frontiers | Frontiers in Education

TYPE Hypothesis and Theory
PUBLISHED 28 September 2022
DOI 10.3389/feduc.2022.889946

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Assessment, Testing and Applied Measurement, a section of the journal Frontiers in Education

RECEIVED 11 April 2022
ACCEPTED 12 August 2022
PUBLISHED 28 September 2022

CITATION
Blankson AN (2022) Specific Processes of Intelligence and Relationships in Academic Learning (SPIRAL). *Front. Educ.* 7:889946. doi: 10.3389/feduc.2022.889946

Specific Processes of Intelligence and Relationships in Academic Learning (SPIRAL)

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We live in an age of cancel culture. Things are canceled sometimes for important reasons and sometimes for superficial reasons. Over 100 years since its inception, the concept of IQ still lingers. Here, I make the argument that IQ should be canceled. I conclude with the proposition of a new theory, Specific Processes of Intelligence and Relationships in Academic Learning (SPIRAL), which can be used to guide future research on cognition and achievement.

KEYWORDS

intelligence, achievement, IQ, executive functioning (EF), context

Introduction

Early work by Spearman in the 1900's (e.g., Spearman, 1904) resulted in the first testable theories and subsequent measures of cognitive abilities. Spearman proposed the idea that a general ability factor ("g") produces the intercorrelations among cognitive ability measures. This theory specifies how a positive manifold may indicate a single concept of intelligence. The reasoning behind Spearman's theory is not wrong—i.e., it is possible that a single general factor can explain a positive manifold among a set of variables. However, past and extant evidence do not support the concept of "g," including evidence from Spearman's own research in which he wrote about "group factors." After a century of research, many theories and methodologies regarding the notion of intelligence and its development have been proposed, including the g theory, extended Gf-Gc theory (Horn and Blankson, 2012), Ceci's (1990) "bio-ecological" framework, and Sternberg's (2001) concept of developing expertise, among others.

Drawing on work conducted by Spearman in the early 1900's, Cattell (1941, 1971) put forth the theory of fluid (Gf) and crystallized intelligence (Gc). Fluid intelligence is the ability to reason inductively, deductively, conjunctively, and disjunctively to arrive at understanding relations among stimuli, comprehend implications, and draw inferences. In contrast, crystallized intelligence is indicated in tests of breadth and depth of knowledge of the dominant culture. The theory posed by Cattell has been expanded by Horn, Stankov, and other colleagues. The extended Gf-Gc theory suggests ∼9 different ability factors. This theory is best summarized in a mega-analysis conducted by

Carroll (1993). However, it should be noted that Carroll's ultimate conclusion appears to take us back to "g" or IQ because the work is often cited in support of g, although Carroll himself did not believe that intelligence was unitary.

Similar to the extended Gf-Gc theory, Ceci's (1990) "bio-ecological" framework posits that there is no g, but that there are multiple cognitive abilities. In addition, the framework stresses the importance of context, including motivational forces, social and physical aspects of a setting, etc., in the initial period of intellectual development as well as during the testing of cognitive abilities. Sternberg (2001) defined "developing expertise" as "the ongoing process of the acquisition and consolidation of a set of skills needed for a high level of mastery in one or more domains of life performance" (p. 160). According to the model of developing expertise, Gf and Gc are equally susceptible to schooling and other environmental variables. In this way, the model is similar to Ceci's (1990) framework.

Although extant evidence indicates that there is not one unitary ability factor, research continues to report what is argued to be evidence in support of the concept of a general intelligence factor (e.g., Lett et al., 2020). In fact, the accumulation of evidence over the last 120-plus years suggests that there is not one unitary concept of intelligence, but that there are several independent lines of development that result in several different forms of intelligence, which, although independent, are positively correlated (see Horn and Blankson, 2012 for review of some of this kind of evidence). Moreover, it is time that we begin to integrate the different theories not only from psychometrics, but from other areas of research, including developmental psychology, anthropology, sociology, etc., if we are ever to know more about intelligence and its development, as well as its relation to achievement.

Cognition and achievement

What do we know about cognition and achievement? We know that children who do well in school early on tend to do well later. We also know that cognitive skills predict achievement. Research has repeatedly shown that children who enter school with better cognitive skills perform better in the later school years. In fact, the link between cognition and academic achievement has been examined for over a century; it is the reason why intelligence tests were developed. Although cognitive ability testing has a long history in education, there are some restrictions in our current knowledge.

Foremost among the restrictions in our knowledge is the fact that cognition is often treated as a unitary construct. The idea of "IQ" continues to linger. However, a unitary factor is not sufficient (Horn and Blankson, 2012). Research suggests that more emphasis should be placed on testing specific abilities, rather than testing one general ability. By testing and studying specific abilities, we can better target areas to address to improve achievement.

Three cognitive skills that might be most pertinent to achievement are fluid intelligence, crystallized intelligence, and executive functioning. Fluid intelligence is illustrated in the well-known matrix reasoning tests. Fluid intelligence does not require previous knowledge about a specific problem or subject. Individuals draw inferences and problem-solve from information that is presented. Crystallized intelligence is measured by tasks indicating knowledge of the dominant culture, such as tests of general information (Horn and Blankson, 2012). Crystallized intelligence relies on previous knowledge and experiences. Theoretically, crystallized intelligence is more strongly related to education, income, and other factors of acculturation than fluid intelligence.

Executive functioning refers to a set of processes that involve managing one's cognitive resources to achieve a goal. Executive functioning includes working memory, set-shifting, and inhibitory control.

The extended theory of fluid (Gf) and crystallized intelligence (Gc; extended Gf-Gc theory; Horn and Blankson, 2012) is far from perfect. But, it is currently one of the guiding theories for helping us understand human cognitive abilities and how cognitive skills relate to achievement. However, there is a question of whether and where executive functioning fits in the theory. Some have equated executive functioning with fluid intelligence (e.g., Decker et al., 2007). These conceptualizations essentially take us back to IQ. But, the evidence does not support that conclusion. Although few research studies have simultaneously examined the independent and joint influence of all three processes on achievement outcomes, in the studies that have examined these aspects of cognition simultaneously, there is a support that they are distinct (e.g., van Aken et al., 2016). Moreover, evidence suggests that these three cognitive processes differentially relate to achievement (e.g., Hale et al., 2008; McGrew and Wendling, 2010).

Another restriction of current knowledge is that the "how" and "under what mechanisms" questions have rarely been asked in studies of intelligence and achievement. Instead, intelligence is often viewed as a variable to be controlled when examining achievement outcomes. Given that cognitive skills are among the strongest predictors of achievement, rather than controlling them in studies of achievement, they should be studied outright.

In particular, the contextual perspective (Bronfenbrenner, 1994) suggests that aspects of the environment interact with the child's own characteristics to produce adaptive or maladaptive outcomes. Thus, it is important to examine cognitive skills in other contexts to better understand the impact that these characteristics and environmental factors play in achievement.

School entry cognitive skills operate within the context of the environment, and recently, there have been increased calls for an examination of children within context, particularly in the

study of academic achievement. Increased understanding of the processes and conditions underlying the relationship between cognition and achievement will best inform policy, treatment, and intervention efforts. In a study that examined whether classroom quality moderates the association between cognition and achievement in kindergarten (Blankson and Blair, 2016), significant interactions were found between fluid intelligence and classroom quality, and crystallized intelligence and classroom quality in the prediction of spring math achievement. In better quality classrooms, children made significant gains in their math achievement from the fall to spring as their levels of fluid intelligence and crystallized intelligence increased. In the poorer quality classrooms, the same gains were not seen. Results, such as these, not only highlight the importance of examining multiple aspects of cognition, but the important role that context plays in development, which harkens back to Ceci (1990).

Finally, most of what we know regarding the relation between cognitive skills and achievement comes from research on primarily White children or low-income Black children. Not only this, but when Black children are included in studies, the approach is usually a deficit perspective, stating that Black children score lower on tests of cognition and achievement than White children. Few studies focus exclusively on Black and other non-White children. In a study of 198 Black children from a broad range of socioeconomic statuses (Blankson et al., 2019), among the findings was that when considered simultaneously, executive functioning and crystallized intelligence predicted both math and reading achievement, whereas fluid intelligence was not a significant predictor of math and reading.

In sum, research has shown that context, such as classroom quality, matters in some cases. We need not neglect that fact when studying achievement. Children can enter school ready to learn, but fail because they do not have adequate support in the classroom. Alternatively, they can enter with limited preparation and succeed if they receive adequate support. The home environment should also not be neglected, and research is needed that does not focus exclusively, or largely, on White children.

SPIRAL

The Specific Processes of Intelligence and Relationships in Academic Learning theory, or SPIRAL, is a suggested guiding framework that can be used in research on cognition and achievement, particularly research focused on children. SPIRAL theory builds on Cattell's (1987) investment hypothesis, Bronfenbrenner's (1977, 1994) bioecological model, Ceci's (1990) "bio-ecological" framework on intelligence, Sternberg's (2001) theory of developing expertise, extended Gf-Gc theory (Horn and Blankson, 2012), as well as conversations of the author with John Horn many years ago. The idea is that intelligence and the development of academic skills occur in a spiral.

In the theory, Specific Processes of Intelligence refers to the fact that we can help young learners more by focusing on specific aspects of cognition and not on only one intelligence factor. The extended theory of fluid and crystallized intelligence (Horn and Blankson, 2012) is among one of many theories of intelligence and can guide the selection of specific processes of intelligence in research on cognition and achievement. Relationships refer to relationships that children have with others or their environment, such as student–teacher relationships or the connection between the home and school environments. Academic Learning focuses the theory on the learning of academic skills.

Intelligence within certain contexts, whether it is environmental, such as in the context of good classroom quality, or biological, such as the joint contribution of different aspects of intelligence, leads to learning. This, in turn, can lead to improvements in intelligence, which, in turn, can lead to improvements in academic achievement, and so on, operating in a spiral manner. The spiral can be tightly coiled or loose, depending on the individual and on the domain of learning. An example of a hypothesis from this theory is that children with high crystallized intelligence might engage with their classroom teachers in a manner that draws additional resources to them for learning a specific topic, say math, which then builds up their math skills, and with these skills, they are better able to reason in other learning contexts associated with math, and so on. To the extent that the individuals continue in this manner through later school years and seek out mathematical resources, they could potentially develop expertise in mathematics in adulthood. Additional hypotheses can be developed from this theory and can be tested with various approaches, such as longitudinal cascade models, among other potential approaches.

Discussion

Several studies highlight the importance of considering multiple aspects of cognition in the examination of achievement. Nevertheless, the idea of IQ still seems to linger. We miss out on valuable information about achievement and other variables when we only focus on IQ. By getting away from the idea of one and only one intelligence—by canceling IQ—we can really begin to understand the links between cognition and achievement. Examining multiple cognitive abilities, in consideration of contextual factors, can lead to improvements in determining what programs, policies, and interventions could be put in place to increase achievement in all children. SPIRAL theory can guide future research on cognition and achievement.

Author contributions

The author confirms sole responsibility for this publication.

Funding

This work was supported by NIH R15HD077511 and NSF Award #1832090. The content is solely the responsibility of the author and does not necessarily represent the official views of the National Institutes of Health or the National Science Foundation.

Acknowledgments

Many thanks to the late John L. Horn, without whom this work would not have been possible.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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