The science behind the Thomas Aptitude assessment

January 2024

What is the Aptitude assessment?

The Aptitude assessment, also known as the General Intelligence Assessment (GIA), is comprised of a series of tasks which measure abilities that are important components of intelligence and provides an index of an individual's competence in acquiring new knowledge and skills. This is known as their trainability.
The Aptitude assessment measures general intelligence (cognitive ability) and trainability (new skills acquisition). It targets five core areas:

- Fluid intelligence
- Concentration
- Response to training
- Mental processing speed
- Speed of development / progression

The Aptitude assessment contains five sub-tasks:

Reasoning

The Reasoning task measures simple deductive verbal reasoning ability and assesses the ability to make inferences, to reason from information provided and to draw correct conclusions. This task assesses the ability of an individual to hold information in their short-term memory and solve problems.

Perceptual Speed

The Perceptual Speed task assesses the ability to recognise details in the environment, incorporating the perception of inaccuracies in written material, numbers and diagrams, the ability to ignore irrelevant information, to identify similarities and differences in visual configurations. This task assesses how quickly and accurately an individual can check and report for error/accuracy.

Number Speed and Accuracy

The Number Speed and Accuracy task measures numerical manipulation and is a measure of basic numerical reasoning ability. It measures the degree to which someone can work comfortably with quantitative concepts. It assesses the ability to work in environments where basic numeracy is required and wherever attention and concentration are required regarding numerical applications.

Word Meaning

The Word Meaning task measures how quickly people can make decisions about words based on their meanings. It assesses the comprehension of a large number of words from different parts of speech. It assesses the ability to work in environments where a clear understanding of written or spoken instructions is required.

Spatial Visualisation

The Spatial Visualisation task measures how quickly people can visualise and manipulate shapes in their heads. The test correlates well with tests of mechanical reasoning and assesses an individual's ability to use mental visualisation skills to compare shapes. It relates to the ability to work in environments where visualisation skills are prerequisites for understanding and executing tasks.

What theory is the Aptitude assessment based on?

The Aptitude assessment is derived from several tests which were originally released in 1992 (see Irvine & Dann, 1994; Collis, Tapsfield, Irvine, Dann & Wright, 1995) following six years of research and development. There are several psychological theories underpinning the Aptitude assessment.

Human intelligence as a complex system (Detterman, 1986)

Detterman viewed human intelligence as "a complex system … of a finite number of independent (i.e., orthogonal) variables" (see Detterman, 1986). Detterman recognised the complex and multifaceted nature of intelligence. He suggested that if it were possible to measure each of these variables separately then the combination of these measures should be predictive of more complex tasks.

Eight basic cognitive task paradigms (Carroll, 1980)

Carroll identified eight basic cognitive task paradigms as part of his comprehensive model of human cognitive abilities. These paradigms were used to identify and measure different cognitive abilities. The eight basic cognitive task paradigms are:

- Verbal comprehension
- Number facility
- Spatial visualisation
- Perceptual speed
- Inductive reasoning
- Deductive reasoning
- Memory
- Word fluency

These eight basic cognitive task paradigms served as the foundation for Carroll's three-stratum theory of cognitive abilities, which organized cognitive abilities into three levels: the general factor (g), broad cognitive abilities, and specific cognitive abilities.
The content of the Aptitude assessment was chosen based on work by both Detterman (1986) and Carroll (1986a, 1986b, 1997) to provide an index of what we have termed 'trainability.'

Trainability (Kyllonen & Christal, 1990)

Kyllonen and Christal introduced the concept of "trainability" as a component of cognitive ability. They proposed that working memory capacity (a cognitive system responsible for temporarily holding and manipulating information during cognitive tasks) is a key factor in an individual's ability to learn and adapt to new tasks and situations.

Working memory (Baddeley, 2000)

Baddeley proposed a model of working memory to explain how information is temporarily stored and manipulated in the mind. The work by Baddeley has been influential in understanding the cognitive processes behind problem solving, decision making and language comprehension.

Emergence of the Aptitude assessment

The theory discussed above was integrated to create the Aptitude assessment. A core component of each task is the requirement to allocate attention resources to solving problems in the short term and working memory. Individuals completing the Aptitude assessment are required to 'work as quickly and as accurately as possible' through each of the sub-tasks. The results from each task are combined to create an overall score known as the General Trainability Index (GTI).

How is the Aptitude assessment predictive of positive work outcomes?

Meta-analysis (Schmidt et al., 2016) (Review of historical research, not specific to the Aptitude assessment)

Measures of cognitive ability tend to receive support for their usefulness in predicting future work success. A meta-analysis conducted by Schmidt et al. (2016) explored various selection procedures to assess their validity in predicting job performance. Cognitive ability was discovered to be one of the strongest predictors of job performance when compared with other selection methods.

Criterion-related validity definition

Criterion-related validity is concerned with the relationship between the measure and an outcome (or criterion) variable. There are two different types of criterion validity: concurrent and predictive. Predictive validity occurs when the criterion measures are obtained at a time after the test. Concurrent, on the other hand, occurs when the criterion measures are obtained at the same time as the test scores.

Concurrent validity of the Aptitude assessment

A benchmark study investigating retention for a professional services company found that staff who had left the company in the last year had lower overall Aptitude scores than those who had remained ($t(62)=2.30, p=.024$; $d=.44$, effect size = small).

Analysis on Aptitude data collected from staff at a large bank found that staff who hit performance targets had significantly higher overall Aptitude scores ($U=40, p=.049$; $d=.95$, effect size = large).

Predictive validity of the Aptitude assessment

Aptitude scores of 165 members of the armed forces were correlated with their training performance. Overall, there was a moderate relationship between the Aptitude score and training tasks (correlation coefficients ranging between $r=.30$ and $r=.51$). A larger study with 2,400 military trainees revealed a moderate relationship between Aptitude scores and training performance.

A benchmarking study was conducted that followed graduate recruits who completed the Aptitude assessment during recruitment for a telecommunications company. Those with a higher Aptitude score were significantly more likely to be promoted in the organisation ($U=1161$, $p=.002$; $d=.80$, effect size = large).

References

Baddeley, A. (2000). The episodic buffer: A new component of working memory? Trends in Cognitive Sciences, 4(11), 417–423. https://doi.org/10.1016/s1364-6613(00)01538-2

Carroll, J. B. (1980). Components and factors: Complementary "units" of analysis? Behavioral and Brain Sciences, 3(4), 587–588. https://doi.org/10.1017/s0140525x00006981

Carroll, J.B. (1993). Survey and analysis of Correlational and factor-analytic research on cognitive abilities: Methodology. Human Cognitive Abilities, 73–114. https://doi.org/10.1017/cbo9780511571312.004

Detterman, D. K. (1986). Human intelligence is a complex system of separate processes. In R. J. Sternberg & D. K. Detterman (Eds.), What is intelligence? Contemporary viewpoints on its nature and definition (pp. 57-61). Norwood, NJ: Ablex.

Kyllonen, P. C., & Christal, R. E. (1990). Reasoning ability is (little more than) working-memory capacity?! Intelligence, 14(4), 389-433.

Schmidt, F. L., Oh, I. S., & Shaffer, J. A. (2016). The validity and utility of selection methods in personnel psychology: Practical and theoretical implications of 100 years. Fox School of Business Research Paper, 1-74.