narrow abilities that are considered “major” abilities. Others are “minor.”

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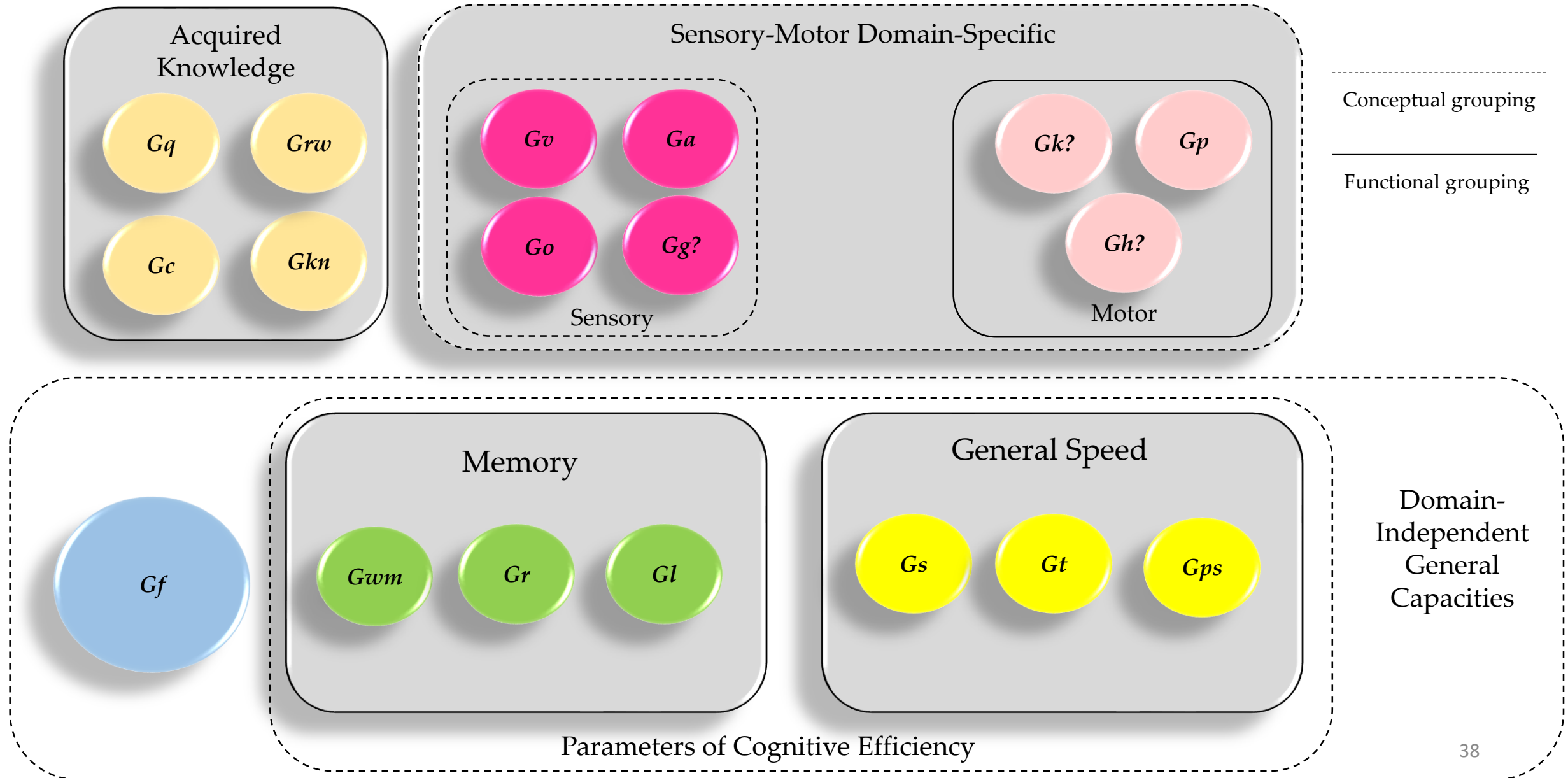
Cattell-Horn-Carroll Theory (CHC) of Cognitive Abilities

(**Functional framework**: Schneider & Newman, 2015)



Cattell-Horn-Carroll Theory (CHC) of Cognitive Abilities

(**Functional-conceptual framework**: Schneider & McGrew, 2012)



Cattell-Horn-Carroll Theory of Cognitive Abilities (Ackerman et al., PPIK framework)

Intelligence-as-Knowledge
(Ackerman)

**Acquired knowledge
systems**

g_c Cattell

Intelligence-as-Process
(Ackerman)

System 2 (controlled deliberate
cognitive operations/processes)
(Kahneman)

g_f Cattell

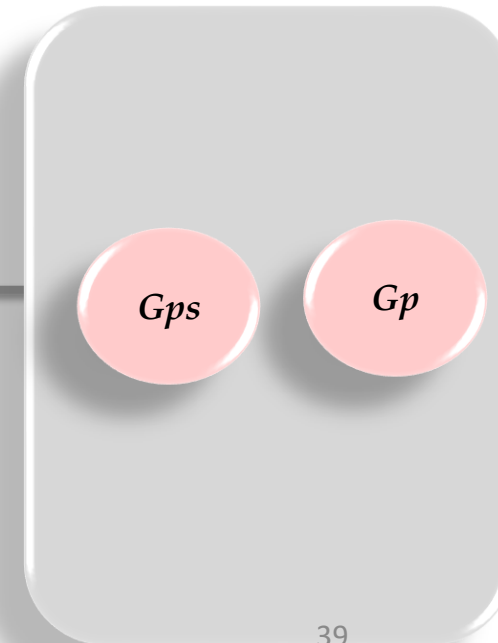
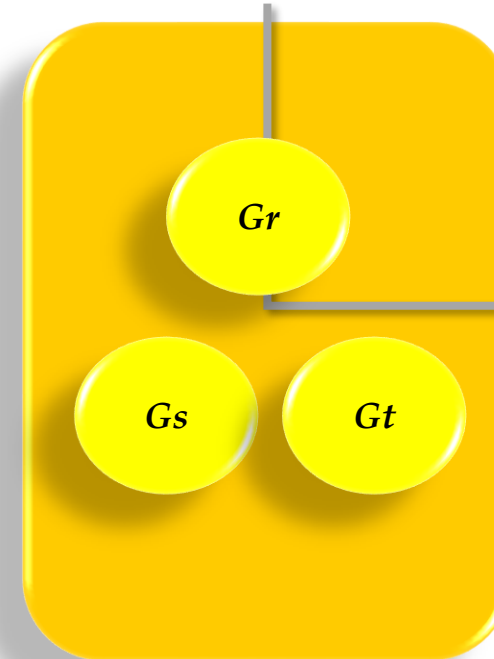
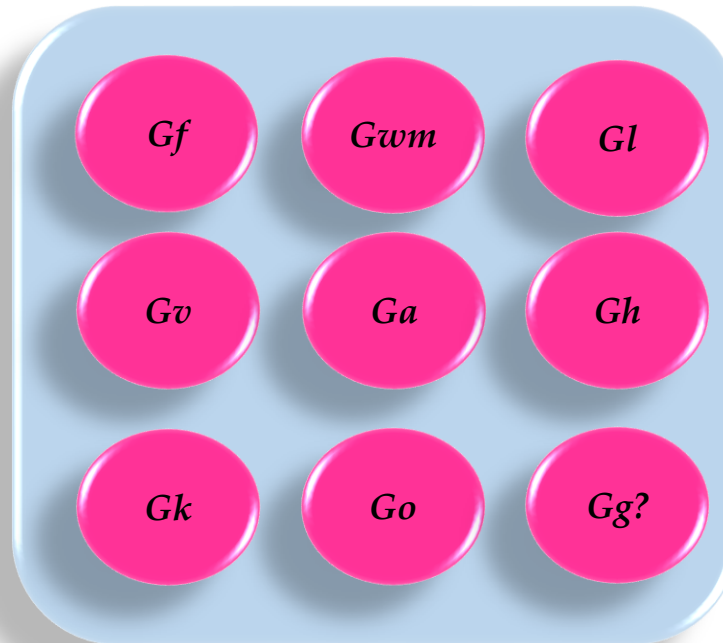
**Intelligence-as-Process:
Speed/fluency**
(Ackerman)

System 1 (automatic rapid
cognitive processes)
(Kahneman)

g_s – General speed factor

Physical Competence

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Support for PPIK
framework of WJ
IV tests

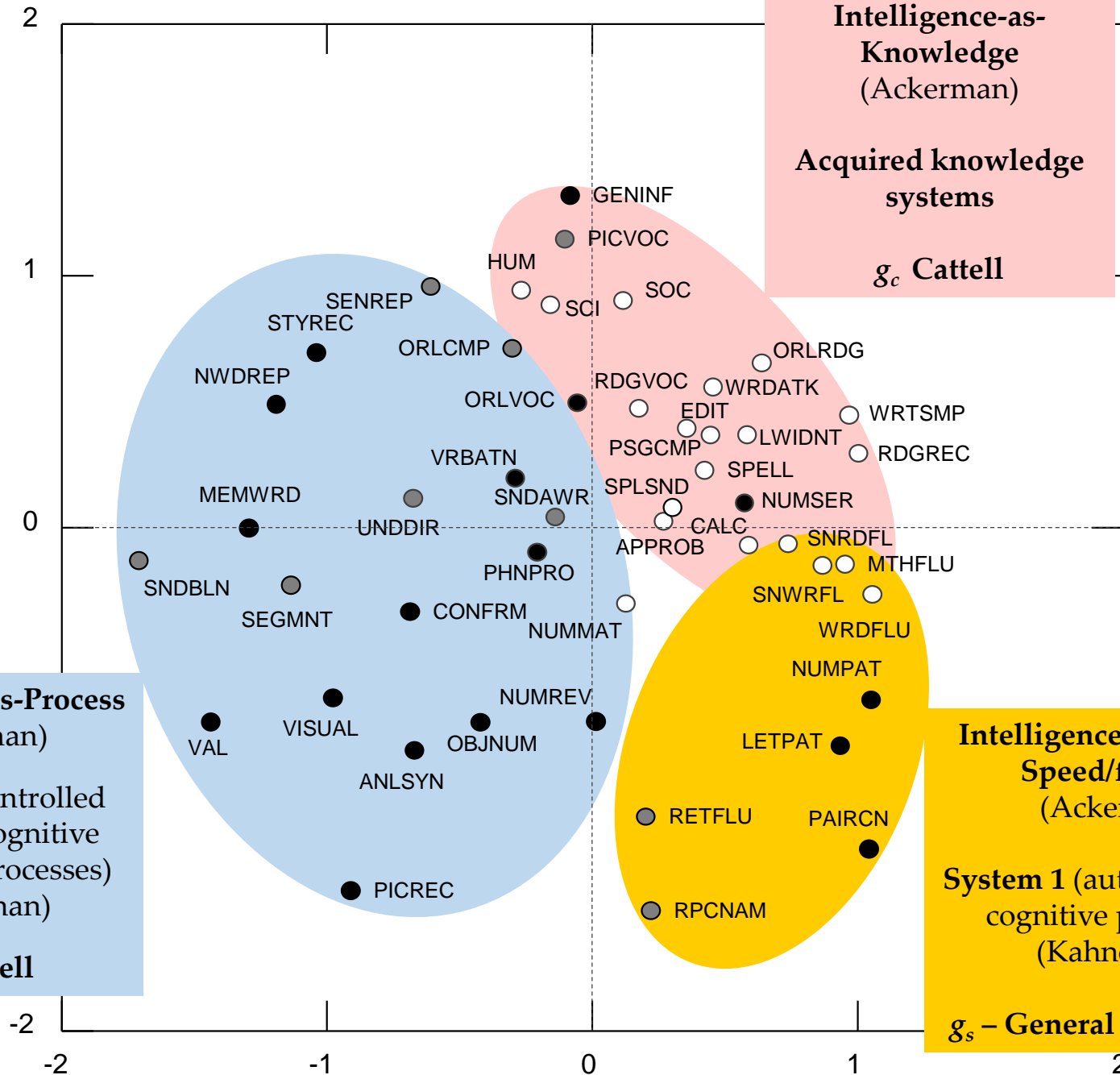
(only NUMSER is not
100% consistent)

2 MDS (Guttman
Radex) solution
for WJ IV tests in
the norm sample
(ages 6-13)

Intelligence-as-Process
(Ackerman)

System 2 (controlled
deliberate cognitive
operations/processes)
(Kahneman)

g_f Cattell



Intelligence-as-Knowledge
(Ackerman)

Acquired knowledge systems

g_c Cattell

Tests closer to the center are more **cognitively complex**. The farther away a test is from the center, the lower the cognitive complexity

The closer two tests are to each other, the more they are **correlated**

Intelligence-as-Process: Speed/fluency
(Ackerman)

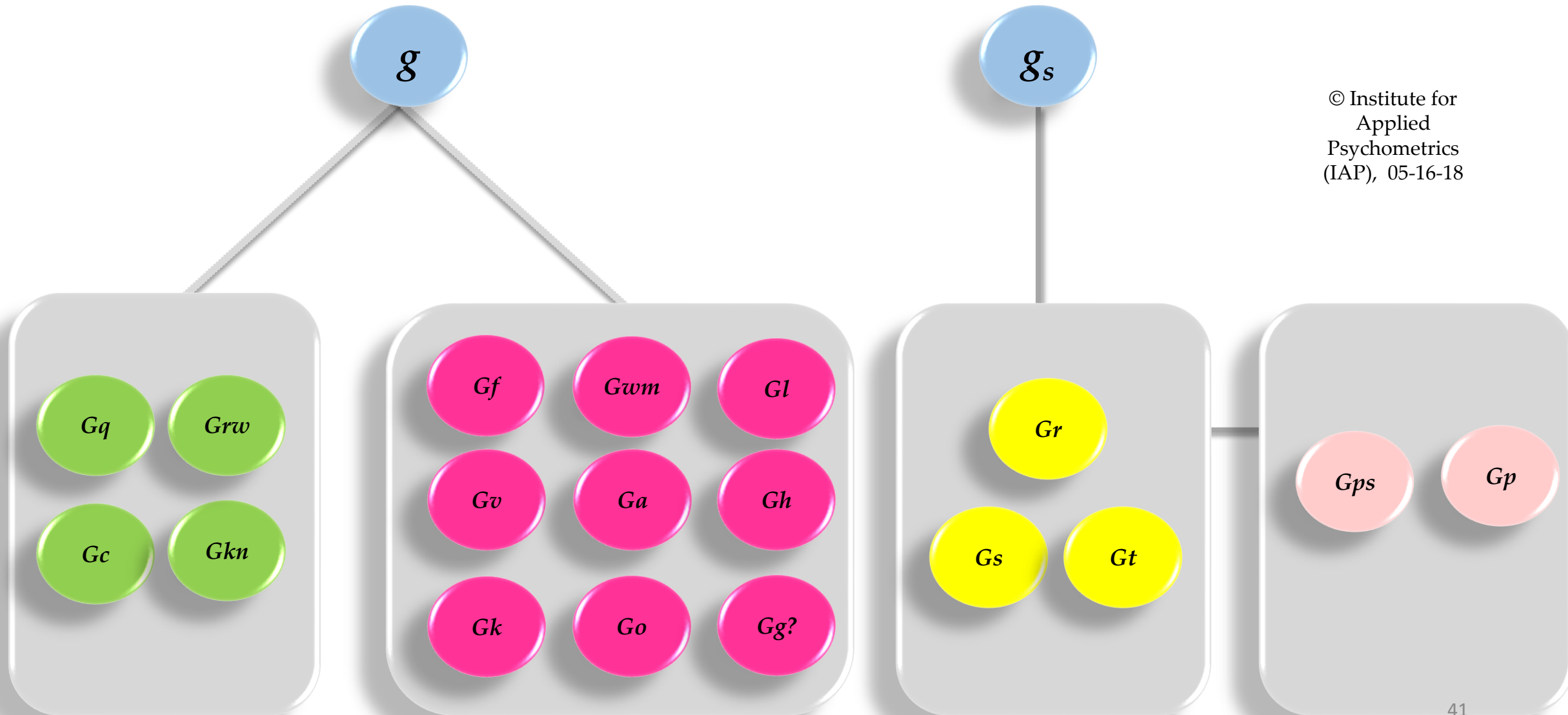
System 1 (automatic rapid cognitive processes)
(Kahneman)

g_s – General speed factor

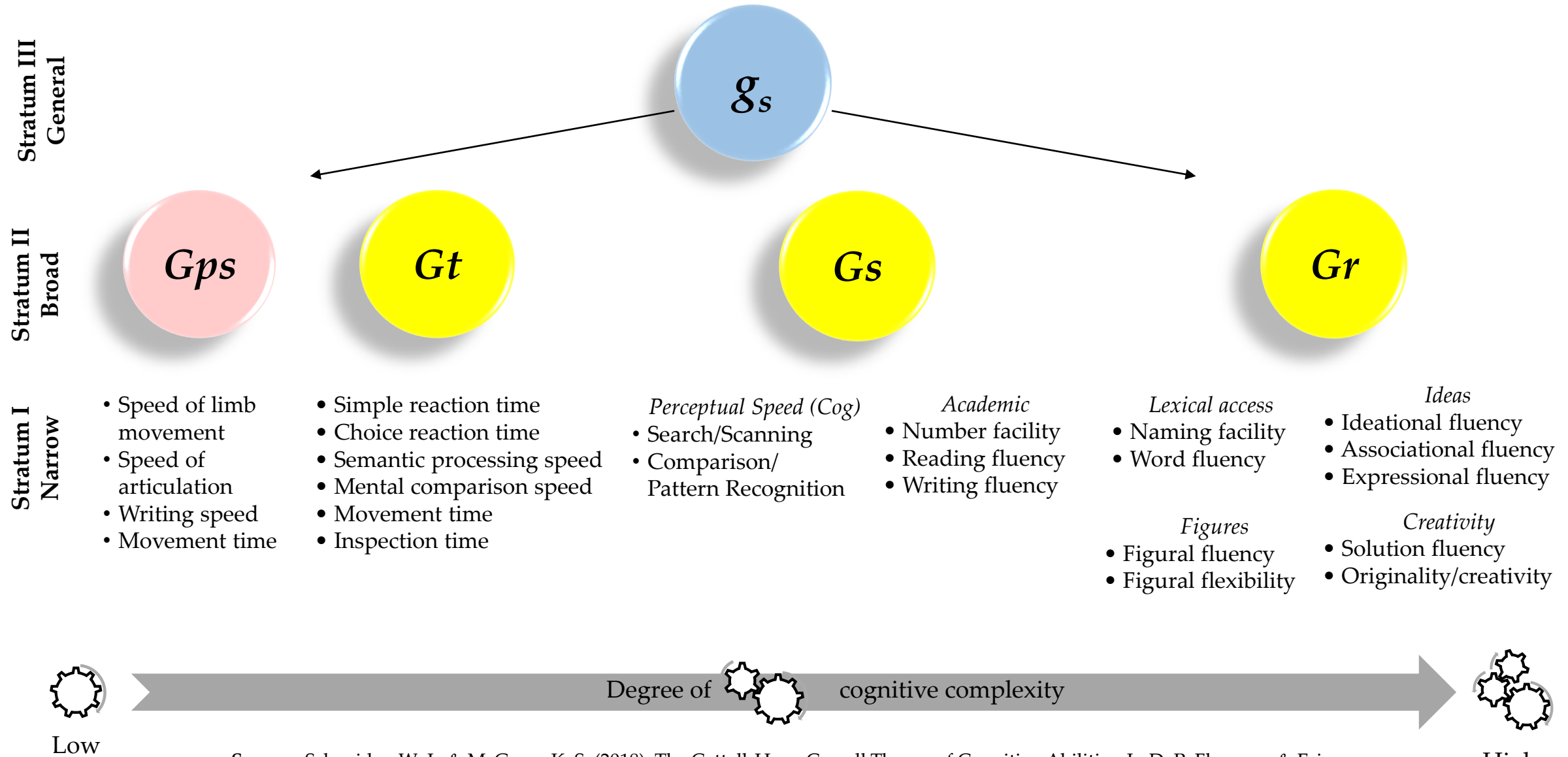
- COG
- OL
- ACH

Cattell-Horn-Carroll (CHC) Theory of Cognitive Abilities

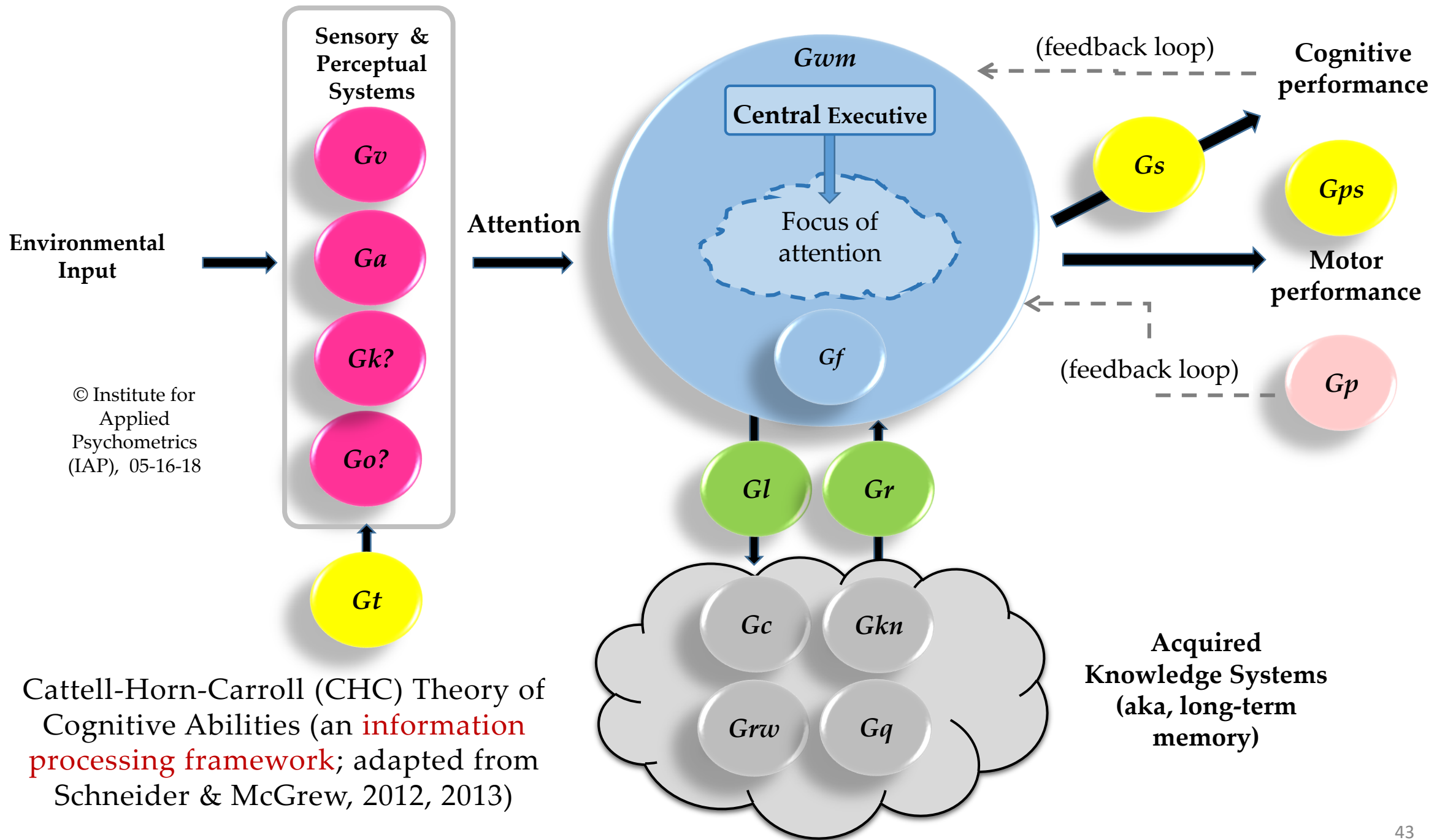
(Ackerman et al., **PPIK framework** + g ; g_s)



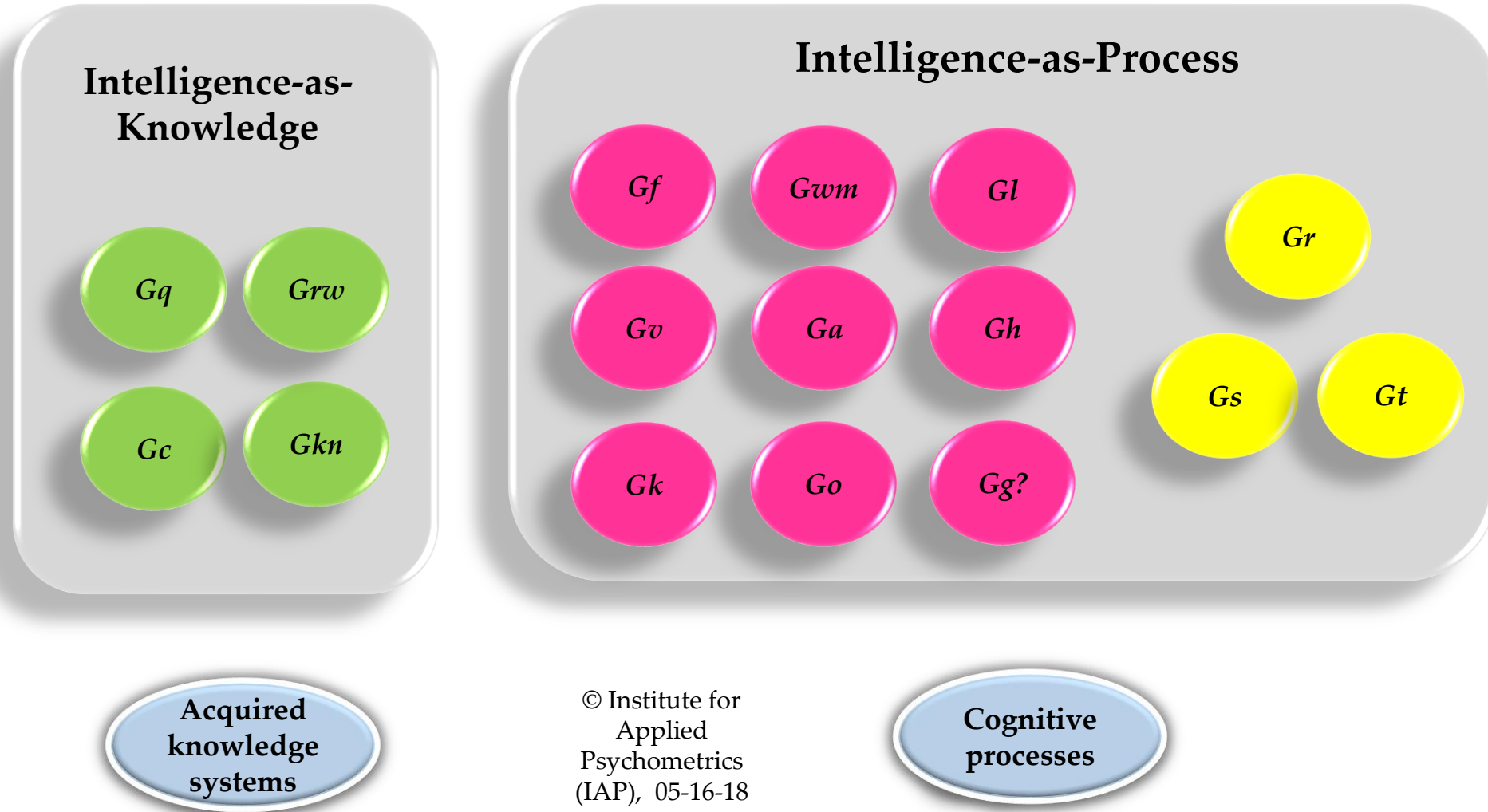
A proposed hierarchy of speed abilities



Source: Schneider, W. J., & McGrew, K. S. (2018). The Cattell-Horn-Carroll Theory of Cognitive Abilities. In D. P. Flanagan & Erin M. McDonough (Eds.), *Contemporary intellectual assessment: Theories, tests and issues* (4th ed.,) New York: Guilford Press.



Cattell-Horn-Carroll Theory of Cognitive Abilities (Ackerman et al., PPIK framework)



The big picture: An adapted Snow (Corno et al., 2002) model of aptitude (MACM revised; K. McGrew 10-13-16)

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