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Cognitive and Academic Profiles of Gifted and Talented Students

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COGNITIVE AND ACADEMIC PROFILES OF GIFTED AND TALENTED STUDENTS

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Dissertation Approval

This is to certify that the thesis presented to us by Deborah Buzinkai on the 23rd day of May, 2013, 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

Global scores such as the FSIQ have been routinely utilized in decision making for special education eligibility. Over time, the use of the FSIQ in making important educational decisions has been replaced by a subtest analysis approach, because the FSIQ was not able to differentiate individual gifted traits, which led to heterogeneity in the gifted and talented population. In the ipsative approach, emphasis is placed on the interpretation of student performance at the subtest level rather than at the level of the global score, the latter of which can obfuscate important individual characteristics. In this sample of data drawn from a population of gifted and talented students (n = 107), hierarchical cluster analysis was undertaken with the WISC-IV standard subtests in order to determine if meaningful subtypes of gifted children could be extrapolated, based upon a pattern of cognitive strengths and weaknesses. Four differential cognitive subtypes were identified: Perceptual/Problem Solving Subtype; High Functioning Subtype; Low Functioning/Executive Subtype; and Low Functioning/Problem Solving Subtype. WISC-IV subtest scores and achievement scores in reading, written language, and mathematics were correlated to determine if significant relationships would be present. A Pearson correlation revealed the FSIQ, which is used often in making decisions about gifted eligibility, did not have the strongest relationship with each academic area when compared with other cognitive scores. Statistically significant subtype differences were found across all cognitive variables, with the exception of Similarities. Statistically significant subtype differences were also revealed between areas of academic achievement, mainly in math calculation and math reasoning. Overall results support the use of a subtest analysis approach in determining

giftedness, which promotes individualization of educational programming. Future research should center on clinical exploration of individual case studies.

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Chapter 1

Introduction

The National Association for Gifted Children (NAGC) reports that approximately six percent or three million children in the United States are potentially eligible for gifted education (NAGC, 2012a). However, the eligibility process is fraught with definitional complexity of what it is that constitutes gifted ability, and some children who possess cognitive strengths and heightened academic achievement are found ineligible. One of the main reasons for this failure to identify giftedness in some children is lack of a national regulatory system that could solidify a definition of giftedness. Presently, a broadly accepted definition for giftedness does not exist. The most widely cited definition was proposed by Renzulli (2002), who defines giftedness as "...an interaction among three basic clusters of human traits - these clusters being above-average general abilities, high levels of task commitment, and high levels of creativity" (p. 69). These traits can be applied "to any potentially valuable area of human performance" (Renzulli, 2011, p. 69). This definition considers the combination of multiple factors, in addition to above-average intellectual abilities; these factors include areas such as a commitment to task (Winner, 1998 & 2000) and creativity displayed through a variety of components such as affective, intuitive and psychomotor attributes (McCollins, 2011). In educational systems across the nation, school psychologists are evaluating children for giftedness and usually rely on the administration of intelligence tests and academic achievement. It is rare to find school psychologists who use a broad array of assessment procedures such as performance-based assessment, portfolio reviews, classroom observations, or even rating scales designed to measure gifted attributes involving creativity, commitment to task, or leadership, in the evaluation for gifted eligibility.

The most common practice is to utilize standardized intelligence tests as an admission criteria with a cutoff of an Intelligence Quotient (IQ) score above 130 (Terman et al., 1925) or in the superior range of intelligence (Simpson, Carone, Burns, Seidman, Montgomery, & Sellers, 2002). One of the flaws in this practice is assuming that the IQ provides a pure score or a global measure of a unitary concept, such as general intelligence *(g)*. In reality, IQ cannot be separated from academic exposure, neuropsychological components (Fiorello, Hale, Holdnack, Kavanaugh, Terrell, & Long, 2007), personality, motivation (Renzulli, 2011), creativity, practical abilities, and wisdom (Sternberg, 2010). In addition, standardized achievement tests are the norm in showcasing the ability to apply cognitive skills to academic subjects such as reading, writing, and math. Renzulli (2002) posits the idea that an individual may have an innate cognitive ability level that reaches into the gifted range; however, without formal educational instruction, showcasing these talents will be more difficult to achieve. Therefore, gifted students benefit best from enrichment opportunities, parental involvement, and even encouragement to reach their fullest potential (Renzulli, 2002).

The practice of equating intelligence with high IQ scores (Terman et al., 1925; Shavinina, 2001) is commonplace in the field. However, utilizing an arbitrary IQ score as the determination of gifted abilities is not informative of the student's strengths and weaknesses (Fiorello et al., 2007; Bowman, Markham, & Roberts, 2002;

Georgas et al., 2003). Furthermore, it does not provide a comprehensive overview of cognitive skills, including how these cognitive skills are related to academic achievement (Fiorello et al., 2007; Bowman, Markham & Roberts, 2002). Given the fact that gifted learners are not a homogenous group, during an evaluation definitional issues must take into account individual strengths and weaknesses that will lend to effective instructional programming on the gifted IEP (GIEP) (McCollin, 2011; Winner, 1998, 2000). Even though students may share the common categorization of being "gifted", this does not equate to equivalence of abilities in all academic areas (Mrazik & Dombrowski, 2010; Rowe, Miller, Ebenstein, & Thompson, 2012; Winner, 1998, 2000).

Despite the variety of variables which compose the potential for a gifted classification, there is currently no differentiation of gifted status. This means that all students who are eligible to receive an education under the gifted classification are compiled together under one over-arching gifted classification. Sadly, the outcome is that all gifted students receive similar instructional practices, curriculum, and service delivery despite their individual pattern of strengths and weaknesses. A delineation of specific cognitive profiles, which further clarifies individuality, would be an efficacious method for addressing educational programming for a potentially gifted student. An analysis of cognitive and academic profiles would allow an examination of relationships between the intelligence scores and areas of academic achievement. For example, some students may present with gifted abilities in math and others show gifted potential in language (Mrazik & Dombrowski, 2010; Rowe, Miller, Ebenstein, & Thompson, 2012; Winner, 1998 & 2000). The component skills underlying these broad abilities can be acknowledged through the subtest approach of identifying a more sophisticated cognitive profile of the gifted learner, rather than relying on a global intelligence score that masks strengths and weaknesses. In addition, multiple psychological processes affect reading, mathematics, language, and written expression (Hale, et al., 2010); thus, these relationships need to be examined for eligibility decisions and educational programming.

The emergence of exploring a pattern of performance across cognitive and academic profiles has been fueled recently with the revised IDEA (2004). The changes to this law acknowledge the dangers of using a global ability score (i.e., IQ) in making educational decisions. The use of the ability - achievement discrepancy (AAD) model for students presenting with learning disabilities has been challenged because it is not comprehensive and it lacks discrimination of individual profiles due to over concentration on an arbitrary number difference between IQ and achievement (Sattler, 1988; Hale et al., 2010). The IDEA (2004) now allows a response to intervention (RtI) approach and also permits the use of a third method approach in determining learning disabilities. This third method approach has been highly advocated because it allows the examiner to determine not only a profile of cognitive strengths and weaknesses, but also how these strengths and weaknesses are related to academic achievement (see Hale et al., 2010 for further discussion). It is clear that governmental regulations have realized the shortcomings of using global scores and a nomothetic approach in making educational decisions. Although this is clear for children with learning disabilities, at the other end of the continuum this same practice has not yet been extended to evaluating gifted and talented students and to making eligibility and instructional decisions. Instead, this third method approach in interpretation of assessment results for the gifted student, which utilizes subtest analysis instead of IQ/ global scores, would provide a comprehensive picture of strengths and weaknesses and makes the most empirical and clinical sense (Hale et al. 2010). Current practice for determining eligibility for gifted education includes the administration of a cognitive assessment and an academic assessment. Utilizing only these assessments in the determination of gifted eligibility provides a limited amount of information, especially if global IQ scores are interpreted instead of an examination of index scores and subscale scores. Also, the exploration of the link between intelligence and academic performance can be evaluated. Sternberg (1997) points out that the intelligence tests do not measure one's ability to learn. They also do not measure all types of intelligence (Sternberg, 1997). Intelligence quotients are only one component of the puzzle of a gifted student; assessment for program placement must consider a multitude of student abilities through utilizing an examination of strengths and weaknesses in lieu of looking at an IQ score as a final determining factor.

Statement of the Problem

The population of gifted and talented students is in need of educational support and understanding in order for population needs to be appropriately identified and addressed. Too commonly, gifted and talented students are under-diagnosed, misidentified, or otherwise ignored in the educational community. Understanding the unique needs and cognitive profiles of this population is critical in developing appropriate educational settings that best meet the child's needs.

A more appropriate exploration of gifted and talented students would focus upon an individual student's unique profile of strengths and weaknesses instead of focusing on an arbitrary intelligence quotient cutoff. Reliance on a number to identify a student as qualifying for a gifted and talented education is arbitrary because it does not take into account the individual student's characteristics and intricacies of strengths and weaknesses (Fiorello et al., 2007; Bowman, Markham, & Roberts, 2002). Clarification of the various components that compose a gifted profile needs to be explored and identified as a third method approach in defining giftedness and eligibility for gifted support. An evaluation that examines a multitude of cognitive functions and determines giftedness through multiple factors should be considered best practices. Ideally, examining the contribution of cognitive skills and examining for concordance between those cognitive strengths and achievement strengths may help solidify an individualized GIEP.

Purpose of the Study

The current study proposed to identify giftedness through an exploration of cognitive and academic strengths and weaknesses. Declaration of gifted abilities based upon an arbitrary intelligence quotient score of 130 or above (Terman et al., 1925) does not adequately account for all potential gifted abilities and utilizing a global number to define giftedness may mask specific cognitive strengths and weaknesses. Alternatively, examination of strengths and weaknesses at an ideographic level will allow for evaluation that examines a multitude of cognitive functions, including how these relate to achievement. Many profiles of gifted learners can be uncovered, which can link directly to that student's individualized instruction, better suiting the student's needs and veering away from the "one size fits all" model of education.

Thus, the purpose of this study was to determine potential cognitive profiles of gifted and talented students through exploration of WISC-IV subtest scores and the relationships between these subtests scores and areas of academic achievement. The third method approach being advocated was the basis for exploring a pattern of strengths and weaknesses in gifted learners. It is hypothesized that the current "one size fits all" model of utilizing a global unitary cut-off score from the WISC-IV (i.e., FSIQ), to indicate gifted and talented status, does not consider the wide range of cognitive strengths and weaknesses as they relate to academic achievement. This study examined the relationships between cognitive abilities and academic achievement in gifted and talented students in order to understand the relationships between cognitive and academic variables in gifted and talented learners.

Second, this study attempted to create meaningful profiles of gifted students by utilizing a cluster analysis technique to form more homogeneous subtypes of the gifted learner. The *Wechsler Intelligence Scale for Children, Fourth Edition* (WISC-IV) was utilized as the cognitive measure of giftedness. The academic dependent measures consisted of the *Wechsler Individual Achievement Test, Third Edition* (WIAT-III) or the *Kaufman Test of Educational Achievement, Second Edition* (KTEA-2). Additionally, these extrapolated subtypes were then compared for significant group differences across the cognitive and academic dependent measures.

Overall, this dissertation will explore the history of gifted education, discuss the lack of a definition of giftedness and the implications of this deficiency, provide current descriptions of intelligence and achievement, explore a correlational approach of the relationships between cognitive processes and achievement, and explore a cluster analytic approach to uncover homogenous subtypes of gifted children based upon patterns of strengths and weaknesses across WISC-IV subtests. The following research questions, rather than explicit hypotheses, guided this exploratory study.

Research Questions

1. What are the relationships between the WISC-IV cognitive variables and achievement variables in reading, written language, and mathematics for this sample of gifted children?

a. Which relationships are significant?

b. What is the direction of these relationships?

c. What is the strength and magnitude of these relationships?

2. Are there meaningful subtypes of gifted children that can be extrapolated through a cluster analysis of the WISC-IV subtests?

a. If there are meaningful subtypes, what is the pattern of cognitive strengths and weaknesses for each subtype, utilizing the third method approach?

b. If there are meaningful subtypes, are there statistically significant differences between the subtypes on the cognitive dependent measures?

c. If there are meaningful subtypes, are there statistically significant differences between the subtypes on the achievement dependent measures?

Chapter 2

Literature Review

History of Giftedness

One of the outstanding luminaries in gifted education was Lewis Terman. In 1921, Terman undertook a thirty year longitudinal study to determine specific traits that characterize children of higher intelligence. Terman disproved a popular notion from that time, which posited "early to rise, early to rot" (Terman et al., 1925). This belief stated that individuals who showed early intellectual promise would not be able to maintain their academic successes over time and by adolescence these early achievers would no longer meet criteria for being highly intelligent. Terman (1925) disproved this notion with his study, which had a 98% retention rate of original participants over the course of thirty years. The male subjects who were initially classified as gifted intellectually as youngsters proved to be successful as adults; they attained advanced educational degrees and had their work published (Terman et al., 1925). Thus, Terman reported that individuals with early gifted promise do not, over time, seem to "lose" the talent.

In 1957, thirty-six years after Terman initially began studying gifted youngsters, the Soviet Union launched Sputnik (McCollin, 2011). This feat commenced a global race between super powers in the search for scientific and mathematical advances. As a result, the United States passed the National Defense Education Act in 1958 (Piltz & Steidle, 1966) that allocated funding to science programs. This trickled down to school districts, and school administrators were encouraged to evaluate and make modifications to current science and math programs.

"The leadership role described by the State science supervisors indicates greater emphasis on elementary science education programs, more attention to the newer approaches in the teaching of science on all levels, increased laboratory experiences and more effective in-service education" (Piltz & Steidle, 1966). The creation of these programs began to shed light into how best to educate the gifted student population.

However, it was not enough to create more challenging programs; differentiation of instruction was also warranted. Terman and Oden (1954) disputed the claim that all students (gifted and non-gifted) should have the same training and educational experiences. In their opinions, the gifted student required an individualized approach to academics. They equated this idea to the absurdity of all children receiving the same type of medical treatment despite manifested ailments. Consideration of treating all children with the same medication and treatment regimen would not be beneficial to all those being treated and might actually be harmful to others. This is also true in education; if students with unique special needs are not "treated" according to their own personal talents, strengths, and weaknesses currently possessed, it may be detrimental to their education (Terman & Oden, 1954).

Despite large numbers of gifted children having been identified as in need of gifted support, much less governmental attention and research have been dedicated to exploration of this population of students over time. In 1993, U.S. Secretary of Education Richard W. Riley reported that only two cents of every $100 spent on pre-collegiate education in 1990 went to gifted programs (Winner, 1996). Until the fiscal year 2011, Congress recognized a need to provide monetary assistance for programs supporting these students through the Jacob Javits Gifted and Talented Students

Education Act. The Javits Act was providing between three million dollars to just over 11 million dollars in funding for gifted education (NAGC, 2012b). In 2011, Congress defunded the Javits Act. The defunding would be in effect through 2013 with no hope for reinstatement. However, according to the National Association for Gifted Children (2012b), the Senate committee did not restore funding for the Javits Act in the 2013 fiscal year. The message that was sent regarding education of this population of students was clear: it is not so important to fund and support gifted students and thus government monetary assistance is not required. Alternatively, due to the governmental regulation of childhood disabilities under the IDEA (2004), many children with difficulty in learning have received the greatest attention geared at meeting the standards set forth in the No Child Left Behind Act of 2001 (NCLB 9 U.S.C. §9101). However, this places the gifted learner without a voice to exact positive change.

Present Day Issues Affecting the Gifted Student

Disparities in educational focus continue in the present day. The NCLB of 2001 was established to close the achievement gap and to ensure that all students were receiving equitable and fair educational opportunities by highly qualified teachers in designated subject areas. According to NCLB, students have the right to obtain an education of high quality, which is delivered by highly qualified teachers. Although NCLB mentions children of exceptional learning needs, which include the gifted and talented as well as children with disabilities, much greater attention has focused on the latter group (NCLB, 2002).

Teacher training programs lack focus on identifying and instructing gifted and talented students. There is currently no federal requirement that teachers be highly qualified or receive specialized training in order to work with the gifted and talented population (NAGC, 2008). Not only is this a disservice to gifted and talented students, but a lack of understanding of the unique population needs may lead to decision making that is actually detrimental to these students. One of these factors is the false belief that gifted and talented students do not experience academic concerns (Crepeau-Hobson & Bianco, 2010), do not display behavioral problems, and do not have needs which cannot be fully met in the general educational setting (Bell & Roach, 2001). The educational system that does not acknowledge these specific needs of the individual gifted student is doing a disservice. A proper evaluation for gifted support services should examine multiple factors that could impact upon the demonstration of the giftedness. Thus, gifted children may best learn when their strengths are being utilized in programming and their needs are being met through best practices, an idea which circles back to the early research of Terman. Gifted children are a unique group of students who are deserving of an individualized approach to evaluation and to educational programming.

The reasons that the gifted population has not received sufficient attention can be due to a general lack of consensus regarding how to approach the evaluation of students, how best to identify giftedness in the school setting, how to interpret assessment results, and how to program appropriately for these students. In addition, factors that may mask giftedness such as a second language issue and social-emotional development are not considered salient aspects with regard to the gifted learner.

Currently, there is a "one size fits all" model applied to children who fall under the umbrella of gifted and talented. Part and parcel of this model, which includes an ill-fated definition of the term, gifted and talented, is the over-reliance on the use of intelligence tests as markers for admission into programs.

Without consistency amongst a definition or criteria, each local educational agency has the leisure not only of creating its own definition regarding what giftedness means, but also of establishing unique criteria for admission (Bell & Roach, 2001). In turn, this practice does not lend itself to a student being afforded similar levels of appropriate education across the country. With no overriding regulatory body overseeing giftedness in our national schools, confusion results in the definition of giftedness between states and even at local levels.

Definitional Issues in Giftedness

There is no current national definition which would afford direction and clarity about requirements for admission to programs; in addition, there are no standards expected in program development and implementation. The policies for identifying giftedness are inconsistent and are at the discretion of state departments of education or local education authorities (Rowe et al., 2012). States and local school districts have devised individual definitions and criteria for giftedness due to the lack of consensus in the literature and across school boards regarding a definition of what it means to be a student who is gifted and talented (Bell & Roach, 2001; Nicpon, Allmon, Sieck, & Stinson, 2011).

In 2006, the National Center for Education Statistics reported that 97, 260 students, which constituted seven percent of New Jersey’s student population, were enrolled in gifted and talented programs (Institute of Education Sciences, n.d.). For the same time period Pennsylvania reported having a total of 75,930 students, which equals five percent of the student population; and New York reported 87,520 students, for about three percent of the school population enrolled (Institute of Education Sciences, n.d). Table 1 depicts information specified in the Administrative Code for the states of New Jersey, Pennsylvania, and New York as well as Federal Regulations from the United States Department of Education and the NCLB of 2001. An overview shows the disparity in the definition for giftedness and also highlights the lack of a comprehensive definition which informs educational placement.

Table 1

Local State and Federal Regulations

	NJ	PA	NY	US DOE	NCLB
Definition mentions cognitive skills	Yes	Yes	Yes	Yes	Yes
Definition mentions creativity	No	Yes	Yes	Yes	Yes
Other concepts of giftedness mentioned	"1 or more content areas"	Academic Strengths, Needs	Academics	Leadership Academic	Leader Acad
Recognize need for modification of program	Yes	Yes	Yes	Yes	Yes
Recognize need for multiple assessment methods	Yes	Yes	No	Yes	No
Establish criteria for giftedness	No	Use of multiple criteria	No		No

Note: NJ = New Jersey; N.J.A.C. 6A:8-3.1; PA = Pennsylvania; P.A.A.C. 22:16.1; NY = New York; N.Y. EDN. Law § 4452; US DOE = United States Department of Education; Title XIV - Part A - Sec 14101; NCLB = No Child Left Behind; NCLB, 2001.

Identification and Eligibility Issues Affecting Gifted Students

After one gets past the insufficient definition of gifted and talented, further difficulties are encountered when attempting to identify the gifted and talented students for gifted support programs. The lack of consensus for identification of students is recognized by the National Society for the Gifted and Talented in the statement: "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" (NAGC, 2012a). Hence, the idiosyncratic definition of a gifted student, which is created by the school district, becomes a determining factor determining whether or not an individual will be eligible for gifted and talented programs in that school district (Bell & Roach, 2001). The problem is enhanced when a gifted student moves to a new school district and no longer qualifies as a gifted student. Thus, the question is raised about whether giftedness is identified locally or whether a student meeting definitional criteria and eligibility is gifted in any school district in the U.S.

In some states, teachers are the gate-keepers in determining which students are identified as possible candidates for the gifted and talented programs, using a screening process. When these teachers possess an inherent bias (McBee, 2006), it is not surprising that the students who are being identified represent a select grouping of students. Teacher biases based upon characteristics of gender, ethnicity, and socio-economic status will act as gatekeepers in allowing only a select group of students to be considered for specialized instruction. For example, a teacher may have an inherent bias that male students are smarter than female students and thus females are underrepresented in teacher nominations. Individuals of minority status (i.e. ethnicity and low socioeconomic status) are also underrepresented in the gifted and talented population.

Evidence of gender bias in teacher's referral patterns has been documented. In one such study, 189 teachers in Colorado and Florida who agreed to participate in a study were distributed vignettes of a student profile. The teachers were asked questions to determine whether or not they would recommend the students described in the vignette either to a gifted and talented program, tutoring, social skills training, or to an extra-curricular art or sports program (Bianco, Harris, Garrison-Wade, & Leech, 2009). All distributed vignettes contained the same content material and demographic information with the exception of gender. Bianco et al. (2009) report finding gender biases because the female student was more likely to be perceived as socially incompetent when compared with the male counterpart and not appropriate for the rigorous demands of a gifted and talented program.

Current methods for identification of students who meet criteria for gifted and talented programs are also not comprehensive. The current identification processes typically utilize teacher nomination, achievement on classroom tests, use of formal cognitive assessment, and performance on statewide assessments. These activities are sometimes referred to as multiple assessment methods. Winner points out that IQ tests are arbitrary, and she posits that they do not assess the ability for critical thinking, but instead measure test-taking skills (Winner, 1996). Thus, multiple assessment methods should be utilized in considering admission into a gifted and talented program (Winner, 1996). Activities designed to identify students who are gifted must include the utilization of multiple criteria (Crepeau-Hobson & Bianco, 2011; Bell & Roach, 2001), teacher training to improve ability and accuracy of identification (Bianco et al., 2009), and a comprehensive, multidisciplinary, psychoeducational evaluation (Crepeau-Hobson & Bianco, 2011), and, normally, include a test of intelligence.

What is Intelligence?

Despite many advances in technology and coupled with what is now known about learning in the brain, it is surprising to think educators continue to assess intelligence in the same way as originally proposed by Terman (1921). In fact, traditional intelligence tests have not changed much in the last couple of decades (Sternberg, 1997). They continue to measure a discrete set of skills in order to label a person with a level of intelligence that has been used to predict success in college and various vocations. Why do educators continue to use an IQ test in most of assessments for giftedness? We continue to see giftedness as superior intelligence, but what constitutes intelligence? The understanding of what intelligence is has shifted, and there are newer ideas, which should be represented by new assessments (Shavinina, 2001; Sternberg, 1997) and newer ways to interpret findings. The third method approach deems to have these values.

The third method approach utilizes traditional IQ tests, which have not changed much over time. However, the interpretation of the results has changed dramatically. In this approach, a pattern of strengths and weaknesses is examined for the child, relative to him/herself and relative to the standardization sample. In this regard, the child's performance on the IQ test is compared with a national sample (i.e., normative level), but also within the child (i.e., idiographic level). It is the normative level that is primarily associated with the use of the global IQ to denote intelligence. It is the addition of the idiographic analysis of strengths and weaknesses that is at the heart of the third method approach. This is a promising approach to the exploration of multiple gifted abilities, instead of reliance on a single IQ score. A flexible battery approach to assessment allows for professional decision making in composing a battery of tests which will address the intended referral question and lead to a more comprehensive understanding of the individual (Koziol & Budding, 2009). However, it is necessary to understand exactly what intelligence is before anyone can begin to measure it (Shavinina, 2001). Intelligence is therefore more than just an IQ number ascertained from a cognitive assessment. Many aspects of intelligence are missing if this static number is examined as an estimate of intelligence.

Spearman speaks of the general factor of intelligence, denoted as *g*. As per Spearman (1961), determining the magnitude of an individual's *g* "will tell us nearly everything about some of his abilities and something about nearly all of them". Although currently the *g* is believed to be synonymous with a general intelligence or ability, this was not the intent of Spearman. The purpose in utilizing the solitary letter of *g* instead of the terms "general intelligence" or "general ability" was to indicate the idea there does not exist "some separate mental power capable of existing on its own account" (Spearman, 1930, p. 343).

In his 1927 book, *The Abilities of Man, Spearman* clarifies the notion that we can talk about what intelligence serves, but we may never know what it means as far as having a succinct definition. Spearman was the first to utilize factor analysis because he discovered individuals who scored highly on one type of intelligence test would score high on other intelligence tests as well (Gottfredson, 2011; Matarazzo, 1992). Extracting the common factors from the intelligence tests on which the individual scored high would provide the *g* factor (Gottfredson, 2011). This *g* factor tells us about intelligence, but still does not provide a definition of intelligence (Spearman, 1927). The common Wechsler intelligence tests and Binet scales largely represent Spearman's *g* (Matarazzo, 1992). This viewpoint has been the widespread theory underlining current gifted practices with the emphasis on a global IQ score to denote intelligence.

Sternberg posits a triarchic theory of intelligence as an alternative. He speaks of three types of abilities: analytical, creative, and practical (Sternberg, 2003). Analytical abilities refer to academics which are abstract but yet familiar (Sternberg, 2003) as students are exposed to the problems in the school setting. Novel tasks and situations are considered to be creative abilities (Sternberg, 2003). Finally, Sternberg defines practical abilities as those applied to everyday problems (Sternberg, 2003). Sternberg (2003) defines intelligence as an individual's ability to succeed, based upon values and abilities to capitalize on strengths, yet recognizing and compensating for weaknesses. Clearly this theory provides an undercurrent to the third method approach with the emphasis on multiple aspects of intelligence and exploration of strengths and weaknesses.

Genetics-environment factors are also studied in relation to intelligence. Is intelligence an innate quality that develops more fully through interaction with the environment? This is the age old debate regarding nature versus nurture. Davies, Tenesa, and Payton et al., (2011) note that there are no specific genes for intelligence; however, the interaction of genes and environment are found to be highly correlated with relation to heritability of intelligence. Often, twin studies are utilized to compare individuals with similar genetic make-ups in an effort to determine if intelligence has a genetic contribution (Gottfredson, 2011). Research by Toga and Thompson (2005) found "adopted monozygotic twins - raised apart - still correlate 0.72 for intelligence, (i.e., one twin's intelligence strongly predicts the other's), despite their different rearing environments" (p. 14). "Genetics is not the only theory for prevalence of gifted ability as interactions with the environment also contribute to differences in brain morphology" (Toga & Thompson, 2005, p. 2). Thus, despite genetic composition, environmental events may affect manifestation of gifted skills.

Neuropsychological theories, which account for intellectual ability, range from brain size to development and organization of brain features. In the beginning "early scientists postulated that there was a correlation between an individual's intellectual capabilities and size of the brain" (Mrazik & Dombrowski, 2008, p. 225). Although this is no longer accepted, brain organization of gifted children has been found to be asynchronous with right and left hemispheres both controlling aspects of brain functioning, which are often controlled by the left hemisphere alone (Winner, 1998). These results have been confirmed through the use of magnetic resonance imaging (MRI). Andreasen & Flaum (1993) studied intelligence using MRI technology during which subjects were administered an intelligence test while brain regions that became activated were correlated with intelligence. Specifically, intracranial cerebral, temporal lobe, hippocampal, and cerebellar volume were indicated as being statistically related to the FSIQ (Andreasen & Flaum, 1993). Similarly, Jin, Kim, Park, and Lee (2007) conducted EEG's on both gifted and average students prior to and during a neuropsychological test used to assess perceptual organization and nonverbal memory. From the research, Jin et al., (2007) confirmed that the gifted brain is more efficient with cognitive functioning and information processing and also gifted students possess dominance of the right hemisphere that is not found in average students.

According to Koziol and Budding (2009) gifted and talented students process information differently, which set them apart from other learners. Koziol (2010) discusses the roles of the white matter tracts, basal ganglia, and the cerebellum when examining gifted intelligence. In essence, these subcortical to cortical connections enable speed of adaptation and the ability to master a learned behavior. Accordingly, Koziol stipulates “prefrontal white matter volume has been related to levels of intellectual development and cortical processing speed" (Koziol, 2010, p. 509). Thus, do the gifted possess the ability to learn, adapt quicker, and master behavior more efficiently than is typical? Further, the basal ganglia are important in making actions, including cognitions, become automatic. Continuous experience thus contributes to the development of expertise according to Koziol. The cerebellum refines the rate, rhythm, and force of information that it receives from the cortex and teaches the brain how to act. As behaviors become more automatic, higher level processes are essentially made available for greater in-depth thinking to take place. Gifted children essentially learn better, think more deeply, and adapt more easily to the environment. Their procedural learning system is quick and efficient, which allows them to free up higher level processes of the declarative learning system. The declarative learning system requires conscious thought and higher levels thinking; however, the procedural learning system is more automated. When individuals no longer need to consciously process information (declarative) that can essentially be processed automatically (procedural); the individual is able to more efficiently utilize these higher level thinking processes. Thus, it appears that gifted students develop expertise in a specific area of strength that is easily automated and leads to higher levels of learning.

Given this profile in the gifted, how can instructional practices become carefully incorporated to teach to the child's strengths? Gottfredson (2011) points out the importance of deciphering different levels of giftedness for educational planning as "individuals of advanced intelligence learn best when they structure their own learning" (Gottfredson, 2011, p. 6). This point exemplifies the fact that assessments must be able to examine for "expertise" in specific cognitive and academic areas. Ultimately, this assessment yields information about that student's strengths and weaknesses in those areas at an idiographic level to inform instructional methods and curriculum.

Do Cognitive Assessments Predict Achievement?

Cognitive assessments are conducted when considering placement in gifted and talented programs. Although the common belief is that cognitive scores can predict academic achievement, little research has been conducted in this area strictly in relation to giftedness. A study by Rowe et al. (2012) posits the theory that the FSIQ generated on the WISC-IV is a predictor of achievement in high achieving students. In this study, the "FSIQ significantly predicted reading and math scores even among students with significant index score variability or scatter" (Rowe et al., 2012, p. 150).

"Traditional intelligence tests and scholastic aptitude tests (SAT) remain a key part of college admissions to this day" (Toga & Thompson, 2005, p. 3) because high aptitude is correlated with academic success. Although alternative factors may impede performance at any one time, based upon Spearman's *g*, performance on one such test should predict performance on similar tests. Gottfredson (1997) believed that predictions could be made regarding achievement, employment success, health outcomes, and financial success.

However, Winner (2000) contends that *g* "is unrelated to high levels of achievement in some domains" (p. 155). Therefore, an individual presenting with a high IQ will not necessarily perform highly on all academic domains. When examining cognitive profiles of academically gifted children, it has been noted that skills are not always enhanced across all domains. As stated previously, gifted children display uneven profiles with either mathematical ability or verbal ability being high and the contrast being average or low (Benbow & Minor, 1990; Winner, 1998 & 2000). This has been termed as asynchronous development.

Commonly, the entrance criterion for admission into a gifted and talented program includes achieving an IQ score of at least 130. However, an arbitrary number cutoff does not inform educational need. This number can be achieved by a combination of different cognitive profiles and does not tell anything about the student's areas of strength (Winner, 1996). "We should be using domain specific kinds of identification so that students are selected as needing advanced instruction in math or reading or writing, but not necessarily in all subjects" (Winner, 1996, p. 1).

Alternatively to the use of the global IQ score, a subtest analysis approach has been advocated in determining a pattern of cognitive strengths and weaknesses (Hale & Fiorello, 2004; Mayes & Calhoun, 2008). Specific patterns of cognitive functioning have been examined with use of the Wechsler scales, which yielded the concept of profiles such as FD, ACID and SCAD. In 1975, Kaufman originally conducted a factor analysis of the WISC-R standardization sample and found a Freedom from Distractibility (FD) factor. This factor consisted of the three subtests, Arithmetic, Coding, and Digit Span. This profile of lower scores on subtests Arithmetic, Digit Span, and Coding on the WISC-R (Vance, Fuller, & Ellis, 1983), and the WISC-III subtests of Symbol Search, Coding, Arithmetic and Digit Span (Prifitera & Dersh, 1993) was termed SCAD. The subtest Information was added to this profile and it was re-coined the ACID profile (Watkins, Kush, and Glutting, 1997). Students who presented with the WISC-III ACID profile were compared with percentages of students who have learning disabilities in the standardization sample. The study found a higher incidence rate of ACID profiles present in the clinical sample (Prifitera & Dersh, 1993). Although this profile was linked with children who have learning difficulties (i.e., low scores on those subtests), might it also be true that children with giftedness would perform much better statistically than the average learner? Are there subtypes of the gifted learner in which these subtypes would also be relatively weaker?

In addition, Mayes and Calhoun (2007) reported that children diagnosed with ADHD often scored lowest on the WISC-IV indices of Working Memory and Processing Speed. "If a child's lowest index is WMI or PSI, ADHD should be considered and needs to be ruled in or out with a comprehensive evaluation" (Mayes & Calhoun, 2007, p. 247). However, if the WMI or PSI were not the lowest indices, it was unlikely the child would have a co-morbid diagnosis of ADHD (Mayes &

Calhoun, 2007). Thus, are there children with giftedness that would meet this profile of inattentiveness and cognitive sluggishness? If so, do they constitute a subtype of a gifted learner, requiring individualized educational programming?

One of the more consistent researchers in this area, Byron Rourke, (1995) provided a profile for students diagnosed with a Non-Verbal Learning Disability in which the students had a significantly higher Verbal IQ than Performance IQ. Rourke was one of the first to demonstrate that low scores on Coding, Block Design, and Object Assembly were consistent with students who displayed well developed language related skills, having poorer right hemisphere visual-spatial and organizational skills (Rourke, 1995). Conversely, children with poorer VIQ and greater PIQ were seen as having impairment in the left hemisphere area of the brain, which is involved in language and memory. Rourke believed that the NVLD profile of right hemisphere weaknesses were attributable to problems in the white matter tracts of the brain. He also suggested that specific WISC profiles based on examination of cognitive strengths and weaknesses were useful in determining a pattern of performance and linking that to academically-driven profiles (Rourke, 2008).

What yet needs to be done is translating these hypothesized patterns of cognitive functioning on the WISC scales in a sample of gifted children. For instance, if an ACID or a SCAD profile could be linked to children with reading disabilities and the WMI and the PSI of the WISC-IV could be linked to potential ADHD, then some combination of subtest or index scores from the WISC-IV could potentially be related to achievement in certain academic domains for children who are gifted. This was the intent of the study, to examine the relationship between the WISC-IV and areas of achievement to determine meaningful gifted profiles that help to better classify gifted students. It also touches upon masking factors, i.e., children who are potentially gifted but also learning disabled. Ultimately the goal is not to abolish the use of intelligence tests, but to determine a better manner of utilizing the results into education programming (i.e. the gifted IEP).

The WISC-IV and Giftedness

Historical changes in how the FSIQ has been viewed over the years from its original form of the WISC (normed in 1947) to the WISC-R (normed in 1972), then to the WISC-III (normed in 1989) and onto the present form used in the WISC-IV (normed in 2002) needs to be mentioned (Flynn & Weiss, 2007). Each subsequent revision of the WISC has resulted in better specificity and clinical acumen, and an increase in the cognitive scores. For instance, when moving from the WISC-III to the WISC-IV, IQ scores showed a 3.83 rate of gain, with scores being higher on the WISC-IV (Flynn & Weiss, 2007). With each revision of the WISC, students have been receiving higher scores (see Flynn Effect), most likely based upon the new standardization samples used for norming purposes as well as to the tendency to remove outdated questions from use when the update occurs (Flynn & Weiss, 2007). As the WISC has been revised, better differentiation between gifted and non-gifted students has been possible.

The current 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). In addition to a Full Scale Intelligence Quotient Score (FSIQ), four additional composite scores are obtained. The four composites include Verbal Comprehension (VCI), Perceptual Reasoning (PRI), Working Memory (WMI), and Processing Speed (PSI), (Wechsler, 2003). In calculating the FSIQ, the VCI and PRI comprise 60% of the variance and the PSI and WMI comprise only 40%; thus, the subtests thought to measure reasoning skills account for more variance in the FSIQ (Wechsler, 2003). The inherent issue in this calculation is discussed in the WISC-IV Technical and Interpretive Manual. The sample of gifted students who were evaluated had a difference of approximately 14 points between the VCI (higher) and PSI (lower) (Wechsler, 2003). Significant variability exists among the index scores on the WISC-IV when evaluating gifted students (Rowe et al., 2012). Variability in index scores results in a FSIQ which merely represents an average that is composed of disparity (Flanagan & Kaufman, 2004). This calls into question whether or not the WISC-IV FSIQ should be the universally accepted score for determining an intelligence quotient worthy of gifted eligibility (NAGC, 2010). Global IQs have been deemed by some researchers to be unreliable and invalid for use in predicting academic achievement when there is variability in scores (Fiorello, Hale, McGrath, Ryan, & Quinn, 2002). Based upon research by Fiorello et al. 2002 "...for about four-fifths of the typical population, the FSIQ may not adequately represent global intellectual functioning" (p. 123). They concluded that "practitioners would do well to de-emphasize FSIQ as a measure of ability and place greater emphasis on index scores" (Fiorello et al., 2002, p. 123). Subtest process scores can be computed to provide greater in-depth information regarding a student's performance and is heavily advocated here.

An alternative to using the FSIQ is the use of the General Ability Index (GAI) as an optional measure of estimated cognitive ability. Unlike the FSIQ, the Working

Memory and Processing Speed indices are not factored into the GAI score. Because of reports that gifted and talented students perform lower on Working Memory and Processing Speed subtests, further consideration to using the GAI when evaluating this population of students has been implied, but has not been universally accepted.

Tables 2, 3, 4, and 5 delineate the WISC-IV factors, subtests that measure the factor, what the subtest purports to measure, and the researchers who support the claims.

Table 2

WISC-IV Verbal Comprehension Index (VCI)

Subtest	Measures
Similarities	concept formation, reasoning with verbal information (Wechsler, 2003)
Vocabulary	word knowledge, fund of knowledge, concept formation / verbal expression (Wechsler, 2003); measure of long term retrieval and word knowledge (Hale & Fiorello, 2004)
Comprehension	reasoning with verbal information and conceptualization, verbal comprehension, expression, knowledge of conventional behavior, social judgment, and common sense (Sattler, 2001); facility with concept formation and language skills (Groth - Marnet, Gallagher, Hale, & Kaplan, 2000); comprehension, knowledge, and crystallized intelligence (Keith, Goldenring-Gine, Taub, Reynolds, & Kranzler, 2006)

Table 3

WISC-IV Perceptual Reasoning Index (PRI)

Subtest	Measures
Picture Concepts	abstract reasoning, ability to reason categorically, may include verbal mediation and naming (Keith, et al., 2006)
Matrix Reasoning	fluid reasoning, visual information processing, abstract reasoning (Keith, et al., 2006)
Block Design	analyzation and visualization of abstract visual stimuli, integrated brain functioning (Kaufmann, 1994); spatial ability (Flanagan, 2000); ability to separate figure and ground (Sattler, 2001); visual processing, processing of part to whole relationships, discordant and divergent thought processes (analysis), concordant or divergent processes (synthesis); attention; executive functioning (Hale & Fiorello, 2004)

Table 4

WISC-IV Working Memory Index (WMI)

Subtest	Measures
Digit Span (Forward)	rote learning; memory; attention; encoding; auditory processing; sequencing (Sattler, 2001); immediate rote auditory memory and measures aspects of the phonological loop for holding information in immediate memory (Hale & Fiorello, 2004)
Digit Span (Backward)	working memory involving mental manipulation and visuospatial imaging (Wechsler, 2003; Sattler, 2001); self-regulatory executive functions such as planning, strategizing, organizing, executing, monitoring, maintaining, evaluating, and changing behavior (Hale & Fiorello, 2004)
Letter Number Sequencing	short-term and working memory processes (Keith, et al., 2006)

Table 5

WISC-IV Processing Speed Index (PSI)

Subtest	Measures
Coding	short-term memory, learning ability, visual perception, visual motor coordination (Keith, et al., 2006); cognitive flexibility, attention, motivation, good measure of processing speed or psychomotor speed (Sattler, 2001); processing speed (Flanagan, 2000)
Symbol Search	short-term memory, visual-motor coordination, cognitive flexibility, visual discrimination and concentration (Sattler, 2001); visual processing (Keith, et al., 2006)

What Does This Mean for Instruction?

Gifted students possess a profound ability to remember information, have a higher overall general intelligence (McCollin, 2011), are more interested in literature, debating, and spend a great deal of time reading informational, nonfiction books (Murphy, 1955). "These children also have the ability to quickly acquire, retain, conceptualize, synthesize, and learn new information; as well as the ability to easily process and manipulate large amounts of information at an accelerated pace" (McCollin, 2011, 294).

Winner (1998, 2000) describes gifted children as precocious, inquisitive, and as possessing what she termed a "rage to master". Gifted children display a high interest in the area for which they possess ability and will remain focused while working in the gifted domain (Winner, 1998 & 2000). Gifted children will work for hours on an area of high interest without parental prodding to continue. Not only do gifted students develop quicker than non-gifted peers, but they also develop and process information differently (Winner 1998 & 2000). Winner (1996) believes this intrinsic motivation, a desire to work long and hard at something, occurs when there is a high innate ability that is further fostered by parental support and encouragement. Children like to work at a skill for which they already have a predisposed talent and this is deemed to further enhance their skills, because practicing a skill results in better performance.

The unique and individual characteristics of gifted students must be taken into consideration when planning for academic instruction. Gifted students pose challenges in the school setting and thus their individual needs should be taken into consideration when program planning. Although this is not a popular belief because gifted students are not considered to need "special education", the lack of attention fails to provide adequate instructional support and appropriate educational opportunities. It is not enough to create a one size fits all gifted and talented program which provides the exact same educational opportunities for all gifted students. As discussed previously, gifted students may possess uneven profiles in which they may be gifted in one domain but weaker or not gifted in other domains (Winner, 1998). "If schools educate then as globally gifted, these students will continually encounter frustration in their weak areas; if they are held back because of their deficiencies, they will be bored and unhappy in their strong fields" (Winner, 1998, p. 2). In order to avoid students becoming frustrated, uninterested in academics, and appearing to be misfits in the classroom (Winner 1998), individualized instruction which capitalizes on information regarding the unique profile of strengths and weaknesses is most appropriate.

Utilizing a strengths and weaknesses profile would allow for individualized program planning. Children who receive special education services are often placed in specialized programming classrooms based upon the area of deficit. Children who are not experiencing academic concerns in mathematics but do display difficulties with reading will be placed in a program that supports the deficiencies in reading. This same concept should be applied to gifted students. Winner feels that “schools should place profoundly gifted children in advanced courses in their strong areas only" (1998, p. 4). For subject matters in which they do not display an affinity, gifted students should remain with their peers in regular education classrooms, thus avoiding severe frustration for the students and also allowing for interaction with same age peers.

After the strengths of a student are understood, instruction for each child should be differentiated. Differentiation of instruction should include modifications of curriculum. In order to best address the unique learning needs of the gifted students, teachers should use flexible teaching strategies, higher levels of thinking, group interaction, pacing / acceleration, and collaboration between teacher, students, and peers (McCollins, 2011). Gifted children benefit from being grouped with peers of similar ability and from acceleration of curriculum (Winner, 2000). Appropriately placing children in classes that match the individual student profile of strengths and weaknesses will benefit children both cognitively and socially (Winner, 2000).

Chapter 3

Method

Source for Data

The data collected consisted of a convenience sample of students who have been identified as mentally gifted. Approximately 32% of the original sample of 334 children met criteria for inclusion into this study. Data were not included for the other 68% of participants because student files did not contain current WISC-IV subtest scaled scores, all five index scores, and current achievement testing results in the areas of reading, mathematics, and/or written language completed simultaneously in the same evaluation. Gender information was not provided for five participants and information regarding grade level was not provided for 30 participants; however, this data were for demographic purposes only and therefore the data were included. The resultant sample included 107 student files that were analyzed. This sample was drawn from two participating school districts in Pennsylvania. Seventy- two percent of the data collected was representative of a relatively small size school district in a rural area of Pennsylvania. The second school district provided 28% of the participants. Although detailed information regarding the socioeconomic status of the selected children was not available, this school district resides in what is considered to be a suburban setting with a higher socioeconomic status. Please see Table 6 for demographic information.

Table 6

Basic Demographic Characteristics of Sample

	n	%
Gender		
Males	52	49
Females	50	47
Grade		
Kindergarten	1	1
First	5	4.7
Second	11	10
Third	24	22
Fourth	12	11
Fifth	8	7.5
Sixth	15	14
Seventh	1	1

Measures

The WISC-IV is a cognitive assessment tool utilized with children between the ages of six years and 16 years, 11 months. As per Wechsler (2003), the WISC-IV is considered a reliable and valid measure of individual cognitive functioning. The WISC-IV is internally consistent with reliability coefficients of the subtests ranging from .79 to .90 and with 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). Wechsler (2003) reports that the standardization gifted sample yielded the following mean scores: Full Scale Intelligence Quotient = 124; Verbal Comprehension Index = 124.7; Perceptual Reasoning Index = 120.4; Working Memory Index = 112.5, and Processing Speed Index = 110.6. It is interesting to note that none of the averaged scores fell above the standard score of 130, which is utilized often in making decisions for gifted eligibility.

Achievement scores were also examined in the areas of reading, math, and written language of the archival data sample. Achievement scores derived from nationally standardized, individually administered instruments and included either the *Wechsler Individual Achievement Test, Third Edition* (70%) (WIAT-III; Wechsler, 2009), or the *Kaufman Tests of Educational Achievement*, *Second Edition* (30%) (KTEA-II/Kaufman & Kaufman, 2004). Both of these instruments have good reliability and validity and have been used in evaluations for gifted students.

The WIAT-III is a diagnostic achievement test individually administered, in which a student's level of achievement is compared with a nationally normed population. It is utilized with children between the ages of four years through twelve years (Miller, 2009). Eight composite scores are obtained: Oral Language, Total Reading, Basic Reading, Reading Comprehension and Fluency, Written Expression, Mathematics, Math Fluency, and Total Achievement. Internal consistency reliability estimates of the WIAT-III subtests are generally high (above .80) and .90 and above for composite scores. Average stability coefficients range from .85 to .98 across the three age groups tested (6 to 9, 10 to 12, and 13-19 years). Inter-scorer reliability has an overall reliability of .94.

The KTEA-II is also a norm referenced assessment of academic knowledge and is considered highly reliable and valid. It is used with children from the ages of four years, six months, to early adults at the age of 25 years. Four composite scores are obtained: Reading, Mathematics, Written Language and Oral Language (Kaufman & Kaufman, 2004). It is considered internally consistent with average reliability scores of .90 for reading, math, spelling, and nonsense word decoding, and average reliability for other subtests at .80 and higher. The large sample was representative of the U.S. census (KTEA-II; Kaufman & Kaufman, 2004).

Procedure

This study underwent review by the PCOM’s Institutional Review Board. This exploratory study utilized archival records of students referred for gifted and talented evaluations in the school setting. Certified school psychologists were asked to volunteer relevant data by releasing archived evaluation data on the most recent evaluations for gifted students. Individual student records were reviewed by the respective school psychologists to determine if WISC-IV subtest scaled scores and five factor indices from the standard battery were included. Achievement standard scores were documented for all areas across available reading, math, and/or written language domains, but cases were not excluded with missing achievement domains. If the school psychologists required permission from their respective districts in order to release requested data, the school psychologist had the School Psychologist Agreement (see Appendix A) signed and returned to the investigator. School psychologists were asked to enter data (WISC-IV subtest scaled scores and factor indices from the standard battery and achievement standard scores) into a document entitled *Dissertation: Student Data Collection Workbook* (see Appendix C). The school psychologist volunteers were provided with the workbook and asked to supply the scaled and standard scores for the WISC-IV and the achievement measures. Alternatively, school psychologist volunteers were provided with the workbook data in an Excel spreadsheet in which they could input the information. The data was then downloaded and analyzed through SPSS Version 18. Only gender and grade were collected as additional variables. At no time did the student investigator or primary investigator have access to confidential information or to filed data.

Analysis

Initially, the WISC-IV subtest scores were correlated with achievement scores through the Pearson correlation method. Specifically, the correlational method was used to determine significant relationships between a cognitive score and an achievement score in a sample of gifted and talented students. In addition, the Pearson statistic indicates the direction and strength of these relationships. Specific cognitive-academic patterns were explored through this methodology.

Second, 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. To further define significant differences between the subtypes, MANOVA was utilized to compare these groups across the various dependent measures of the WISC-IV. Given varying levels of subtype sample size across the achievement measures, multiple one way analyses of variance were computed to examine for subtype differences in achievement. Post hoc multiple comparisons were conducted through the Bonferroni method and eta-squared was utilized as the measure of effect size.

Chapter 4

Results

Descriptive Statistics

Reported in Table 7 are the descriptive statistics for the WISC-IV variables across the entire gifted and talented sample. Clinically speaking, the FSIQ was found to be in the superior range which is similar to the WISC-IV gifted standardization sample. The VCI and PRI means were relatively comparable and in the superior range as well; however, the WMI and PSI means tended to be lower for this sample of children, with both falling in the high average range. This has been noted in prior clinical populations and is often the argument for the use of the GAI instead of the FSIQ in gifted evaluations. The highest mean was found for Matrix Reasoning and the lowest mean score was found for the Digit Span, Coding, and Symbol Search subtests, which would be expected, given the lower WMI and PSI composite mean scores. The standard deviations tended to be comparable across the subtests and within the 15-point range for standard scores.

Table 7

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

Variable	*M*	*SD*	*Range*
	Global Scores		
Full Scale Intelligence Quotient	124	8	107-142
Verbal Comprehension Index	121	10	96-144
Perceptual Reasoning Index	124	10	98-145
Working Memory Index	115	11	86-144
Processing Speed Index	112	13	68-144
	Subtest Scores		
Similarities	14	2	9-19
Vocabulary	14	2	10-19
Comprehension	13	2	9-19
Block Design	13	2	9-18
Picture Concepts	13	2	7-18
Matrix Reasoning	15	2	9-19
Digit Span	12	2	6-18
Digit Span Forward	11	2	6-14
Digit Span Backwards	12	2	6-17
Letter-Number Sequencing	13	2	7-17

Table 7 continued

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

Variable	*M*	*SD*	*Range*
Coding	12	3	3-18
Symbol Search	12	2	5-19

The achievement means depicted in Table 8 illustrate high average mean scores for Word Reading, Math Calculation, and Spelling in this sample of gifted and talented children. Means for Reading Comprehension, Math Reasoning, and Written Expression fell into the superior range. Math Reasoning received the highest mean score, and the area of Spelling received the lowest mean score. It is interesting to note that the higher level academic areas requiring reasoning abilities were in the superior range for this sample of gifted children, but the basic academic skills were in the high average range only. The range of scores extended from the average range to the very superior range in this sample of gifted and talented students, indicating that not all gifted children excel in all academic domains.

Table 8

Means and Standard Deviations for Entire Sample across Achievement Variables

Variable	*n*	*M*	*SD*	*Range*
Word Reading	77	118	10	101-146
Reading Comprehen	106	125	11	100-153
Math Calculation	77	119	14	92-151
Math Reasoning	107	127	10	103-148
Spelling	71	117	12	96-146
Written Expression	72	125	14	95-158

Relationships between Cognitive and Academic Variables

Pearson bivariate correlations were computed to determine if any significant relationships existed between measures of cognitive processes and academic achievement in gifted and talented students. The results shown below indicate that there are significant relationships found between many of the cognitive and academic variables. All relationships found were positively correlated, indicating that the higher the level of cognitive process, the higher the level of achievement. Examination of these relationships as depicted in Tables 9, 10, 11, 12, and 13 revealed several interesting findings.

First, the FSIQ used often in making decisions about gifted eligibility did not have the strongest relationships with each academic area when compared with other cognitive scores. In fact, the VCI had a stronger relationship with reading comprehension skills than did the FSIQ as evidenced by an approaching large effect size. Medium effect sizes were noted for the relationships between the subtests which comprise the VCI and Reading Comprehension. In addition, the WMI index was more strongly correlated with Spelling, Word Reading, and Written Expression than was the FSIQ with medium effect sizes. The WMI had the strongest relationship with Written Expression than did any other global score. Both WMI subtests were found to be significantly correlated with the achievement measures. Interestingly, Digit Span was found to have strong relationships with Reading Comprehension, Word Reading, Math Calculation, Math Reasoning, Spelling, and Written Expression. Letter Number Sequencing was also found to have a medium effect size with Reading Comprehension and Word Reading.

The FSIQ was more closely related to the math academic domains than the reading or written language domains. The FSIQ was strongly correlated with Math Reasoning but the relationship with Math Calculation revealed a medium effect. In terms of the PRI, significant relationships were found for Math Calculation and Math Reasoning only, with medium effect sizes noted between these academic areas and the Matrix Reasoning subtest. The PSI revealed significant relations with Math Calculation, Math Reasoning, and Spelling, with medium effect sizes.

Table 9

Correlation of WISC-IV Index Scores and Achievement Measures

	FSIQ	VCI	PRI	WMI	PSI	RC	WR	MC	MR	SP	WE
FSIQ	----	.54**	.63**	.68**	.53**	.37**	.20	.39**	.43**	.29*	.29*
VCI		----	.03	.29**	-.05	.43**	.13	.11	.19*	.03	.31**
PRI			----	.27**	.14	.05	.01	.30**	.27**	.08	.05
WMI				----	.18	.35**	.33**	.27*	.27**	.41**	.41**
PSI					----	.08	.06	.25*	.29*	.26*	-.03
RC						----	.58**	.14	.28**	.35**	.35**
WR							---	.15	.33**	.59**	.28*
MC								----	.60**	.35**	.11
MR									----	.37**	.14
SP										----	.33**
WE											----

Note. FSIQ = Full Scale IQ; VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; PSI = Processing Speed Index; RC = Reading Comprehension; WR = Word Reading; MC = Math Calculations; MR = Math Reasoning; SP = Spelling; WE = Written Expression.

*$p < .05$ **$p < .01$

Table 10

Correlation of WISC-IV VCI Subtest Scores and Achievement Measures

	Sim	Comp	Vocab	RC	WR	MC	MR	SP	WE
Sim	----	.48**	.48**	.32**	.06	.20	.12	-.03	.19
Comp		----	.53**	.345**	.05	.00	.13	.01	.34**
Vocab			----	.37**	.19	.04	.20*	.00	.25*
RC	.			----	.58**	.14	.28**	.35**	.35**
WR					----	.15	.32**	.59**	.28*
MC						----	.59**	.345**	.12
MR							----	.37**	.14
SP								----	.33**
WE									----

Note. Sim = Similarities; Comp = Comprehension; Vocab = Vocabulary; RC = Reading Comprehension; WR = Word Reading; MC = Math Calculations; MR = Math Reasoning; SP = Spelling; WE = Written Expression.

*p < .05 **p < .01

Table 11

Correlation of WISC-IV PRI Subtest Scores and Achievement Measures

	BD	PC	MR	RC	WR	MC	MR	SP	WE
BD	----	.21*	.235*	-.11	.00	.17	.19	.05	-.02
PC		----	.25**	.14	-.01	.07	.10	-.11	.12
MR			----	.08	.04	.38**	.27**	.22	.01
RC	.			----	.58**	.14	.28**	.35**	.35**
WR					----	.15	.32**	.59**	.28*
MC						----	.59**	.345**	.11
MR							----	.37**	.14
SP								----	.33**
WE									----

Note. BD = Block Design; PC = Picture Concepts; MR = Matrix Reasoning; RC = Reading Comprehension; WR = Word Reading; MC = Math Calculations; MR = Math Reasoning; SP = Spelling; WE = Written Expression.

*p < .05 **p < .01

Table 12

Correlation of WISC-IV WMI Subtest Scores and Achievement Measures

	DS	LNS	RC	WR	MC	MR	SP	WE
DS	----	.56**	.32**	.26*	.26*	.30**	.44**	.36**
LNS		----	.31**	.30**	.20	.15	.20	.32**
RC	.		----	.58**	.14	.28**	.35**	.35**
WR				----	.15	.32**	.59**	.28*
MC					----	.59**	.345**	.11
MR						----	.37**	.14
SP							----	.33**
WE								----

Note. DS = Digit Span; LNS = Letter Number Sequencing; RC = Reading Comprehension; WR = Word Reading; MC = Math Calculations; MR = Math Reasoning; SP = Spelling; WE = Written Expression.

*p < .05 **p < .01

Table 13

Correlation of WISC-IV PSI Subtest Scores and Achievement Measures

	CD	SS	RC	WR	MC	MR	SP	WE
CD	----	.50**	.05	-.02	.274*	.26**	.21	-.06
SS		----	.04	.11	.14	.22*	.21	-.06
RC	.		----	.58**	.14	.28**	.35**	.35**
WR				----	.15	.33**	.59**	.28*
MC					----	.59**	.345**	.11
MR						----	.37**	.14
SP							----	.33**
WE								----

Note. CD = Coding; SS = Symbol Search; RC = Reading Comprehension; WR = Word Reading; MC = Math Calculations; MR = Math Reasoning; SP = Spelling; WE = Written Expression.

*p < .05 **p < .01

Inferential Statistics

The gifted and talented population is often considered heterogeneous in terms of cognitive strengths and weaknesses (McCollin, 2011; Mrazik & Dombrowski, 2010; Rowe et al., 2012; Winner, 1998, 2000); therefore, utilization of cluster analysis can be valuable for discovering the underlying cognitive constructs associated with this heterogeneous gifted and talented sample. In this study, cluster analysis was undertaken with the purpose of identifying and classifying homogeneous subtypes of children who are eligible for gifted and talented classification, based on direct cognitive performance on the WISC-IV subtests. The cluster analysis utilized the Average Linkage Within Groups variant of the UPGMA as the amalgamation or linkage rule. The results of the Average Linkage Within Groups variant of the UPGMA revealed four cognitive subtypes according to the agglomeration schedule coefficient changes from Step 4 (76.87) to Step 3 (77.95). Exploring the means of the WISC-IV subtests and composite scores across the four clusters helped to clarify the differential subtypes in the gifted and talented sample. These gifted and talented subtypes were identified as Perceptual/Problem Solving Subtype; High Functioning Gifted and Talented Subtype; Low Functioning Gifted/Executive Subtype; and Low Functioning Gifted/Problem Solving and Working Memory Subtype. Cognitive gifted and talented subtype characteristics are displayed in Table 11. Gender and grade were not provided for all participants. Most subtypes were composed of a greater number of males than females; however, The Low Functioning Gifted / Problem Solving and Working Memory subtype had the highest number of females. Similar to referral rates in schools, children were more likely to be in the intermediate grades of 3, 4, 5, and 6, with grade 3 having the largest representation of gifted students.

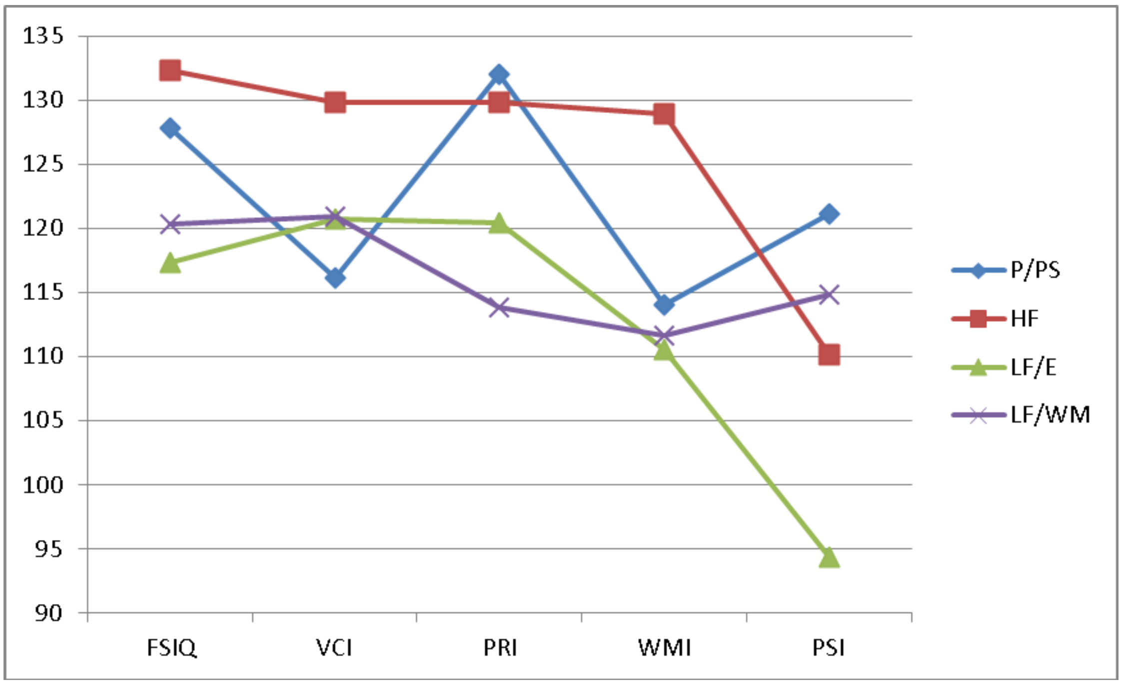
Table 14

Participant Characteristics on Demographic Variables within Gifted and Talented Subtypes

	Cluster			
	P/PS (n = 33)	HF (n = 16)	LF/E (n = 21)	LF/WM (n = 32)
Gender (%)				
Female	11	5	9	22
Male	20	10	10	8
Grade (%)				
Kindergarten	1	0	0	0
Grade 1	2	1	1	1
Grade 2	5	2	2	2
Grade 3	6	5	5	8
Grade 4	4	3	3	2
Grade 5	1	0	3	4
Grade 6	3	5	3	4
Grade 7	0	0	1	0

Note. P/PS = Perceptual / Problem Solving Subtype; HF = High Functioning Gifted and Talented Subtype; LF/E = Low Functioning Gifted / Executive Subtype; LF/WM = Low Functioning Gifted / Problem Solving and Working Memory Subtype.

In addition, Figure 1 and Figure 2 provide a graphic display of the cognitive variables across the four cognitive gifted and talented subtypes.



Wechsler Intelligence Scale for Children - Fourth Edition Composite Scores

Figure 1. Composite gifted and talented subtypes across WISC-IV composite scores. FSIQ = Full Scale Intelligence Quotient; VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; WMI = Working Memory Index; PSI = Processing Speed Index; P/PS = Perceptual / Problem Solving Subtype; HF = High Functioning Gifted and Talented Subtype; LF/E = Low Functioning Gifted / Executive Subtype; LF/WM = Low Functioning Gifted / Problem Solving and Working Memory

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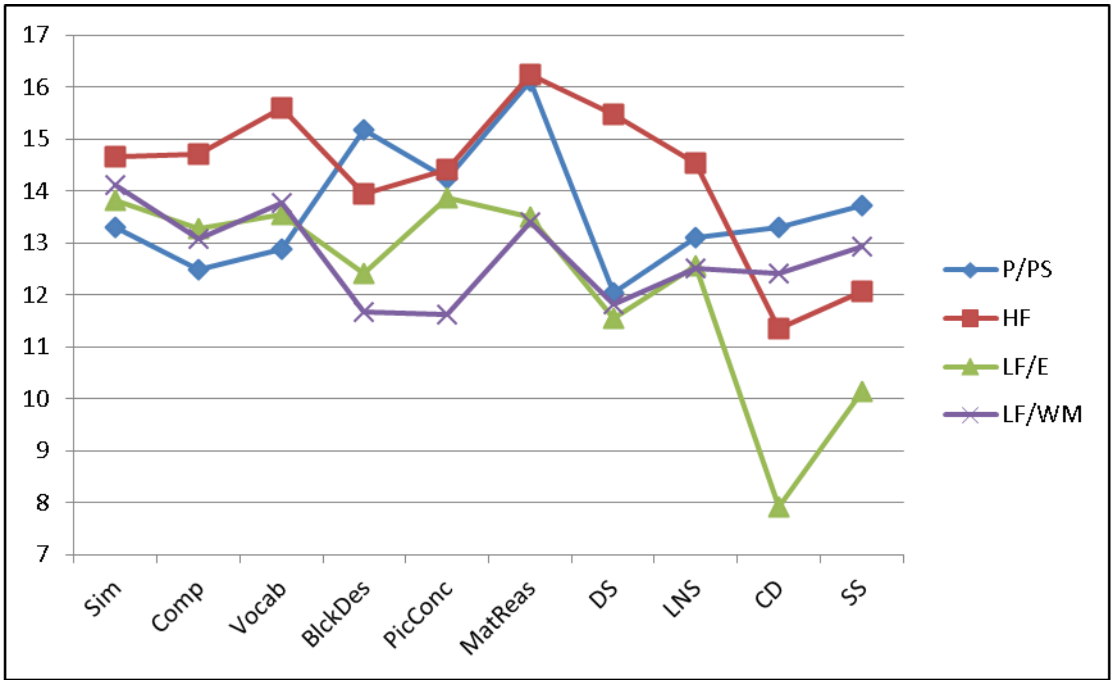

Wechsler Intelligence Scale for Children - Fourth Edition Subtests

Figure 2. Cognitive gifted and talented subtypes across WISC-IV subtest variables. Sim = Similarities; Comp = Comprehension; Vocab = Vocabulary; BlckDes = Block Design; PicConc = Picture Concepts; MatReas = Matrix Reasoning; DS = Digit Span; LNS = Letter-Number Sequencing; CD = Coding; SS = Symbol Search; P/PS = Perceptual / Problem Solving Subtype; HF = High Functioning Gifted and Talented Subtype; LF/E = Low Functioning Gifted / Executive Subtype; LF/WM = Low Functioning Gifted / Problem Solving and Working Memory

Before further interpretation began, the contribution of achievement variables across these gifted and talented subtypes was explored. Examination of the achievement variables helped to ascertain further the composition of the homogeneous gifted and talented subtypes. Therefore, each subtype was further described by examining the means of the achievement variables across each gifted and talented subtype.

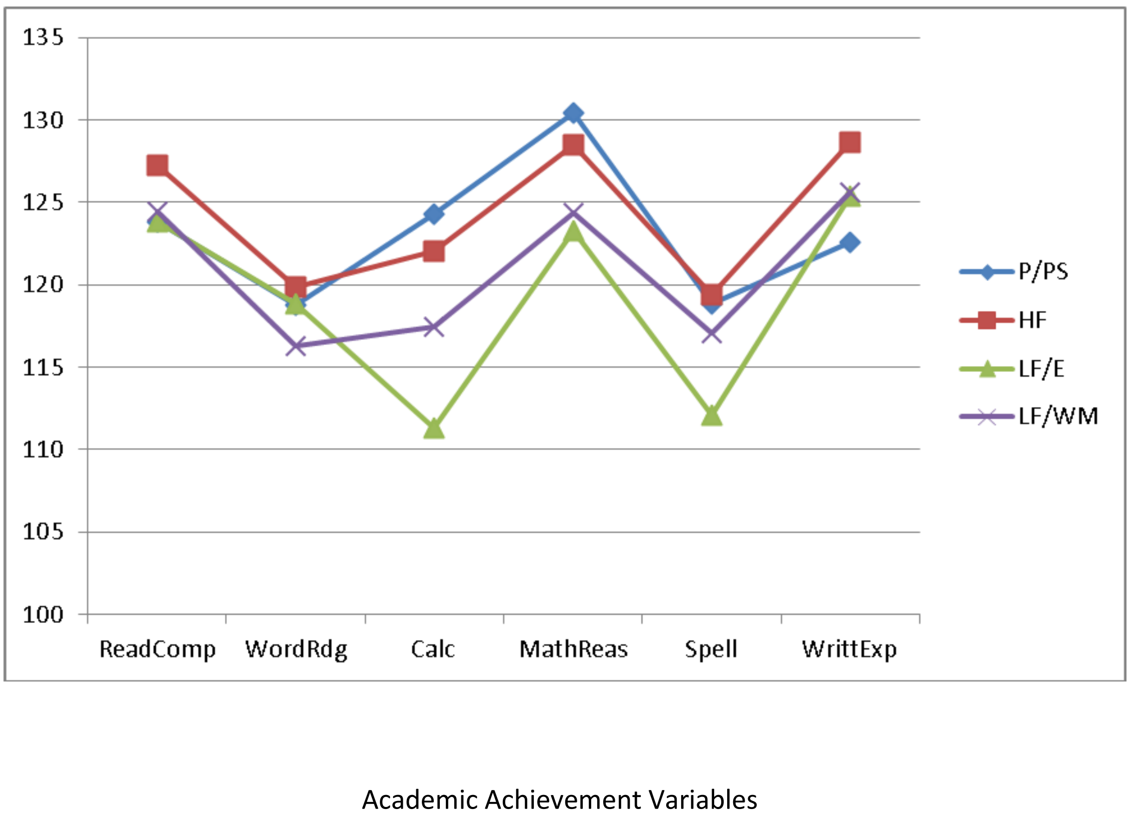

Figure 3. Cognitive gifted and talented subtypes across achievement variables. ReadComp = Reading Comprehension; WordRdg = Word Reading; Calc = Math Calculation; MathReas = Math Reasoning; Spell = Spelling; WrittExp = Written Expression.

Clinical Presentation of Gifted and Talented Subtypes

Perceptual / problem solving subtype. This subtype was characterized by a cognitive profile with specific strengths and weaknesses, achieving the second highest FSIQ mean (in the superior range). Across the WISC-IV composites a relative strength was present on the PRI (very superior) and PSI domains (superior). On the PRI domain subtests, this group achieved the highest score on the BD subtest (superior), scored comparably with the High Functioning Gifted and Talented subtype for highest MR subtest (very superior / area of strength) , and scored equivalently with the High Functioning Gifted and Talented and the Low Functioning Gifted and Talented / Working Memory subtypes on the PC subtest (superior). The PSI was noted to be in the superior range. This group achieved the highest PSI as well as the highest mean subtest scores on both subtests in this domain. Comparatively, discrepancies were noted by relatively lower VCI and WMI mean scores, both in the high average range. Although this group achieved the second highest WMI mean score, there was a fifteen point discrepancy from the highest achieving group. They achieved the second highest mean scores on the LNS subtest and scored equivalently with the Low Functioning Gifted / Problem Solving and Working Memory subtype for the second highest mean score on DS (both mean scores in the high average range). This group demonstrated relative weaknesses, receiving the lowest mean VCI (high average) as well as the lowest mean scores on all three of the subtests which compose the VCI.

Examination of the achievement means for this gifted and talented subtype demonstrated that subtest mean scores for Math Calculation and Math Reasoning (both in superior range) were higher for this group than for any of the others. Considering the fact that this group also received the highest PRI scores, one would expect math skills to be an area of strength, given the prior correlations. This group had scores comparative with the Low Functioning Gifted / Executive Subtype and the Low Functioning Gifted / Problem Solving and Working Memory Subtype on Reading Comprehension (superior range). They also had scores equal to the High Functioning Gifted and Talented subtype for the highest Spelling mean scores (high average). Both Word Reading and Spelling were the lowest mean scores received (high average range). Variability was noted in the written language tasks. Although Spelling was in the high average range, the Written Expression subtest mean was in the superior range.

High functioning gifted and talented subtype. This subtype was characterized by the highest mean FSIQ (very superior), VCI (very superior), and WMI (superior) amongst the four groups. Although the PRI was also in the very superior range, this group did not outperform the Perceptual / Problem Solving subtype on this composite domain and instead achieved the second highest mean score for this domain. This group scored highest on all 3 subtests which comprise the VCI (very superior, indicating strength in reasoning and verbal skills. Composite score analysis tended to obscure the performance in the PRI domain. Overall this group received very superior PRI scores; however, the subtest analysis revealed the overall domain score was inflated, based upon very superior performance on the Matrix Reasoning subtest. The Perceptual/Problem Solving subtype outperformed this group on Block Design. This subtype had intact subtest scores across the WMI and had the highest mean scores on the DS and LNS (both in superior range) subtests of the four gifted and talented subtypes. This group experienced considerable difficulty on the PSI (high average mean performance) in comparison with their performance on the other domains. They received the second lowest scores on both CD (average) and SS (high average).

Examination of achievement means across the reading, math, and writing domains revealed variability. In reviewing the reading areas, the High Functioning Gifted and Talented subtype received the highest overall mean scores on Reading Comprehension (superior) and Word Reading (high average) achievement areas. This group also showed the highest performance on Written Expression (superior) and performed equivalently with the Perceptual / Problem Solving subtype for the highest mean score in Spelling (high average). This group achieved the second highest mean scores in Math Calculation (superior) and Math Reasoning (superior).

Low functioning gifted / executive subtype. This subtype was characterized by having the lowest mean FSIQ of the four groups (in the high average range). A large discrepancy was noted on this subtype across global scores. Although the VCI and PRI were noted to be in the superior range, a high average performance in WMI and especially an average performance on PSI brought down the overall FSIQ. In comparison with the other three groups, this group achieved the second lowest mean score on vocabulary (high average) and achieved equivalently with the Low Functioning Gifted / Problem Solving and Working Memory subtype for the second lowest mean scores in both Similarities (superior) and Comprehension (high average). Within the PRI they achieved the second lowest mean scores (high average) and evidenced variability across the subtests with a better performance on the Picture Concepts subtest, tending to inflate the overall PRI. This subtest mean fell in the superior range; however, the Block Design and Matric Reasoning subtest means both fell in the high average range. This group had the lowest mean score for Matrix Reasoning (similar to the Low Functioning Gifted / Problem Solving and Working Memory subtype) and the second lowest mean score for Block Design.

Examination of the WMI and PSI accounts for the overall lower FSIQ. This group had the lowest mean scores for the WMI (high average) domain as well as for the two subtests comprising the domain: Digit Span (average) and Letter Number Sequencing (high average). This group also achieved the lowest mean score for the PSI (average) as well as the lowest mean subtest scores (both average). This group experienced relatively weaker working memory and processing speed skills.

Review of achievement means for this subtype demonstrated academic difficulties in Math Calculations (lowest mean score in high average range) and Spelling (lowest mean score in high average range). This group evidenced the lowest mean scores on Math Calculation, Math Reasoning, and Spelling.

Low functioning gifted / problem solving and working memory subtype. This fourth subtype is characterized by having the second lowest mean FSIQ (superior range). The VCI was in the superior range and the PRI, WMI, and PSI were all in the high average range. This subtype had the second highest mean scores for the

Similarities and Vocabulary subtests (tied with the Low Functioning Gifted / Executive Subtype). This subtype had the lowest mean PRI as well as the lowest performance on all three subtests that comprise this domain: Block Design, Picture Concepts, and Matrix Reasoning (high average range). The PSI mean score for this group was the second highest of the four subtypes. They achieved the second highest mean scores for the Coding and Symbol Search subtests (both in high average range). Of the four subtypes, this group achieved the second lowest WMI mean score (high average). Their scores were equivalent to the Perceptual / Problem Solving subtype for the lowest mean Digit Span (high average) and with the Low Functioning Gifted / Executive Subtype for the lowest mean Letter Number Sequencing (high average).

Exploration of the achievement means revealed that this subtype had the lowest performance on Word Reading. Math Calculation (high average) and Math Reasoning (superior) were areas of concern for this group because they scored the second lowest mean scores on both. The highest score for this group was found on Written Expression (superior).

Gifted and Talented Subtype Differences across the Cognitive Dependent Variables

A multivariate GLM was computed with the WISC-IV dependent measures with the four gifted and talented subtypes derived from the cluster analysis serving as the between-subjects factor. Box's Test of the equality of covariance matrices was not significant; therefore, a multivariate approach to the data was appropriate. Alpha level was set at p = .05 for all analyses. The Wilks' Lambda multivariate test of overall differences between groups demonstrated significance across the WISC-IV dependent measures $F(45, 265) = .8.881$, $p < .001$, partial $\eta^2 = .598$. The F statistic for Wilks' Lambda was exact. Power was acceptable for the WISC-IV dependent measures (power = 1.00). Therefore, a type II error was unlikely. Levene's test of equality of error variances was not significant for any dependent variables.

Univariate between-subjects tests revealed that levels of the between-subjects variable, gifted and talented subtypes, eventuated in significant differences across the dependent measures of the WISC-IV cognitive variables. Post-hoc multiple comparisons utilizing the Bonferroni method revealed differences between the gifted and talented subtypes across all the WISC-IV dependent variables. Table 15 and Table 16 depict the *M*, *SD*, *F* statistic, and eta-squared (effect size measure) for these variables across the gifted and talented subtypes. Significant group differences were found for all subtypes on all composite domains of the WISC-IV. Only one subtest on the WISC-IV, Similarities, did not show significant subtype differences. The largest effect sizes were not found between the FSIQ and the subtypes. The largest effect sizes were noted for the PRI and PSI between the subtypes, with the WMI also showing a medium effect size between groups. At the subtest level, the strongest effects between the subtypes were noted for Block Design and Coding followed by Matrix Reasoning, Picture Concepts, Symbol Search, and Digit Span. The VCI subtests showed the smallest effects, suggesting that the VCI did not substantially discriminate gifted subtypes.

Table 15

Nomothetic Results for WISC-IV Composites and Gifted and Talented Subtypes

		P/PS (n = 35)	HF (n = 17)	LF/E (n = 22)	LF/WM (n = 33)	F^1	eta^2
FSIQ	*M*	127.77[c, d]	132.35[c, d]	117.32	120.36	26.52	.436
	SD	6.01	4.08	5.93	7.47		
VCI	*M*	116.11	129.82[a, b, c]	120.73	120.88	7.92	.187
	SD	8.67	6.75	11.70	9.97		
PRI	*M*	132.03[c, d]	129.82[c, d]	120.41[d]	113.85	52.50	.605
	SD	5.77	6.56	5.94	7.27		
WMI	*M*	114.03	128.88[a, c, d]	110.50	111.61	14.59	.298
	SD	9.46	9.9	8.04	10.81		
PSI	*M*	121.11[b, c]	110.12[c]	94.32	114.82[c]	38.20	.527
	SD	10.33	9.17	8.2	9.1		

Note. FSIQ = Full Scale IQ; VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; WMI = Working Memory Index; PSI = Processing Speed Index; P/PS = Perceptual / Problem Solving Subtype; HF = High Functioning Gifted and Talented Subtype; LF/E = Low Functioning Gifted / Executive Subtype; LF/WM = Low Functioning Gifted / Problem Solving and Working Memory

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

[a]Higher than Perceptual / Problem Solving Subtype.

[b]Higher than High Functioning Gifted and Talented Subtype.

[c]Higher than Low Functioning Gifted / Executive Subtype.

[d]Higher than Low Functioning Gifted / Problem Solving and Working Memory Subtype.

Table 16

Results for WISC-IV Subtests and Gifted and Talented Subtypes

		P/PS (n = 35)	HF (n = 17)	LF/E (n = 22)	LF/WM (n = 33)	*F*[1]	eta^2
S	*M*	13.31	14.65	13.82	14.12	2.26	.062
	SD	2	2	2	2		
C	*M*	12.49	14.71[a, d]	13.27	13.09	5.89	.147
	SD	2	1	2	2		
V	*M*	12.89	15.59 [a, c, d]	13.55	13.76	7.64	.182
	SD	2	2	2	2		
BD	*M*	15.17[c, d]	13.94[d]	12.41	11.67	25.01	.421
	SD	2	1.5	2	2		
PC	*M*	14.23[d]	14.41[d]	13.86[d]	11.61	12.31	.264
	SD	2	2	2	2		
MR	*M*	16.11[c, d]	16.24[c, d] 13.5	13.5	13.39	16.72	.327
	SD	2	2	2	2		
DS	*M*	12.03	15.47[a, c, d]	11.55	11.82	14.49	.297
	SD	2	1	2	2		
LNS	*M*	13.11	14.53[a, c, d]	12.55	12.52	6.09	.151
	SD	2	2	1	2		
CD	*M*	13.31 [b, c]	11.35[c]	7.91	12.42 [c]	29.76	.464
	SD	2	2	2	2		
SS	*M*	13.71[c]	12.06[c]	10.14	12.94[c]	13.38	.280
	SD	2	2	2	2		

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; P/PS = Perceptual / Problem Solving Subtype; HF = High Functioning Gifted and Talented Subtype; LF/E = Low

Functioning Gifted / Executive Subtype; LF/WM = Low Functioning Gifted / Problem Solving and Working Memory Subtype.

F^1 ratios significant at $p \leq .001$ with exception of Similarities

[a]Higher than Perceptual / Problem Solving Subtype.

[b]Higher than High Functioning Gifted and Talented Subtype.

[c]Higher than Low Functioning Gifted / Executive Subtype

[d]Higher than Low Functioning Gifted / Problem Solving and Working Memory Subtype.

Gifted and Talented Subtype Differences across the Achievement Dependent Variables

Multiple one way analyses of variance were computed separately between the gifted and talented subtypes and the achievement dependent measures. Because the achievement scores were not provided for every academic area, sample sizes differed within the subtypes when examined across the academic areas. Table 17 depicts the *M*, *SD*, *F* statistic, and eta-squared (effect size measure) for these variables across the four gifted and talented subtypes. As is noted, there were significant subtype differences between the gifted and talented subtypes on the achievement measures of Math Calculation and Math Reasoning, although effect sizes were small.

Table 17

Results for Achievement Measures and Gifted and Talented Subtypes

		P/PS	HF	LF/E	LF/WM	*F*[1]	eta^2
RC	*n*	33	28	22	23		
	M	123.85	127.24	123.82	124.42	.430	.012
	SD	11.13	7.99	13.00	10.16		
WR	*n*	22	16	18	21		
	M	118.74	119.86	118.83	116.28	.468	.019
	SD	11.48	8.21	10.39	8.19		
MC	*n*	22	16	18	21		
	M	124.26 [c]	122.00	111.33	117.46	3.527	.127
	SD	16.08	8.66	12.40	11.70		
MR	*n*	34	28	22	23		
	M	130.40 [c]	128.47	123.27	124.33	3.270	.087
	SD	9.87	7.49	9.81	11.19		
SP	*n*	21	14	15	21		
	M	118.82	119.40	112.07	117.07	1.169	.050
	SD	14.12	10.57	12.18	8.64		
WE	*n*	22	12	18	20		
	M	122.61	128.60	125.39	125.62	.335	.015
	SD	13.68	3.64	18.30	12.74		

Note. RC = Reading Comprehension; WR = Word Reading; MC = Math Calculation; MR = Math Reasoning; SP = Spelling; WR = Written Expression; P/PS = Perceptual / Problem Solving Subtype; HF = High Functioning Gifted and Talented Subtype; LF/E = Low Functioning Gifted / Executive Subtype; LF/WM = Low Functioning Gifted / Problem Solving and Working Memory

F^1 $p < .05$ for Math Calculation and Math Reasoning

[a]Higher than Perceptual / Problem Solving Subtype.

[b]Higher than High Functioning Gifted and Talented Subtype.

[c]Higher than Low Functioning Gifted / Executive Subtype

[d]Higher than Low Functioning Gifted / Problem Solving and Working Memory .

Chapter 5

Discussion

The purpose of this current study was to examine the relationships between WISC-IV subtest scores and achievement scores in reading, written language and mathematics for a population of gifted and talented students. Furthermore, the study sought to determine if meaningful profiles of gifted and talented children could be extrapolated through hierarchical cluster analysis of the WISC-IV subtests. The focus was to utilize subtest scores in the cluster analysis instead of relying solely on the FSIQ or other global score, in order to define homogeneous clusters of gifted and talented students. Determining unique profiles for gifted and talented students could aid practitioners in decision making for eligibility and program placement of gifted and talented students (McCollin, 2011; Winner, 1998, 2000). Differentiated cognitive profiles based upon strengths and weaknesses (Fiorello et al., 2007; Bowman, Markham, & Roberts, 2002) also foster differentiated educational programs including instruction to prevent a one size fits all methodology. Additionally, in finding homogeneous subtypes of gifted and talented subtypes, it was an additional aim of the study to reveal significant differences across the dependent variables of the WISC-IV and achievement measures.

Current practice for admitting students into gifted and talented programs relies heavily on the FSIQ in documenting gifted "ability", which typically equates with a standard score of 130 or above. In this study, a correlational approach was adopted that showcased the different relationships between cognitive and academic variables for a sample of gifted and talented youngsters. However, the FSIQ did not exhibit a significantly stronger relationship across all the academic achievement areas than did the other index scores or subtest scores. The VCI and WMI and their associated subtests evidenced strong relationships with the academic areas of word reading, reading comprehension, spelling, and written expression – those academic skills most often associated with verbal ability. On the other hand, the PRI and PSI had the stronger relationships with the math areas involving calculation and reasoning – those skills most often associated with "nonverbal" ability. The PSI, although significantly related to the math areas and spelling, did not demonstrate the same magnitude in the relationships as did the other index scores. The outcomes of this correlational approach revealed that using both cognitive as well as academic measures in determining giftedness should be an overriding necessity. At the evaluation level, school psychologists could engage in examining these relationships and consider the contribution of cognitive skills to specific academic areas, with specific subtests allowing for a more defined pattern of strengths and weaknesses in identifying giftedness.

Subtype Differentiation and Clinical Implications

The second focus of this study was to ascertain if meaningful homogeneous subtypes of the gifted and talented learner could be extrapolated from the heterogeneous population. Results of the cluster analysis yielded four statistically significant gifted and talented subtypes. These subtypes were differentiated across all of the cognitive index scores including the FSIQ. This is important and noteworthy because in the FISQ, among these four groups, there were significant differences that are typically utilized to determine giftedness and need for gifted programming.

Considering that not all of these four subtypes achieved a FSIQ in the superior range, it begs the question about the reasons why we continue to use this global score in educational decision making. In addition, significant subtype differences were noted across all of the subtest scores with the exception of Similarities, in which all subtypes performed well. This suggests that utilizing a subtest approach may very well lead to the ability to individuate the gifted evaluation with the ultimate goal of this individuation trickling to the GIEP.

Clinically, two of the subtypes, Perceptual / Problem Solving and High Functioning Gifted and Talented, appear to be a higher functioning subtype of gifted and talented students. The Perceptual / Problem Solving subtype displayed strength in visual analysis and synthesis, but they performed less well on tasks measuring verbal comprehension and working memory. Given the stronger performance on visually-based tasks, it is no surprise they performed very well across both Math Calculation and Math Reasoning. The High Functioning Gifted and Talented subtype appeared to have intact executive functioning as evidenced by very superior performance on verbal comprehension, working memory, and processing speed tasks (Hale et al., 2010). This subtype achieved the highest reading comprehension and word reading scores, which is also not surprising, given the strengths across multiple cognitive domains.

Two other subtypes appear to present with relatively weaker cognitive skills and are considered lower functioning gifted students: Low Functioning Gifted and Talented / Executive and Low Functioning Gifted / Problem Solving and Working Memory. These subtypes displayed significant weakness in processing speed and working memory skills, showcasing the weaknesses in executive ability, with stronger developed vocabulary and perceptual reasoning abilities. These two subtypes are the epitome of the gifted learner who show higher level cognitive ability, but are more easily prone to the effects of processing speed and working memory on their FSIQ. In this regard, these subtypes would perhaps benefit from the use of the General Ability Index (GAI) in order that they might qualify for gifted programming. Flanagan and Kaufman (2004) propose utilization of the GAI, which examines only the VCI and the PRI subtests at a global level. It is likely that some gifted children are misidentified or not identified at all by the classroom teacher because of these “average” processing speed and working memory abilities. However, these constraints are minimized when using a third method approach in understanding each student’s unique constellation of strengths and weaknesses. Significant differences were noted across academic domains among these subtypes, especially in the math domains, suggesting differences that warrant clinical examinations and differentiated instructional programs.

Table 18 depicts the four gifted and talented subtypes differentiated by cognitive and academic strengths and weaknesses.

Table 18

Differentiation of Subtypes by Cognitive and Academic Strengths and Weaknesses

Subtypes	Cognitive Strength (VS to S)	Cognitive Weakness (HA to A)	Academic Strength (VS to S)	Academic Weakness (HA to A)
P/PS	Blk Des Sym Search Coding Matrix Reas Pic Concept	Similarities Vocabulary Comprehen	Math Calc Math Reas Read Comp Written Exp	Spelling
HF	Matrix Reas Digit Span LetNumSeq Similarities Vocabulary Comprehension	Coding Sym Search	Read Comp Writt Exp Math Calc Math Reas	Word Read Spelling
LF/E	Pic Concept Similarities	DigitSpan Blk Design Coding Sym Search Vocabulary Comprehension Matrix Reas		Math Calc Spelling Math Calc Math Reas
LF/WM		Blk Design Pic Concepts Matrix Reas Digit Span LetNum Seq Coding Sym Search		Math Calc Word Read

Notes: P/PS = Perceptual / Problem Solving; HF = High Functioning Gifted and Talented; LF/E = Low Functioning Gifted and Talented / Executive Subtype; LF/WM = Low Functioning Gifted and Talented / Problem Solving Working Memory Subtype.

Based upon this information alone, program planning for each subtype should be disparate and individualized to address unique strengths and weaknesses. Whereas the P/PS subtype would benefit from a more visually-based program incorporating visual analysis and synthesis, visual processing of information, grapho-motor processing tasks, and visual discrimination, the LF/E subtype would not benefit from a similar program. Instead the LF/E would require a program which utilizes more abstract thought and combines both verbal and visual modalities in instruction. The HF subtype would benefit from tasks which utilize reasoning, comprehension, and conceptualization using a language-based approach. Tasks which incorporate rote learning and working memory skills will also be easily met. However, challenges will be found in visual-motor coordination, visual processing, and processing speed. The LF/PS subtype presents as a verbally aware group, which results in a referral for gifted and talented evaluations. This subtype would benefit from a verbally-based curriculum; however, the subtype displayed weaknesses on tasks that were novel and abstract, requiring visual information processing, cognitive flexibility, and concentration.

Therefore, each subtype requires a GIEP that truly is individualized. Each subtype would require unique goals and objectives which are related to its strengths and weaknesses. Whereas the LG/E and LG/PS subtypes will require math instruction amongst grade level peers, the P/PS and HF subtypes display strength in math and instruction should be more challenging. In fact, the only academic areas that were significantly different across the subtypes were math calculation and math reasoning. Perhaps school psychologists could benefit from using the math areas as discriminating variables in evaluation and program planning. Last, these results supply evidence of the potential for some students to exhibit gifted performance in math, yet others show gifted potential in language (Mrazik & Dombrowski, 2010; Rowe et al., 2012; Winner, 1998, 2000).

Utilizing an ideographic subtest approach to instructional programming would lead to more effective GIEP's (McCollin, 2011; Winner, 1998, 2000). The current proposed delineation of specific cognitive profiles, clarifying individual strengths and weaknesses would be an efficacious method for addressing educational programming for gifted students. As has been shown, global intelligence scores mask strengths and weaknesses and do not provide opportunity for eligibility decisions and educational programming based upon multiple cognitive constructs, rather than the reliance on the FSIQ alone.

Teachers, parents, school psychologists, and other school personnel involved in determining eligibility of students for gifted and talented programs must be aware of the subtypes of gifted and talented students. Instead of searching for a student who possesses skills in every academic domain, one must look for the child who displays significant strengths, despite the potential presence of average abilities. Not all gifted students are gifted in every academic domain, as was the case revealed in this study; instead, a varied profile is probably more common. It is unfortunate to miss these students who possess gifted skills because of the detrimental effects that can occur if students are not provided with educational programming that best meets their individualized needs. The "one size fits all" model of education is not acceptable for children who possess unique abilities. As Winner (1998) points out, if students are educated as being globally gifted when, instead, they possess uneven profiles, students will encounter frustration, boredom, and unhappiness. Instructing the gifted student appropriately in the unique areas of strengths and weaknesses may lead to feelings of higher self-esteem and increase future success rates. GIEPs that are written to address a student's individual skills will be better able to promote the student's strengths and lead to appropriate future planning when considering college and careers. Students should receive advanced academic programming in their areas of strength (Winner, 1998). Further, gifted children would benefit from being grouped with peers of similar ability.

When screening for students who may be eligible for gifted and talented programming, it is no longer useful to utilize Terman's cutoff score of 130. In this study, the FSIQ was not the most effective means for determining gifted abilities. Instead, the third method approach to interpretation of assessment results for the gifted student provides a more comprehensive picture of strengths and weaknesses (Hale et al., 2010). A subtest analysis approach is considered reliable and valid for children who present with variable cognitive profiles (Hale & Fiorello, 2004; Mayes & Calhoun, 2008). Utilization of the third method approach easily translates into the development of a GIEP which stresses the individual student's academic needs.

The WISC-IV can provide valuable information needed to determine whether or not a student would qualify for gifted and talented services; however, the FSIQ is not the best indicator of success and potential. Individualized information can be obtained by examining subtest scores rather than looking at the convoluted FSIQ which is not a pure score. Koziol and Budding (2009) indicate that the use of fixed battery assessments as a determining factor of gifted abilities runs the risk of missing students who may be eligible; this is due to a combination of elevated and depressed scores, which when summarized into composite, may look like average ability. Therefore, the same method for determining special education should be utilized and individual profiles of strengths and weaknesses which highlight the student's abilities should be considered.

Based upon the current criteria for determining eligibility, dependent upon a FSIQ score of 130 or above, only one subtype would have met criteria. The High Functioning Gifted and Talented subtype was the only group that would have qualified for acceptance into a gifted and talented program. If the GAI were used to determine eligibility, the Low Functioning Gifted and Talented / Executive subtype would also be identified as eligible. What can be done to ensure better specificity in determining who is mentally gifted? Given the results of this study, the first step is to acknowledge and promote the need to analyze subtest scores in order to determine eligibility and to denounce the traditional and antiquated reliance on the FSIQ. Guidelines for determining eligibility and program planning are warranted as well as better training for teachers to instruct this group of students.

Limitations of the Study

Several issues must be discussed regarding limitations of the present study. First, although the original sample size was 334 students; many data entries had to be excluded due to important variables not being reported. This has important ramifications for this archived sample. Given that school districts are typically using the FSIQ in gifted evaluation, the data to be shared from the recent evaluations were limited to the FSIQ, and subtest scores were less available. The final sample size of 107 students is considered to be a limited sample of convenience; therefore, direct assessment as in a true experiment with gifted participants may lead to differing results. Additionally, the student data were collected from two school psychologists, both of whom reside in Pennsylvania. Considering this limitation of the range of states sampled in the United States, these results may not extend or generalize to other states or populations. Complete demographic information was not collected, which limits the ability to discuss ethnicity, age, gender, grade, or region. Results therefore may not generalize to other samples of students with differing demographic characteristics. In addition, this sample included students who were gifted and *talented* and not all students were currently receiving gifted support services due to meeting the strict criteria of a FSIQ of 130 or above.

Therefore, future research should investigate subtypes with a more representative sample of gifted students. This study is considered exploratory because of the clustering technique utilized; hence, the clinical subtypes presented may not be found in all school districts. Demographic information collected should include age, grade, gender, and ethnicity. Data should be sought from more school districts and not only from those in the state of Pennsylvania. A variety of socio-economic status areas should be included in the study. The current study design could be applied to a larger, more representative sample size in future research.

Future Directions

This current study has shown, contrary to popular belief, that gifted and talented students are a heterogeneous group of individuals who possess unique strengths and weaknesses, but who can become more homogeneous when examining subtypes. An area of research this study largely ignored was the impact of social emotional factors and co-morbid deficits on gifted learners. Research by Mayes and Calhoun (2007) discuss the impact of Attention Deficit Hyperactivity Disorder (ADHD) on gifted and talented students. Rourke (1995) discusses a profile of Non-Verbal Learning Disorder (NVLD), which may also have an impact on this population of students. Winner (1998, 2000) discusses gifted children in terms of the social emotional characteristics of being precocious, inquisitive, and highly focused on an area deemed to be of high interest. Further, utilizing a profile of strengths and weaknesses will benefit children both cognitively and socially (Winner, 2000); this can be explored further in order to provide the most reliable support academically and emotionally for this select group of students.

Future research should focus on eliminating the over-reliance of the FSIQ in lieu of utilizing a third method approach which examines specific cognitive strengths and weaknesses. A delineation of specific gifted and talented subtypes further clarifies individuality and more importantly, can be used to address educational programming.

The results of this study should be further explored, verified, and replicated in order to provide validity to the subtypes found.

At the clinical level, evaluation results should be utilized in order to devise an appropriate instructional program which best serves the individual needs of each student. Students who present with strengths in specific domains can receive more challenging and rigorous classroom supports, yet remain with grade level peers for socialization purposes and for instruction in subjects that are not in the gifted range. In order to avoid student frustration, feelings of failure, and / or boredom (Winner, 1998), schools must educate the students appropriately in their specific areas of strengths and weaknesses. In addition, Gottfredson (2011) points out that students of above average intelligence learn differently from other students and learn best when they are allowed to structure their own learning (Gottfredson, 2011). Therefore, research may wish to explore the instructional techniques used with gifted students and also the learning style of the students as they relate to subtypes.

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Appendix A

School Psychologist Agreement

School Psychologist Name: ____________________________

School: ____________________________

Date: ____________________________

I, ____________________________________, hereby allow the use of my archival WISC-IV, and standardized achievement scores in the research project entitled *Cognitive / Academic Profile Subtypes of Gifted and Talented Students*. I understand the archival data will be anonymous and will not be reported by individual, practitioner, or school. I have obtained school district permission if needed for the release of this data.

Signatures:

____ Date:
School Psychologist

____ Date:
Director (Supervisor) of Special Education (if needed)

____ Date:
Superintendent (if needed)

Appendix B

Request for Data Letter

Dear School Psychologist,

We would appreciate your participation in a study entitled *Cognitive / Academic Profile Subtypes of Gifted and Talented Students.* The research is being conducted by Debora L. Buzinkai, Psy. D. Candidate, as a partial requirement for the Doctor of Psychology degree, and the principal investigator and supervisor of the research project is Lisa A. Hain, Psy.D.

The purpose of this project is to examine cognitive subtypes of gifted and talented students based upon subtest scores of cognitive and academic assessments. The archival data sought includes scores from the Wechsler Intelligence Test for Children – Fourth Edition (WISC-IV) and achievement assessment that were part of the most recent evaluation to aid in verifying the student as eligible for gifted and talented services. The achievement test scores can derive from any standardized, individually-administered, achievement test.

We are asking you to provide raw scores and standard scores/scaled scores of the WISC-IV, and the raw scores and standard scores/scaled scores from the test of achievement. As this is an *archival record review*, there will be *no contact* between myself or Dr. Hain and the child, family, or team members. In fact, we ask you to only report the WISC-IV, achievement scores, age, grade, gender, and disability label, not the child's name or any identifying information. There is no harm to the students or any involvement of the students needed, and all data will be presented in summative form, with no individual data identified. Although there will be no benefit to the individual child, we will be willing to provide participants with a summary of the results after the study is completed.

We thank you in advance for your attention and possible participation. If you wish to participate, you will be asked to sign an agreement form indicating that you have provided permission for the archival data to be utilized in this study. If you need further assistance or have any questions, please contact either Debora L. Buzinkai at deborabu@pcom.edu or Lisa A. Hain at lisahai@pcom.edu.

Debora L. Buzinkai, Ed.S. Lisa A. Hain, Psy.D.

Appendix C

Dissertation: Student Data Collection Workbook

Participant Identification Code #:_____________________

Date data was removed from student file:________________________

Check that each assessment has scores provided in full.

______ WISC-IV Subtests Scaled Scores, Standard Scores

______ Achievement Measure (Name:____________________________)

Other Variables: (Please indicate the following for the data file.)

Age: _________________

Grade: ________________

Gender: _______________

Check if data included in study: (All Criteria Met)

______Yes

______ No

WISC-IV Scores

Measures	Raw	Scaled/Standard
Similarities		
Comprehension		
Vocabulary		
Block Design		
Picture Concepts		
Matrix Reasoning		
Digit Span Forward (if computed)		
Digit Span Backward (if computed)		
Digit Span		
Letter-Number Sequencing		
Coding		
Symbol Search		
Verbal Comprehension Index		
Perceptual Reasoning Index		
Working Memory Index		
Processing Speed Index		
Full Scale IQ		

Notes:

Achievement Measure (Name)____________________________

Area (fill in)	Raw	Standard Score
Reading		
Math		
Written Language		