

2 Intelligence and Intelligence Testing

Most online tests measure intelligence or facets of intelligence. The most extensive research in personality has been applied to the area of intelligence (Holling, Preckel, & Vock, 2004). Intelligence tests have been shown to be amongst the most valid predictors of outcomes such as job performance (Schmidt & Hunter, 1998), academic performance (Watkins, Lei, & Canivez, 2007), health (Gottfredson, 2004), and socioeconomic status (Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007). Despite this fact, there is no universally valid definition of the term (Asendorpf & Neyer, 2012).

An early definition was offered by Alfred Binet (1905), one of the creators of the first general-purpose intelligence test (Gardner & Hatch, 1989). He considered being able to judge, comprehend, and reason to be at the core of intelligence. A few years later, William Stern (1912) suggested a slightly more concrete definition: “Intelligence is an individual’s ability to consciously adapt his or her thinking to new requirements; it is a general mental ability to adapt to new tasks and conditions in life” (p. 3; translated by the author). Louis Leon Thurstone (1921) defined intelligence as “(a) the capacity to inhibit an instinctive adjustment, (b) the capacity to redefine the inhibited instinctive adjustment in the light of imaginably experienced trial and error, (c) the volitional capacity to realize the modified instinctive adjustment into overt behavior to the advantage of the individual as a social animal” (p. 201). David Wechsler (1939), the author of one of the most widely used intelligence tests, defined intelligence as “the global capacity of a person to act purposefully, to think rationally, and to deal effectively with his environment” (p. 229). Similarly, Gordon Allport (1961) referred to intelligence as the capacity to make judgments, learn from experience, and deal with novel prob-

lems. Finally, Robert Sternberg (1985) defined intelligence as “mental activity directed toward purposive adaptation to, selection and shaping of real-world environments relevant to one’s life” (p. 45).

At the core of these definitions is the ability to comprehend one’s environment, to reason and to judge on the basis of this understanding, and thus to deal with novel problems, to learn and adapt to one’s environment, and to do all of this on purpose. Or, to shorten this definition, a constituting element of intelligence seems to be the quality and speed with which novel tasks are solved (Schuler & Höft, 2006).

There are also more general definitions such as the one presented by Eysenck (1976): Intelligence is an “innate, general, cognitive ability” (p. 115). In Howard Gardner’s (1999) view, on the other hand, there is no universal notion of “the” intelligence. Rather, intelligence comprises abilities that are valued in certain periods of time (which were, e.g., different in ancient Greece than they are today) or in certain cultures. However, all of these definitions are vague and difficult to operationalise. It remains unclear what acting purposefully and effectively means because these words could easily be replaced by “intelligent”; thus, the definitions are tautological (Stemmler, Bartussek, Hagemann, & Amelang, 2011). Furthermore, it remains unclear what an adaptation to and an assimilation of environment looks like. Therefore, in a rather pragmatic approach, Edwin Boring (1923) stated: “intelligence is what the tests test” (p. 23).

As provocative as this may sound, it is in line with a 1921 symposium on intelligence and its measurement on which a special issue was published in the *Journal of Educational Psychology* (No authorship indicated, 1921): Although the concept of intelligence is controversial, there is wide agreement on how to measure it. This fact seems to reflect the view that is still held by researchers

today. For example, Eysenck (1998) stated that a definition of intelligence is not necessary because the meaningful contribution of research on intelligence can be found in the fact that instruments that allow for the construct to be tested have been implemented. Thus, by looking at the tests and their designs, it becomes obvious what intelligence means.

Therefore, in this chapter, some tests assessing intelligence will be discussed. As such tests are always based on models of intelligence, some of the most influential intelligence theories will be introduced first.

2.1 MODELS OF INTELLIGENCE

There are many models describing the structure of intelligence. Most of them are factor models that were created using the results of different intelligence test tasks to try to extract common factors. In the early days of intelligence testing, there was a controversy with regard to whether there was something like a general factor of intelligence or whether there were a number of distinct factors. Finally, a model with several levels subsumed the two opposing models, although it is still controversial whether something like a general factor of intelligence exists.

2.1.1 *Two-Factor Theories*

In 1904, Charles Spearman found intercorrelations between intelligence test tasks and therefore concluded that performance on these tasks could be predicted by two factors: a general (“g”) factor that expressed general ability and a specific (“s”) factor that was specific to the respective task (Spearman, 1904). He defined the test that best measured g as the one that showed the highest correlations with all other tests and considered g to be the essence

of intelligence. At the core of his g factor, he placed operations such as problem solving, deduction, induction, and discovering rules, differences, and similarities; thus, operations that are commonly labeled “reasoning”.

Raymond B. Cattell (1941, 1943, 1950) also found that intelligence was comprised of two factors; however, he divided them into “fluid intelligence” (gf) and “crystallised intelligence” (gc). Fluid intelligence comprises reasoning, such as problem solving, deduction, induction, and discovering rules, differences, and similarities as in Spearman’s model, whereas crystallised intelligence refers to knowledge and learned structures. Thus, fluid intelligence is innate and begins to decline at a certain age, whereas crystallised intelligence increases as humans accumulate knowledge across the life course. Later, Horn (1965) extended the theory by adding some more specific factors: short-term memory (Gsm), long-term retrieval (Glr), processing speed (Gs), and visual-spatial thinking (Gv). Finally, auditory processing (Ga) was added to the model (Stankov & Horn, 1980). In contrast to Spearman (1904), Cattell and Horn did not assume one general factor of intelligence but rather saw Gf and Gc as the highest order factors (Horn & Cattell, 1966).

2.1.2 Primary factors

Louis Leon Thurstone (1938) did not agree with the idea of a general factor of intelligence. He claimed that there are seven domain-specific intelligence factors that he called primary mental abilities (PMA). These factors are:

- perceptual speed (P): the ability to quickly see differences and similarities between objects
- space (S): visual-spatial abilities
- numerical ability (N): the ability to deal with numbers

- word fluency (W): the ability to fluently use vocabulary
- verbal comprehension (V): the ability to deal with vocabulary and concepts
- memory (M): the ability to memorise
- reasoning (R): the ability to discover rules and relationships

However, due to the extraction method he used (i.e., an oblique one), his factors are moderately intercorrelated, which many see as evidence of a general factor of intelligence.

2.1.3 *Integration of the models*

John B. Carroll (1993) found that it was possible to integrate the above-mentioned models into one with several layers: at the bottom level or Stratum III, there are specific factors that converge to form the more complex factors of fluid and crystallised intelligence on the intermediate level or Stratum II and eventually to form one general factor on the top level or Stratum I. Therefore, the theory is called the Three-Stratum theory. Table 1 provides an overview of the stratum II factors and some examples of the respective stratum III factors (excerpt from McGrew, 2009, pp. 5–6):

Table 1

Stratum II Abilities and Descriptions and Examples of Stratum III Abilities in the Carroll (1993) Model (Excerpt of the Table in McGrew, 2009, pp. 5–6)

Stratum II Ability	Stratum II Ability Description	Stratum III Abilities
Fluid intelligence (Gf)	The use of deliberate and controlled mental operations to solve novel problems that cannot be performed automatically.	Deductive reasoning, induction, quantitative reasoning
Crystallised intelligence (Gc)	The knowledge of the culture that is incorporated by individuals through a process of acculturation.	Lexical knowledge, foreign language proficiency, oral production, and fluency
General memory and learning (Gy)	The ability to apprehend and maintain awareness of a limited number of elements of information in the immediate situation (events that occurred in the last minute or so).	Memory span, working memory
Broad visual processing (Gv)	The ability to generate, store, retrieve, and transform visual images and sensations.	Spatial relations, spatial scanning, imagery
Broad auditory perception (Gu)	Abilities that depend on sound as input and on the functioning of our hearing apparatus.	General sound discrimination, temporal tracking, sound localisation

Table 1 (continued)

Stratum II Abilities and Descriptions and Examples of Stratum III Abilities in the Carroll (1993) Model (Excerpt of the Table in McGrew, 2009, pp. 5–6)

Stratum II Ability	Stratum II Ability Description	Stratum III Abilities
Broad retrieval ability (Gr)	The ability to store and consolidate new information in long-term memory and later fluently retrieve the stored information (e.g., concepts, ideas, items, names) through association.	Associative memory, ideational fluency, originality/creativity
Broad cognitive speediness (Gs)	The ability to automatically and fluently perform relatively easy or over-learned elementary cognitive tasks, especially when high mental efficiency (i.e., attention and focussed concentration) is required.	Perceptual speed, number facility, writing speed
Processing speed (RT decision speed)	The ability to make elementary decisions and/or responses (simple reaction time) or one of several elementary decisions and/or responses (complex reaction time) at the onset of simple stimuli.	Simple reaction time, choice reaction time, semantic processing speed

McGrew (2009) proposed a few extensions to the model: He proposed general (domain-specific) knowledge (Gkn) such as knowledge of English as a second language, mathematical, or geography knowledge; however, most of his extensions refer to abilities that go beyond the classical cognitive ones such as tactile (Gh), kinaesthetic (Gk), and olfactory (Go) abilities as well as psychomotor abilities (Gp) and psychomotor speed (Gps). depicts the Three-Stratum Model (Carroll, 1993), the Cattell-Horn Model (Cattell, 1963; 1968; Horn & Cattell, 1966), and the Integrated Model (McGrew, 2009).

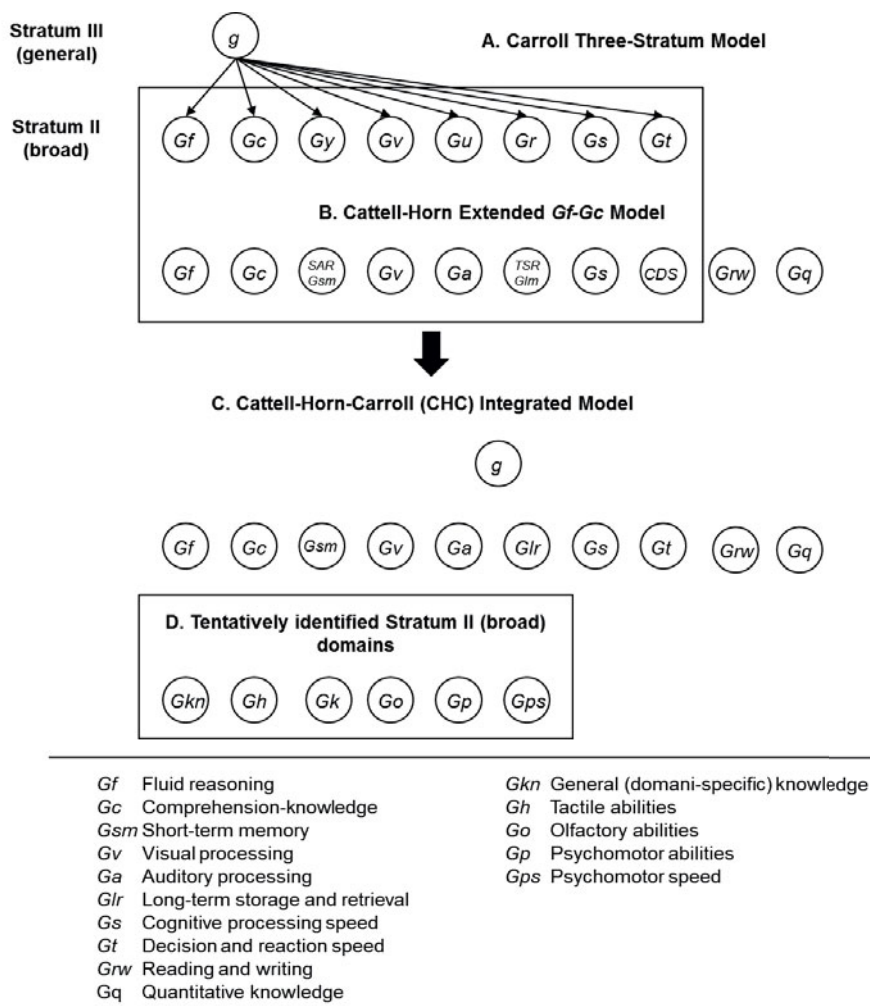


Figure 1. Integration of Carroll Three-Stratum Model into Cattell-Horn-Carroll (CHC) Model. Graphic from McGrew (2009) with slight changes. Printed with permission.

As the model integrates Cattell, Horn, and Carroll's findings, McGrew (2009) and Schneider and McGrew (2012) suggested calling it the "Cattell-Horn-Carroll Model" or the CHC Model.

As already mentioned above, McGrew's (2009) extensions mainly comprise noncognitive factors. In this sense, it comes close to Howard Gardner's model of Multiple Intelligences (Gardner, 1983), which contains eight factors (musical-rhythmic, visual-spatial, verbal-linguistic, logical-mathematical, bodily-kinesthetic, interpersonal, intrapersonal, and naturalistic), amongst which are also some noncognitive ones. These factors, however, have been criticised as being composites of abilities, interests, motivation, achievement, socialisation, and enculturation, all of which are difficult or impossible to assess (Sternberg, 1991). By contrast, the CHC Model without the extensions has provided the theoretical basis for widely used intelligence tests and can be and is used for classifying most of the commonly used intelligence test batteries (McGrew & Flanagan, 1998).

2.1.4 Multidimensional Model

Multidimensional models assume that there is no hierarchical order of intelligence factors, but rather that there are different dimensions along which the components of intelligence can be classified into clusters.

Guilford's Structure of Intellect theory (Guilford, 1967) assumes three dimensions: operations, content, and product. Operations are comprised of cognitive processes, cognition, memory recording and retention, divergent and convergent production, and evaluation. Content refers to the type of information that is processed and can be figural, semantic, symbolic, or behavioural. Finally, product describes the outcomes of operations made on the content and can be units, classes (sets of units), relations (links

Successful Emotions

How Emotions Drive Cognitive Performance

Lochner, K.

2016, XVIII, 455 p. 31 illus., Softcover

ISBN: 978-3-658-12230-0