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The non-Cattell-Horn-Carroll (non-CHC) Model of Ancillary Broad and Narrow Abilities

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Abstract: The Cattell-Horn-Carroll (CHC) theory of abilities is a comprehensive model of human cognitive abilities denoted by the G-code. Developed by three prominent psychologists - Raymond Cattell, John Horn, and John Carroll - the CHC theory suggests that there are three strata of cognitive abilities. In this paper, the authors argued that the CHC model faces seven challenges: First, it is a complex model with numerous factors and subtests, posing difficulties in administration and interpretation. Second, the theory itself has limited coverage and may not address all cognitive abilities. Third, critics have been arguing that the CHC theory has failed to sufficiently address socio-cultural variations. Fourth, the CHC model of broad and narrow abilities lacks concrete operational definitions, relying on theoretical constructs. Fifth, it always fails to account for complex interactions between cognitive abilities. Sixth, the CHC model continually evolves, requiring frequent updates. Lastly, the CHC theory might not fully capture individual differences in cognitive abilities and potential, leaving room for improvement. There are alternative models (e.g., extended fluid-crystallized and verbal-perceptual-image rotation theories) to the CHC model. Despite these limitations, the CHC model remains a valuable tool for understanding cognitive abilities. In this paper, the authors have chosen to focus on the non-CHC categories of broad abilities with their respective narrow abilities. Termed as ancillary abilities denoted by the Q-code, this paper aims to provide another model of abilities (not necessarily cognitive), not to replace the current CHC model, but to complement or supplement it.

Keywords: Ancillary Abilities, Broad Abilities, Cattell-Horn-Carroll (CHC) model, G-code, Narrow Abilities, Q-code

1. Introduction

The Cattell-Horn-Carroll (CHC) theory of abilities (see Flanagan & Dixon, 2014; Schneider & McGrew, 2012a, 2012b, 2018, for more detail) is a comprehensive model of human cognitive abilities that has been updated over the past few years (see Euler, Vehar, & Guevare, 2023, and McGrew, 2023, for detail), and applied in many areas of studies, to list a few, autism spectrum disorder (Chua & Xie, 2022), executive functions (Furey et al., 2024), figurative language comprehension (Biesok et al., 2024), sensory abilities/disabilities (Liu & Xie, 2023), and CHC-based validation of a digital cognitive test battery (Vermeent et al., 2020).

The development of the CHC theory was accredited to three prominent psychologists: Raymond B. Cattell (b.1905-d.1998) (Revelle, 2015), John L. Horn (b.1928-d.2006) (McArdle & Hofer, 2014) and John B. Carroll (b.1916-d.2003) (Lubinski, 2004). The CHC theory or model (the two terms *theory* and *model* will be used interchangeably to mean the same thing) is widely recognized as a groundbreaking investigation into human intelligence development. Spanning more than seven decades, Carroll's 3-stratum theory (see Carroll, 1997, for detail) was formulated through the use of psychometrics, involving the objective assessment of cognitive differences, and factor analysis, a statistical method for revealing relationships between variables and the fundamental structure of concepts, such as intelligence (see Keith & Reynolds, 2010; Flanagan & Dixon, 2014, for detail). As noted by Neisser et al. (1996), this psychometric approach has consistently supported the creation of dependable and accurate measurement tools and remains influential in the current field of intelligence research (e.g., Euler, Vehar, & Guevara,

2023; McGrew, 2023). The CHC theory suggests that there are three strata or levels of cognitive abilities (see Table 1).

Table 1. The 3 Strata of Cognitive Abilities in the CHC Model

Strata	Descriptors
Stratum I	This level represents narrow, specific abilities, such as mathematical reasoning, verbal comprehension, and memory. These are highly specialized skills.
Stratum II	This level includes broad cognitive abilities that encompass a range of specific skills. Examples include fluid intelligence (problem-solving ability) and crystallized intelligence (knowledge and skills acquired through experience).
Stratum III	At the highest level, Stratum III, are general cognitive abilities, often referred to as "g." This is the general intelligence factor that influences performance on a wide range of cognitive tasks.

The CHC theory is widely used in the field of psychology and education to understand and assess cognitive abilities (Flanagan & Dixon, 2014). It provides a framework for measuring and analyzing various aspects of human intelligence, helping in educational assessment and intervention programs. Table 2 below is the version 2.1 of the CHC model (Schneider & McGrew, 2012b).

Table 2. The CHC Model Version 2.1 (Schneider and McGrew, 2012b)

Acquired Knowledge	Domain-Independent General Capacities	Sensory-Motor Domain-Specific Abilities		General Speed
		Sensory	Motor	
Quantitative Knowledge (Gq)	Short-Term Memory (Gsm)	Auditory Processing (Ga)	Kinesthetic Abilities (Gk)	Processing Sped (Gs)
Reading & Writing (Grw)	Long-Term Storage & Retrieval (Glr)	Visual Processing (Gv)	Psychomotor Abilities (Gp)	Reaction & Decision Speed (Gt)
(Comprehension-Knowledge (Gc)	Fluid Reasoning (Gf)	Olfactory Abilities (Go)		Psychomotor Speed (Gps)
Domain Specific Knowledge (Gkn)		Tactile Abilities (Gh)		

Key: Shaded boxes: Functional Grouping of Broad Cognitive Abilities; and Unshaded boxes: Conceptual Grouping of Broad Cognitive Abilities

In this paper, we have chosen to use the version 2.5 of the CHC periodic table of human abilities adapted from (Schneider & McGrew 2018). The CHC theory of cognitive abilities has identified 18 broad abilities that are further divided into 91 narrow abilities. The 18 broad cognitive abilities in the CHC model (Schneider & McGrew, 2018) have been classified under four key categories of global or broad cognitive abilities (labeled as G-code), covering the following: I. Intelligence as Process; II. Intelligence as Knowledge; III. Intelligence as Process (Speed and Fluency); and IV. Others and Tentatively identified Domains (see Table 3).

Table 3. The 4 Categories of Abilities in the CHC Model

I. Intelligence as Process	II. Intelligence as Knowledge	III. Intelligence as Process (Speed & Fluency)	IV. Others and Tentatively Identified Domains
1. Fluid Intelligence (Gf): The ability to solve new	1. Crystallized Intelligence (Gc): The knowledge and skills acquired through	1. Retrieval Fluency (Gr): The ability to retrieve	1. Psychomotor Speed (Gps): The ability to perform skilled physical body motor movements (e.g., movement

problems, reason, and think abstractly.	education and experience.	information with fluency from long-term memory.	of fingers, hands, legs) with precision, coordination, fluidity or strength.
2. Short-Term Working Memory (Gwm): The ability to temporarily store and manipulate information.	2. Domain-Specific Knowledge (Gkn): A crucial skill within the interconnected framework of learned information.	2. Processing Speed (Gs): The speed at which cognitive tasks are executed.	2. Psychomotor Abilities (Gp): The ability to perform skilled physical body motor movements (e.g., movement of fingers, hands, legs) with precision, coordination, or strength.
3. Learning Efficiency (Gl): The ability to learn, store, and consolidate new information over periods of time measured in minutes, hours, days, and years.	3. Reading and Writing Ability (Grw): Competence in reading and writing.	3. Decision/Reaction Time (Gt): The speed of cognitive decision-making and reaction to stimuli.	3. Olfactory Abilities (Go): These are the "abilities to detect and process meaningful information in odors" (Schneider & McGrew, 2012b, p. 132).
4. Visual Processing (Gv): The ability to perceive, analyze, and manipulate visual information.	4. Quantitative Knowledge (Gq): Mathematical and numerical abilities.		4. Tactile Abilities (Gh): The ability to detect and process meaningful information in haptic (touch) sensations. It includes perceiving, discriminating and manipulating touch stimuli.
5. Auditory Processing (Ga): The ability to perceive, analyze, and manipulate auditory information.			5. Kinesthetic Abilities (Gk): The ability to detect and process meaningful information in proprioceptive sensations
			6. Emotional Intelligence (Gei): The ability to perceive emotions expressions, understand emotional behavior, and solve problems using emotions

The abovementioned broad abilities are further divided into numerous specific factors (also known as narrow abilities), creating a comprehensive CHC model of cognitive abilities (see Schneider & McGrew, 2018, as well as Flanagan & Dixon, 2014, for more details).

2. Limitations of the CHC Model

However, the CHC model of cognitive abilities (under G-code) also has its own challenges and we have identified seven of them as briefly described here: Firstly, the complexity of the CHC with its multiple factors and subtests has made it challenging to administer and interpret. Secondly, it has a limited coverage and may not encompass all cognitive abilities, and there could be other factors not addressed by the CHC model. Next, there is some cultural bias, too. Some (e.g., Hanschell, 2013) have argued that the CHC model may not adequately consider cultural variations in cognitive abilities. Fourthly, there is a lack of concrete operational definitions. The CHC model relies on theoretical constructs, which can make it difficult to precisely define and measure these factors. Fifthly, the CHC model does not always account for the complex interactions between different cognitive abilities. Next, the CHC

model has evolved over time and continues to be so, and that means assessments need to be updated to stay relevant. Lastly, as there are individual differences, the CHC model may not capture the full range of individual differences in cognitive abilities and potential.

Despite its limitations, as mentioned earlier, we want to reiterate that the CHC model remains a valuable tool for understanding the human potential in terms of the cognitive abilities.

3. What are the Abilities not included in the CHC Model?

There are many other categories of broad and narrow abilities not included in the current CHC model (Schneider & McGrew, 2012a, 2012b), and, hence, there is a need to look out for alternative models. Two good examples of non-CHC models are the extended fluid-crystallized (Gf-Gc; Al-Bakri & Salman, 2020; Baltes et al., 2012) and verbal-perceptual-image rotation (VPR; Johnson & Bouchard, 2005a, 2005b) theories. Both have provided differing descriptions of the structure of intelligence (McGrew, 2009; Horn & Blankson, 2005; Johnson & Bouchard, 2005a, 2005b). Major, Johnson, and Deary (2012), using data from Project TALENT, found that the VPR model of intelligence fits the data better than the CHC (Cattell-Horn-Carroll) and extended Gf-Gc models, suggesting that the VPR model may provide a more accurate framework for understanding intelligence in this context. It is not within the scope of this paper to discuss about this topic. Interested readers can read the relevant papers listed in the References.

Perhaps one of the best known non-CHC models is that of the multiple intelligences (under the Quotient-code, which is known as Q-code for short) postulated by Howard Gardner (b.1943-today), an American developmental psychologist and professor of Cognition and Education at Harvard University, in his book *Frames of Mind: The Theory of Mulitple Intelligences* (Gardner, 1983). The theory of multiple intelligences suggests that an intelligence 'modality' needs to meet eight conditions: (1) it should be isolatable by brain damage, (2) have a place in evolutionary history, (3) include core operations, (4) be symbolically expressible, (5) exhibit a distinct developmental progression, (6) involve individuals with exceptional abilities, (7) be supported by experimental psychology, and (8) be backed by psychometric evidence (see Gilman, 2001, for detail).

In this paper, we have termed the non-CHC categories as ancillary broad and narrow abilities represented by the Q-code in order to distinguish them from the G-code used to represent the CHC categories of broad and narrow abilities. We have selected five examples - Naturalistic Intelligence (NatQ; Morris, 2004; Sadiku et al., 2021), Practical Intelligence (PractQ; Sternberg & Grigorenko, 2000), Adaptability Intelligence (AdaptQ; Chaouachi et al., 2010), Socialization Intelligence (SocQ; (Resnick & Nelson-Le Gall, 2003), and Sensory Intelligence (SenQ; Lombard, 2007; Liu & Xie, 2023) - to discuss what these non-CHC categories of ancillary broad and narrow abilities in order to illustrate certain gaps between the CHC and non-CHC models. According to Chia (2024), "[T]hese ancillary abilities are used in specialized ancillary diagnostic assessments, which are specific evaluation tools or methods used to gather additional information about a patient's condition or situation beyond what a standard assessment might provide. The goal is to gain deeper insights into particular aspects of an individual's functioning or circumstances" (Educational Diagnostics Handout #12).

3.1 Naturalistic Intelligence (NatQ)

Gardner (1983) has listed eight intelligences (we have included our Q-codes for the different intelligences that are not represented in the CHC model): (1) musical (MusQ); (2) visuo-spatial (somewhat associated with Gv in the CHC model); (3) linguistic (somewhat associated with Gc in the CHC model); (4) logical-mathematical (most closely associated with Gf-RQ and also Gq in the CHC model); (5) bodily-kinesthetic (somewhat associated with Gk but currently no well-supported narrow abilities); (6) interpersonal and (7) intrapersonal (both are related to SocQ); and (8) naturalistic (NatQ). Among them, we have selected the last one - the Naturalistic Intelligence (NatQ) - to discuss further as an example here (also see Morris, 2004, and Sadiku et al., 2021, for more detail). Table 4 below shows the five Q-code narrow abilities (not mentioned in the CHC theory) in our senses (i.e., sensory nervous system) that we have identified to contribute to the broad ability of Naturalistic Intelligence (NatQ).

Table 4. The Narrow Abilities of the Broad Ability of NatQ

Narrow Abilities	Descriptors
1. NatQ-Systemizing (NatQ-Sy)	The ability to systemize and understand how things in nature work.
2. NatQ-Environmentalizing (NatQ-En)	The ability to care about the environment and like to be in touch with nature.
3. NatQ-Fauna/Flora Identification (NatQ-FFI)	The ability in identifying fauna and flora.
4. NatQ-Exploration & Discovery (NatQ-ED)	The ability to initiate exploring and discovering new things, e.g., species & behaviours.
5. NatQ-Tool Utilization (NatQ-TU)	The ability with keen interest in using tools to help observation, e.g., microscopes, binoculars, telescopes.

3.2 Practical Intelligence (PractQ)

The practical abilities that are categorized under the Practical Intelligence (PractQ) are often associated with "street smarts" or "common sense." Sternberg and Grigorenko (2000) have provided a detailed description of the development of PractQ, but in short, it refers to the "intelligence as it applies in everyday life in adaptation to, shaping of, and selection of environments" (p. 215). This broad ability of PractQ is a concept not explicitly defined within the CHC (Cattell-Horn-Carroll) model of cognitive abilities. The CHC model primarily focuses on broad and narrow cognitive abilities that are well-researched and established in psychology. While the PractQ is an important aspect of human functioning, it does not fit neatly into the model's structure, and there is no agreed-upon set of narrow abilities associated with it.

The CHC model includes broad abilities such as fluid intelligence (Gf), crystallized intelligence (Gc), processing speed (Gs), memory (Gwm), and learning which can be further divided into learning efficiency (Gl) and retrieval fluency (Gr), and more. These broad abilities encompass various specific abilities and skills. The PractQ is often considered an integration of many of these core CHC broad abilities, and its definition can be context-dependent, making it challenging to isolate specific narrow abilities associated with it. The PractQ relies on applying acquired knowledge and problem-solving skills to real-world situations, and its measurement is less standardized than the components of the CHC model. Table 5 shows four *probable* (represented by the lowercase letter 'þ' in the CHC model) Q-code narrow abilities that can be found in the broad ability of the PractQ.

Table 5. The Narrow Abilities of the Broad Ability of PractQ

Narrow Abilities	Descriptors
1. Common Sense (PractQ-CS)	The ability to make sound judgments and decisions based on practical considerations and everyday experiences.
2. Problem-Solving (PractQ-PS)	The ability to identify and solve practical problems efficiently, often involving creativity and resourcefulness.
3. Street Smarts (PractQ-SS)	Navigating social and environmental situations successfully, such as understanding social norms, staying safe in various contexts, and making wise decisions in everyday life.
4. Practical Skills (PractQ-SP)	Proficiency in tasks and activities that are valuable in daily life, such as cooking, budgeting, time management, and basic handyman skills.

The PractQ also collaborates with two other ancillary broad abilities, i.e., the AdaptQ and the SocQ (see Table 6 below) since there are overlapping narrow ancillary abilities among the three of them.

Table 6. Ancillary Broad Abilities of AdaptQ and SocQ

Broad Ancillary Abilities	**Adaptability Intelligence (AdaptQ)**	**Socialization Intelligence (SocQ)**
Descriptor	The capacity to adjust to changing circumstances, learn from experience, and handle new challenges effectively.	Understanding and effectively interacting with others, including skills related to empathy, communication, and conflict resolution.

In summary, the PractQ is a complex and context-dependent concept that does not fit neatly into the CHC model of cognitive abilities. It is for this key reason, the Q-code narrow abilities of the broad ability of PractQ are also not explicitly included as a separate broad or narrow ability in the CHC model.

3.3 Adaptability Intelligence (AdaptQ)

The second category of ancillary broad ability with its Q-code narrow abilities come under the Adaptability Intelligence (AdaptQ), which refers to an individual's capacity to adjust to changing circumstances, learn new skills, and thrive in dynamic environments. Chaouachi et al. (2010) described the AdaptQ as an affect and mental (cognitive) engagement in learning activities. We have identified several Q-code narrow abilities or sub-components involved in the AdaptQ as follows (see Table 7):

Table 7. The Narrow Abilities of the Broad Ability of AdaptQ

Narrow Abilities	**Descriptors**
1. Learning Agility (AdaptQ-LA)	The ability to rapidly acquire new knowledge and skills. This includes being able to learn from experiences, both positive and negative.
2. Flexibility (AdaptQ-Fx)	The capability to adapt to new situations and be open to different approaches or perspectives. It involves being comfortable with uncertainty and change.
3. Problem-Solving (AdaptQ-PS)	The skill to analyze complex problems, generate creative solutions, and make decisions, especially when faced with novel challenges.
4. Resilience (AdaptQ-Rs)	The capacity to bounce back from setbacks and adversity, maintaining emotional stability and motivation in the face of difficulties.
5. Innovation (AdaptQ-Iv)	The aptitude for generating original ideas, thinking outside the box, and applying creativity to various contexts.
6. Adaptation to Technology (AdaptQ-Tc)	The skill to quickly adapt to and utilize new technologies and digital tools, given the ever-evolving nature of the modern workplace.
7. Cultural Competency (AdaptQ-CC)	The capacity to understand and work effectively within diverse cultural and social contexts, essential in our interconnected world.

In addition, the AdaptQ also involves the Emotional Intelligence (EQ or Gei in the CHC model), i.e., the ability to understand and manage one's emotions and those of others, which is crucial for effective communication and collaboration, in order to adapt to the environment. This is because the EQ helps individuals understand and manage their own emotions as well as perceive and navigate the emotions of others. In the CHC model, the EQ comes under the broad ability of Gei (Emotional Intelligence) which has four G-code narrow abilities: Emotion perception (Gei-Ep); Emotion knowledge (Gei-Ek); Emotion management (Gei-Em); and Emotion utilization (Gei-Eu). However, Gei remains incomplete.

3.4 Socialization Intelligence (SocQ)

The next category of ancillary broad ability with its Q-code narrow abilities not incorporated into the CHC model is related to the socialization or socializing abilities. We have classified them under the Socialization Intelligence (SocQ) which is also known as Socializing Intelligence (Resnick & Nelson-Le Gall, 2003). It is important to note that though socialization (socializing process) and social skills are related concepts, they refer to different aspects of human interaction (see Table 8).

Table 8. The Differences between Socialization and Social Skills

Socialization/Socializing	**Social Skills**
❖ Socialization is the process by which individuals, typically in childhood and throughout life, learn and internalize the norms, values, behaviors, and cultural practices of their society or social group. ❖ It involves acquiring a sense of identity, understanding societal roles, and developing a sense of belonging within a particular culture or community. ❖ Socialization is a broader concept that encompasses various aspects of human development and adaptation to a social environment.	❖ Social skills are specific abilities or behaviors that individuals use to interact effectively and appropriately with others in various social situations. ❖ These skills include communication, active listening, empathy, conflict resolution, cooperation, assertiveness, and the ability to read social cues. ❖ Social skills are the practical tools that enable individuals to navigate social interactions successfully and build positive relationships.

In summary, socialization or socializing (the two terms are used interchangeably throughout this paper) is the overarching process of learning to function within a society or culture, while social skills are the specific competencies and behaviors that facilitate successful social interactions within that society. Socialization helps shape an individual's social skills with its foundation for understanding and engaging in social interactions or social communication.

The socialization or socializing ability can be broken down into several narrow abilities, each of which plays a specific role in an individual's capacity to interact and engage effectively in social situations. Several *probable* (represented by the lowercase letter 'p' in the CHC model) Q-code narrow socialization abilities are listed under the non-CHC model in Table 9.

Table 9. The Narrow Abilities of the Broad Ability of SocQ

Narrow Abilities	**Descriptors**
1. Communication Skills (SocQ-CS)	This involves the ability to express oneself clearly and to understand and interpret verbal and non-verbal communication from others.
2. Empathy (SocQ-Em)	The capacity to understand and share the feelings and perspectives of others, facilitating better interpersonal relationships.
3. Conflict Resolution (SocQ-CR)	The skill to manage and resolve conflicts, whether they are between individuals or within groups.
4. Perspective-Taking (SocQ-PT)	The ability to see situations from the viewpoint of others, aiding in understanding their thoughts and emotions.
5. Active Listening (SocQ-AL)	Being attentive and responsive when others are speaking, which is crucial for effective communication and building rapport.
6. Social Awareness (SocQ-SAw)	The capability to read social cues and adapt behavior accordingly, which is fundamental for appropriate social interactions.

7. Cultural Competence (SocQ-CC)	Understanding and respecting diverse cultural norms and practices to interact effectively with people from various backgrounds.
8. Etiquette and Manners (SocQ-EM)	Knowing and applying appropriate social and behavioral norms in different contexts.
9. Social Adaptability (SocQ-SAp)	Being able to adjust, accommodate and/or transform to meet the demands of different social situations and environments.
10. Group Dynamics (SocQ-GD)	Understanding how groups function, and the ability to work effectively in teams and adapt to various roles within them.

These Q-code narrow abilities under the ancillary broad ability of SocQ collectively contribute to an individual's overall socialization ability and their capacity to engage successfully in a variety of social settings.

3.5 Sensory Intelligence (SenQ)

The Sensory intelligence (SenQ), also known as sensory processing or sensory integration, refers to the ability of the brain to receive, interpret, and respond to sensory information from the immediate environment. Lombard (2007) has described the impact of SenQ on learning by playing a crucial role in how individuals perceive, process, and acquire knowledge and experiences from their environment. It involves the ability to use sensory information (e.g., sight, hearing, touch, taste, and smell) to understand and interact with the world. People rely on their senses to gather information, make sense of their surroundings, and learn from their experiences. The SenQ can vary from person to person and can influence the way individuals learn and remember information (Liu & Xie, 2023).

According to the CHC model, under the Sensory-Motor Domain-Specific Abilities (SMD-SA) in the CHC model Version 2.1 (Schneider & McGrew, 2012b; also see Liu & Xie, 2023), the SMD-SA involves various broad abilities (i.e., Ga, Gv, Gh, Go, Gk and Gp) with their respective narrow abilities. Not all the broad sensory-based cognitive abilities in the CHC model have narrow abilities. For instance, currently Gh-Tactile Abilities and Gk-Kinesthetic Abilities have no well-supported narrow abilities, while Go-Olfactory Abilities has only one narrow ability, Go-OM (Olfactory Memory), listed. The *probable* (represented by the lowercase letter þ') pGg-Gustatory Abilities is not included in the CHC model in any of its versions. As such, the CHC model does not provide a complete record of all sensory abilities. Whatever is not found in the CHC model of its G-code broad abilities with their respective G-code narrow abilities will be included in the Q-code broad abilities with their respective Q-code narrow abilities in the non-CHC model as ancillary capabilities or skills (see Table 10).

Table 10. The Gaps between CHC and non-CHC Models

CHC Model	**Probable (p) Broad Abilites**	**Non-CHC Model**
G-code	**(Using G-code)**	**Q-code**
Ga-Auditory Processing	pGg-Gustatory Abilities	SenQ-GA: Gustatory Abilities
Gv-Visual Processing	pGvs-Vestibular System	SenQ-VS: Vestibular System
Gp-Psychomotor Abilities	pGpp-Proprioception	SenQ-Pp: Proprioception
Go-Olfactory Abilities	pGpx-Praxis	SenQ-Px: Praxis
Gh-Tactile Abilities		
Gk-Kinesthetic Abilities		

Figure 1 (adapted from Liu & Xie, 2023, p. 21) provides an example of two broad abilities Ga (Auditory Processing) and Gv (Visual Processing) with their respective narrow abilities listed in the CHC model version 2.1 (Schneider & McGrew, 2012b). The broad abilities of Ga and Gv with their respective narrow abilities remain unchanged in the CHC model version 2.5 (Schneider & McGrew, 2018).

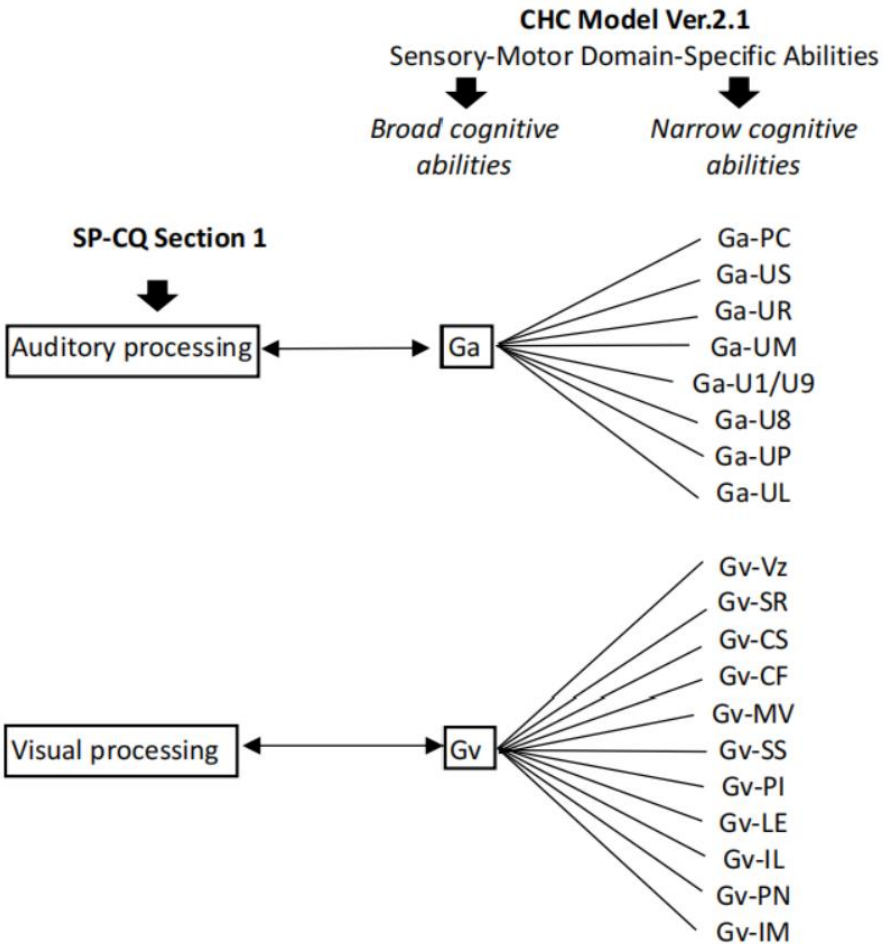

Figure 1. The CHC Model of Ga and Gv (Liu & Xie, 2023, p. 21)

However, not all the senses mentioned in Dunn's Sensory Profile (Dunn, 1999) are listed in the CHC model. The sensory model proposed by Dunn (1997, 1999) outlines the senses and the narrow abilities under the ancillary broad ability of SenQ (as shown in Table 11) included in the non-CHC model of categorization.

Table 11. The non-CHC Categorization of Senses and Narrow Abilities of SenQ

Broad Ability	**Senses**	**Narrow Abilities**
Sensory Intelligence (SenQ)	1. Vision: Including visual perception and eye-hand coordination. 2. Hearing: Involving auditory perception and sound localization. 3. Touch: Incorporating tactile discrimination and proprioception (awareness of one's body in space). 4. Taste and Smell: Relating to gustatory and olfactory processing. 5. Vestibular System: Maintaining balance and spatial orientation. 6. Interoception: Sensing internal bodily states like hunger, thirst, and emotional responses.	1. Sensory Detection (SenQ-SDt): The ability to detect sensory stimuli, such as seeing, hearing, or feeling something. 2. Sensory Modulation (SenQ-SM): Regulating the intensity and responsiveness to sensory input. It includes being able to filter out irrelevant stimuli and respond appropriately to relevant ones. 3. Sensory Discrimination (SenQ-SDs): The ability to distinguish between different sensory stimuli, such as recognizing shapes, colors, textures, or sounds. 4. Sensory Integration (SenQ-It): The capacity to combine and process information from multiple senses

	7. Praxis: The ability to plan and execute purposeful movements. 8. Sensory-Based Motor Skills: Fine and gross motor skills influenced by sensory input.	simultaneously, leading to a coherent perception of the environment. 5. Sensory-Motor Integration (SenQ-MIt: The coordination of sensory input with motor responses, which is essential for activities like balance, fine and gross motor skills.

The ancillary broad ability of SenQ plays a crucial role in how individuals navigate and interact with their surroundings, and difficulties in these areas can lead to sensory processing disorders or other sensory-motor-related challenges encountered in the activities of daily living.

4. Conclusion

We believe that the non-Cattell-Horn-Carroll (CHC) or Q-code broad and narrow abilities are just as important as CHC or G-code abilities for four key reasons stated here: Firstly, for comprehensive understanding, the non-CHC or Q-code abilities help provide us a more comprehensive understanding of an individual's cognitive profile. While CHC abilities cover a broad range of G-code cognitive skills, non-CHC or Q-code abilities can capture unique talents and strengths that may not be adequately represented within the CHC framework. Secondly, the non-CHC abilities can highlight the individual's specific skills and talents, which can be essential for personalized education and career planning. This is personalization by recognizing these abilities can guide individuals toward fields and activities where they can excel. Thirdly, many non-CHC abilities (e.g., creativity, practical problem-solving, and emotional intelligence) are highly relevant in real-world situations. They play a crucial role in various aspects of life, from interpersonal relationships to professional success. Lastly, the non-CHC or Q-code abilities reflect the diversity of human intelligence. They encompass a wide range of talents, from artistic and musical abilities to social and emotional competencies. As such, by acknowledging and nurturing these diverse strengths is vital for promoting a person's well-being and societal progress.

In summary, we have opined that both CHC (G-code) and non-CHC (Q-code) abilities are equally important because they offer a more holistic view of any individual's cognitive and intellectual capabilities, allowing for better-informed decision-making and support in various aspects of life.

References

Al-Bakri, S.A.B., Salman, A.M. (2020). Fluid, crystallized intelligence and language proficiency: A correlational study. Journal of Global Scientific Research, 9, 834-844.

Baltes, P.B., Cornelius, S.W., Spiro, A., Nesselroade, J.R., Willis, S.L. (1980). Integration versus differentiation of fluid/crytallized intelligence in old age. Developmental Psychology, 16(6), 625-635. https://doi.org/10.1037/0012-1649.16.6.625.

Biesok, A., Ziegler, M., Montag, C., Nenchev, I. (2024). Adding a piece to the puzzle? The allocation of figurative language comprehension into the CHC model of cognitive abilities. Journal of Intelligence, 12(3), 29. https://doi.org/10.3390/jintelligence12030029

Carroll, J.B. (1997). The three-stratum theory of cognitive abilities. In D.P. Flanagan, J.L. Genshaft, P. L. Harrison (Eds.), Contemporary intellectual assessment: Theories, tests and issues (pp. 122-130). Guilford Press. New York.

Chaouachi, M., Chalfoun, P., Jraidi, I., Frasson, C. (2010). Affect and mental engagement: Towards adaptability for intelligent systems. In Proceedings of the 23rd international FLAIRS conference. Daytona Beach: AAAI Press, USA.

Chia, K.H. (2024). Ancillary diagnostic assessment tools. Educational Diagnostics Handout #12. International Association of Counselors & Therapists-Singapore Chapter, Singapore

Chua, A.C.K., Xie, G.H. (2022). Diagnostic profiling of cognitive strengths and weaknesses in autism spectrum disorder: What the Cattell-Horn-Carroll theory tells us. Journal of Early Years Research, 2(2), 16-22.

Dunn, W. (1997). The impact of sensory processing abilities on the daily lives of young children and their families: A conceptual model. Infants & Young Children, 9, 23-35. https://doi.org/10.1097/00001163-199704000-00005

Dunn, W. (1999). The Sensory Profile user's manual. Psychological Corporation, San Antonio, TX. https://doi.org/10.1037/t15155-000

Euler, M.J., Vehar, J.V., Guevara, J.E. (2023). Theories of intelligence. In J. L. Matson (Ed.), Handbook of clinical child psychology: Integrating theory and research into practice (pp. 289-323). Switzerland, Cham: Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-031-24926-6_15

Flanagan, D.P., Dixon, S.G. (2014). The Cattell-Horn-Carroll theory of cognitive abilities. In C.R. Reynolds, K.J. Vannest, E. Fletcher-Janzen (Eds.), Encyclopedia of special education: A reference for the education of children, adolescents, and adults with disabilities and other exceptional individuals (13 pages). John Wiley & Sons, New Jersey https://doi.org/10.1002/9781118660584.ese0431

Furey, R.T., Bowden, S.C., Jewsbury, P.A., Sudarshan, N.J., Connolly, M.L. (2024). Investigating the latent structure of executive function in the Delis-Kaplan executive function system using Cattell-Horn-Carroll theory. Assessment, 31(2), 363-376. https://doi.org/10.1177/10731911231161779

Gardner, H. (1983). Frames of mind: The theory of mulitple intelligences. Basic Books, New York. https://doi.org/10.2307/3324560

Gilman, L. (2001). The Theory of Multiple Intelligences. Indiana University, Bloomington, IN. Retrieved from: https://web.archive.org/web/20121125220607/

Gordon, L. M. (2014). Gardner, Howard (1943–). In N. J. Salkind (Ed.), Encyclopedia of Human Development, Vol. 2 (pp. 552-553). Thousand Oaks, CA: Sage Publishing. https://doi.org/10.4135/9781412952484

Hanschell, J. (2013). Intelligence, testing and discrimination. Certificate of Competence in Educational Testing (Level A): Assignment 3. Retrieved from: https://lockerbie.nibblecs.com/LCK/Public/CCET%20FOR%20WEBSITE.pdf

Horn, J.L., Blankson, N. (2005). Foundations for better understanding of cognitive abilities. In D. P. Flanagan P. L. Harrison (Eds.), Contemporary intellectual assessment: Theories, tests, and issues (pp. 41-68). Guilford Press, New York.

Johnson, W., Bouchard Jr, T.J. (2005a). The structure of human intelligence: It is verbal, perceptual, and image rotation (VPR), not fluid and crystallized. Intelligence, 33(4), 393-416. https://doi.org/10.1016/j.intell.2004.12.002

Johnson, W., Bouchard Jr, T.J. (2005b). Constructive replication of the visual-perceptual-image rotation model in Thurstone's (1941) battery of 60 tests of mental ability. Intelligence, 33(4), 417-430. https://doi.org/10.1016/j.intell.2004.12.001

Keith, T.Z., Reynolds, M.R. (2010). Cattell-Horn-Carroll abilities and cognitive tests: What we've learned from 20 years of research. Psychology in the Schools, 47(7), 635-650. https://doi.org/10.1002/pits.20496

Liu, W., Xie. G.H. (2023). Sensory abilities/disabilities: An application of the Sensory Profile-Caregiver Questionnaire to better understand the sensory-motor domain-specific abilities in the CHC model version 2.1. The Asian Educational Therapist, 1(1), 1-21.

Lombard, A. (2007). Sensory intelligence. Welgemoed, Metz, South Africa.

Lubinski, D. (2004). John Bissell Carroll (1916-2003). American Psychologist, 59(1), 43-44. https://doi.org/10.1037/0003-066X.59.1.43

Major, J.T., Wendy Johnson, W., Deary, I.J. (2012). Comparing models of intelligence in Project TALENT: The VPR model fits better than the CHC and extended Gf-Gc models. Intelligence, 40(6), 543-559. https://doi.org/10.1016/j.intell.2012.07.006

McGrew, K. S. (2009). CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research. Intelligence, 37(1), 1-10. https://doi.org/10.1016/j.intell.2008.08.004

McArdle, J. J., & Hofer, S. M. (2014). Fighting for intelligence: A brief Overview of the academic work of John L. Horn. Multivariate Behavioral Research, 49(1), 1-16. https://doi.org/10.1080/00273171.2013.841089

McGrew, K. S., Schneider, W. J. (2018). CHC Theory Revised: A Visual-Graphic Summary of Schneider and McGrew's 2018 CHC Update Chapter. Retrieved from: http://iapsych.com/mindhubpub4.pdf

McGrew, K.S. (2023). 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. Journal of Intelligence, 11(2), 32. https://doi.org/10.3390/jintelligence11020032

Morris, M. (2004). The eighth one: Naturalistic intelligence. Counterpoints, 278, 159-173.

Neisser, U., Boodoo, G., Bouchard Jr, T.J., Boykin, A.W., Brody, N., Ceci, S.J., Halpern, D.F., Loehlin, J. C., Perloff, R., Sternberg, R.J., Urbina, S. (1996). Intelligence: The knowns and unknowns. American Psychologist, 51(2), 77. https://doi.org/10.1037/0003-066X.51.2.77

Resnick, L.B., Nelson-Le Gall, S. (2003). Socializing intelligence. In L.B. Resnick & S. Nelson-Le Gall (Eds.), Piaget, Vygotsky & beyond (pp. 110-120). Oxfordshire, Routledge, UK.

Revelle, W. (2015). Raymond B. Cattell 1905-1998. In R. L. Cautin, & S. O. Lilienfeld (Eds.), The Encyclopedia of Clinical Psychology, 5 Volume Set. (S–Z 2505). Hoboken, NJ: John Wiley & Sons. https://doi.org/10.1002/9781118625392.wbecp553

Sadiku, M.N., Musa, S.M., Sadiku, M.N., Musa, S.M. (2021). Naturalistic intelligence. In M.N.O. Sadiku & S.M. Musa (Eds.), A primer on multiple intelligences, (pp. 31-42). Springer, New York. https://doi.org/10.1007/978-3-030-77584-1

Schneider, J., McGrew, K. (2012b). The Cattell-Horn-Carroll (CHC) model of intelligence v2. 2: a visual tour and summary. Institute for Applied Psychometrics (IAP), 1, 03-13.

Schneider, W.J., McGrew, K.S. (2012a). The Cattell-Horn-Carroll model of intelligence. In D. P. Flanagan & P. L. Harrison (Eds.), Contemporary intellectual assessment: Theories, tests, and issues (pp. 99-144). The Guilford Press, New York.

Schneider, W.J., McGrew, K.S. (2018). CHC theory revised: A visual-graphic summary of Schneider and McGrew's 2018 CHC: Update Chapter. Retrieved from http://www.iqscorner.com/2018/05/cattell-horn-carroll-chc-intelligence.html

Sternberg, R.J., Grigorenko, E.L. (2000). Practical intelligence and its development. In R. Bar-On J. D. A. Parker (Eds.), The handbook of emotional intelligence: Theory, development, assessment, and application at home, school, and in the workplace (pp. 215-243). Jossey-Bass/Wiley. https://doi.org/10.1017/CBO9780511807947.018

Vermeent, S., Dotsch, R., Schmand, B., Klaming, L., Miller, J.B., Van Elswijk, G. (2020). Evidence of validity for a newly developed digital cognitive test battery. Frontiers in Psychology, 11, 491143. https://doi.org/10.3389/fpsyg.2020.00770

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