CHC Theory: Unlocking the Structure of Human Intelligence

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Recent advances in current theory and research on the structure of human cognitive abilities have resulted in a new empirically derived model commonly referred to as the Cattell-Horn-Carroll theory of cognitive abilities (CHC theory). CHC theory of cognitive abilities is an amalgamation of two similar theories about the content and structure of human cognitive abilities. The first of these two theories is Gf-Gc theory (Cattell, 1941; Horn 1965), and the second is Carroll's (1993) Three-Stratum theory. Carroll's expansion of Gf-Gc theory to CHC theory was developed in the course of a major survey of research over the past 60 or 70 years on the nature, identification, and structure of human cognitive abilities. That research involved the use of the mathematical technique known as factor analysis. In comparison to other well-known theories of intelligence and cognitive abilities, CHC theory is the most comprehensive and empirically supported psychometric theory of the structure of cognitive and academic abilities.

The CHC model was expanded by McGrew (1997) and later revised with the help of Flanagan (1998). There are a fairly large number of distinct individual differences in cognitive ability, and that the relationships among them can be derived by classifying them into three different strata: stratum I, "narrow" abilities; stratum II, "broad abilities"; and stratum III, consisting of a single "general" ability.

CHC theory abilities

There are 10 broad stratum abilities and over 70 narrow abilities below these. The broad abilities are Crystallized Intelligence (Gc): includes the breadth and depth of a person's acquired knowledge, the ability to communicate one's knowledge, and the ability to reason using previously learned experiences or procedures. Fluid Intelligence (Gf): includes the broad ability to reason, form concepts, and solve problems using unfamiliar information or novel procedures. Quantitative Reasoning (Gq): is the ability to comprehend quantitative concepts and relationships and to manipulate numerical symbols.

Reading & Writing Ability (Grw): includes basic reading and writing skills. Short-Term Memory (Gsm): is the ability to apprehend and hold information in immediate awareness and then use it within a few seconds. Long-Term Storage and Retrieval (Glr): is the ability to store information and fluently retrieve it later in the process of thinking. Visual Processing (Gv): is the ability to perceive, analyze, synthesize, and think with visual patterns, including the ability to store and recall visual representations. Auditory Processing (Ga): is the ability to analyze, synthesize, and discriminate auditory stimuli, including the ability to process and discriminate speech sounds that may be presented under distorted conditions.

Processing Speed (Gs): is the ability to perform automatic cognitive tasks, particularly when measured under pressure to maintain focused attention. Decision/Reaction Time/Speed (Gt): reflect the immediacy with which an individual can react to stimuli or a task (typically measured in

seconds or fractions of seconds; not to be confused with Gs, which typically is measured in intervals of 2-3 minutes). (G) from Carroll's model has been omitted, but fluid and crystallized intelligence from the Cattell-Horn model remained. Please refer to Flanagan et. al. (2005) for a description on narrow abilities.

CHC model tests

Many tests of cognitive ability have been classified using the CHC model and are described in The Intelligence Test Desk Reference (ITDR) (McGrew & Flanagan, 1998). CHC theory is particularly relevant to school psychologists for psychoeducational assessment. 5 of the 7 major tests of intelligence have changed to incorporate CHC theory as their foundation for specifying and operationalizing cognitive abilities/processes. Since even all modern intellectual test instruments fail to effectively measure all 10 broad stratum abilities an alternative method of cognitive assessment and interpretation called Cross Battery Assessment (XBA; Flanagan, Ortiz, Alfonso, & Dynda, 2008) was developed. Recently (March 11th, 2009) McGrew released a draft of the revised broad and narrow ability definitions.

Three stratum theory

In 1993 John Carroll (1916 - 2003) published "Human cognitive abilities: A survey of factor-analytic studies", which outlined his hierarchical, Three-Stratum Theory of cognitive abilities. The theory is based on a factor analytic study of correlation of individual differences variables from measures including psychological tests, school marks, and competence ratings. The factor analysis suggests three layers or strata, with each layer attempting to account for the variation in factor loadings at the next lower level. Thus, the three strata are defined as representing narrow, broad, and general cognitive ability.

Stratum and Ability

General (Stratum III) - General intelligence factor
General (Stratum II) - Fluid intelligence, crystallized intelligence, general memory and learning, broad visual perception, broad auditory perception, broad retrieval ability, broad cognitive speediness and processing speed.
General (Stratum I) - 69 narrow abilities, each related to a specific Stratum II domain.

Carroll argues that factors are not mere artifacts of a mathematical process. The factors do describe stable and observable differences among individuals in the performance of tasks. The existence of physiological explanations for the differences in ability (e.g., muscle firing rates) does nothing to limit the effectiveness of factors in accounting for behavioral differences.

Carroll proposes a taxonomic dimension in the distinction between level factors and speed factors. The tasks that contribute to the identification or level factors can be sorted by difficulty and individuals differentiated by whether they have acquired the skill to perform the tasks. Tasks that contribute to speed factors are distinguished by the relative speed with which individuals can complete them. Carroll suggests that the distinction between level and speed factors may be the broadest taxonomy of cognitive tasks that can be offered. Carroll distinguishes his hierarchical approach from taxonomic approaches such as Guilford's Structure of Intellect model (three-dimensional model with contents, operations, and products).