



The Looking Glass for Intelligence Quotient Tests: The Interplay of Motivation, Cognitive Functioning, and Affect

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OPEN ACCESS

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Specialty section:

This article was submitted to
Educational Psychology,
a section of the journal
Frontiers in Psychology

Received: 13 March 2019

Accepted: 03 December 2019

Published: 17 December 2019

Citation:

Ganuthula VRR and Sinha S (2019)
The Looking Glass for Intelligence
Quotient Tests: The Interplay of
Motivation, Cognitive
Functioning, and Affect.
Front. Psychol. 10:2857.
doi: 10.3389/fpsyg.2019.02857

The Intelligence Quotient (IQ) tests and the corresponding psychometric explanations dominate both the scientific and popular views about human intelligence. Though the IQ tests have been in currency for long, there exists a gap in what they are believed to measure and what they do. While the IQ tests index the quality of cognitive functioning in selected domains of mental repertoire, the applied settings often inflate their predictive value leading to an interpretive gap. The present article contends that studying the influence of motivational and affective processes on cognitive functioning would help to evolve a more psychologically comprehensive account of the IQ tests and bridge the interpretive gap. To conclude, the article suggests possible future research directions that could strengthen the predictive value of the IQ tests.

Keywords: affect, cognitive functioning, intelligence quotient, motivation, intelligence

INTRODUCTION

The need to distinguish ourselves from others around us is perhaps distinctly human. Intelligence as a concept not only sets us apart as a species from the rest of the animals but also enables us to place ourselves uniquely in the company of fellow human beings (Sternberg, 2018). Roughly speaking, the concept of intelligence accounts for the efficacy of the mental functioning that underlies behavior based on specific criteria (Perkins, 1995). However, the set of rules that qualify mental functioning has been a subject of considerable debate between the narrow vs. the broad theories of intelligence (Stanovich, 2009).

The narrow theories identify intelligence with performance on a set of tests that account for cognitive functioning in selected domains of human mental repertoire. The composite of such tests is known as the Intelligence Quotient (IQ) test. Binet and Simon (1916) were among the first to develop the influential tradition of IQ testing. Their objective was to identify cognitively challenged children registered in the French public school system and educate them. To this end, they designed tests that measured how a child's cognitive functioning shaped mental abilities such as judgment, comprehension, and reasoning. Lewis Terman took this test to Stanford University and revised it to what has come to be known as the Stanford-Binet IQ test (Roid and Pomplun, 2012). From then on, the test has been revised frequently and continues to be used in countries all over the world as a measure

of intelligence (Deary, 2001). Many other IQ styled tests, such as the SAT (Scholastic Aptitude Test), have come in vogue with time (Sternberg, 2006). The variety of IQ tests in use today differ in the number and kind of mental abilities they attempt to measure (Sternberg, 2018).

For instance, the one widely used IQ test is the Wechsler Adult Intelligence Scale III (WAIS-III) (The Psychological Corporation, 1997; Wechsler, 1997). WAIS-III measures the performance of an individual on a set of four mental abilities: verbal comprehension, processing speed, perceptual organization, and working memory (Wechsler, 1997). A collection of 13 distinct tasks account for each of the four mental abilities. These tasks, in turn, have a specific number of items that contribute to the overall score.

Psychometric theories characterize the performance on the IQ tests through factor analytic procedures (Deary, 2001; Sternberg, 2006). Typically, a psychometric theory accounts for the performance on the IQ tests in two related steps. Firstly, the performance on the items across a set of related tasks converges to a particular mental ability (Kline, 2013). Then the common variance underlying scores on candidate's mental abilities converge to a single factor termed as the g-factor. The g-factor so arrived is representative of an individual's general intelligence (Kline, 2013). The intuitive idea here is that performance across individual mental ability tests (termed as factors) is positively correlated – a phenomenon referred to as “positive manifold” in psychometric parlance (Sternberg, 2018). However, few variants follow a single-step procedure to account for the common variance across the scores on different tasks of the IQ test to arrive at the g-factor (Deary, 2001). Despite the procedural nuances, all the psychometric theories agree that the g-factor culled out of the performance on the IQ tests represents an individual's intelligence (Eysenck, 2018). Together, the IQ tests and the corresponding psychometric explanations paved the way for the birth of differential psychology – a systematic study of how and why our minds work differently (Eysenck, 2018).

While the narrow theories dominate the scientific and common-sense notion of intelligence, they are not devoid of criticism. Notably, the critique contends that narrow theories are not representative of mental functioning. The IQ tests characterize the efficiency with which an individual gathers and processes information in particular domains that are primarily cognitive. They leave out non-cognitive aspects of mental functioning such as socio-emotional skills and interpersonal capabilities, among others (Neisser et al., 1996). Furthermore, the research raises questions around the representativeness of the tests. Researchers find the IQ tests inadequate in accounting for performance on even cognitively loaded aspects of an individual's mental life. Related evidence suggests that IQ scores are inconsistent at predicting variation in performance (including the extremities) on activities such as learning, reasoning, and decision-making (Stanovich, 2009; Fletcher et al., 2018).

This critique of the IQ tests leads to the rise of the broad theories of intelligence. The broad theories emphasize on the

aspects of mental functioning associated with the vernacular use of the term intelligence including adaptation to the environment, display of wisdom, creativity, etc., irrespective of whether these aspects are amenable to measurement or not (Gardner, 1993; Perkins et al., 1993; Ceci, 1996; Sternberg, 2018). They highlight aspects of mental functioning that shape human behavior that is otherwise largely ignored by the narrow theorists, including biological characteristics, psychological processes, and socio-cultural environs.

However, the narrow theorists accuse the broad perspectives of deliberately expanding the conceptual scope and usage of the term intelligence to counter the elevated status of the IQ tests. They argue that the generous conceptualizations of broad theories strategically downplay the importance of the IQ tests by broadening the definition of intelligence to make them only a part of the larger whole (Stanovich, 2009). Moreover, critics also highlight the fact that broad theories lack empirical grounding and exclusively rely on anecdotal evidence for support (Stanovich et al., 2016). Overall, both the narrow and broad theories form the core of the longstanding debate regarding the nature of intelligence and its measurement. Nevertheless, the narrow approaches with the IQ tests at heart enjoy an excellent scientific and popular reputation in comparison to the broad theories. EG Boring's (1923) famous assertion that “Intelligence is what IQ tests measure” reflects the status enjoyed by the IQ tests in the scientific community.

THE INTERPRETIVE GAP

The use of IQ tests permeates many spheres of human activity (Sternberg et al., 2001). The IQ tests are used to make decisions in a variety of contexts, including school and college admissions, employment opportunities, and even mate selection (Hunt, 1995; Fitzsimons, 2015). The wide-ranging applications of the IQ tests, however, raise specific concerns. Conceptually, the IQ tests index the quality of cognitive functioning in selected aspects of an individual's mental life.

However, their real-world interpretations inflate them to represent overall mental functioning across wide-ranging domains, from education achievement to job performance and interpersonal relationships (Sternberg et al., 2001). This inflation is evident from the contradictions observed in the evidence on the predictive value of the IQ tests. Related research suggests a weak to moderate correlation between performance on IQ tests and outcomes on education, job performance, income levels, and overall individual well-being (Bowles and Gintis, 2002; Strenze, 2007). Other factors, such as parent's socio-economic status (Strenze, 2007), have been shown to moderate these correlations actively. Overall, the evidence points to an interpretive gap between what the IQ tests are believed to measure and what they do.

The interpretive gap adversely impacts critical factors that shape human development. Modern meritocratic societies restrict access to opportunities to education, employment, and overall growth to those who fare well on the IQ tests while excluding

others who do not do well on them (Neisser et al., 1996). Much of the criticism on the IQ tests mounted by the broad theorists also stems from this interpretive gap (Sternberg, 2018). Therefore, the debate on the nature of intelligence needs to be reframed to address the issues concerning the interpretation of the IQ scores, rather than altogether abandoning these tests.

In this regard, the advances in how motivational and affective processes influence cognitive functioning hold promise. Mental functioning largely rests on the three psychological processes of motivation, cognitive functioning, and affect (Crocker et al., 2013; Pessoa, 2013). Motivational and affective processes shape and reshape cognitive functioning, giving rise to much of the behavioral diversity observed in the real world (Simon, 1967; Crocker et al., 2013).

This article attempts to summarize the evidence on how motivational and affective processes account for cognitive functioning in general and the IQ tests in particular. To conclude, the article lays out specific future research directions. The next sections lay out the role of motivation in different aspects of cognitive functioning and suggest how affect modulates motivations and cognitive functioning.

INFLUENCE OF MOTIVATION AND AFFECT ON COGNITIVE FUNCTIONING

A salient feature of human behavior is that it is not only organized but also purposive (Ryan, 2012). It is the motivations that imbue an individual's action with structure and purpose. Motivations are value-laden cues that are an outcome of person-environment interaction (Braver et al., 2014). They carry forward two functions: energization and direction (Heckhausen and Heckhausen, 2018). While energization instigates or activates the individual's cognitive functioning, the direction function orients the energized cognitive repertoire to specific ends (Elliot, 2008). Evidence compiled over decades of research indicates that motivations influence various aspects of cognitive functioning ranging from rudimentary perception (Rothkirch and Sterzer, 2015), to more complex attention (Rothkirch et al., 2014), learning (Daw and Shohamy, 2008), memory (Miendlarzewska et al., 2016), and control (Botvinick and Braver, 2015).

Motivations drive expectations that bias human vision and perceptual mechanisms to selectively process features of the visual environment (O'Callaghan et al., 2017). This skewing of the perceptual apparatus impacts the estimates of size, distance, steepness, and salience of the objects in the visual environment (Firestone and Scholl, 2016). Moreover, expectations also help interpret ambiguous stimuli and make meaning of the perceptual settings even when constrained on information (O'Callaghan et al., 2017). Likewise, motivations also drive higher level information search and processing underlying reasoning, judgment, and decision-making (Chiew and Braver, 2011; Epley and Gilovich, 2016). They orient attention mechanisms to selectively acquire information and modulate parameters such as speed, accuracy, and depth of information processing (Dweck et al., 2004).

Further, the motivational cues also drive learning mechanisms ranging from simple associative to more complex conditioning strategies that help to establish relationships between distinct pieces of information (Dayan and Balleine, 2002; Daw and Shohamy, 2008). They importantly modulate the strength of the learning (Braver et al., 2014). Relatedly, research also suggests that motivational relevance modulates encoding and retrieval of acquired information (Miendlarzewska et al., 2016).

Motivations also facilitate control processes that help choose between competing motivations (Botvinick and Braver, 2015; Suri et al., 2018). This preferential treatment of some motivations over others enables not only cognitive functioning to swiftly shift from one information environment to the other (Suri et al., 2018), but also drive behavioral responses within the selected context (Yee and Braver, 2018).

However, the successful pursuit of motivation also requires continuous monitoring and feedback (Carver, 2018). Monitoring enables people to be alerted to the congruence between the current behavior and its consequences to the characteristics of the desired actions and outcomes (Benn et al., 2014). This continuous check over motivation referent behaviors warrants people to identify the discrepancies and close the gaps between the current and desired behavioral responses (Harkin et al., 2016).

Feedback from periodic monitoring of the motivation referent behavior takes the shape of affect (Fishbach and Finkelstein, 2012). The positive affective states (i.e., good-for-me feelings) convey advancements in motivational pursuits, while the negative affective states (i.e., bad-for-me feelings) signal discrepancies in purposive behavior (Hart and Gable, 2013; Inzlicht et al., 2015). Further, the positive affect strengthens motivational intensity (Orehek et al., 2011), while the negative affect typically weakens it (Watkins and Moberly, 2009). These changes to motivations because of affect impact subsequent cognitive functioning and behavior (Carver and Scheier, 2008; Gable and Harmon-Jones, 2010; Gable et al., 2016).

Recent neuroscientific evidence also supports the interplay between the three strands of mental functioning (Pessoa, 2019). Several anatomical and functional studies suggest that brain regions are highly interconnected. These interconnected networks form the basis of interaction among motivation, cognitive functioning, and affective processes (Pessoa, 2013). In all, motivational and affective processes influence cognitive functioning significantly. This evidence has implications for the IQ tests and their interpretation.

ROLE OF MOTIVATION AND AFFECT ON PERFORMANCE IN THE INTELLIGENCE QUOTIENT TESTS

Growing evidence suggests that motivations energize and guide the cognitive performance of a typical test taker (Duckworth et al., 2011). Relatedly, the dispositional theory of intelligence (Perkins et al., 1993) predicts that trait motivations drive much of the variation in performance on the IQ tests. Likewise, research suggests that traits such as growth mindset, openness

to experience, and need for cognition modulate the willingness to search and process information that, in turn, influences an individual's performance on an IQ test (Dweck, 2006; Woods et al., 2019).

However, a recent meta-analytic review of motivational influences on cognitive performance suggests that dispositional traits account for less considerable variation when compared to shifts in motivational states (Van Iddekinge et al., 2018). In a seminal study, Duckworth et al. (2011) present evidence on how state changes in test taker's motivations significantly predict performance on the IQ tests. The research also suggests that the predictive validity of the IQ scores for various life outcomes substantially diminishes with the shifts in motivational levels of the test taker.

Feedback on performance and subsequent affective states influence the cognitive functioning of the test taker. Mainly, the negative affective states like task anxiety have been found to lower the performance on the IQ tests substantially (von der Embse et al., 2018). To sum up, sparse but significant evidence on motivational and affective processes suggests that they account for substantial variation in performance on the IQ tests.

IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS

The evidence on the impact of motivational and affective processes has implications for the interpretation and use of IQ tests. Conventionally, differences in performance on the IQ tests have been assumed to solely convey discrepancies in the quality of cognitive functioning of the test takers. However, with the new evidence on the anvil, variability in performance on the IQ tests also appears to be a function of the kind and intensity of motivations and affective states the test takers experience during the test. This evidence calls for a change in the way the IQ scores are interpreted to make real-world decisions. Therefore, moving forward, more concerted efforts at unearthing the effects of motivational and affective processes on cognitive functioning in the context of the IQ tests are necessary.

Notably, future research could examine what kind of motivational cues, i.e., task vs. outcome-oriented (Pintrich, 2000), are optimum for performance on an IQ test. An individual with task-oriented motivation perceives doing well on an IQ

test as an end in itself. In contrast, the individual driven by outcome-oriented motivation assumes performing on an IQ test as instrumental to other life outcomes. Further, research needs to examine how motivational intensity (whether task-oriented or outcome-oriented) modulates cognitive functioning on an IQ test.

Research on goal-directed behaviors suggests that monitoring and feedback might as well account for variation in cognitive functioning (Fishbach et al., 2010; Carver, 2018). Therefore, future studies could also examine how the frequency of monitoring and the nature of feedback influence performance on IQ tests. Likewise, affective responses to monitoring performance during the IQ test could also account for the overall performance on the test. Pertinent research only examined the impact of negative affective states such as anxiety (von der Embse et al., 2018). However, positive affective states could also contribute to the variation in IQ scores (Fredrickson, 2004). Lastly, studies could also examine how trait emotion regulation strategies influence performance on IQ tests as they modulate the generation and expression of emotions (Gross, 2002).

Put together, these strands of research could eventually contribute to a more psychologically nuanced account of the IQ tests. Such an integrated view would help to purge the interpretive gap that plagues their real-world applications.

CONCLUSION

The notion of intelligence is here to stay, and so are the IQ tests that index intelligence. However, there is a case for a more psychologically comprehensive interpretation of what IQ scores reflect. Examining the influence of motivational and affective processes on cognitive functioning underlying performance on the IQ tests is a step in this direction. A reliable account of what the IQ scores reflect would enable a more cautioned use of these numbers to determine access to opportunities that shape individual life outcomes in modern meritocratic societies.

AUTHOR CONTRIBUTIONS

Both VG and SS contributed equally at all stages of the development of the manuscript leading to its submission.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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