Understanding Intelligence, Giftedness and Creativity Using the PASS Theory

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Despite nearly a century of research on IQ tests of ability, there have been many changes in our understanding of human abilities. This failure to evolve is often a result of the challenge the Wechsler-Binet test posed to the Cognitive Assessment System (CAS; Naglieri & Das, 1997a). The CAS is based on the PASS theory (Naglieri, 1999), which centers on Planning, Attention, Simultaneous, and Successive cognitive processes. The inclusion of planning in particular allows for a more accurate assessment of gifted and creative children, as past research has shown a strong connection between planning and creativity. This more extensive and inclusive measure of intelligence could identify gifted children who would otherwise not be identified using traditional IQ tests. In this article, we will consider the validity of an alternative approach to intelligence and illustrate its utility for the identification of gifted and creative children.

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Donna is a very capable young girl who earned an IQ score of 123 on the Wechsler Intelligence Scale for Children—Third Edition (WISC-III; Wechsler, 1991). She was referred for possible placement in the gifted program because the teacher noted she was very verbal and seemed to be very creative as well. The teacher also noted that Donna seemed somewhat self-conscious about the things she did. In addition, Donna often developed many different ways of doing things and was able to understand ideas from perspectives other children do not. Unfortunately, Donna’s IQ score is not high enough for her to qualify as intellectually gifted using the Wechsler Scale of Children’s Intelligence—Third Edition (Wechsler, 1991). Is it possible she is gifted, but the test of intelligence does not assess her abilities? Is it also possible, given a different definition of intelligence and a different test of intelligence, she could earn a very different score? The answers to these questions are the focus of this article.

Intelligence is a term that has been used for a long time and is one that carries with it many different meanings. During this century, intelligence has been defined by the tests that have been used to measure it. This includes measures such as the Stanford-Binet (Thorndike, Hagan, & Sattler, 1986) and Wechsler Scales (e.g., Wechsler, 1991). These tests have defined the construct of intelligence since they were developed in the early part of the 20th century because they provided structured useful methods to evaluate children and adults. They have been used for so long because the research has shown that IQ is significantly correlated with achievement, related to acquisition of knowledge in employment settings, related to acquisition of knowledge in nonacademic settings, and even related to the acquisition of knowledge by one’s children (Brisby, 1997). Because of these factors and the practical utility of IQ tests, general measures of intelligence have enjoyed widespread use for nearly 100 years. These tests, however, have two main weaknesses which are especially relevant to the question of identification of gifted children. First, the age of traditional IQ tests has not permitted integration of current understandings of intelligence that have emerged from research conducted over the past 50 years; second, traditional IQ tests are based on a weak theoretical foundation of general ability with vaguely defined constructs and tests that are clearly achievement laden (Naglieri, 1999). Both of these issues have considerable impact on the extent to which these tests are related to academic performance and are fair for minority children. In addition, these problems render traditional tests ineffective for identifying creativity (e.g., Minhas, 1981).

Age of Current IQ Technology

The Wechsler and Binet tests represent a technology that has not changed since Binet and Simon introduced their first scale in 1905 and Wechsler published his first test in 1939. The Fourth Edition of the Stanford-Binet and the latest revisions of the Wechsler Scales (e.g., Wechsler Adult Intelligence Scale—Third Edition, Wechsler, 1997) are essentially the same as their respective earlier versions, despite cosmetic modifications and improved standardization samples. The content of these tests was mainly based on the seminal work of Alfred Binet whose influence was noted by Yoo (1920) when they stated that the “origin of general intelligence tests is due to the genius of Alfred Binet” (p. 1). Those researchers who developed the Army mental testing program relied heavily on the work of Binet for the examination of a large number of adults entering military service for World War I (Yoo & Yerkes, 1920). The work of the military was important because David Wechsler adopted those methods for his now famous scales. The 60 years of test use and research which followed has focused on these measures of IQ. Most importantly, there has been stagnation in the evolution of IQ tests and our understanding of intelligence because the tests have defined the construct and the tests have not changed during this century. There have been important research findings in the field of intelligence and especially neuropsychology and cognitive psychology since these tests were developed.

A considerable amount of research has been conducted on the construct of intelligence during this century, but especially during the past 50 years. The examination of specific abilities that extend beyond the concept of general undifferentiated intelligence has been especially important. In the 1960s, in particular, a growing number of cognitive theorists studied neuropsychology, neuroscience, and higher mental processes. These efforts, described as the cognitive revolution (Miller, Galanter & Pribram, 1960), had a substantial influence on theoretical psychology and more recently in applied psychology. The cognitive revolution has impacted the way intelligence is conceptualized and measured.

The cognitive revolution provided important foundational research for redefining intelligence as cognitive processes which has resulted in alternatives to traditional IQ tests (Naglieri, Naglieri)
solutions to problems (p. 2). The process provides the means to solve problems of varying complexity. Planning tests on the CAS require the child to develop a strategy or plan, evaluate the value of the method, monitor its effectiveness, revise or reject an old plan as the task demands change, and control the impulse to act without careful consideration. The use of strategies to solve planning tests is a topic discussed in Naglieri and Das (1997b).

Planning as a process that demands the development and use of strategies to solve problems is well illustrated by the Planned Codes test on the CAS. This test requires the child to write a code (e.g., OX or X0), under the corresponding letter (e.g., A or B). Children allowed to complete the task in any way they think is best, and they often use a variety of strategies to complete the test in an efficient and timely manner. In fact, a large percentage of children use a strategy that involves completing the page by letter, which is associated with high scores on the planning subtest (Naglieri & Das, 1997b). Children who use good plans will likely earn high scores while those who do not use strategies earn lower scores (Naglieri & Das, 1997b). The important point is that this test is sensitive to planning because the scores reflect how the child met the demands of the task.

Planning processes are involved in many tasks children complete in school which require them to apply a strategy. For example, writing a story involves development of a story theme, details, consideration of how to present the information, checking the writing for flow, completeness, amount of detail included, and so on. The child who can organize, analyze, and evaluate a wide variety of stimuli is good in planning.

Attention: Attention is a mental process by which the individual selectively focuses on particular stimuli while inhibiting responses to competing stimuli presented over time (Naglieri & Das, 1997b, p. 3). Attention tests should demand focused, selective, sustained, and effortful activity. Focused attention involves directed concentration toward a particular activity but selective attention requires the inhibition of responses to distracting stimuli. Sustained attention refers to the variation of performance over time, which can be influenced by different amounts of effort required to solve the test. For example, the Stroop test (see Jensen & Rohwer, 1966) is one where the stimuli are words (e.g., Red, Green, Blue) which are printed in colors that are inconsistent with the word (e.g., Green, Blue, Red, respectively). Each stimulus (the word) has two dimensions, the word and the color and the instruction to say the color the word is printed in not read the word. This format places strong demands on attention (Naglieri, 1999). Multiple-choice tests offer excellent examples of the kinds of activities children may encounter. For example, suppose a child has completed the math problem 1.1 X 11 and arrived at the correct answer of 12.1. The following multiple-choice options (A) 121 (B) 121 (C) 111 (D) 12 (E) 11 (F) 12 create an environment that demands careful examination of each of the numbers and resistance to the options that are very similar (e.g., 121) to the answer (12.1). The similarity of the options presents a situation where considerable attention is required.

Simultaneous: Simultaneous processing is a mental process by which the individual integrates separate stimuli into a single whole or group (Luria, 1970, as cited in Naglieri & Das, 1997b, p. 4). The essential aspect of simultaneous processing is that all of the separate elements must be interrelated into a conceptual whole. Simultaneous processing has strong spatial dimensions (perception of stimuli as a whole) but may include both nonverbal as well as verbal (e.g., grammar) content. Simultaneous processing is involved in comprehension of grammatical statements that demand the integration of words into a whole idea. This integration involves comprehension of word relationships, prepositions, and inflections so the person can obtain meaning based on the overall idea. Simultaneous processing is also involved in recognition of patterns as found in Ravens (1947) or progressive matrices (Naglieri, 1985, 1997).

Example of a child’s school activity that has strong demands on simultaneous processing is reading comprehension. Children need to understand the relationships among the facts presented in a story to obtain the meaning. A reader with good simultaneous processing will be able to coordinate the different facts and ideas in the sentences at the same time in order to understand the overall picture.

Successive: Successive processing is a mental process by which the individual integrates stimuli into a specific serial order that forms a chain-like progression (Naglieri & Das, 1997b, p. 5). Successive processing is required when a person must arrange things “in a strictly defined order” (Luria, 1966, p. 78).
where each element is only related to those that precede it and these stimuli are not interrelated. Successive processing involves both the perception of stimuli in sequence and the formation of sounds and movements in order. For this reason, successive processing has a strong relationship to arranging of sounds in order to make words and is involved with the syntax of language. This was noted by Luria and Tsvetkova (1990, p. xvi) when they stated that the serial organization of spoken speech and the production of “separate sounds and motor impulses into consecutive series” are tasks that involve successive processing. Luria (1966) also noted that successive processing allows for the comprehension of the meaning of speech when the “individual elements of the whole narrative always behave as if organized in certain successive series (p. 78)” because the serial presentation of the narrative determines the meaning.

Successive processing is involved in children’s schoolwork, for example, when a child is asked to round a number. The child may follow prescribed steps to complete the task. A 10-year-old girl, Antonia, used the following steps to round the number 3.86 to the nearest 100ths. If you look at the 100ths place, an 8 is there, then you look at the number next to it [she points to the number 6] and see a 6. A 6 is higher than 5, so you turn the 8 to a nine. Everything in front of it [she points to the number 3] stays the same. So the answer is .39. In this example, there is a carefully executed series of events and these steps are used to accomplish the task. A student with good skills in successive processing will be able to use the linear order of events to solve problems such as these.

Relationships Among the PASS Processes

The four PASS processes are related abilities that function as a whole to varying degrees based upon the demands of the task. Luria (1973) recognized this when he wrote each form of conscious activity is always a complex functional system and takes place through the combined working of all three brain units, each of which makes its own contribution. The well established facts of modern psychology provide a solid basis for this view (p. 99). This conception means that the four PASS processes are interdependent yet distinctive. For example, in the early stages of reading a child might use planning processes when making decisions about what to read, finding the first page, and how each word will be decoded. Attention is needed to focus on the appropriate stimuli and ignore distractions. Simultaneous processes are involved in seeing the sentence as a whole, and successive processing is used to decode words and comprehend information based on syntax or ordering of events. All of the PASS processes are involved, but at any point in time there may be a shift in the contribution each is making to the particular goal. If an unknown word is found, the child may decide (use planning) to decode the word phonetically (successive), but if that does not work, may try to see the word as a whole or group the letters (simultaneous). During the procedure of reading, therefore, different processes may be relied on at different times to obtain meaning from the written words. Thus, the PASS processes form a working constellation (Luria, 1966, p. 70) of cognitive activity. Effective functioning is accomplished through the integration of planning, attention, simultaneous, and successive processes (as well as the base of knowledge) as demanded by the particular task.

Cognitive Assessment System (CAS)

PASS and the CAS

The PASS theory was used as the basis for the CAS (Naglieri & Das, 1997). This provided an instrument for assessing important cognitive functions and as an alternative to traditional tests based on the general ability concept. The PASS theory was used to guide the conceptualization and construction of the test so that the content of the test was not constrained by previous approaches to intelligence. High psychometric qualities were demanded so that the theory would be properly assessed within the context of a user-friendly practical test. The main goal of the CAS was to integrate a theoretical view of human abilities based on neuropsychology and cognitive psychology with excellent psychometric qualities. In addition to these two essential goals, other important sub-goals were included which have specific relevance to effective assessment of children. Some of these goals are listed below:

- A test of ability should be based on a sound theory, which posits multiple dimensions rather than a single general ability concept and is based on a sizable amount of basic and applied research.
- A theory of ability should be based on the view that intelligence is best described as cognitive processes, and the term cognitive processes should be used to replace the term intelligence.
- A theory of cognitive processes and a test to measure it should be highly related to achievement, have relevance to differential diagnosis, and be relevant to instructional design and intervention.
- A test of cognitive processing should evaluate an individual using items that are as free from acquired knowledge as possible.

Description of the Cognitive Assessment System

The CAS is an individually administered test that was standardized on a nationally representative sample of children aged 5-17 years in the U.S. The CAS is organized into four scales (Planning, Attention, Simultaneous, and Successive) according to the PASS theory, and a Full Scale standard score. Each scale is made up of subtests designed to assess the corresponding process. The CAS Planning subtests require the child to consider how to solve each item, create a plan of action, apply the plan, verify that an action taken conforms to the original goal, and modify the plan as needed. These subtests that measure planning are relatively easy to perform but require the individual to make decisions about how to solve novel tasks. The Attention subtests focus on cognitive activity, detection of a particular stimulus, and inhibition of responses to competing stimuli. These subtests require the examination of the features of the stimulus and a decision to respond to one and not to other competing features. Subtests included in the Simultaneous processing scale all require the synthesis of separate elements into an interrelated group. The subtests use a variety of content (verbal and nonverbal) and some involve memory. The Successive processing subtests in the CAS were developed to demand the repetition or comprehension of the serial organization of events. All the Successive subtests require individual to deal with information that is presented in a specific order and for which the order drives the meaning. These subtests have been subjected to extensive validation examination (for summaries see Das, Naglieri & Kirby, 1994; Naglieri, 1999; Naglieri & Das, 1997b).

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Evidence for the PASS theory and CAS

The development of tests to measure the PASS processes began with a paper by Das (1972) about the differences between persons with and without mental retardation. That study involved only simultaneous and successive cognitive processes, but led to the suggestion that these two processes could be included as a model for cognitive abilities (Das, Kirby, & Jarman, 1975). In their book, *Simultaneous and Successive Cognitive Processes*, Das, Kirby, and Jarman (1979) presented tasks used to operationalize simultaneous and successive processes and discussed a need to develop measures of attention and planning. That book was followed by others, including Kirby’s (1984) *Cognitive Strategies and Educational Performance and Assessment of Cognitive Processes: The PASS Theory of Intelligence* by Das, Naglieri, and Kirby (1994). These three books provided a complete summary of the experimental research conducted on the PASS theory from 1972 through 1994. The most recent summary of research on the PASS theory as represented by the CAS can be found in the *CAS Interpretive Handbook* (Naglieri & Das, 1997b) and *Essentials of CAS Assessment* (Naglieri, 1999).

Naglieri (1999) and Naglieri and Das (1997b) provide a lengthy discussion of the utility of the PASS theory as measured by the CAS. The sources of utility include reliability and validity studies, as well as investigations into the relevance of PASS to instruction and intervention. For the purpose of this paper, two sources of validity are most relevant—predictive validity (correlations with achievement) and fair assessment for diverse populations of children. Prediction to achievement is important because one of the main reasons to give a test of ability is to determine if high achievement is likely given appropriate instruction. This is especially important when the assessment of young children is being conducted. Fair assessment of diverse populations is also important because of the historic under-representation of minority children in programs for gifted children (Ford, 1998; Passow & Frasier, 1996).

**Relationships to Achievement**

One important way to assess a new theory, and the test built upon that theory, is to examine how well the new test correlates with achievement in comparison to other tests. In fact, some researchers have suggested that one of the most important dimensions of validity for a test of cognitive ability is the relationship to achievement (Brody, 1992; Cohen, Swerdlik, & Smith, 1992). Naglieri (1999) studied this question for a variety of IQ tests and found that the correlation between the Full Scale of various tests of ability with tests of achievement does vary.

Naglieri (1999) summarized several studies involving large numbers of children and several tests of ability. He found that the median correlation between the WISC-III (Wechsler, 1991) FSIQ and all WIAT achievement test scores (Wechsler, 1992) was .59 for a national sample of 1,284 children aged 5-19. A similar median correlation of .60 was found between the Differential Ability Scales (Elliott, 1990) General Conceptual Ability and achievement for a sample of 2,400 children included in the standardization sample. Using the Woodcock-Johnson Revised Broad Cognitive Ability Extended Battery score (which is comprised of seven subtest types) and Woodcock-Johnson Revised Achievement Test Battery reported by (McGrew, Waber, & Woodcock, 1991), Naglieri (1999) found a median correlation of .63 (N = 888 children aged 6, 9, and 13 years). This value was virtually the same as the median correlation between the K-ABC (Kaufman and Kaufman, 1983) Mental Processing composite (MPC) and achievement of .63 for 2,656 children aged 7 through 12 years. Importantly, the K-ABC only has two scales and content that does not include verbal/achievement content like that found in the first three tests. Finally, the median correlation between the CAS Full Scale and the WJ-R Test of Achievement (Naglieri & Das, 1997b) was .70 (for a representative sample of 1,600 children aged 5-17 years who closely match the population of the United States). These results showed that the PASS theory has considerable utility as a predictor of achievement and accounted for substantially more variance in achievement (about 50%) for a wide variety of children. These findings are especially important because the CAS (and K-ABC), unlike the Wechsler scales, do not have items that are highly reliant on acquired knowledge (e.g., Arithmetic, Information, and Vocabulary) found in the WISC-III, DAS, and WJ-R Cognitive test. This has considerable implications for assessment of gifted minority children and those who come from economically disadvantaged homes.

**Fair Assessment of Diverse Populations**

Assessment of gifted children who come from minority groups or low socioeconomic backgrounds is a problem of considerable importance (Ford, 1998). Naglieri (1999) has argued that all of the major intelligence tests except the CAS and K-ABC are problematic for assessment of minority children with limited English language or academic skills (especially arithmetic and verbal concepts) because the verbal and quantitative tests could be considered tests of achievement rather than ability (Naglieri, 1999). Naglieri and Rojahn (1999) illustrated the problem of using such achievement-like tests to measure ability when they found that minority children were more likely to be identified as mentally retarded according to their WISC-III scores (especially because of low Verbal Scale IQs) than when assessed with the CAS. The inclusion of subtests such as Vocabulary, Information, Arithmetic, and Similarities has led many to consider the Verbal Scale IQ to be a measure of achievement. In fact, Kaufman and Lichtenberger (1999) state that “the Verbal Scale does measure achievement” (p. 133). This raises considerable questions about interpretation of the Verbal IQ score as a measure of intelligence, especially if it is conceptualized as a measure of verbal intelligence. Results of minority-nonminority comparisons between intelligence tests that do not have verbal achievement tests (e.g., K-ABC and CAS) show that these tests yield smaller differences than traditional IQ tests (Naglieri, 1985; Naglieri & Rojahn, 1988; Wasserstein & Becker, 1999). Thus, the effect of removing verbal content from the measurement of ability and a focus on cognitive processing has led to an increase in fairness to minority populations.

Wasserman and Becker (1999) summarized research that examined mean score differences between African-American and White children on several tests of intelligence. They reported that the standard score differences between the groups was 11.0 on the WISC-III, 12.7 for the Stanford-Binet IV, and 4.9 for the CAS. A difference between African-American and white children on the K-ABC of 6.0 standard score points was reported by Naglieri (1986). These data strongly suggest that tests which do not include verbal and achievement items yield smaller differences between African-
American and White children. Thus, these data imply that gifted minority children are more likely to be identified if they are assessed with tests like the CAS that do not include verbal/achievement subtests.

From Theory to Application to Gifted Identification

The PASS theory, as represented by the CAS, could be used to help identify children who are gifted. For the purpose of this paper, we will emphasize the Federal guidelines for giftedness (U.S. Department of Education, 1995), which requires children to both excel in one or more of a variety of areas—academic, creative, artistic, or leadership—and need services or events not usually provided by schools for full development of their potential. In the remainder of this paper, we will discuss identification of children who are remarkably high in intellectual and creative dimensions.

The identification of high intelligence and creativity has often proved problematic. Robinson and Clinkenbeard (1998), in a review of the literature, describe the variety of opinions and descriptions of a gifted child. Terman (1925) used a conservative rule of the top one percent in intelligence, but other definitions of giftedness have expanded the parameters to include motivation (e.g., Feldhusen 1986), creativity (Reznick, 1986), and leadership abilities (Marland, 1971). A number of recent theories on giftedness raise interesting points. Ericsson and Charness (1994), in their research on giftedness and expert performance, propose that giftedness has little to do with innate abilities, but rather with deliberate practice. Baharav (1999) has researched the Dynamic Theory of Giftedness, based on Vygotskian theory, in which experimental curricula are geared toward fostering children who are potentially gifted. Detterman and Ruthsatz (1999) propose a three-pronged theory of giftedness that includes general intelligence, domain-specific skills, and practice.

Giftedness is typically operationalized, however, as a child who has an IQ that reaches some minimum, for example, 130 or higher along with other criteria defined by the relevant State Department of Education. Although the standard score of 130 (98th percentile) can be obtained using a variety of kinds of tests, the content of the test selected can have important implications for which children are identified. For example, if a child is administered the Wechsler Intelligence Scale of Intelligence—Third Edition (Wechsler, 1992), then ability would be measured using a test of general ability assessed with verbal and nonverbal tests. This distinction, dating back to the early part of this century, is very different than the cognitive processing approach represented by the CAS. The multiple dimensions of the PASS theory provides for more opportunities for a child to excel but more importantly, it provides for a theory-based approach to defining abilities that are relevant to academic success. These specific processes can be related to specific strengths, for example in creativity.

Implications of PASS Theory to the Concept of Creativity

While designed to measure and assess intelligence, the PASS theory can also be utilized to examine creativity. Intelligence and creativity have long been associated, although this relationship weakens with IQs higher than 120 (Fuchs-Beaucamp, Karnes, & Johnson, 1993). Indeed, some have argued that children with very high IQs can sometimes be less creative or at least have difficulty communicating their creative ideas (see Simonton, 1994, for an overview of the research). Others have suggested that there is a strong link between the two constructs (see Barron & Harrington, 1981), and Albert and Runco (1986) have argued that it is often hard to distinguish intelligence and creativity at high levels of talent and ability.

There is a particular connection between planning and creativity. The important role of planning in creativity is found in both empirical studies and in philosophical theory. Guastello, Shissler, Driscoll, and Hyde (1998) studied eight cognitive styles and found that the planner was significantly positively correlated with creative productivity. Baker-Sennett (1995) argued that both planning and improvisation were positively related to creativity. Redmond, Mumford, and Teach (1993) found that more time spent planning and re-planning a project resulted in more productivity and higher creativity. In Finke, Ward, and Smith’s (1992) theory of creative cognition, they propose a Geneplore model. This model features two central cognitive processes that contribute to creativity. One process is generative, in which an idea is initially created; the other process is exploratory, in which this idea is then examined and interpreted in different ways. Both of these processes require significant planning for successful execution. Indeed, the exploratory phase of creative cognition in which the generated ideas are explored is a good example of the regulation phase of planning.

A mable (1983, 1996) presents a component theory of creativity, which also shows the influence of planning. Her three components are domain-relevant skills (i.e., knowledge, technical skills), task motivation, and creativity-relevant skills. It is in the latter component that the importance of planning can be seen. These creativity-relevant skills include exploring new pathways, keeping response options open for as long as possible, and suspending judgment. These three skills reflect not only an individual’s potential creativity, but also his or her planning ability. A mable’s theory has been extensively empirically tested (e.g., Conti, Con, & Amabile, 1996; Ruscio, Whitney, & Amabile, 1998).

Another link between creativity and planning ability is metacognition. Metacognition, the act of thinking of one’s own cognitive processes (Feldhusen, 1995), is a key aspect of planning. A student who scores high in planning is aware of the task-strategy relationship and monitors strategy success—two essential aspects of metacognition (Das, Naglieri, & Kirby, 1994). Feldhusen and Goh (1995) have argued that metacognition is a central aspect of creativity that is found in most theories of the concept. Jaukovec (1994) and Boyce, Van Tassel-Baska, Burrus, Shier, and Johnson (1997) have pointed out the link between metacognition and creative problem solving. Davidson and Sternberg (1998) describe how metacognitive knowledge and processes contribute to smart problem-solving.

Conclusions

At the beginning of this article, we presented the case of Donna who earned an IQ score of 123 on the WISC-III (Wechsler, 1992) after being evaluated for possible placement in the gifted program. She was described as very verbal child who was also strategic and planning and seemed very creative. Her IQ score, which should be one part of the evaluation procedure, however, did not qualify her as being gifted. When given the CAS, however, the picture changed dramatically. Donna earned CAS scores of
REFERENCES


