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Exploration of Gifted Subtypes Differentiated Across Standardized Cognitive Variables

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EXPLORATION OF GIFTED SUBTYPES

DIFFERENTIATED ACROSS STANDARDIZED COGNITIVE VARIABLES

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Dissertation Approval

This is to certify that the thesis presented to us by Bridgette M. Vecchio on the 29th day of June 2012, in partial fulfillment of the requirements for the degree of Doctor of Psychology, has been examined and is acceptable in both scholarship and literary quality.

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Abstract

The field of gifted education has evolved through the 20th century, with legislative efforts by the federal government providing the framework necessary to highlight the needs of gifted learners. Gifted and talented learners are not a homogeneous group; to the contrary, they are varied and unique (Reis & Sullivan, 2010). Ideally, researchers and educators could collaborate to compile a conclusive list of characteristics of gifted learners, which could guide identification, teaching strategies, and curriculum selection for this population (Reis & Sullivan, 2010). Little is known about the cognitive profiles of gifted children.

This study will review the utilization of the WISC-IV in defining the highest levels of intelligence as evidenced in the gifted learner. In doing so, it is hoped that the construct of giftedness will be explored, highlighting the vast heterogeneity evident in this population.

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CHAPTER 1

Introduction

Much time and energy has been devoted to defining giftedness (Sternberg, 1990), yet a standardized definition remains elusive because even those researchers studying this construct cannot agree on a unitary description (Harrison, 2004). Although the definition of giftedness is not agreed upon, students in American schools are continuously assessed for gifted attributes and decisions are made regarding eligibility for gifted support programming. This begs the question of whether or not we are engaging in best practices in identification of those that are gifted; if we cannot agree on how to define it, how can we measure it?

Identifying and educating gifted and talented children has been a concern in education for many years (Fasko, 2001). Giftedness has been difficult to define due to several factors. The first factor to complicate the definitional processes is that giftedness has historically, beginning in early in educational history, been tied to the notion of intellectual ability (Terman, 1925). The introduction of intelligence testing has led the way to utilization of a global intelligence score as a yardstick for eligibility for gifted programming. Early intelligence tests were thought to measure a general intellectual ability and the criterion for eligibility was thought to equate with an intelligence score in the gifted range on standardized intelligence tests. Newer tests of cognitive functions assess a much broader range of skills and a multifactorial approach is slowly altering the notion of a unitary global intelligence. Utilizing a process-oriented approach, the skills underlying the larger ability being measured lends itself to examining a pattern of performance that equates with characteristics of giftedness that can link to curriculum and to instruction for gifted learners.

Howard Gardner, although recognizing the advantages of a unitary concept of intelligence, such as the ability to categorize easily an individual's level of intelligence based on a test score, also believed that a unitary approach did not do justice to the strengths and weaknesses in assessing an individual (Fasko, 2001). Gardner's (1983) Multiple Intelligence (MI) Theory provides a useful framework for understanding both the rudimentary competencies of all people as well as the unique strengths of individuals (Fasko, 2001). Despite the overwhelming evidence that supports the assessment of cognitive strength and weaknesses (see Hale et al., 2010 for discussion) in the evaluation of learning in learning disabled individuals, this practice has not bridged over to the assessment of the gifted learner.

The second factor that creates difficulty in defining giftedness is lack of federal governmental control because this population has been seen by some as a neglected special needs population (Pfeiffer, 2001). In the report *Mind the (Other) Gap! The Growing Excellence Gap in K–12 Education*, Plucker, Burroughs, and Song (2010) provide persuasive evidence that "The presence of an excellence gap is demonstrated on both national and state assessments of student performance" (p. 28). This underinvestment in excellence is highlighted by the recent focus on the lowest achieving students under the No Child Left Behind Act of 2001 (NCLB, 2001), which has resulted in discounting the high achieving, gifted and talented students and the appropriate services and programing for this population (Plucker et al., 2010). The U.S. Department of Education (Title XIV - Part A - SEC 14101) defines the gifted and talented as individuals "who give evidence of high performance capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who require services or activities not ordinarily provided by the school in order to fully develop such capabilities" (p.1959). Although these policies address the definition of giftedness, they do not provide objective criteria geared at eligibility or programming nor do they provide monetary support. Researchers have documented a growing gap both on statewide assessments and on the National Assessment of Educational Progress (Plucker et al., 2010). Limited federal leadership, in connection with a focus on grade-level proficiency, has resulted in an educational system that neglects the unique learning needs of gifted students.

The heterogeneous nature of defining giftedness extends to how school districts develop their processes of screening and evaluating potentially gifted students and in how eligibility criteria are determined (Bell & Roach, 1986; Nicpon, Allmon, Sieck, & Stinson, 2011). The National Society for the Gifted and Talented recognize the lack of consensus for identification of gifted in which they state, "There are no nationwide or even state-wide standards for identification. Each school district decides based on its definition of gifted students and the sort of services they intend to offer" (NSGT, 2012). Hence, the idiosyncratic definition of giftedness, created by the school entity, is the determining factor deciding whether or not an individual will be eligible for gifted and talented programs (Bell & Roach, 1986).

An often overlooked factor is that giftedness is not expressed in the same manner across all individuals who are considered gifted. Examining students with gifted abilities has revealed that variation is typical, rather than the exception to the rule. Within a gifted individual there is also a degree of asynchronous development across skill sets (Delisle, 1990). The key to keep in mind is that giftedness must be examined along an individualized developmental continuum. Abilities examined between gifted children may manifest differently along this developmental trajectory (Sternberg & Davidson, 2005). In essence, giftedness must be considered at a broad level that encompasses assessment of intellectual, creative, and motivational abilities (Steiner & Carr, 2003).

Research about gifted and talented learners points to the great diversity among this heterogeneous group of young people (Neihart, Reis, Robinson, & Moon, 2001) and the fact that many do not realize their potential occurs, in part, because of school factors that contribute to underachievement (Reis & Renzulli, 2010). Gifted and talented learners are not a homogeneous group; to the contrary, they are varied and unique (Reis & Sullivan, 2010). Ideally, researchers and educators could collaborate to compile a conclusive list of characteristics of gifted learners, which could guide identification, teaching strategies, and curriculum selection for this population (Reis & Sullivan, 2010). However, given the great heterogeneity among gifted learners, this may be difficult to actualize.

Given this variability, the question becomes one of how to assess and plan, educationally, for the gifted student. This has implications for how to screen for gifted characteristics, what assessments to use in determining eligibility, what type of standardized scores to examine in order to determine giftedness, and how the results of gifted evaluations can be utilized differently in planning individualized gifted programs. In essence, this problem is not much different from the problem seen regarding children with learning disabilities who also represent a heterogeneous population, and also for schools that continue to struggle to meet the needs of diverse learners. This diversity can be applied to a gifted population as well. Thus, multiple assessment methods should be utilized in considering admission into a gifted and talented program. Consideration can be given to the utilization of multiple criteria which includes, as only one piece, a comprehensive, multidisciplinary psychoeducational evaluation (Crepeau-Hobson & Bianco, 2011; Bell & Roach, 1986).

This dissertation will review the literature on historical orientations of giftedness, define what giftedness means, examine characteristics of giftedness, and critique the assessment and eligibility process for gifted support services. Last, it will review the utilization of the WISC-IV in defining the highest levels of intelligence as evidenced in the gifted learner. In doing so, it is hoped to explore that construct of giftedness which highlights the vast heterogeneity evident in this population; it is also hoped, that by utilizing current eligibility criteria for gifted children, to determine why and how we fail to examine the more subtle processing strengths and weaknesses that could be useful for educational planning at the individual level. By examining a pattern of performance through examination of the subtest and factor scores, instead of reliance on the global FSIQ, we can better link assessment to curriculum and instruction for the gifted learner.

CHAPTER 2

Literature Review

History of Giftedness

In order to appreciate how the concept of giftedness has emerged, it is imperative to examine the historical underpinnings and the role that intelligence testing has played in this manifestation. According to the National Association for Gifted Children (NAGC), the educational origins of giftedness date to the late 1800s when acceleration for gifted students was discussed as a way to challenge their learning. Likewise, at the beginning of the 20th century, several publications focused on using the term "gifted" to describe students who were moving through curriculum quickly and whose work was qualitatively different from average learners (see NAGC, 2008). There was still a need for a definition of what constituted giftedness and for the development of a standardized manner in which to assess for gifted abilities.

This challenge was answered through contributions from Terman who provided the first widely published studies on gifted children. The measurement of intelligence through the development of the Stanford-Binet by Terman in 1916 was a perfect vehicle to measure abilities that were associated with giftedness. In his *Genetic Studies of Genius,* Terman (1925) reported the results of a longitudinal study of 1,528 intellectually gifted children, documenting their psychosocial development, maturity, adjustment, mental health, personality characteristics, friendships and intimate attachments. Terman's research eventually resulted in the defining features of giftedness and was pivotal in broadening the understanding of gifted learner characteristics. A by-product of this endeavor resulted in the development and implementation of the intelligence test which became utilized by educational entities to identify students who would benefit from a “qualitatively different education” to meet their intellectual capacity (Lagermann, 2000).

The field of gifted education continued to evolve through the 20th century, with legislative efforts by the federal government providing the framework necessary to highlight the needs of gifted learners. According to the NAGC, the Jacob Javits Gifted and Talented Students Education Act funded the development of the National Research Center on the Gifted and Talented and provided grants for gifted research and programming (NAGC, 2008). As part of these legislative efforts, two prominent papers were produced, providing a global overview of the “state of giftedness” in America. These two papers, *A Nation at Risk* (1983) and *National Excellence: A Case for Developing America’s Talent* (1993) emphasized the neglected opportunities to identify and serve gifted students nationally. This missed opportunity was further overshadowed by the passage of the Elementary and Secondary Education Act (e.g. No Child Left Behind), which brought attention to the underachieving student population; however, the needs of the gifted learner were not addressed. This “excellence gap” was recently highlighted with federal legislation focused on improvements for gifted education. The Talent Act of 2011 (i.e., To Aid Gifted and High-Ability Learners by Empowering the Nation’s Teachers) is one of the more salient amendments to the No Child Left Behind Act that purports the role of federal governance in meeting the needs of gifted and high-ability students. The Act targets four key areas relating to gifted education: changes to assessment and accountability systems, increase in professional development, focus on underserved populations, and emphasis on research and dissemination. For a timeline of the history of giftedness, please see Table 1.

Table 1

A Timeline of Key Dates in Gifted and Talented Education

Date	Event
1868	William Torrey Harris, superintendent of public schools for St. Louis, institutes the earliest systematic efforts in public schools to educate gifted students.
1869	Francis Galton's seminal work, *Hereditary Genius*, is published indicating that intelligence was passed through successive generations. His biographical study over 400 British men throughout history leads him to conclude through statistical methods that intelligence was derived from heredity and natural selection.
1901	Worcester, Massachusetts opened the first special school for gifted children.
1905	French researchers, Binet and Simon, developed a series of tests (Binet-Simon) to identify children of inferior intelligence for the purpose of separating them from normally functioning children for placement in special classrooms. Their notion of mental age revolutionizes the science of psychological testing by capturing intelligence in a single numerical outcome.
1908	Henry Goddard studies in France with Binet and is introduced to the Binet-Simon measurement scales. Subsequently, he ferries the test back to American in order to translate it into English and disseminate it to American educators and psychologists.
1916	Lewis Terman, the “father” of the gifted education movement, publishes the Stanford-Binet, forever changing intelligence testing and the face of American education.

Table 1 (continued)

Date	Event
1917	The United States' entry into World War I necessitates the mobilization of a large scale army. The Army Alpha and Beta were created and administered to over one million recruits, further legitimatizing intelligence testing in both academia and with the general public.
1921	Lewis Terman begins what has remained the longest running, longitudinal study of gifted children with an original sample of 1,500 gifted children.
1922	Leta S. Hollingworth begins the Special Opportunity Class at P.S. 165 in New York City for gifted students. This class would yield nearly forty research articles, a textbook and blueprints for Hollingworth's work at P.S. 500, the Speyer School.
1925	Lewis Terman publishes *Genetic Studies of Genius*, concluding that gifted students were: (a) qualitatively different in school, (b) slightly better physically and emotionally, in comparison with normal students, (c) superior in academic subjects, in comparison with the average students, (d) emotionally stable, (e) most successful when education and family values were held in high regard by the family, and (f) infinitely variable in combination with the number of traits exhibited by those in the study. This is the first volume in a five-volume study spanning nearly 40 years.
1926	Leta Hollingworth publishes *Gifted Child: Their Nature and Nurture*, what is considered to be the first textbook on gifted education.
1936	Hollingworth establishes P.S. 500, the Speyer School, for gifted children ages 7-9.
1944	G.I. Bill of Rights making a college education available to veterans of World War II, who would otherwise not have had the opportunity to pursue higher education.

Table 1 (continued)

Date	Event
1950	J.P. Guilford gives the key note address at the annual APA convention, challenging an examination of intelligence as a multidimensional construct.
1950	National Science Foundation Act provides federal support for research and education in mathematics, physical sciences, and engineering.
1957	The Soviet Union launches Sputnik, sparking the United States to reexamine its human capital and quality of American schooling, particularly in mathematics and science. As a result, substantial amounts of money pour into identifying the brightest and most talented students who would best profit from advanced math, science, and technology programming.
1958	The National Defense Education Act passes. This is the first large scale effort by the federal government in gifted education.
1964	The Civil Rights Act passes, emphasizing equal opportunities including those in education.
1972	The Marland Report - The first formal definition is issued, encouraging schools to define giftedness broadly, along with academic and intellectual talent; the definition includes leadership ability, visual and performing arts, creative or productive thinking, and psychomotor ability. *[Note: psychomotor ability is excluded from subsequent revisions of the federal definition.]*
1974	The Office of the Gifted and Talented House within the U.S. Office of Education is given official status.
1975	Public Law 94-142, The Education for all Handicapped Children Act. This Act establishes a federal mandate to serve children with special needs, but does not include children with gifts and talents.

Table 1 (continued)

Date	Event
1983	A Nation at Risk reports scores of America's brightest students and their failure to compete with international counterparts. The report includes policies and practices in gifted education, raising academic standards, and promoting appropriate curriculum for gifted learners.
1990	National Research Centers on the Gifted and Talented are established at the University of Connecticut, University of Virginia, Yale University, and Northwestern University.
1993	National Excellence*: The Case for Developing America's Talent* issued by the United States Department of Education outlining how America neglects its most talented youth. The report also makes a number of recommendations influencing the last decade of research in the field of gifted education.
1998	NAGC publishes *Pre-K – Grade 12 Gifted Program Standards* to provide guidance in seven key areas for programs serving gifted and talented students. The standards were revised in 2010 as Pre-K-Grade 12 Gifted Programming Standards.
2002	The No Child Left Behind Act (NCLB) is passed as the reauthorization of the Elementary and Secondary Education Act. The Javits program is included in NCLB, and expanded to offer competitive statewide grants. The definition of gifted and talented students is modified again.
2004	A Nation Deceived: How Schools Hold Back America's Brightest Students, a national research-based report on acceleration strategies for advanced learners is published by the Belin-Blank Center at the University of Iowa.

The Complexity in Defining Giftedness

When Terman proposed the concept of giftedness, the criterion was based on a normative approach (intelligence quotient) and for many years the most widely accepted definition equated with an intelligence quotient of 140 and above (Terman, 1925). Nearly 50 years later the Marland Report (1972) advocated a definition of giftedness that centered on gifted and talented children who were capable of high performance. As reviewed by Antshel (2008), the Report also substantiated that these children required differentiated educational programs beyond those typically provided by schools for these children to realize their true potential. To clarify further, the Report stated that gifted and talented children included those with demonstrated achievement and/or potential ability in any of the following areas: general intellectual ability, specific academic aptitude, creative or productive thinking, leadership ability, visual or performing arts, or psychomotor ability. This definition was further supported through the paper entitled *National Excellence and Developing Talent* (U.S. Office of Educational Research and Improvement, 1993). This report modified the term "gifted” and replaced it with a definition centering on "outstanding talent", taking into consideration cultural and socioeconomic variables influencing identification (NAGS, 2008). Bracken & Brown (2006) suggest that as the field of gifted education evolved, there grew a sense of “elitism” with admittance to the “intellectual club”, which tended not to take into account diverse students from culturally and linguistically different backgrounds. Thus, leaders in gifted education began to include comprehensive methodology and procedures for identifying gifted students.

Harvard psychologist Howard Gardner shared his view of intelligence in his 1983 book, *Frames of Mind: The Theory of Multiple Intelligences*, in which he suggested that all people have different kinds of "intelligences." Furthermore, he proposed that intelligence is not just a single intellectual capacity. Instead, he suggested that there are multiple kinds of intelligence that people can possess. Gardner describes eight different kinds of intelligence: Visual – good with art and design; Linguistic – good with words; Logical – good with numbers and math; Bodily – good at action, movement and sports; Musical – good with music, tone and rhythm; Interpersonal – good at communicating with others; Intrapersonal – good at self-reflection, and Naturalistic – good at appreciating the world and nature (Gardner, 1983).

The theory has come under criticism from psychologists and educators who argue that Gardner's definition of intelligence is too broad, and that his eight different intelligences simply represent talents, personality traits and abilities (Delisle, 1996). Despite this, the multiple intelligence theory is well-accepted and utilized by many educators who incorporate the multiple intelligences into their teaching philosophy and strive to integrate Gardner's theory in the classroom setting, not only for the gifted learner, but also for all students.

Additionally, educational leaders with a particular interest in gifted learners have expressed concern about aspects of the standards movement as envisioned and enforced by No Child Left Behind (Hockett, 2009). This Act defines gifted or talented children as those who give evidence of high achievement capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who need services or activities not ordinarily provided by the school in order to fully develop those capabilities. One goal of NCLB is to ensure that all children have access to a rigorous curriculum (Hockett, 2009). However, state accountability systems have influenced teachers to emphasize a one-size-fits-all pedagogy at the expense of differentiated curricula and instruction, including those identified as gifted and talented. Moreover, the quality of gifted programming is at risk in educational settings focused on minimal competency (Hockett, 2009). To maximize potential, gifted learners require educational programs beyond the typical classroom instruction; otherwise, these learners may be left unchallenged, bored, and at- risk for school problems (Seeley, 1993). In summary, policy changes are required to meet the needs of gifted children and to enhance developmental well-being (O’Boyle, 2008).

Assessment and Eligibility for Gifted Support

The identification of gifted and talented children remains a stern challenge to professional educators (Cunningham, Thompson, Alston, & Wakefield, 1978). The Association for the Gifted refers to the identification process as searching for “hints and clues” of giftedness in all students. In practice, school psychologists and other educators interested in the assessment and identification of giftedness in children use a variety of instruments in the process of selection for specialized educational programs (Simpson, Carone, Burns, Seidman, Montgomery, & Sellers, 2002). Typically, the gifted selection process begins with a screening procedure that is intended to find those children who may require specialized services above that of the general education curriculum (McIntosh & Dixon, 2005). Individuals who perform well on this initial screening will typically proceed to a formal evaluation conducted by the school psychologist to determine presence of giftedness and eligibility for gifted support services (McIntosh, Dixon, Williams, & Youman, 2008).

The most common methods of operationalizing giftedness include standardized measures of intelligence and standardized measures of academic achievement (Antshel, 2008). Students are often identified as gifted if they perform at superior levels on the individual intelligence test (Winner, 2000) because the IQ test is almost routinely used in determining whether or not a student qualifies for gifted support (Pfeiffer, 2002; Sparrow, Pfeiffer, & Newman, 2005). Specific IQ cutoffs vary from state to state, yet most states stipulate that IQ is only one of the criteria employed to define giftedness (Antshel, 2008). According to a review by Koziol, Budding, and Chidekel (2010), IQ refers to a derived score, summarized from performances on many discrete subtests that are presumed to measure a general ability (i.e. intelligence). In essence, there may not be a "general" intellectual function. Instead, the subtests are multifactorial in nature, measuring many discrete skills (Koziol et al., 2010) in which a pattern of performance can be more meaningful. Whereas traditional theories focus on general intelligence, modern theories purports that intelligence is a broad construct that goes beyond *g*. Similarly, Naglieri and Kaufman (2001) developed the PASS (Planning, Attention, Simultaneous, and Successive cognitive processes) model which focuses on these cognitive abilities to identify giftedness rather than focusing on an overall IQ score (Simpson, et. al, 2002).

One measure which has been recommended for use in identifying gifted children is the Structure of Intellect (S.O.I.) Learning Abilities Test (Meeker, Mestyanek, &

Meeker, 1976). This instrument measures twenty-four of the intellectual abilities hypothesized by Guilford (1967). Briefly, Guilford has hypothesized a three dimensional structure of the intellect (Cunningham et. al., 1978). The three dimensions are defined as intellectual operations (cognition, memory, divergent production, convergent production, and evaluation), contents (figural, symbolic, semantic, and behavior), and products (units, classes, relations, systems, transformations, and implications) (Cunningham et al., 1978). The rationale for the approach was used via Guilford's (1956) Structure of Intellect Model (SI). Using factor-analytic techniques, they found sets of distinct intellectual abilities beyond those factored by Thurstone, which could be conceptualized along three dimensions. They referred to these dimensions as the Structure of Intellect (Meeker & Meeker, 1973). Meeker (1963) devised a set of templates which allowed the examiner to place Binet and WISC responses into an SOI profile as a means of getting away from an IQ score and going to a profile or pattern of a child's intellectual responses. In this manner, rooting the IQ test in theory, it is possible to identify in the profile strengths and weaknesses which allow for prescriptive education (Meeker & Meeker, 1973).

Given this complexity with the use of IQ to denote giftedness, researchers reiterate the need to use multiple criteria and informational sources when identifying gifted children in any context (Tyler-Wood & Louis, 1991; Coleman, 2003). Data collected through the use of multiple criteria provide indicators of giftedness and need for gifted support. When used appropriately, no single criterion should prevent a student's identification as gifted (Castellano, 2003). Nonetheless, individually administered intelligence tests remain a central component within an evaluation for giftedness. These will not be quickly or easily displaced in the school context for two reasons: first, the instruments are familiar to practitioners and they are, undeniably, statistically sound. Second, there is, at present, no practical substitute for the Binet and WISC; i.e., there are no differentiated abilities tests (group or individual) that can be used within the limits of time and no personnel that are normally allocated to testing. In other words, general intelligence instruments, although inadequate, will find continued use as long as there are no practical specific-abilities tests available (Meeker & Meeker, 1973).

Over the last century there have been considerable changes in the ways in which giftedness has been conceptualized (Friedman-Nimz, O'Brien, & Frey, 2005). These changes are seen clearly in a recent national survey. The National Association of Gifted Children (2009) completed a nationwide survey to determine salient aspects of the gifted process. Forty-seven states participated. In terms of the definition of "giftedness," 41 states have a definition included in their state regulations. Other states currently report "high levels of ability," "advanced learning," "outstanding talent," and "exceptional ability," as part of the definition for giftedness (NAGC, 2009). In regard to determining eligibility, 28 states have reported that they use a predetermined set of criteria or methods to determine which students are gifted. Of these states, 21 reported using a multiple criteria model. As can be seen, our nation continues to lack one agreed upon manner in which to assess and identify giftedness. Nonetheless, the most widely accepted definition put forth by Sattler (1992) indicated that in order to meet the intellectual criterion for giftedness, a child must earn an overall IQ that is at least two standard deviations above the mean.

Cognitive Characteristics of the Gifted

To truly understand gifted performance, it is necessary to merge research and theory on giftedness with current thinking in cognitive development (Steiner & Carr, 2003). Understanding gifted children's thinking may help to create better curriculum and assessment procedures for gifted children (Friedman and Shore, 2000). According to Hong's review, research on human cognitive abilities has broadened the knowledge base and has provided a means to identifying those cognitive influences that differentiate gifted children, namely strength in acquiring, in organizing, in accessing, and in representing knowledge. Understanding the cognitive processes involved in giftedness can provide educators with opportunity to provide individualized and differentiated instruction.

For instance, research from cognitive neuroscience suggests that the brains of mathematically gifted children are quantitatively and qualitatively different from those with average math ability. According to O'Boyle (2008), children gifted in mathematics exhibit signs of heightened right hemisphere development and display intensified inter-hemispheric exchange of information between the left and right sides of the brain. Numbers of neurobiological mechanisms related to exceptional mathematical reasoning ability have been postulated, including enhanced brain connectivity. Studies conducted using fMRI showed heightened intra hemispheric frontal parietal connectivity, as well as enhanced inter hemispheric frontal connectivity between the dorsolateral prefrontal and premotor cortex in the brains of gifted children (Prescott, Gavrilescu, Cunnington, O'Boyle, & Egan, 2010). According to these researchers, the enhanced connectivity patterns are associated with high fluid intelligence, which may further suggest a unique neural characteristic of the mathematically gifted brain. One of the notable characteristics of gifted students is the dominance of the right hemisphere, compared with that of average students (Jin, Kim, Park, & Lee, 2007). Mathematically gifted children have shown enhanced brain activity in the right hemisphere when recognizing faces (O'Boyle, Alexander, & Benbow, 1991). Additionally, studies have also demonstrated that children who are mathematically and musically gifted have a greater than usual bilateral symmetrical brain organization and that the right hemisphere participates in tasks usually reserved to the left hemisphere (O'Boyle, Gill, Benbow, & Alexander, 1994).

Benbow & Minor (1990) found that verbally gifted youth scored higher on general knowledge tests and that math gifted youth scored higher on tests of nonverbal reasoning, spatial ability and memory, with speed being considered an important component of extreme giftedness. The gifted also use strategies such as switching cognitive strategies in recognition of personal strengths, which might be a metacognitive component of giftedness (Shore & Carey, 1984). Rogers (1986) and Cheng (1993) reviewed the literature and found that gifted children exhibited significantly more characteristics of metacognitive functioning. Cheng (1993) states that both theoretical and empirical evidence support superior metacognitive ability as being an essential component of giftedness. In addition, gifted children are thought to have strength in their cognitive perceptual efficiency which further implicates the notion that sub processes in the gifted mind have been automated and no longer require conscious attention (Koziol et al., 2010). Cognitive efficiency has also been demonstrated in high IQ and academically gifted children (Saccuzzo, Johnson, & Guertin, 1994), suggesting that the more efficiently organized the information stored in memory is, and also how quickly and accurately it is retrieved, the higher the level of performance in many domains (Jackson, & Butterfield, 1986). The gifted use more advanced rules in applying strategies to novel problems (Geary & Brown, 1991), and show easier flexibility in thinking (Kanevsky, 1992).

The motivation seen in children who are gifted eventuates in being intensely interested in their subjects of study (Winner, 1997), which may be seen as a highly engaged motivational system in the brain. According to Winner's classic work, giftedness denotes children who demonstrate three atypical characteristics. Gifted children begin to master a domain (i.e., language, mathematics, music) at an early age and this learning comes easily so progress is rapid. Gifted children independently acquire the skills for a domain and need little or no help from adults, often teaching themselves. Last, gifted children appear to be intrinsically self-motivated and their interest is obsessive in nature; it is often described as being over-focused, which Winner refers to as a "rage to master". Thus, gifted children not only demonstrate good met cognitive thinking, but they also demonstrate a greater level of motivation which keeps them engaged in the learning process.

Feldman and Goldsmith (1991) sought an evolutionary explanation of child giftedness, especially the phenomenon of the child prodigy. These researchers argued that the evolution of working memory and the cerebellum may have produced the child prodigy within agricultural villages as early as 10,000 years ago. In addition, these child prodigies have heightened emotional-attentional control in the central executive of working memory. This heightened emotional-attentional control begins with initial visuospatial processing, links visuospatial and language processing in working memory, and initiates and accelerates a positive feedback loop with the cerebellum in a specific knowledge domain. These researchers concluded that the working memory-cerebellar approach provides an evolutionary and developmental explanation of the child prodigy.

This theory is further strengthened by Koziol et al. (2010); these researchers postulate a framework that takes into account the brain's "vertical organization". This theory suggests that giftedness must be examined in relation to evolutionary and neurodevelopmental factors. Koziol et al. (2010) further discuss the role of the basal ganglia which acts to make actions automatic and is important in instrumental learning. In addition, this model sees the role of white matter tracts being related to speed of adaptation and mastery of a learned behavior. Last, the model includes the cerebellum as having a crucial role in refining behaviors and in the automaticity of cognition and behavior. This model would explain giftedness as being able to make most behaviors habitual, in order to free higher level processes for greater in-depth thinking. These skills are then crucial to adapting to the environment, in which gifted children are able to do well.

The Use of the WISC-IV in Assessment of Giftedness

The *Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV)* is the intelligence instrument that is the focus of this study. The *WISC-IV* was released in

August of 2003, and is structured in a manner significantly different from its predecessor the *WISC-III* (Falk, et. al., 2004). The Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV; Wechsler, 2003) provides four index scores, Verbal Comprehension, Perceptual Reasoning, Working Memory and Processing Speed (Cheramie, Stafford & Mire, 2008). The Verbal Comprehension Index and the Perceptual Reasoning Index have emerged as influential factors in the selection to gifted programs (Silverman, 2007). The Perceptual Reasoning Index is superior to the Performance IQ of the WISC-III as a measure of abstract visual reasoning and is likely to be a better predictor of success in a gifted program, especially for culturally diverse, bilingual, twice exceptional and visual-spatial learners (Silverman, 2007). Moreover, the WISC-IV now yields process subtests that are more sensitive to the robust nature of cognitive functioning (Keith, Goldenring-Fine, Taub, Reynolds, & Kranzler, 2006; Wechsler, 2003). Furthermore, this new structure helps one better understand a child's strengths and needs in relation to contemporary theory and research.

According to Silverman's (2007) review, the nonverbal section of the test has been modified, eliminating many of the subtests that measured visual perception, replacing them with a stronger emphasis on visual-spatial reasoning. The WISC-IV continues to provide a robust test of verbal reasoning. The major drawback of the WISC-IV in the identification of giftedness is that Processing Speed and Working Memory are doubled in weight in the calculation of FSIQ scores, representing 40% of the FSIQ score. In a study of 103 children tested on the WISC-IV at the Gifted Development Center, the mean score in Verbal Comprehension was in the gifted range (131.7), and mean scores in the Processing Speed were average (104.3) (Falk, Silverman, & Moran, 2004). More than 70% of the students applying for gifted placement have Processing Speed Index scores in the average range or below (Silverman, 2007).

Because gifted children tend to show greater variability and lower overall performance on processing speed and working memory items (Roid, 2003), the use of full scale scores that place an increasing emphasis on these factors will likely exclude some children who may be gifted. As a way to circumvent this problem, the use of a general ability index (GAI) was developed for use with the WISC-III by Prifitera, Weiss, and Saklofske (1998). Prifitera et al. (1998) recommended the WISC-III GAI as a useful composite to estimate overall ability if a great deal of variability existed within VIQ and/or PIQ due to low scores on Arithmetic and/or Coding. The GAI is the sum of scaled scores for three Verbal Comprehension subtests and three Perceptual Reasoning subtests, which was developed as an alternative global measure of cognitive functioning designed to reduce the effects of working memory and processing speed (Raiford, Weiss, Rolfhus, & Coalson, 2005).

Raiford et al. (2005) provided criteria in the WISC-IV Technical Report in which the GAI should be considered in clinical situations. These rules suggest that in a situation in which there is a “significant and unusual” difference between any of the four index scores that the FSIQ score may not be the best representation of intelligence. The use of calculating the GAI is not restricted, but rather it is intended to be used in situations in which there is substantial variability within the cognitive profile. Furthermore, the GAI can be used interpretively to show the effects of working memory and processing speed on the full expression of cognitive ability (Cheramie, Stafford, & Mire, 2008). Moreover, the classroom performance of two children with the same GAI score but with very different WMI/PSI scores will likely be quite different (Raiford et al., 2005).

Although globally gifted children do abound, many other gifted children may present unevenness in their cognitive behaviors. For example, in the study conducted by Rowe, Kingsley, and Thompson (2010), which investigated "Predictive Ability of the General Ability Index (GAI) Versus the Full Scale IQ Among Gifted Referrals", significant variability among index scores was found. Rowe, et al. (2010) stated, "All students received testing as part of the application process for gifted and talented (GT) programming in their schools, and all evidenced significant variability among their index cores on the WISC-IV." The FSIQ is an aggregate score that summarizes performance across multiple cognitive abilities with a single number. When unusual variability is observed within the set of subtests that comprise the FSIQ, clinical interpretation should characterize this diversity of abilities in order to be most useful for parents, teachers, and other professionals (Raiford et al., 2005).

Test interpretation can be visualized as a process of information aggregation. Aggregation combines details within a conceptual framework unit to produce a more easily distinguishable pattern. According to the WISC-IV Interpretative Cycle, WISC-IV interpretation patterns can be characterized using five information aggregation units: 1) Intra-Item Task Performance – combining the interplay of various component cognitive processes within the performance of a single test item. 2) Intra-Subtest Item Performance – combining performance elements common to various items within a subtest. 3) Subtest

Scaled Scores – combining performance on similar items of a single subtest. 4) Index Standard Scores – combining subtest scores into distinguishable domains. 5) Full scale Score –combining the information from all distinguishable domains into a total score. The cycle allows for the most important clinical information to rise to the surface and be highlighted (Kaplan et al., 1991).

For example, Detterman &Daniel (1989) found that the higher the IQ, the lower the correlation among subtests on the IQ test. Wilkinson (1993) reported stark discrepancies between verbal and performance IQs in children with IQs of 120 or higher. Educational programs that rely on global IQ scores as an eligibility criterion are likely to miss children who are unevenly gifted. In addition, when using the global IQ, children talented with mathematic gifts and those with verbal gifts are treated identically in programming; there is little individualized instruction. Even more than 20 years ago, researchers were calling for admittance to gifted programs for children that are tailored to the domain in which the children are gifted (Stanley & Benbow, 1986).

Statement of the Problem

According to the National Association for Gifted Children, the twenty-first century represents a new era in which the possibilities are limitless and the future for gifted and talented children can become a national priority. However, American educational systems have been placed in a dilemma between choosing equity and excellence that has been tied to federal legislation. Most of the recent emphasis on public policy has been placed on equity. Laws such as No Child Left Behind place an emphasis on low-level accountability, in which students are tested on basic knowledge, rather than on high-level achievement. The National Excellence Report (U.S. Department of Education, 1993) recommended that challenging curriculum standards need to be set and gifted students need to be provided with more challenging opportunities to learn.

The assessment and identification process for the gifted also remains controversial. The use of a FSIQ in determining eligibility ignores the multifactorial nature of IQ tests (Koziol et al., 2010) and the large variation often observed in gifted children, suggesting large heterogeneity. Indeed, the use of the FSIQ has also kept children from gifted programs because they come from different cultures or from different linguistic backgrounds. Last, the FSIQ can mask strengths and weaknesses that are evident when examining performance at the subtest level. As an alternative, some have called for use of the GAI to remove the influence of working memory and processing speed, which again ignores other sets of skills evident on subtests that could be linked to instructional efforts. Thus, a process based approach and an examination of a pattern of strengths and weaknesses may be utilized in determining giftedness. This approach would continue to see the influential roles of working memory and processing speed in gifted individuals, suggested to be important and causal roles in the biology of giftedness. Why then would we ignore the WMI and PSI of the WISC-IV in determining giftedness and gifted programming?

Educators are obligated today to gain more knowledge about the individual student if that student's performance in school is to yield maximum dividends in helping him or her meet the demands of the future (Meeker, 1965). Separate abilities are defined by Guilford's "Structure of Intellect", in which a procedure is presented, making possible the characterization of intelligence test items in terms of factors. An appraisal of these separate abilities as defined by the structure and contained with the Stanford-Binet might show consistent patterns for each child (Meeker, 1965). A graphic representation of any child's pattern of abilities which directly relates to curriculum tasks would make educational planning for him or her realistic, practical, and rewarding (Meeker, 1965).

Purpose of the Study

Although the research community has some knowledge of the developmental path that cognition takes in gifted children, the body of research continues to have significant gaps (Steiner & Carr, 2003). Few longitudinal studies of gifted learners' cognitive development exist despite the influence that longitudinal research can have on our understanding of giftedness (Monks & Mason, 1993). Thus, the purpose of this study is to capture, adequately, the nature of the cognitive strengths and weaknesses in a heterogeneous sample of gifted children. In order to meet the mandates in the Talent Act, school psychologists will need to redesign how they assess for characteristics of gifted children, and utilize a process-oriented approach in the identification and conceptualization of gifted ability. This study attempts to describe meaningful subtypes of gifted children. These subtypes may have strengths and weaknesses at the cognitive level that will lend to effective instruction, curriculum choices, advancement, and acceleration. Gifted programs, which are defined by a narrow band of interests on the part of educators or on an opinionated philosophy, will define giftedness too narrowly. Such programs become passive and lead not only to narrowness, but also to limitations in the development of human intelligence in its broadest range (Meeker, 1987). Gifted programs should address the teaching and enhancing of the child's intelligence. An individualized gifted educational plan can be developed based on the strengths of the child and lead to greater achievements in life. Intelligence is not simply the straightforward amalgamation of discrete cognitive processes but rather different cognitive processes appear to be more strongly associated with intelligence (Antshel, 2008). Further, given the research on the different cognitive skills found in gifted children, it makes much better clinical sense to examine separate cognitive abilities, rather than relying on a FSIQ in determining giftedness and need for services. Given the homogeneous nature of the "gifted" construct, this study examined gifted cognitive subtypes by exploring the strengths and weaknesses of the cognitive profile rather than by the global IQ scores.

Research Questions

The current study was undertaken to identify and describe meaningful cognitive subtypes of children with gifted ability as determined by hierarchical cluster analysis, and to examine subtype differences on standardized cognitive measures. Differentiating cognitive patterns could aid practitioners with more accurate gifted identification practices, not only for determining eligibility, but also for developing effective gifted, individualized education programs that meet the academic needs of these children. It is clear that researchers should undertake studies involving subtypes if relevant conclusions and implications are to be delineated for children with gifted abilities. Through examination of the cognitive differences in gifted subtypes, this study sought to further the understanding of this heterogeneous and enigmatic population, so that gifted children could be better served in the educational community.

1. Can we adequately cluster this gifted sample into meaningful cognitive subtypes based on performance across the WISC-IV subtests?
2. If so, are these gifted subtypes significantly different across all the dependent cognitive measures of the WISC-IV?

CHAPTER 3

Method

Source for Data

The participant data included the *Wechsler Intelligence Scale for Children, Fourth Edition* gifted standardization sample. Permission was sought and agreement provided from NCS Pearson Corporation for utilization of this data. Data were limited to students in the second to fifth grades who participated in the norming and standardization of the WISC-IV and who were identified as being included in the gifted sample (N = 63). Table 2 (below) illustrates the demographic characteristics of the entire sample.

Table 2

Basic Demographic Characteristics of Overall Sample

Demographics	n	%
Gender		
Males	32	50.8
Females	31	49.2
Grade		
Second	1	1.6
Third	5	7.9
Fourth	16	25.4
Fifth	41	65.1
Ethnicity		
Asian	3	4.8
Black	7	11.1
Hispanic	6	9.5
White	47	74.6
Region		
North Central	13	20.6
North East	7	11.1
Southern	29	46.0
Western	14	22.2

Measures

The WISC-IV standard battery, which is considered a reliable and valid measure of individual cognitive functioning according to Wechsler (2003), was utilized for this study. The WISC-IV is widely used and respected (Baron, 2005). The WISC-IV is internally consistent with reliability coefficients of the subtests ranging from .79 to .90 and reliability coefficients for the composite scores ranging from .88 to .97. The WISC-IV is considered equally reliable for children with gifted abilities and is considered to have adequate stability over time (Wechsler, 2003).

Approaches in understanding the cognitive skills assessed by the WISC-IV include both nomothetic and idiographic approaches. At the nomothetic level, the index level scores are compared with the standardization sample in determining gifted ability. In this approach, thought-to-be gifted children are compared with gifted children to determine if their abilities fall within the “very superior” range. Idiographic analysis looks within the child for a pattern of performance which entails examination of strengths and weaknesses. Subtest analysis and examination of a pattern of performance across these subtests has received much attention in recent years. This approach is conducted to determine the processing skills needed to perform certain tasks and to interpret performance, based across several subtests that purport to measure that skill. A variety of cognitive processes are necessary to complete any given task, thus it is important to consider a pattern of performance that is evidenced across subtests. Therefore, the following descriptions of subtests are simply to provide a general understanding of some of the skills tapped by the WISC-IV measure.

The WISC-IV standard battery is composed of ten core subtests (Block Design, Similarities, Coding, Vocabulary, Digit Span, Picture Concepts, Matrix Reasoning, Letter Number Sequencing, Comprehension, and Symbol Search). Four index scores (Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed) and a Full Scale Intelligence Quotient (FSIQ) are computed from these subtests.

According to Wechsler (2003), the Verbal Comprehension Index requires utilization of reasoning, comprehension, and conceptualization in measuring verbal abilities. It consists of the Similarities, Vocabulary, and Comprehension subtests. The Similarities subtest is thought to measure concept formation and reasoning with verbal information. The Vocabulary subtest measures word knowledge, fund of knowledge, concept formation and verbal expression (Wechsler, 2003). The Comprehension subtest measures reasoning with verbal information and conceptualization, verbal comprehension, and expression. It also involves knowledge of conventional behavior, social judgment, and common sense (Sattler, 2001). The Vocabulary subtest can be considered a measure of long-term retrieval and word knowledge for some children (Hale & Fiorello, 2004). Fiorello et al. (2006) found that the Vocabulary and Information subtests are measures of auditory-crystallized-language based skills. Groth-Marnat and colleagues also suggest that the VCI measures facility with concept formation and language skills (Groth-Marnat, Gallagher, Hale, & Kaplan, 2000). According to Keith and colleagues, the VCI can be interpreted confidently because the subtests that compose the VCI measure are thought to measure comprehension, knowledge, and crystallized intelligence (Keith et al., 2006).

The Perceptual Reasoning Index assesses perceptual reasoning, fluid reasoning, and perceptual organization. It consists of the Picture Concepts, Matrix Reasoning, and Block Design subtests. The Picture Concepts subtest is thought to measure abstract reasoning and the ability to reason categorically, and may also include verbal mediation and naming (Keith et al., 2006). The Matrix Reasoning subtest measures fluid reasoning, visual information processing, and abstract reasoning. These two subtests together measure inductive reasoning, which is a major component of fluid reasoning (Keith et al., 2006). The Block Design subtest assesses analyzation and visualization of abstract visual stimuli and integrated brain functioning (Kaufman, 1994). The Block Design subtest has also been shown to measure spatial ability (Groth-Marnat & Teal, 2000) and ability to separate figure and ground (Sattler, 2001).

The Working Memory Index assesses attention, concentration, and working memory. It consists of Digit Span (Forward and Backward) and Letter Number Sequencing. It is important to note the differences between theses tasks because they likely measure different aspects of functioning (Hale, Hoeppner, & Fiorello, 2002). Digit Span Forward measures rote learning and memory, attention, encoding, and auditory processing and sequencing (Sattler, 2001). The Digit Span Forward subtest loaded on the CHC short-term memory (Gsm) factor in the Flanagan (2000) study. The DS forward task also appears to measure immediate rote auditory memory and measures aspects of the phonological loop for holding information in immediate memory (Hale et al., 2002; Hale & Fiorello, 2004). Digit Span Backward is a measure of working memory involving mental manipulation and visual spatial imaging (Sattler, 2001; Wechsler, 2003). Digit

Span Backward also likely measures aspects of self-regulatory executive functions such as planning, strategizing, organizing, executing, monitoring, maintaining, evaluating, and changing behavior (Hale & Fiorello, 2004). Digit Span and Letter Number Sequencing are measures of short-term and working memory processes (Keith et al., 2006).

The Processing Speed Index is thought to assess the speed of mental and graphomotor processing. It consists of the Coding and Symbol Search subtests (Wechsler, 2003). The Symbol Search subtest involves short-term memory, visual-motor coordination, cognitive flexibility, visual discrimination, and concentration (Sattler, 2001). However, Symbol Search may also be better described as visual processing. In the Keith et al. (2006) study, Symbol Search loaded with Block Design on the Gv factor. The Coding subtest assesses short-term memory, learning ability, visual perception, visual-motor coordination, cognitive flexibility, attention, motivation, and is a good measure of processing speed or psychomotor speed (Keith et al., 2006; Sattler, 2001). Coding loaded on the processing speed (Gs) factor in the Flanagan (2000) study. Overall, the PSI can be interpreted confidently because the component subtests measure a coherent factor (Keith et al., 2006).

Procedure

The faculty investigator formally requested the WISC-IV gifted standardization sample directly through NCS Pearson Corporation. The faculty investigator procured this data through following this organization’s policies and procedures regarding release and dissemination of the data. Upon confirmation through the Philadelphia College of

Osteopathic Medicine’s Institutional Review Board, the data were downloaded and analyzed through SPSS Version 18.

Analyses

The WISC-IV subtests were subjected to a hierarchical cluster analysis to determine if subtypes would emerge in this sample of gifted children. The cluster analysis utilized the Average Linkage Within Groups variant of the Unweighted Pair-Group Method Arithmetic Average (UPGMA) as the amalgamation or linkage rule. This variant also combines clusters, so that the average distance between all possible pairs of cases in the resulting cluster is as small as possible, thereby minimizing within group variability. The Euclidean method was chosen as the distance measure involved in determining the amount of distance that serves as a criterion for grouping items. Analyses of variance were computed between the four gifted subtypes and the cognitive variables of the WISC-IV. Bonferroni post hoc tests were utilized for multiple group comparisons. Alpha was set at $p < .05$ for all analyses.

CHAPTER 4

Results

Descriptive Statistics

Reported in Table 3 are descriptive statistics for the entire sample for the WISC-IV variables. (*Note:* VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; WMI. = Working Memory Index; PSI = Processing Speed Index; FSIQ = Full Scale Intelligence Quotient.) The FSIQ fell in the superior range when examining this sample at the global level. However, examination of the range revealed that some gifted children had a FSIQ in the average range. This pattern remained the same for the VCI, the PRI, the WMI, and the PSI; these were variable in nature and scores fell between the low average range and the very superior range for this sample of gifted children. As suspected, the index score means of the FSIQ, the VCI, and the PRI were greater than the index score means of the WMI and PSI. The PSI score mean was the lowest overall.

Moreover, the subtests which compose the VCI revealed the highest subtest score means and the subtests which compose the WMI and the PSI revealed the lowest subtest score means. Similarly, subtest scaled scores ranged from the low average range to very superior range. The largest range – 13 points, was found on the Picture Concepts subtest and the smallest range – 9 points, was found on the Vocabulary and Digit Span subtests. Overall, the Vocabulary subtest yielded the highest range with scaled scores falling only within the average range to very superior range.

Table 3

Means and Standard Deviations for Entire Sample across WISC-IV Variables

Variable	n	M	SD	Range
Global Scores				
FSIQ	59	123.49	8.53	107-141
VCI	63	124.71	10.99	102-144
PRI	63	120.44	10.98	86-151
WMI	60	112.45	11.85	91-141
PSI	62	110.60	11.54	80-133
Subtest Scores				
Similarities	63	14.10	2.36	7-19
Vocabulary	63	14.60	2.15	10-19
Comprehension	63	14.05	2.30	9-19
Block Design	63	13.79	2.57	8-19
Picture Concepts	63	12.73	2.06	6-19
Matrix Reasoning	63	13.35	2.62	8-19
Digit Span	62	12.02	2.41	8-17
Letter-Number Sequencing	61	12.57	2.21	7-19
Coding	63	11.51	2.25	7-17
Symbol Search	62	12.11	2.46	6-18

Extrapolation of Gifted Subtypes

In this study, cluster analysis was undertaken with the purpose of identifying and classifying homogeneous subtypes of gifted children, based on direct cognitive performance on the WISC-IV subtests. Four participants were excluded from this hierarchical cluster analysis because of missing scores on subtests and/or index scores (N = 59). The cluster analysis utilized the Average Linkage Within Groups variant of the Unweighted Pair-Group Method Arithmetic Average (UPGMA) as the amalgamation or linkage rule. This variant also combines clusters so that the average distance between all possible pairs of cases in the resulting cluster is as small as possible, thereby minimizing within group variability. The Euclidean method was chosen as the distance measure involved in determining the amount of distance that serves as a criterion for grouping items. The results of the hierarchical cluster analysis revealed four gifted subtypes, according to the agglomeration schedule coefficient changes from 10.110 to 8.519. Table 4 displays the demographic information for the four subtypes.

Table 4

Participant Characteristics on Demographic Variables within Gifted Subtypes

Demographic	Lin. (n = 17)	Log. (n = 9)	Lin./Log./Spa. (n = 18)	Lin./Log. (n = 15)
Gender (*n*; %)				
Female	10 (58.8)	4 (44.4)	8 (44.4)	7 (46.7)
Male	7 (41.2)	5 (55.6)	10 (55.6)	8 (53.3)
Grade (*n*; %)				
Second	0	1 (11.2)	0	0
Third	2 (11.8)	2 (22.2)	0	1 (6.7)
Fourth	7 (41.2)	3 (33.3)	4 (22.2)	2 (13.3)
Fifth	8 (47.1)	3 (33.3)	14 (55.6)	12 (80.0)
Ethnicity (*n*; %)				
Asian	0	0	2 (11.1)	0
Black	5 (29.4)	0	0	1 (6.7)
Hispanic	1 (5.9)	0	0	4 (26.7)
White	11 (64.7)	9 (100)	16 (88.9)	10 (66.7)
Region (*n*; %)				
North Central	5 (29.4)	0	4 (22.2)	2 (13.3)
North East	0	0	4 (22.2)	3 (20.0)
Southern	8 (47.1)	7 (77.8)	9 (50.0)	4 (26.7)
Western	4 (23.5)	2 (22.2)	1 (5.6)	1 (5.6)

Note: Lin. = Linguistic; Log. = Logical; Lin./Log./Spa. = Linguistic/Logical/Spatial; Lin./Log. = Linguistic/Logical

Exploring the means of the WISC-IV subtests and composite scores across the four subtypes helped to determine and clarify the gifted subtypes. The four gifted subtypes were classified as Linguistic, Logical, Linguistic/Logical/Spatial, and Linguistic/Logical, terms taken from Gardner's theory of multiple intelligences.

Analysis at the global level revealed composite mean scores that ranged from high average (WMI and PSI) to superior (VCI and PRI). Moreover, significant differences in performance were found within each index, including the FSIQ, which ranged from an average mean score of 107 to a very superior mean score of 141 (34 point range). The VCI mean scores also ranged from an average mean score of 102 to a very superior mean score of 144 (42 point range). The PRI mean scores revealed the largest range (65 points); this range extended from a below average means score of 86 to a very superior mean score of 151. The WMI mean scores ranged from an average means score of 91 to a very superior mean score of 141 (50 point range); and the PSI means scores ranged from a below average means score of 80 to a very superior mean score of 133 (53 point range). Furthermore, analysis of subtests at the global level also revealed a broad range from below average to very superior. A 13 point range was found on the Picture Concepts subtest, and a 12 point range was found on the Similarities, Letter-Number Sequencing, and Symbol Search subtests. A smaller range (9 points) was found on the Vocabulary subtest, which overall veered toward the best performances (10-19); and on the Digit Span subtest. The heterogeneity found in this population, as well as in the 2010 study conducted by Rowe et al. solidifies the need for conducting more comprehensive gifted evaluations.

Figure 1 and Figure 2 provide graphic displays of the means of the cognitive variables across the four gifted subtypes at both the nomothetic and the idiographic levels. For each subtype to be differentiated, a pattern of performance was noted across the subtests and composites to determine a constellation of strengths and weaknesses.

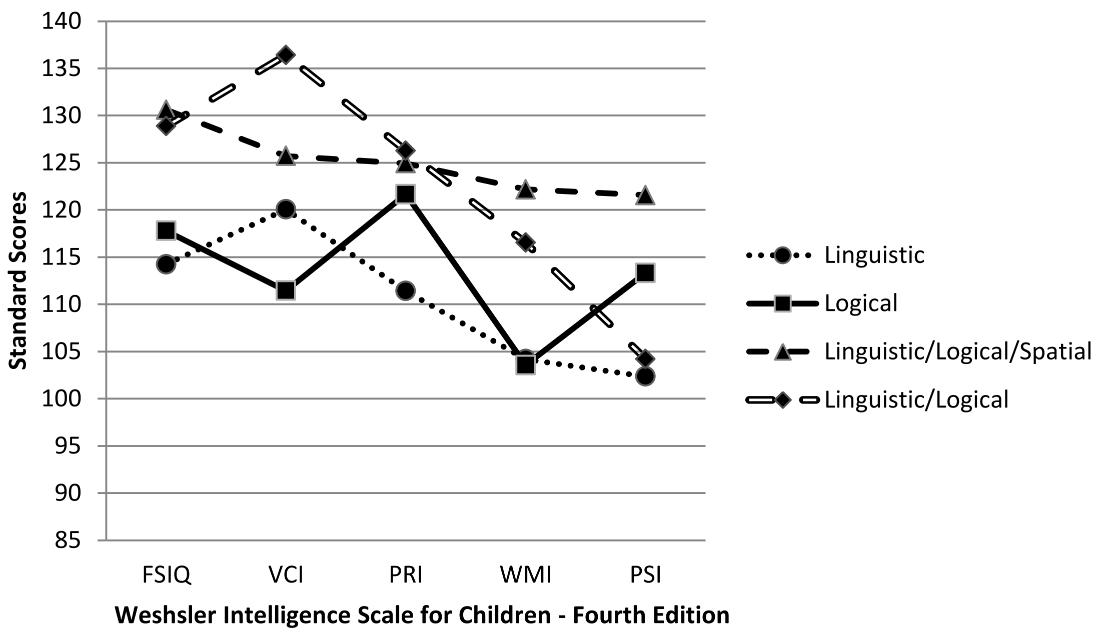

Figure 1. *Composite Profiles for the Cognitive Gifted Subtypes*

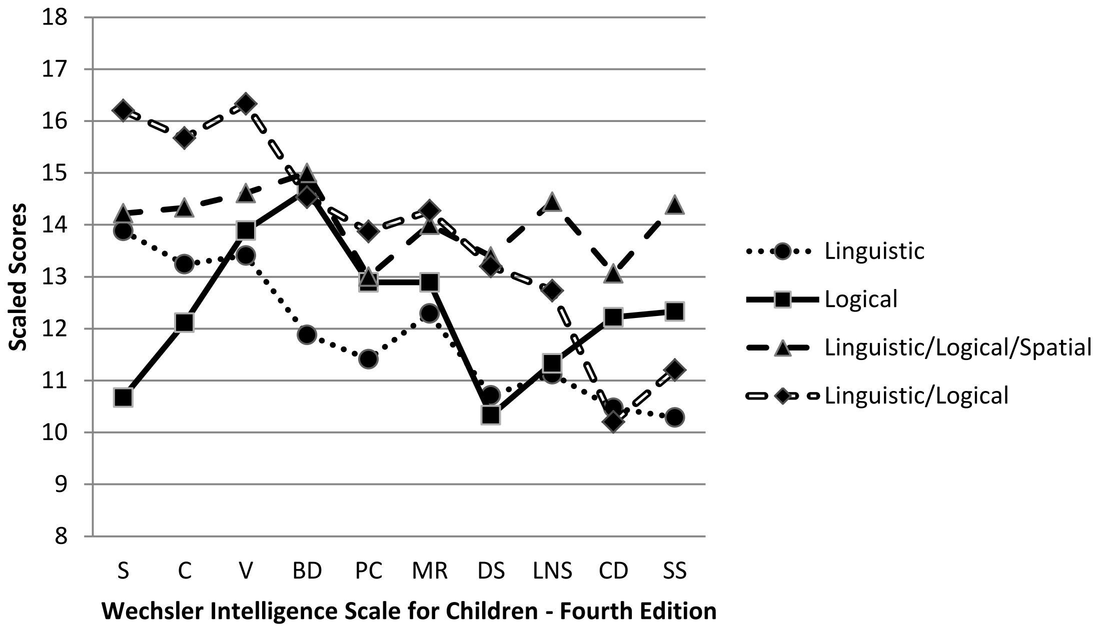

Figure 2. *Subtest Profiles for the Cognitive Gifted Subtypes*

Gifted Subtype Differences across the Cognitive Variables

Table 5 and Table 6 display the *M*, *SD*, and *F* statistic of the WISC-IV variables across the gifted subtypes. One way analyses of variance were computed to determine significant differences between the four gifted subtypes on the WISC-IV composite and subtest variables. Significant group differences were found between and among all subtypes on all variables of the WISC-IV at $p < .01$, with the exception of Matrix Reasoning which was not significant between or among any of the subtypes. Bonferroni post-hoc comparisons revealed significance between the gifted subtypes on multiple index and subtest scores.

Table 5

Nomothetic Results for WISC-IV Composites and Gifted Subtypes

Composite		Lin. (n = 17)	Log. (n = 9)	Lin./Log./Spa. (n= 18)	Lin./Log. (n = 15)	F^1
VCI	*M*	120.06[b]	111.44	125.72	136.40[a,b,c]	24.96
	SD	9.25	6.02	7.37	5.14	
PRI	*M*	111.41	121.67[a]	124.94[a]	126.27[a]	11.14
	SD	7.36	6.06	6.48	11.49	
WMI	*M*	104.18	103.56	122.17[a,b]	116.53[a,b]	16.59
	SD	6.75	3.47	9.61	11.43	
PSI	*M*	102.35	113.33[a]	121.56[a,d]	104.2	19.17
	SD	*10.12*	10.93	6.7	5.76	
FSIQ	*M*	114.24	117.78	130.61[a,b]	128.87[a,b]	50.47
	SD	4.59	4.66	2.4	6.07	

Note: VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; WMI = Working Memory Index; PSI = Processing Speed Index; FSIQ = Full Scale Intelligence Quotient

[1]All *F* ratios significant at $p < .001$

[a]Higher than Linguistic subtype

[b]Higher than Logical subtype

[c]Higher than Linguistic/Logical/Spatial subtype

[d]Higher than Linguistic/Logical subtype

Table 6

Nomothetic Results for WISC-IV Subtests and Gifted Subtypes

Subtest		Lin. (n = 17)	Log. (n = 9)	Lin./Log./Spa. (n = 18)	Lin./Log. (n = 15)	F^1
S	*M*	13.88[b]	10.67	14.22[b]	16.20[a,b,c]	19.46
	SD	1.62	2.29	1.9	1.15	
C	*M*	13.24	12.11	14.33	15.67[a,b]	6.8
	SD	2.14	1.54	2.33	1.84	
V	*M*	13.41	13.89	14.61	16.33[a,b]	7.08
	SD	2.06	1.05	1.34	2.44	
BD	*M*	11.88	14.67[a]	15.00[a]	14.53[a]	8.17
	SD	1.41	2.92	1.75	2.36	
PC	*M*	11.41	12.89	13.00[a]	13.87[a]	5.98
	SD	1.33	1.45	1.61	2.17	
MR	*M*	12.29	12.89	14	14.27	2.16
	SD	2.6	2.37	2.38	2.66	
DS	*M*	10.71	10.33	13.39[a,b]	13.20[a,b]	8.93
	SD	1.9	1.41	2.06	2.36	
LNS	*M*	11.12	11.33	14.44[a,b,d]	12.73	11.86
	SD	1.7	1.23	2.06	1.79	

Table 6 (continued)

Subtest		Lin. (n = 17)	Log. (n = 9)	Lin./Log./Spa. (n = 18)	Lin./Log. (n = 15)	*F*[1]
CD	*M*	10.47	12.22	13.06[a,d]	10.2	7.87
	SD	1.77	2.77	2.01	1.52	
SS	*M*	10.29	12.33[a]	14.39[a,b,d]	11.2	15.99
	SD	2.42	1.5	1.85	1.08	

Note: S = Similarities; C = Comprehension; V = Vocabulary; BD = Block Design; PC = Picture Concepts; MR = Matrix Reasoning; DS = Digit Span; LNS = Letter-Number Sequencing; CD = Coding; SS = Symbol Search

[1]All *F* ratios significant at $p < .001$with exception of Matrix Reasoning ($p > .05$)

[a]Higher than Linguistic subtype

[b]Higher than Logical subtype

[c]Higher than Linguistic/Logical/Spatial subtype

[d]Higher than Linguistic/Logical subtype

CHAPTER 5

Discussion

The current study was undertaken to identify and describe meaningful cognitive subtypes of children with gifted ability as determined by hierarchical cluster analysis, and to examine subtype differences on standardized cognitive measures. Differentiating cognitive patterns could aid practitioners with more accurate gifted identification practices, not only for determining eligibility, but also for developing effective, gifted, individualized education programs that meet the academic needs of these children. Through examination of the cognitive differences in gifted subtypes, this study sought to further the understanding of this heterogeneous and enigmatic population, so that gifted children could be better served in the educational community. This study questioned whether or not the gifted population could be clustered into meaningful subtypes, and if so, would these subtypes be significantly different across all the dependent variables of the WISC-IV. The standardization sample of the WISC-IV gifted population was utilized as the sole data sample for this study and was secured through permission through NCS Pearson, Inc.

Clinical Implications of the Subtypes

Utilizing hierarchical cluster analyses of the WISC-IV subtests, four gifted subtypes emerged and were named according to their pattern of strengths and weaknesses across the variables of the WISC-IV, utilizing Gardener's subtypes. The subtypes were differentiated by large variability across the FSIQ, the four indices and the subtests. Gardner's MI Theory provided a means to describing each subtype. Although, Gardner suggests that there are eight different kinds of intelligence, only three are used to depict the four subtypes (Linguistic, Logical, and Spatial) alone or in combination.

The Linguistic subtype was characterized by a superior VCI mean score. Gardner proposed that people who are strong in linguistic intelligence are able to use words well, both when writing and speaking and are typically very good at reading. Within the Linguistic subtypes' cognitive profiles, the VCI mean score was markedly higher than the other mean scores across composites, especially compared with this subtype's average mean scores on the WMI and PSI composites. Additionally, the Linguistic subtype's VCI was significantly higher than the VCI mean score of the Logical subtype. Consistent performances were found on subtests within each composite; hence, the subtests that make up the VCI yielded the highest mean scores, all falling in the high average range. Moreover, this subtype's performance on the Similarities subtest was found to be significantly higher than the Logical subtype's mean score.

As indicated by the VCI mean score, the Linguistic subtype was most effective and efficient in the performance of tasks that required an ability to reason with and provide verbal responses to orally presented questions and to retrieve verbal information from long-term storage. The PRI mean score was in the high average range; however, very notable was the fact that the Block Design subtest mean score was significantly lower than all other subtypes' mean scores for the Block Design subtest. In addition, the Linguistic subtype displayed much weaker WMI and PSI mean scores, as compared with the VCI, which supports the use of a GAI score to determine giftedness.

The Logical subtype was characterized by a superior PRI mean score. Although the PRI was significantly higher than only the Linguistic subtype, it was markedly different from the other mean scores across composites, especially compared with the average mean score on the WMI composite., Gardner (1983) would suggest that this subtype, as defined, includes people who are good at reasoning, at recognizing patterns and at analyzing problems logically. Performance on subtests within the WMI and PSI were consistent, whereas performance on subtests within the VCI and PRI displayed some variability. This subtype demonstrated average ability to reason with verbal information and average ability to reason with nonverbal visual material. Above average performances were found on tasks which required visual perceptual abilities integrated with motor movements for responding and which required retrieval of verbal information from long-term memory. Moreover, performance on the Similarities subtest was significantly lower than all other subtypes, and performance on the Digit Span subtest was significantly lower than other two subtypes (Linguistic/Logical/Spatial and Linguistic/Logical).

The Linguistic/Logical/Spatial subtype, defined by three of Gardner's intelligences, was the most consistently functioning group across all areas of the WISC-IV. This subtype is the only one to have all composites in the superior range. Additionally, of the four subtypes, this subtype's FSIQ was the only one to fall within the very superior range. According to Gardner (1983), the Linguistic/Logical/Spatial subtype is characterized by strengths with words and language; with analyzing problems and mathematical operations; and with visual and spatial judgment. This group of gifted learners displayed a solid capacity to reason with verbal information and nonverbal visual material, as well as to work quickly and accurately on timed visual-processing tasks and on tasks measuring the ability to encode and manipulate verbally presented information. Moreover, the mean score on the Block Design subtest was this subtype's best performance, demonstrating very well developed visual and spatial processing, visual analysis and synthesis, and an understanding of part-whole relationships (Groth-Marnat & Teal, 2000).

The Linguistic/Logical subtype was characterized by an exceptionally well developed ability to reason with verbal and nonverbal visual material defined by Gardner's notion of verbal and mathematical intelligence. Moreover, the VCI was significantly higher than the VCI in all other subtypes, and the PRI was significantly higher than the Linguistic subtype's VCI. Additionally, at the subtest level, performance on the Similarities subtest was significantly higher than all other subtypes. Performances on the Comprehension and Vocabulary subtests were higher than both the Linguistic subtype and the Logical subtype. Within the Linguistic/Logical subtype's cognitive profile, processing speed and working memory emerged as weaknesses. The average mean scores for the SS and CD subtests revealed less well developed processing speed, psychomotor speed, and automaticity of simple cognitive processing. However, as noted by Kaufman (1992), Rowe et al. (2010) reported that gifted children are not always superior in sheer speed. In essence, gifted and talented students frequently sacrifice speed for accuracy. The average and high average means scores on the subtests which compose the WMI also revealed less well developed working memory. Nonetheless, the WMI mean score was significantly better, as compared with the Linguistic and Logical subtype.

Furthermore, similar to the study conducted by Rowe et al., (2010) the gifted sample scored lowest on subtests that make up the Working Memory and Processing Speed Indices. However, worthy of note, in the Rowe et al. (2010) study, among the WISC-IV index scores, Working Memory had the highest correlation with achievement, specifically reading and math scores on the WIAT-II. If this would hold true for the current study then one would assume that the Linguistic/Logical/Spatial subtype would produce the highest achievement levels.

Educational Implications

Utilizing hierarchical cluster analysis of the WISC-IV subtests, four gifted subtypes emerged; they were significantly different from each other on all global scores including the FSIQ, the VCI, the PRI, the WMI, and the PSI. This is important for many reasons. First, the practice used in schools is one based on examining the FSIQ and determining if it falls into the “very superior” range which equates with a standard score above 130. This study, which utilized the standardization sample against which other children are compared, revealed the mean of the FSIQ to be in the superior range with large variability.

According to current eligibility criteria, (FSIQ score of 130 or above) only one subtype would have been identified for acceptance to a gifted educational program. The General Ability Index, suggested by Flanagan and Kaufman (2004), utilizes only the VCI subtest scores and the PRI subtest scores. If the GAI is utilized, then a second group

(Linguistic/Logical) would also be identified. Furthermore, analyzing subtest scores within these two "gifted" subtypes reveals additional valuable information for developing a gifted curriculum.

Howard Gardner's MI theory was utilized to identify and describe the four subtypes found in this population. Theoretically, MI might have something to offer for the identification and education of gifted children (Fasko, 2001); however, caution is noted because controversy exists about whether or not his subtypes are "intelligences" or abilities (Fasko, 2001). Therefore, it is imperative that school psychologists consider utilizing a process-oriented approach when interpreting a gifted student's cognitive abilities. Astute clinicians will recognize that at least equal, and possibly greater value can come from interpretation at the subtest level (McCloskey, 2003). The use of a FSIQ in determining eligibility ignores the multifactorial nature of IQ tests (Koziol et al., 2010) and the large variation often observed in gifted children.

A recap of history reminds us of the establishment of the National Research Center on the Gifted and Talented, which coincided with the U.S. Congress passing of the Javits Act (1998) to provide research monies for gifted education. The National Excellence: A Case for Developing America's Talent report, issued by the U.S. Department of Education, followed in 1993 and outlined research and programming recommendations for America's most talented students (Jolly & Kettler, 2008). Furthermore, the report describes the "quiet crisis" that continues in how we educate our top students, which makes it impossible for Americans to compete in a global economy demanding their exceptional skills.

The identification of students to participate in gifted education programming is particularly complex because gifted education lacks the legal guidance found in most other areas of exceptional student education (Matthews and Kirsch, 2011). There are few descriptions in the literature concerning the cognitive processes of exceptionally gifted children (Lovecky, 1994). Furthermore, the lack of professional development for teachers in gifted education results in fewer challenges, less differentiation, more underachievement and dropping out, and lower achievement for all gifted and talented students (Reis & Renzulli, 2010).

In an educational climate where curriculum is being adversely affected by accountability measures, educators with an interest in highly able learners have reason to be encouraged by the observations of key experts and organizations in general education, relative to the components of a high-quality curriculum (Hockett, 2009). Without exemplary core curriculum as a foundation, there is little hope for making meaningful curricular modifications for advanced learners (Tomlinson et al., 2005). Perhaps the lack of research on teaching and instruction is indicative of a growing divide between those who conduct research in gifted education and practitioners who work daily in classrooms with gifted students (Jolly & Kettler, 2008).

Gardner's MI theory has many positive implications for curriculum and instructional goals for the Gifted and Talented (Fasko, 2001). As noted by Krechevsky and Seidel (1998), MI theory could help teachers be more specific about their instructional practices. Furthermore, they report four implications of MI theory for classroom instruction for all students: individualizing students' education; teaching subject matter in more than one way; project- based learning; and art-infused curriculum. "From the first day of school, students bring working minds to class. The educator's job is to create the best possible working environment for those minds" (Krechevksy & Seidel, 1998). According to Meeker (1987), teachers must be creative in stimulating the gifted learners and lead them to actualize their wonderful minds.

Limitations of Study

Regarding limitations of the present study, several issues must be discussed. One issue involves the small number of participants, limited to students at the elementary level; more specifically, it involved only students in second to fifth grade. Moreover, 65% of the students were in fifth grade. This restriction of the sample may have influenced the results and these results may not translate to other grade levels. Additionally, although students represented four different ethnicities, 75% of the sample was White and the Logical subtype was 100% White. Thus, results may not generalize to differing ethnicities not represented adequately in this sample. Last, students were selected from four regions; however, the majority was identified from the Southern region. Considering this limitation in the range of American regions, these results may not extend to differing regional populations.

In addition, and perhaps the major limitation, was the fact that these students were selected for purpose of WISC-IV norming and standardization rather than for assessment of giftedness in schools. Therefore, future research should investigate cognitive subtypes with a more representative sample of gifted students who are or who have been evaluated for gifted eligibility and support through school district criteria. The current study design could also be applied to a larger, more representative sample size in future research.

Future Directions

Gifted and talented learners are not a homogeneous group; to the contrary, they are quite unique with varied cognitive strengths, as proven with the current study. Future research should explore academic achievement and social-emotional functioning to further identify the connections between the cognitive and emotional systems and further clarify the gifted subtypes. The impact that being “academically challenged” has on gifted learners’ emotional well-being has generally not been well researched (Cross, 2004). In a study conducted by Eddles-Hirsch, Vialle, Rogers, & McCormick (2010), it was concluded that although the offer of daily challenge is an important variable in the gifted child’s perceptions of a positive school environment, it is intricately linked to the social context of the school. Thus, a school-wide system change appears needed to adequately assess and teach the gifted learner. Future studies should center on evaluating gifted children through a process-oriented approach examining specific cognitive strengths and weaknesses, rather than relying on the FSIQ in making important educational decisions.

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