The CHC taxonomy of cognitive abilities codebook:
Current status

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The CHC definitions included in this document are adapted from Schneider and McGrew (2012) and McGrew, LaForte and Schrank (2014), which include more in-depth definitions.

CHAPTER 4

The Cattell–Horn–Carroll Model of Intelligence

W. Joel Schneider
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John Horn, compared the process of classifying and categorizing human abilities and intelligence to “slicing smoke”. (Horn, 1991)
Contemporary psychometric research has converged on the Cattell-Horn-Carroll (CHC) model of cognitive abilities as the consensus working taxonomy of human intelligence.

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<table>
<thead>
<tr>
<th>Quantitative Knowledge (GQ):</th>
<th>Reading + Writing (Gw):</th>
<th>Comprehension - Knowledge (GC):</th>
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<tbody>
<tr>
<td>Depth and breadth of knowledge related to mathematics.</td>
<td>Depth and breadth of knowledge and skills related to written language.</td>
<td>Depth and breadth of knowledge and skills that are valued by one's culture.</td>
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<th>Fluid Reasoning (GF):</th>
<th>Short-Term Memory (GSM):</th>
<th>Long-Term Storage + Retrieval (GLR):</th>
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<td>The ability to perform simple repetitive cognitive tasks quickly and fluently.</td>
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The CHC taxonomy of cognitive abilities: 

Current status
Parameters of Cognitive Efficiency

Domain-Independent General Capacities

Memory

Sensory-Motor Domain-Specific Abilities

Sensory

Motor

Conceptual Grouping

Functional Grouping

(From Schneider & McGrew, 2012)
CHC model is analogous to the Periodic Table of Elements in Chemistry.
The CHC Periodic Table of Human Abilities

Adapted from Schneider & McGrew (2012) and McGrew, LaForte and Schrank (2014)

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The CHC Periodic Table of Human Abilities

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CHC: Domain-Independent Capacities

The CHC Periodic Table of Human Abilities

Adapted from Schneider & McGrew (2012) and McGrew, LaForte and Schrank (2014)

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CHC: Acquired Knowledge Systems

Comprehension/Knowledge (Gc)
- Language Development (LD)
- Lexical Knowledge (VL)
- Gen. (Verbal) Information (K0)
- Listening Ability (LS)
- Comm. Ability (CM)
- Grammatical Sensitivity (MY)

Domain-Specific Knowledge (Gkn)
- Foreign Lang. Proficiency (KL)
- Gen. Science Information (K1)
- Knowledge of Culture (K2)
- Geography Achievement (A5)
- Mechanical Knowledge (MK)
- Knowledge of Signing (KF)
- Skill in Lip-Reading (LP)
- Knowledge of Behavioral Content (BC)

Reading and Writing (Grw)
- Verbal (print) Lang. Comp. (V)
- Reading Decoding (RD)
- Reading Comp. (RC)
- Reading Speed (RS)
- Writing Ability (WA)
- Spelling Ability (SG)
- English Usage (EU)
- Writing Speed (WS)

Quantitative Knowledge (Gq)
- Mathematical Knowledge (KM)
- Mathematical Achievement (A3)

The CHC Periodic Table of Human Abilities
Adapted from Schneider & McGrew (2012) and McGrew, LaForte and Schrank (2014)
Sensory-Motor Domain-Specific Abilities

Visual Processing (Gv)
  - Visualization (V2)
  - Speeded Rotation (SR)
  - Visual Memory (MV)
  - Closure Speed (CS)
  - Spatial Scanning (SS)
  - Flexibility of Closure (CF)
  - Imagery (IM)
  - Serial Perc. Integration (PI)
  - Length Estimation (LE)
  - Perceptual Illusions (IL)
  - Perceptual Alternations (PN)

Auditory Processing (Go)
  - Phonetic Coding (PC)
  - Speed Sound Discr. (US)
  - Main & Judge. Rhy. (U8)
  - Res. to Aud. Stim. Dist. (UR)
  - Musical Disc. Judge. (U1/U9)
  - Absolute Pitch (UP)
  - Sound Localization (UL)

Tactile Abilities (Gh)
  - Olfactory Abilities (Go)
  - Kinesthetic Abilities (Gk)

Psychomotor Abilities (Go)
  - Manual Dexterity (P1)
  - Finger Dexterity (P2)
  - Static Strength (P3)
  - Gross Body Equilibrium (P4)
  - Multilimb Coord. (P6)
  - Arm-Hand Steadiness (P7)
  - Control Precision (P8)
  - Aiming (A1)

The CHC Periodic Table of Human Abilities
Adapted from Schneider & McGrew (2012) and McGrew, LaForte and Schrank (2014)

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Defining and measuring fluid reasoning ($G_f$)
The deliberate but flexible control of attention to solve novel “on the spot” problems that cannot be performed by relying exclusively on previously learned habits, schemas, and scripts.

• Solving unfamiliar problems (novel problem solving).

• Most evident in abstract reasoning that depends less on prior learning.

• Deductive and inductive reasoning are primary characteristics.

• Inferential reasoning; concept formation; classification of unfamiliar stimuli; hypothesis generation and confirmation; identification of relevant similarities; the perception of relevant consequences of newly acquired knowledge; extrapolation of reasonable estimates in ambiguous situations.
Induction (I): The ability to observe a phenomenon and discover the underlying principles or rules that determine its behavior.

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, either with induction or deduction, with numbers, mathematical relations, and operators.
Defining and measuring short-term working memory (Gwm)

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Short-term working memory (Gwm)  
Definition & features

The ability to encode, maintain, and manipulate information in one’s immediate awareness.

• A limited capacity system.

• Loses information quickly through decay of memory traces, unless individual activates other cognitive resources to maintain the information in immediate awareness.
Working Memory Capacity (WM): The ability to direct the focus of attention to perform relatively simple manipulations, combinations, and transformations of information within primary memory while avoiding distracting stimuli and engaging in strategic/controlled searches for information in secondary memory.

Memory Span (MS): The ability to encode information, maintain it in primary memory, and immediately reproduce the information in the same sequence in which it was represented.

Attentional Control (AC): The ability to focus on task-relevant stimuli and ignore task-irrelevant stimuli. The ability to regulate intentionality and direct cognitive processing. Sometimes referred to as spotlight or focal attention, focus, control of attention, executive controlled attention, or executive attention.
Defining and measuring long-term retrieval ($Gl_r$)
The ability to store, consolidate, and retrieve information over periods of time measured in minutes, hours, days, and years.

- A *Glr* test involves information that has been put out of immediate awareness long enough for the contents of primary memory to be displaced completely.
- Retrieving and recreating information from long-term memory.
- **Learning efficiency abilities:** Tasks were more information is presented than can be retained in *Gwm*.
- **Learning retrieval fluency abilities:** The rate and fluency at which individuals can access information stored in long-term memory.
Long-Term Retrieval (Glr)

Narrow ability definitions

**Associative Memory (MA):** The ability to remember previously unrelated information as having been paired.

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

**Free Recall Memory (M6):** The ability to recall lists in any order.
Fluency abilities that involve the production of ideas

Ideational Fluency (FI): The ability to rapidly produce a series of ideas, words, or phrases related to a specific condition or object. Quantity, not quality or response originality, is emphasized.

Associational Fluency (FA): The ability to rapidly produce a series of original or useful ideas related to a particular concept. In contrast to Ideational Fluency (FI), quality, rather than quantity of production, is emphasized.

Expressional Fluency (FE): The ability to rapidly think of different ways of expressing an idea.
Fluency abilities that involve the production of ideas

Sensitivity to Problems/Alternative Solution Fluency (SP): The ability to rapidly think of a number of alternative solutions to a particular practical problem.

Originality/Creativity (FO): The ability to rapidly produce original, clever, and insightful responses (expressions, interpretations) to a given topic, situation, or task.

Long-Term Retrieval (Glr)
Narrow ability definitions
Fluency abilities that involve the recall of words

Naming Facility (NA): The ability to rapidly call objects by their names. In contemporary reading research, this ability is called rapid automatic naming (RAN), or speed of lexical access.

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). Also includes the ability to rapidly produce words that share nonsemantic features (e.g., fluency of retrieval of words starting with the letter T).

Speed of Lexical Access (LA): The ability to rapidly and fluently retrieve words from an individual’s lexicon; verbal efficiency or automaticity of lexical access.
Fluency abilities that involve figures

Figural Fluency (FF): The ability to rapidly draw or sketch as many things (or elaborations) as possible when presented with a non-meaningful visual stimulus (e.g., set of unique visual elements). Quantity is emphasized over quality.

Figural Flexibility (FX): The ability to rapidly draw different solutions to figural problems.
Defining and measuring processing speed ($G_s$)

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The ability to perform both simple and complex repetitive cognitive tasks quickly and fluently.

Automaticity.

Fluency of performing tasks.

Speed of executing relatively over-learned cognitive processes.
Perceptual Speed (P): The speed at which visual stimuli can be compared for similarities or differences.

Number Facility (N): The ability to manipulate numbers in working memory, and the speed of number pattern comparison. It includes the speed at which basic arithmetic operations are performed accurately.

Rate-of-Test-Taking (R9): The speed and fluency with which simple cognitive tests are completed. Through the lens of CHC theory, the definition of this factor has narrowed to simple tests that do not require visual comparison (P) or mental arithmetic (N).
Defining and measuring comprehension-knowledge (Gc)
The depth and breadth of knowledge and skills that are valued by one’s culture.

• 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.
**Language Development (LD):** The general understanding of spoken language at the level of words, idioms, and sentences. Language Development is at the core of $Gc$—understanding words in context.

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

**General (Verbal) Information (K0):** The breadth and depth of knowledge that one’s culture deems essential, practical, or otherwise worthwhile for everyone to know.
Listening Ability (LS): The ability to understand speech. Tests of listening ability typically have simple vocabulary but increasingly complex syntax or increasingly long speech samples to listen to.

Communication Ability (CM): The ability to use speech to communicate one’s thoughts clearly. This ability is comparable to Listening Ability except that it is productive (expressive) rather than receptive.

Grammatical Sensitivity (MY): The awareness of the formal rules of grammar and morphology of words in speech.
Defining and measuring visual processing ($G_v$)

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The ability to make use of simulated mental imagery (often in conjunction with currently perceived images) to solve problems.

- Ability to generate, retain, retrieve, and transform well-structured visual images

- The ability to perceive and 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”
Visualization (Vz): The ability to perceive complex patterns and mentally simulate how they might look when transformed (e.g., rotated, changed in size, partially obscured, and so forth). Vz is the core ability of Gv.

Speeded Rotation (Spatial Relations; SR): The ability to solve visual problems quickly using mental rotation of simple images. The speed at which mental rotation tasks is completed is what is different from Vz.

Visual Memory (MV): The ability to remember complex images over short periods of time (less than 30 seconds). The tasks that define this factor involve being shown complex images and then identifying them soon after the stimulus is removed.
Spatial Scanning (SS): The ability to quickly and accurately survey (visually explore) a wide or complicated spatial field or pattern and to (a) identify a particular target configuration or (b) identify a path through the field to a determined end point. It is not clear whether this ability is related to complex large-scale real-world navigation skills.

Closure Speed (CS): The ability to quickly identify a familiar, meaningful visual object from incomplete (e.g., vague, partially obscured, disconnected) visual stimuli without knowing in advance what the object is. This ability is sometimes called Gestalt Perception because it requires people to “fill in” unseen or missing parts of an image to visualize a single percept.

Flexibility of Closure (CF): The ability to identify a visual figure or pattern embedded in a complex distracting or disguised visual pattern or array when the pattern is known in advance.
Imagery (IM): The ability to mentally imagine very vivid images

Serial Perceptual Integration (PI): The ability to recognize an object after only parts of it are shown in rapid succession.

Length Estimation (LE): The ability to visually estimate the length of objects.

Perceptual Illusions (IL): The ability to not be fooled by visual illusions.

Perceptual Alternations (PN): Consistency in the rate of alternating between different visual perceptions.
Defining and measuring auditory processing ($Ga$)

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**The ability to detect and process meaningful nonverbal information in sound.**

- Abilities that depend on sound as input and on the functioning of our hearing apparatus.

- Key feature is the extent to which a person can cognitively “control” the perception of auditory information.

- Wide range of abilities in this domain:
  - 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
Phonetic Coding (PC): The ability to hear phonemes distinctly. This ability also is referred to as phonological processing and phonological awareness. People with poor phonetic coding have difficulty hearing the internal structure of sound in words.

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. Poor speech sound discrimination can produce difficulty in the ability to distinguish variations in tone, timbre, and pitch in speech.

Memory for Sound Patterns (UM): The ability to retain (on a short-term basis) auditory codes such as tones, tonal patterns, or speech sounds.
Maintaining and Judging Rhythm (U8): The ability to recognize and maintain a musical beat.

Resistance to Auditory Stimulus Distortion (UR): The ability to hear words correctly even under conditions of distortion or loud background noise.

Musical Discrimination and Judgment (U1 U9): The ability to discriminate and judge tonal patterns in music with respect to melodic, harmonic, and expressive aspects (phrasing, tempo, harmonic complexity, intensity variations).