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Stealth Dyslexia: Cognitive and Achievement Profiles Of Gifted Students With Dyslexia

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ABSTRACT

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Identifying students who are gifted with dyslexia (GWD) has presented a host of challenges to practitioners in school and clinic settings because these individuals possess both qualities of giftedness and learning difficulties, yet do not 'fit' in either category. The term "stealth dyslexia" was coined to indicate the presence of high abilities that may mask dyslexia traits, complicate diagnostic accuracy, and allow individuals to compensate for their weaknesses. The masking of reading difficulties can cause dyslexia to remain undetected in gifted children for a prolonged period of time which may leave them prone to academic disengagement.

The present study provided an empirical examination of the patterns of academic strengths and weaknesses students with GWD. Using data from 98 clients from a private clinic, the scores of three different identified groups were compared: GWD, Gifted-only, and Dyslexia-only. A profile analysis, followed by post-hoc one-way ANOVAs, compared the groups across cognitive (WISC-V) and achievement (WIAT-III) measures. Results indicated that the cognitive scores of the groups varied from each other in the predicted patterns (i.e., higher verbal, abstract, and visual spatial reasoning) for Gifted-only and GWD, and lower cognitive efficiency (i.e., working memory and processing speed) for GWD and Dyslexia-only groups. Across achievement subtest variables, GWD scores were significantly above the Dyslexia-only students on all measures with the exception of Pseudoword Decoding, and below the Gifted-only students on all measures with the exception of Reading Comprehension and Listening Comprehension. Across achievement composite scores, the GWD scores were in between the Dyslexia-only and Gifted-only groups Total Reading and Reading Comprehension & Fluency, no different from Dyslexia-only on Basic Reading, and no different from Gifted-only on Oral Language. The GWD group displayed greater variability, as measured by the difference between highest and lowest subtest scores, in reading performance than the comparison groups. Finally, overall cognitive scores were significantly lower than the index score that omits working memory and processing speed among participants in the GWD group. The implications from this study regarding the nature, magnitude, and range of cognitive and achievement strengths and weaknesses of GWD students will help educators and psychologists accurately recognize and advocate for these students.

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DEDICATON

This dissertation is dedicated to my father, the late Cmdr. Martin E. Hardy.

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CHAPTER I

INTRODUCTION

Twice-exceptional (2E) is a term used to refer to students who have high abilities and coexisting disabilities. The term twice-exceptional has met with confusion and criticism (Lovett & Lewandowski, 2006) due to a lack of consensus of the characteristics and needs of this population of students. An operational definition, written by Reis et al. (2014) and based upon deliberations from the National Commission on Twice Exceptional Students, provided guidance that was broad enough to represent the diverse group of students comprising the 2E population but definitive enough to allow for appropriate services:

> Twice-exceptional learners are students who demonstrate the potential for high achievement or creative productivity in one or more domains such as math, science, technology, the social arts, the visual, spatial, or performing arts or other areas of human productivity AND who manifest one or more disabilities as defined by federal or state eligibility criteria. These disabilities include specific learning disabilities; speech and language disorders; emotional/behavioral disorders; physical disabilities; Autism Spectrum Disorders (ASD); or other health impairments, such as Attention Deficit/Hyperactivity Disorder (ADHD). These disabilities and high abilities combine to produce a unique population of students who may fail to demonstrate either high academic performance or specific disabilities. Their gifts may mask their disabilities and their disabilities may mask their gifts. (p. 222)

It is this last component that creates frustration for 2E students. Their abilities and difficulties tend to mask each other, and these under-identified students have often struggled in school. Students who are 2E have reported feelings of frustration due to pressure to perform (because of their gifted label) but not always having the ability (due to their disability; Barber & Mueller, 2011). These students, particularly those who were unidentified, were found to be at risk for emotional challenges, poor attendance, and school failure, feelings of academic ineptitude, anxiety or fear of failure in academic tasks, as well as academic underachievement (Baum & Owen, 2004; Kaufman, 2018).

While 2E students have broadly encompassed students who were identified as gifted and presented with any form of disability (such as ADHD, Autism Spectrum Disorder, or other developmental disorder), the largest group within this population have been students who were presented with giftedness and dyslexia. They have possessed both qualities of giftedness and learning difficulties; however, they have not functioned solely like a gifted student or as a student with learning disability. Instead, they displayed a combination of strengths and weaknesses, with the strengths often masking areas of struggle (Antshel, 2008; Antshel et al., 2007). 00

Defining Twice Exceptional Students

It is important to clarify the terminology and language used throughout the present study. Scholarship on twice exceptional students includes a wide range of definitions depending largely on the clinical or educational settings in which the disorders or disabilities are identified. As noted, the term twice exceptional or 2E refers broadly to a population of students who have been identified as both gifted and having any form of disability as defined by federal or state eligibility criteria (such as ADHD, Autism Spectrum Disorder, or any specific learning disorder).

The terms learning disorder (LD) or specific learning disorders (SLD) are used in medical and clinical settings, while the term "learning disability" is used by both the educational and legal systems. Confusion arises because the terms are often used interchangeably, however, it is important to note that an individual with learning disability (often noted in research as LD) is not exactly the same as an individual with specific learning disorder (often noted as SLD). However, most individuals with a diagnosis of SLD will also meet criteria for a learning disability (5th Edition; DSM-5; American Psychiatric Association [APA], 2013).

The term "dyslexia" is a type of learning disability that refers to a pattern of learning difficulties characterized by problems with accurate or fluent word recognition, poor decoding and poor spelling abilities. In the context of schools, dyslexia is included within the Specific Learning Disability (SLD) category under IDEA. As with the other terms, there are many definitions for dyslexia and controversies surrounding its identification, which will be covered in Chapter 2. It is important to note that a child who is diagnosed with a Specific Learning Disability (SLD) is not necessarily dyslexic; however, dyslexia is the most common SLD.

For the purposes of this study, the term dyslexia was used to refer to a difficulty in acquiring and processing language that is typically manifested by the lack or proficiency in reading, spelling and writing, which is distinct from other types of SLDs. However, when citing the work of other researchers, the terminology used by those authors will be preserved to accurately reflect their work.

Stealth Dyslexia

The focus of this study was on the specific combination of high cognitive ability and dyslexia, sometimes referred to as stealth dyslexia. Eide and Eide (2006) were the first to describe the phenomenon of students with average to above average verbal reasoning abilities who used coping strategies to hide their reading deficits. The term "stealth dyslexia" was coined to indicate the presence of high abilities in verbal or non-verbal information processing which could mask dyslexia traits, complicate the diagnosis, or help individuals compensate for their weaknesses (Silverman, 2009; van Viersen et al., 2016). Individuals with stealth dyslexia are viewed as somewhat of a paradox because they struggle academically due to difficulties with reading accuracy, fluency, and decoding; yet they often showed age-appropriate or even superior reading comprehension skills (Eide & Eide, 2005; Silverman, 2003). It was hypothesized that bright individuals could compensate by getting the gist of what they read, thus appearing to be reading on a level with their peers. However, they actually had some form of difficulty with the core aspects of decoding and had to rely on use of context and verbal reasoning to make sense of a passage (Eide & Eide, 2012). They were also able to compensate for problems in decoding words on the basis of sound (phonological awareness) by skipping words they did not know, filling-in the gaps by guessing or through relying on inference and/or their general knowledge. However, superior verbal reasoning does not eliminate the core impairments of dyslexia related to the verbal working memory architecture that supports written language (Berninger & Abbott, 2013). As reading material became more complex and less familiar, the inability to automatically decode words jeopardized reading comprehension, and coping strategies were no longer sufficient to compensate for their deficits. Unless these skills were assessed and educators were aware of which skills were impaired in an individual student, the stealth dyslexia would remain invisible.

Identifying those students who are gifted with dyslexia (GWD) in a school setting has presented a host of challenges. Achievement scores earned by the gifted child with a learning disability were often within the average range of performance based on grade placement yet were relatively weak when one considered overall high cognitive performance. This “average” performance was not “failure” enough to be referred for an evaluation due to this masking effect (Assouline et al., 2010). The result was that these students received neither the interventions they needed for their disability, nor the interventions they needed to support their giftedness. The National Association for Gifted Children’s (NAGC, 2018) position paper on twice exceptionality called for awareness and understanding for this critical group of learners with early interventions so that their educational and personal needs could be met. The paper further stated that the gifted student with a learning disability often went unnoticed in the classroom because average performance on grade-level curriculum appeared to satisfy most educators.

In their qualitative study with parents of children who were both gifted and had a disability, Berninger and Abbott (2013) described the frustrations and challenges that parents experienced in the process of accurately identifying their children as GWD. Parents whose children had superior or very superior verbal reasoning shared how difficult it was to convince educators that their child had a learning disability. Teachers frequently reported that the student was bright, and the problem was just a matter of motivation and poor work ethic (Berninger & Abbott, 2013). As Ali (2015) summarized, parents of readers who were GWD often heard that their children were:

> Lazy, unmotivated, underachieving, inattentive, in his own world, daydreamer, argumentative, stubborn, complains, whines about assignments, makes careless mistakes, has messy handwriting, lacks organization, needs to try harder, prefers to work alone, needs prompting to finish written classwork, non-preferred task, aversion to schoolwork and other pejorative terms are written in report card comments, when the child is trying so hard to swim against the tide. (p. 1)

Gifted students with dyslexia tend to present with high verbal reasoning abilities but may struggle with many aspects of reading. Despite the appearance of age-appropriate reading comprehension which enabled them to use their higher order oral language skills, gifted children with dyslexia may struggle with word decoding which, in turn, may impair their ability to read short passages where they could not rely on context or read passages on an unfamiliar topic with many unfamiliar words. They may also struggle to keep up with lengthy reading or writing assignments (Eide & Eide, 2009). The reading difficulties were inconsistent with expectations for their perceived ability. Unfortunately, these difficulties persisted, were resistant to remediation, and threatened self-esteem (Gilman & Peters, 2014). The masking of literacy difficulties could cause dyslexia to remain undetected in gifted children for a protracted time, despite achievement being lower than anticipated given the intellectual capacities of the child (van Viersen et al., 2016). It is difficult to recognize literacy difficulties in these children because of their achievement; they might not appear to fulfill the criteria for dyslexia and have not been referred for a diagnostic assessment. As Berninger and Abbott (2013) stated, "Although students with dyslexia may not be the lowest achieving readers in a class, they still need to have their dyslexia diagnosed and treated regardless of their level of verbal reasoning ability" (p. 230).

Problem Statement

In order to identify students who are GWD, a thorough understanding of their academic and achievement strengths and weaknesses is needed, and indeed, failure to analyze the unique profile of these learners may leave them prone to academic disengagement (Ottone-Cross et al., 2017). Much research has been conducted on the pattern of strengths and weaknesses of students with either dyslexia or giftedness, but very few have examined the population of students who were identified both gifted and with dyslexia (Berninger & Abbott, 2013; Hannah & Shore, 1995; Lovett & Sparks, 2013; Maddocks, 2018, 2020; Ottone-Cross et al., 2017; Ottone-Cross et al., 2019).

The pattern of cognitive strengths and weaknesses of students with learning disabilities (but without gifted identification) has been well-documented and thought to be domain specific, meaning that, while the weaknesses interfered with learning and achievement, they were not pervasive and did not affect all areas of cognition (Flanagan & Alfonso, 2017). Students with dyslexia tend to have average or higher scores in the domains of verbal reasoning, visual spatial skills, and fluid reasoning skills, and relatively lower performance in working memory and processing speed (Shanahan et al., 2006). Recent neurological research has provided insight into these underlying deficits, which were thought to relate to impairment of the phonological loop and, thus, negatively affected areas of cognitive proficiency, including working memory and processing speed (Berninger et al., 2006). Regarding achievement profiles, students with dyslexia had scores that were unexpectedly low as compared to their cognitive abilities on orthographic processing, phonological processing (e.g., blending words), sight word recognition, reading accuracy and fluency, and comprehension (Flanagan & Alfonso, 2017). Students who were gifted typically had mean scores in the superior range for all cognitive measures, both in their verbal and non-verbal reasoning abilities as well as domains of cognitive proficiency (Raiford et al., 2014). Gifted students without dyslexia typically showed achievement scores at a level that was commensurate with their cognitive abilities (Murphy, 2020).

The cognitive and academic profiles of students who are both gifted and have dyslexia has been more complex. Over the last decade, there has been an ongoing debate regarding the specific identification criteria for gifted among students with learning disabilities (Bracamonte, 2010; Foley Nicpon et al., 2011, Foley Nicpon & Assouline, 2020; Lovett & Sparks, 2011). The lack of standardized identification criteria has a major impact on the number students who qualified for services and supplemental instruction. As a result, both researchers and practitioners have called for reliable and valid methods to identify these students who are 2E. Lovett and Sparks (2011) reviewed 19 empirical studies on gifted students with learning disabilities and found wide variability in identification criteria for giftedness with standard scores cutoffs ranging from 120 to 130 on overall ability. Using an IQ-achievement discrepancy, indication of a learning disability was identified using an achievement cluster score for math, writing, or reading that was between 1 and 1.75 standard deviations below the IQ score. Importantly, they found that academic skills in a GWD population may be substantially above average, meaning that they may not appear impaired in an absolute sense (i.e., relative to their same-age peers).

To highlight the variability in identification criteria, Maddocks (2018) explored the number of students who would be identified as gifted with a learning disability within a nationally representative sample population using methods. The wide-ranging criterion tended to over- and under-identify students for giftedness and learning disability categories. The results of this exploration suggested that popular discrepancy models for identifying learning disabilities in a gifted population were inadequate and more precise identification criteria were needed. To address these concerns, Maddocks (2018) suggested that future research identify the magnitude of the score discrepancy for the population of gifted with a learning disability population and evaluate the best way to use assessment scores for this identification.

Another approach proposed as useful for identifying GWD was to explore the variability, or scatter, between high and low subtest scores on measures of cognitive ability (Ferri et al., 1997). The authors, who used the term gifted with a learning disability (GLD) found that the difference in cognitive ability subtest means between standard deviations of the GLD group and the LD only group was significant with a large effect size. Earlier work by Silverman (1989) also found significant scatter in various scores. Very little research has explored whether score variability, as measured by the difference between high and low scores as well as the variance of both cognitive and achievement scores, is a distinguishing factor in the identification of GWD.

More recently, patterns of academic strengths and weaknesses have begun to emerge in the literature. A study by Ottone-Cross et al. (2017), compared GLD with gifted only and SLD only students on measures of academic achievement. The results indicated that the GLD students performed similarly to the gifted students on measures of reading comprehension, written expression, and math concepts, while they performed similarly to the SLD group on a measure of basic phonic decoding. The GLD group also showed weaknesses relative to their gifted counterparts in phonological processing, word reading, reading accuracy, reading fluency, spelling, and memorizing math facts. Two limitations of this study were that students were identified as potentially gifted using a brief oral language screener as a proxy for verbal reasoning abilities which was not a robust indicator of ability. Furthermore, all disability categories (math, writing, and reading) were grouped together which clouded the profile of strengths and weaknesses for the subpopulation of reading disability-only.

Similarly, Berninger and Abbott (2013) compared performance on a variety of cognitive and academic measures for students identified as gifted with dyslexia and those who were identified as average with dyslexia. Verbal reasoning was used as a proxy for overall ability. Performance on working memory, reading, and writing measures were compared between the two group groups of students. The two groups did not differ on measures of working memory (including non-word repetition, rapid automatic naming, and other measures of sustained attention), however, they did differ by approximately 1.5 standard deviations on measures of word reading and non-word decoding. These findings supported the conclusion that superior verbal reasoning did not eliminate the core impairments in dyslexia, including pseudoword reading and rapid automatic naming. The current study builds on the work of Berninger and Abbott (2013) with two key differences: giftedness was assessed using a more global composite (e.g., General Ability Index from the Wechsler Intelligence Scale for Children-Fifth Edition) and reading was assessed using a variety of achievement measures to evaluate several reading skills important to the identification of dyslexia in gifted children (e.g., the Wechsler Individual Achievement Test, 3rd Edition).

The most appropriate assessment tools for identifying giftedness in students with a co-existing learning disability have also been a source of debate. On standardized measures of cognition such as the Wechsler Intelligence Scale for Children (WISC-V), gifted students have tended to earn high mean scores on tasks that involved verbal or non-verbal reasoning ability, while they earned lower scores on measures of cognitive proficiency, such as working memory and processing speed. Extreme variation in scores could render the Full-Scale Intelligence Quotient (FSIQ) uninterpretable (NAGC, 2018; Silverman, 2018; Silverman & Gilman, 2020). The National Association for Gifted Children (2018) has issued a position statement related to use of the WISC□V recommending that the FSIQ should not be required for admission to gifted programs because it undermined the identification of gifted students by overemphasizing processing skills, relying on timed subtests, and creating an imbalance between verbal and nonverbal tests. Rather, they recommended that composite scores most heavily loaded on abstract reasoning, such as the General Ability Index (GAI) should be used to identify giftedness instead. Participants for the current study were identified as gifted if they met or exceeded a standard score of 120 on the GAI composite. A question that was explored in this study was whether GAI and FSIQ scores significantly differed between the youth identified with dyslexia, giftedness, and GWD.

To summarize, very little quantitative research has been conducted on the pattern of strengths and weaknesses on cognitive and achievement measures specifically for the sub-population of students with GWD. This study provided an empirical examination of the cognitive and academic profile of a clinically referred sub-population of gifted students with dyslexia. Understanding patterns of strengths and weaknesses between youth with GWD, Gifted-only, and Dyslexia-only may lead to more appropriate identification and intervention. Information about the nature, magnitude, and range of cognitive and achievement strengths and weaknesses of GWD students would help educators and psychologists accurately recognize and advocate for these students.

Purpose of the Study

The population of gifted children with dyslexia form a special group within the population of gifted children who also have learning disabilities. As van Viersen et al. (2016) discussed, the field of twice-exceptional research has relied heavily on anecdotal information and is in need of evidence-based practices regarding identification criteria for these students. The overall goal of the present study was to examine the score profiles on measures of cognitive ability and achievement between Gifted-only, Dyslexia-only, and GWD groups. These insights may provide a step toward better identification of students who are 2E.

The primary aim of the current study was to compare performance on cognitive and achievement measures in a clinical sample of three distinct groups of students: Gifted-only, Dyslexia-only, and GWD. Based on the literature, it was hypothesized that the students who were identified with GWD would have a pattern of scores that resembled Gifted-only students on measures of verbal reasoning, non-verbal reasoning, visual spatial ability, and reading comprehension. However, their performance on processing speed, working memory, word reading, pseudoword decoding, and spelling would be more similar to students identified with Dyslexia-only. A distinct pattern of cognitive ability and achievement scores would alert psychologists to the possibility of dyslexia in gifted students and giftedness in students with dyslexia. Thus, the first step was to identify characteristic patterns of index and sub-test score strengths and weaknesses on cognitive and achievement measures for children identified with GWD and then to analyze whether this pattern significantly differed from those students who were in the Gifted-only or Dyslexia-only groups. Secondly, this study sought to evaluate whether indicators of variability, as measured by the average range of scatter between the highest and lowest subtest scores as well as the variance of both cognitive and achievement scores, was a common factor in the profile. Lastly, this study investigated the use of WISC-V FSIQ versus GAI in the identification of giftedness among GWD students, who may obtain artificially low FSIQ scores, reflecting potential problems with cognitive proficiency sometimes associated with dyslexia.

Research Questions and Hypotheses

Based on the above reasoning, the following research questions were addressed by this study:

Q1 Are there unique profiles of GWD, Gifted-only and Dyslexia-only in the cognitive domain areas of Verbal Comprehension, Visual Spatial, Fluid Reasoning, Working Memory, and Processing Speed?

H1 The GWD group mean scores will be similar to the Gifted-only group on Verbal Comprehension, Visual Spatial and Fluid Reasoning.

H2 The GWD group mean scores will be lower than the Gifted-only group but higher than the Dyslexia-only group on Working Memory.

H3 There will be no difference between GWD and Dyslexia-only group on Processing Speed.

Q2 Are there unique profiles of GWD, Gifted-only, and Dyslexia-only in the academic achievement areas of reading?

H4 On the WIAT-III subtests of Word Reading, Pseudoword Decoding, Oral Reading Fluency, Spelling, the GWD group will be within 1 standard deviation of the Dyslexia-only group.

H5 On the WIAT-III subtest of Listening Comprehension, Reading Comprehension, and Oral Expression, the mean scores of students in the GWD group will fall within 1 standard deviation of the Gifted-only group.

H6 On the WIAT-III composite scores of Oral Language, Total Reading, Basic Reading and Reading Comprehension and Fluency, the mean scores of participants in the GWD group will fall between the mean scores of the Gifted-only and Dyslexia-only groups.

Q3 Is there a pattern of cognitive ability and achievement subtest score variability that is unique to the GWD group?

H7 Within the GWD group, there will be a larger discrepancy between subtests that leverage their reasoning skills (Reading Comprehension and Listening Comprehension) versus subtests that measure lower-level processing skills (Pseudoword Decoding and Spelling). This discrepancy will be significantly larger for the GWD group than for the Dyslexia-only or Gifted-only groups.

Q4 Is there a significant difference between FSIQ and GAI in the GWD group?

H8 FSIQ will be significantly lower than GAI for the GWD group.

Significance of the Study

Research about the GWD population has been largely qualitative (Dole, 2001; Hannah & Shore, 2008; Mann, 2006; Olenchak, 2009; Reis et al., 2000; Reis et al., 1995, 1997). More thorough empirical investigation has been a top priority in the field (Foley Nicpon et al., 2011). The goal of this study was to extend knowledge of the cognitive strengths and weaknesses of gifted children with dyslexia and to provide empirical data on their achievement and cognitive characteristics. This study quantified the cognitive and achievement discrepancies in a clinical sample with commonly used assessment measures. The implications of these findings illustrate the difficulty of recognizing literacy difficulties in this population based on their achievement. These findings will help school psychologists and diagnosticians move toward new diagnostic criteria for the GWD population. With more specific criteria, practitioners will be able to improve identification, intervention, and programming practices for GWD students.

Definitions of Key Terms

Dyslexia. Dyslexia is a specific learning disability that is neurobiological in origin. It has been characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically resulted from a deficit in the phonological component of language that was often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that could impede growth of vocabulary and background knowledge. In the present study, the term established by the International Dyslexia Association and adopted by the National Institute of Child Health and Human Development (Lyon et al., 2003) was used:

> Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge. (p. 2)

Gifted students. Those who demonstrate outstanding levels of aptitude or competence in one or more domains. Domains include any structured area of activity with its own symbol system and/or set of sensorimotor skills.

Stealth or masked dyslexia. Children with advanced cognitive ability who, similar to non-gifted children, struggle with sound-symbol recognition (phonemic awareness), reading fluency, spelling, writing, processing speed, and auditory processing of language.

Twice-exceptional. Students who demonstrate the potential for high achievement or creative productivity in one or more domains such as math, science, technology, the social arts, the visual, spatial, or performing arts or other areas of human productivity AND who manifest one or more disabilities as defined by federal or state eligibility criteria are considered twice-exceptional. These disabilities include specific learning disabilities; speech and language disorders; emotional/behavioral disorders; physical disabilities; Autism Spectrum Disorders (ASD); or other health impairments, such as Attention Deficit/Hyperactivity Disorder (ADHD).

CHAPTER II

REVIEW OF THE LITERATURE

This chapter provides a review of the current literature related to students who have been identified as GWD. The following topics are reviewed: (a) history of 2E identification, (b) prevalence of 2E students in the United States, (c) theoretical frameworks of giftedness and controversies surrounding identification of giftedness, (d) theoretical frameworks of dyslexia and controversies surrounding identification of dyslexia, and (e) a review of the literature regarding cognitive and achievement profiles of students identified as GWD.

Historical Background of Twice Exceptional Identification

The first psychologist to describe instances of normal intelligence among "defective" children was Leta Hollingworth (1923). She noticed that some students displayed special talents and advanced general mental ability coupled with learning difficulties in subjects such as reading, basic math, spelling, and handwriting. Subsequent research helped lay the groundwork for the field of learning disabilities, though the focus at that time was on "brain dysfunctions" and perceptual difficulties (e.g., Cruickshank et al., 1961; Kirk & Bateman, 1962). It was not until the 1970s when the famous child psychologist, David Elkind (1973) explicitly introduced the idea of "gifted children with learning disabilities". Throughout the 1960s and 1970s, gifted education and special education were largely separate fields, with little overlap in the classifications (Kaufman, 2018). In the 1970s and 1980s, the idea of giftedness expanded beyond just general intelligence and included specific aptitudes and abilities. With the recognition that children could be both gifted and have learning challenges, Meisgeier et al. (1978) argued for learning supports and advanced programming to meet student needs. Additionally, he noted their unique emotional needs. The term twice exceptional (sometimes abbreviated as 2E) was first introduced by Baum and Owen (1988) and further expanded upon in their influential book *To Be Gifted and Learning Disabled*. In the 1990s, state and federal funds as well as school programs for 2E students became available, alongside a growing understanding that individualized instruction was optimal and essential for students whose abilities were discrepant. The 2004 reauthorization of the Individuals with Disabilities Education Improvement Act was the first time that the federal government acknowledged the 2E profile and definitively asserted that a child could be both gifted and learning disabled.

Prevalence of Twice Exceptional Students in the United States

Estimates for the prevalence of students identified with giftedness and dyslexia range from 1% to 5% of the total population of children with learning disabilities (McCoach et al., 2004). It has been estimated that more than 360,000 students who are 2E attend school in the United States (National Education Association, 2006). However, it is important to keep in mind that these estimates may be conservative because they are based on a wide variety of definitions of giftedness and dyslexia that differ from state to state. Moreover, many 2E children might remain undetected as they may not stand out compared to the general population (Nielsen, 2002). Despite the growing body of research regarding these unique students, no clear consensus has emerged about the best way to screen for or identify gifted and learning-disabled status (Assouline & Whiteman, 2011). A lack of concrete definition, patterns of underachievement, underestimation of intellectual abilities, and masking effects were considered the main reasons for the problems with adequate identification and early intervention for students who are 2E

(Brody & Mills, 1997; Foley Nicpon et al., 2011; McCoach, et al., 2001). In order to explore these criteria in more detail, the next sections provide a review of the definitions of giftedness and dyslexia, the controversies that surround their identification, and the implications for the present study.

Giftedness

Theories of Giftedness

Broadly speaking, giftedness is described as individuals who possess skills or abilities that are superior to that of their same-aged peers. Although giftedness has historically been associated with cognitive abilities, more contemporary models have included individuals who have superior abilities across academic and non-academic domains. There have been several theoretical frameworks of giftedness; those of Lewis Terman, Francois Gagné, and Joseph Rezulli are three of the most important.

Terman (1922), a pioneer in educational psychology, developed some of the earliest and most successful measures of individual differences. He believed that mental abilities were largely the product of heredity, and he viewed giftedness as a product of general intelligence. Terman adapted the Binet test into the Stanford Binet intelligence scale and was the first to calculate a full-scale intelligence quotient (FSIQ) based on a normative sample. By standardizing the scores, he was able to identify the average level of intelligence among test takers. It also allowed him to identify individuals who were well above or below this range. Those whose scores exceeded this norm by more than two standard deviations (IQ above 140) were considered gifted. Terman (1925) suggested that gifted children should be identified early, offered tailored instruction, and have access to specially trained teachers. His research was influential in the early conceptualization of giftedness as high cognitive ability, or IQ, a variable that has continued to play a major role in most models of giftedness. However, several contemporary conceptualizations extended giftedness to other types of intelligence and domain-specific abilities.

For example, Renzulli (1978) suggested that giftedness was more than just high ability and posited that it occurred when there was an interaction between three basic clusters of human traits: high abilities, high motivation, and high creativity. In his view, gifted students were those who could synthesize these three traits and apply them to an area of human endeavor. Gagné (1985) proposed a differentiated model of giftedness and talent which designated the possession and use of untrained and spontaneously expressed natural abilities (called aptitudes or gifts) in at least one ability domain to a degree that it placed a child among the top 10% of their same-age peers. His model included five aptitude domains: intellectual, creative, socioaffective, sensorimotor, and "others" (e.g., extrasensory perception).

Today, there is still ongoing debate about the nature of giftedness and whether it represents a trait, innate ability, or whether it is the result of nurturing and disciplined practice. In an attempt to integrate the multiple conceptualizations of giftedness, NAGC (2014) offered the following definition:

> Gifted individuals are those who demonstrate outstanding levels of aptitude (defined as an exceptional ability to reason and learn) or competence (documented performance or achievement in top 10% or rarer) in one or more domains. Domains include any structured area of activity with its own symbol system (e.g., mathematics, music, language) and/or set of sensorimotor skills (e.g., painting, dance, sports). (p.1)

The NAGC implied that the term “giftedness” was specifically defined in some educational regulations in some states, but may be called "high ability," "talented," or other designation in other states. Subotnik et al. (2011) offered an integrated definition that focused on the potential outcomes associated with gifted identification. The authors argued that potential was transformed into achievement and then expertise and that some experts go on to become eminent due to the transformative and enduring nature of their contributions. Hence, fully developed talent, demonstrated by some creative product, performance, or idea that changes a field or domain, was the ultimate goal of the talent development process.

To summarize, there are several frameworks to measure giftedness that range from giftedness as cognitive ability, talent development, or as early potential that transitions to expertise in a domain. The next section discusses the theoretical framework used for identifying giftedness that guided the present study, common practices to identify gifted students, and the role of school psychologists in this process.

Theoretical Framework: Cattell-Horn-Carroll Theory of Intelligence

The Cattell-Horn-Carroll (CHC) theory of intelligence has particular relevance for school psychologists as it is the underlying foundation for the psychoeducation assessments used to identify giftedness and learning disabilities. CHC is considered to be one of the most researched, empirically supported, and comprehensive hierarchical psychometric frameworks for understanding the content and structure of cognitive abilities. Given the breadth of empirical support for the CHC structure of intelligence, it provided one of the most useful frameworks for designing and evaluating psychoeducational batteries, including intelligence, achievement, and neuropsychological tests (Flanagan et al., 2008; Keith & Reynolds, 2010). The integrated model of CHC theory of intelligence includes broad abilities and narrow abilities. The broad abilities are listed in Table 1.

Table 1

Definitions of Cattell-Horn-Caroll Broad Cognitive Abilities

Broad Ability	Definition
Fluid reasoning (Gf)	The broad ability to reason, form concepts, and solve problems using unfamiliar information or novel procedures
Comprehension-knowledge (Gc)	The breadth and depth of a person's acquired knowledge, the ability to communicate one's knowledge, and the ability to reason using previously learned experiences or procedures
Visual processing (Gv)	The ability to perceive, analyze, synthesize, and think with visual patterns, including the ability to store and recall visual representations
Short-term working memory (Gwm)	The ability to apprehend and hold information in immediate awareness and then use it within a few seconds
Long-term storage and retrieval (Glr)	The ability to store information and fluently retrieve it later in the process of thinking
Processing speed (Gs)	The ability to perform automatic cognitive tasks, particularly when measured under pressure to maintain focused attention
Auditory processing (Ga)	The ability to analyze, synthesize, and discriminate auditory stimuli, including the ability to process and discriminate speech sounds that may be presented under distorted conditions

Note. Adapted from Schneider and McGrew (2012).

Assessing Intelligence

There are a number of tools used to measure intelligence in children and adolescents. One of the most commonly used is the Wechsler Intelligence Scale for Children (WISC-V), which has been adapted from previous versions to align with CHC theory (Wechsler, 2014). The WISC-V is a carefully normed instrument for use with children and adolescents aged 6 to 17 years old. It was designed to identify intellectual giftedness, intellectual disability, neuropsychological functioning, and specific cognitive strengths and weaknesses, and is commonly used as part of a battery of tests to identify specific learning disabilities such as dyslexia. There are 16 sub-tests that are combined in various ways to measure six of the broad abilities as outlined above (Gc, Gv, Gf, Gsm, Gs, Glr). These abilities are grouped into index scores that include Verbal Comprehension (using and understanding language), Fluid Reasoning (solving nonverbal problems), Visual Spatial (organizing items in space), Working Memory (memorizing auditory and visual information), and Processing Speed (fluent problem solving).

The Use of General Ability Index Versus Full-Scale Intelligence Quotient

The WISC-V contains three general ability scores that provide a summary of intellectual abilities: the Full-Scale Intelligence Quotient (FSIQ), the Non-Verbal Intelligence index (NVI), and General Ability Index (GAI). The FSIQ is the most comprehensive estimate of overall ability because it is based on seven sub-tests that measure aspects of five cognitive constructs (Gc, Gv, Gf, Gsm, and Gs). The NVI measures four cognitive constructs, and the GAI measures three (Gc, Gv, and Gf). The GAI represents an estimate of overall intellectual ability, verbal and non-verbal reasoning ability, and minimizes the demands of working memory and processing speed. These two constructs are considered to be reflective of cognitive proficiency rather than cognitive ability. According to outcomes with the norming sample, the GAI was highly reliable (.96; Wechsler, 2014) and had a high correlation with FSIQ (.96). From a clinical perspective, there are times when use of the GAI is recommended. Specifically, when these indices are substantially discrepant from the other subtests or if it is suspected that an individual’s identified disorder (e.g., Attention Deficit Hyperactivity Disorder) is interfering with their performance on these subtests, use of a GAI may be indicated. Flanagan and Alfonso (2017) noted that working memory and processing speed were not typically the strongest areas of performance for individuals of high intellectual ability and, in fact, the higher the individual's ability level, the more common it was to see larger differences between reasoning abilities and cognitive proficiency. Unfortunately, in some circumstances, use of a FSIQ instead of GAI excluded students from gifted and talented programs (Flanagan & Alfonso, 2017). They suggested that many very bright individuals used a methodical and reflective approach to tasks such that they valued accuracy over speed. Furthermore, processing speed and working memory were subject to threshold effects, meaning that a certain level of memory and speed are required to perform higher-level reasoning tasks, but beyond that level, they did not add to intelligence measures. Normative data from the WISC-V appeared to support this conclusion because when working memory and processing speed were in the average range, higher level reasoning abilities were not compromised (Flanagan & Alfonso, 2017). The GAI, as a measure of processing information necessary to learning, problem solving, and higher-level thinking, has been a viable alternative to the FSIQ for summarizing overall intellectual ability, particularly in students with high ability. Therefore, the GAI was used in the identification of students for participation in the present study.

Identification of Students who are Gifted

Because there is no agreed upon definition that has been adopted by each state, there are many different approaches to identifying youth who are gifted. Furthermore, there has been a great deal of focus on assessment instruments and identification protocols within the field of gifted education. Although early research focused on definitions of giftedness that relied on intellectual ability, over time these definitions have expanded leading to a broader range of instruments that can be used to identify giftedness.

Identification of giftedness has typically been based on unusually high aptitude in one or more areas of cognitive functioning. According to Webb and Dietrich (2005) defining giftedness has been controversial; it is a broad concept that ranges in definition from high intellectual abilities to rarities in different aspects of life skills. The two broadest definitions come from NAGC (2014) and the federal definition according to The Jacob Javits Gifted and Talented Students Education Act which stated:

> Children and youths who give evidence of higher performance capability in such areas as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who require services or activities not ordinarily provided by schools in order to develop such capabilities fully. (U.S. Department of Education, 2012, p. 5)

Best practices for psychological and school-based assessments of giftedness require the use of multiple criteria that may include measures of achievement as well as cognitive ability (NAGC, 2015). However, for the purposes of research, it is more common to use a single score as an estimate or proxy for intelligence. The traditional standard for gifted identification in research settings has been a cutoff score of either 120 or 130 on a full-scale intelligence measure (Silverman & Gilman, 2020; Volker & Phelps, 2004)

Standardized intelligence tests have been normed on a representative sample of the U.S. population and, therefore, comparing a student's abilities with those of their same-aged peers allowed researchers to identify those whose abilities were exceptional (more than two standard deviations above the mean) and rare (occurring in 2-3% of the population). Determining giftedness from an IQ test was a reasonable approach to gifted identification given that there was robust research indicating that IQ was a substantive predictor of both school achievement and job performance (Neisser et al., 1996; Nisbett et al., 2012). As Johnsen (2012) argued, using standardized scores was preferable to other methods of identification that relied on performance in school or teacher recommendation. He reasoned that gifted identification should be based on IQ scores that were psychometrically sound and technically accurate, with demonstrated construct validity and reliability for the population being evaluated.

As previously mentioned, if using an ability assessment such as the WISC-V, the GAI is preferred over the FSIQ for identification of children for gifted programs. A position statement by the NAGC related to use of the WISC-V warned against the mandatory use of full-scale scores and endorsed the use of index scores that optimized measures of reasoning and minimized processing skills. In research, there was no consensus regarding the optimal cutoff to identify giftedness with a single indicator score, however, researchers have argued that a score of GAI > 120 was appropriate (Assouline et al., 2010; Silverman, 1989). The dataset provided for the present study used the threshold of GAI > 120 which represented a "Superior" level of performance. This specific approach permitted consistency of data collection and assured a certain level of standardization in the sample.

Identification protocols used by school systems often incorporate criteria related to accomplishment in academic areas, which reflect the controversy between high achievers and giftedness. Some in the field have argued that many gifted students were simply high academic achievers without necessarily having a corresponding high IQ. Conversely, there may be students who did not demonstrate exceptional academic performance, but in other ways would be considered gifted. High academic achievement was not a universal goal for all gifted students (Gilman, 2020). Identification has also been complicated by equity concerns in that children from low-income backgrounds or those who are ethnically and linguistically diverse would not have experienced the same opportunities as their peers and would be under-identified, thus, creating an opportunity gap (Ford, 2012). Similarly, these performance related criteria were likely to miss 2E students who were achieving below their potential.

State and local school districts have not been required to use the federal definition of giftedness nor have they been required to define, identify, or serve gifted students. According to State of the States in Gifted Education survey from NAGC for the 2014-2015 academic year, only 37 states defined giftedness, and even fewer states (32) mandated identifying or providing services for gifted learners (NAGC, n.d.). For those states that have an identified process, most require a teacher or parent referral as an initial step followed by further assessment for gifted services at multiple points across grades K-12. Local school districts have used specific criteria to identify gifted and talented students, most commonly by applying a multiple-criteria model with a minimum of two types of information (e.g., typically IQ test score and teacher referral). According to the NAGC, the most frequently required criteria for identification included IQ scores, achievement data, teacher nominations, performance on state assessments, and student portfolios. Given the variability among states, the determination of whether students were identified as gifted and talented was highly dependent upon the state in which they lived.

More recently, schools have started to utilize group screening measures to identify giftedness, believing that evaluating all students on the same measure was the most equitable approach. The Cognitive Abilities Test (CogAT Form-7; Warne, 2015) and earlier versions of this measure have been commonly administered as a screener for giftedness. However, criticisms of these screeners include their brevity and the lack of detailed assessment of strengths and weaknesses found in comprehensive intelligence tests (Gilman, 2020).

School psychologists have played an important role in identifying and supporting academically gifted students within the school setting. As such, the National Association of School Psychologists (NASP, 2010) has provided guidance on the roles and responsibilities of school psychologists in relation to the students within their schools. One of the main jobs of a school psychologist is to help all students live up to their highest potential. This goal is particularly important for academically gifted populations because studies indicated that a failure to identify outstanding students' academic talent can lead to frustration, a loss of self-esteem, boredom, laziness, and underachievement (Crocker, 2004; Knight & Becker, 2000). Diezmann and Watters (2006) found that gifted students who were not identified quickly surpassed their non-gifted classmates and became accustomed to a relaxed approach to learning, which created serious learning difficulties when confronted with difficult and complex material in higher grades. Leaders in the field of gifted research have called for school psychologists to adopt a talent development perspective by leveraging systems of assessment that are able to identify academically gifted youth as well as provide students with multiple opportunities to exhibit academic talents (Worrell et al., 2019).

To summarize, procedures for identifying gifted students has been an important topic in the field of education and school psychology. There is a long history of identifying giftedness based on cognitive ability scores. Specifically, cognitive instruments that use a CHC model to identify the cognitive domains provide a solid foundation for measuring different aspects of ability. Among these instruments, the WISC-V is one of the most commonly used instruments in school and clinic setting. Based on the unique patterns shown by individuals who are twice exceptional, use of the GAI from the WISC-V provided a less biased approach to documenting the strengths of gifted children (Silverman & Gilman, 2020).

Dyslexia

Broadly speaking, dyslexia is thought of as an unexpected difficulty in an individual who has the intelligence to be a much better reader (Ferrer et al., 2010). Dyslexia is often first evident in kindergarten when children are not able to name letters or learn sounds that are associated with them (Berninger et al., 2006). People with dyslexia have trouble matching the letters they see on the page with the sounds those letters and combinations of letters make. Children and adults with dyslexia struggle to read fluently, spell words correctly, and learn a second language, among other challenges (Shaywitz et al., 2021). Dyslexia has been reported in every culture studied (Peterson & Pennington, 2012). An estimated 5 to 15% of school-age children struggle with a learning disability of any kind while an estimated 80% of those with learning disorders have dyslexia (APA, 2013). Dyslexia is the most common of all neurodevelopmental disorders, affecting 20% of the population, and is found in males and females equally (Shaywitz et al., 2021). The cause of dyslexia has been thought to be multifactorial and has been associated with multiple genes and environmental risk factors (Peterson & Pennington, 2012). Dyslexia is familial and moderately heritable (Pennington & Olson, 2005).

Definitions of Dyslexia

One of the major problems in the identification of SLDs, and especially dyslexia, has been that the federal and state definitions are not technical, thus determining if a student has this disorder has been a subjective process (Beaujean et al., 2018). In fact, Congress has not taken a clear position on how SLD should be identified. The Federal definition has required that students fail to make “adequate progress” or perform significantly below grade-level expectations before they might be identified as having a learning disability, however, the specific criteria have differed from state to state. The 2004 definition of Specific Learning Disability from the Individuals with Disabilities Education Act (IDEA, 2004) described it as

> A disorder in one or more of the basic psychological processes involved in understanding or using language, spoken or written, which manifests itself in the imperfect ability to listen, think, speak, write, spell, or do mathematical calculations. Such terms include such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. (p. 2688)

As a result, there has been little consensus about the characteristics of dyslexia other than an unexpected underachievement, and it has been left up to each state to determine how to measure the discrepancy. After the reauthorization of IDEA in 2004, school districts were granted greater flexibility in assessment procedures for determining LD identification, and some states (including Colorado) have since mandated the use of Response to Intervention (RTI) as the primary method for identifying learning disabled students (Zirkel, 2012). Today, 39 states have continued to allow school districts to use the RTI model, while 11 states have forbidden its use.

This broad term (SLD) is more narrowly defined for dyslexia by focusing on a specific area of deficit. The International Dyslexia Association has characterized dyslexia by "difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected, in relation to other cognitive abilities and the provision of effective classroom instruction" (Lyon et al., 2003, p. 2). Fletcher (2009) has argued that new definitions of dyslexia are moving away from describing a general "reading disorder" and are focusing on specific types of reading problems, which include problems in decoding single words, fluency problems marked as a difficulty to read words and text automatically, and comprehension problems.

Fletcher (2009) further noted that even though individuals who have dyslexia typically show problems in the three domains described above, smaller groups of children with dyslexia have also experienced problems in fluency and/or comprehension abilities only (Fletcher et al., 2018). Regardless of the presentation, in most cases, these difficulties persist into adulthood (e.g., Lyon et al., 2003).

Current Theoretical Models of Dyslexia

The prominent theoretical models of dyslexia have tended to focus on phonological processing deficits. There has been considerable evidence that dyslexia is marked by deficits in phonological awareness, orthographic coding, or rapid naming abilities which impair students' ability to connect sounds to letters in the accurate and rapid manner required for fluent reading (Vellutino et al., 2004). There has been a general agreement that dyslexia is the result of brain differences leading to a cognitive difference in processing the information that the brain is receiving from the senses, though there is less agreement on its exact causes.

The phonological theory postulates that individuals with dyslexia have a specific impairment in the representation, storage and/or retrieval of speech sounds. The model proposes that reading an alphabetic system requires learning the grapheme–phoneme correspondence, and if these sounds are poorly represented, stored, or retrieved, reading impairments may result (Ramus, 2003; Snowling et al., 2000; Vellutino et al., 2004). According to Ramus (2003), having poor phonological awareness contributed to difficulties in performing tasks such as syllable counting, phoneme deletion or substitution, or rapid oral naming of letters or objects in a rapid manner. Therefore, according to this theoretical model, the central and causal role of phonology in dyslexia points to a direct link between a cognitive deficit and resulting output difficulties. Neurologically, it is thought that the origin of the disorder is a dysfunction of left□hemisphere brain areas underlying phonological representations (Pugh et al., 2000; Shaywitz et al., 2002; Temple et al., 2001). Support for the phonological theory comes from evidence that dyslexic individuals perform particularly poorly on tasks requiring phonological awareness, such as segmentation and manipulation of speech sounds. However, evidence for poor verbal short-term memory and slow automatic naming in individuals with dyslexia also points to a more basic phonological deficit, perhaps having to do with the quality of phonological representations, or their access and retrieval (Snowling et al., 2000).

The rapid auditory processing theory is an alternative to the phonological deficit theory, which specifies that the primary deficit lies in the perception of short or rapidly varying sounds. Support for this theory arises from evidence that people with dyslexia show poor performance on a number of auditory tasks, including the retrieval of verbal labels for visual stimuli (Marshall et al., 2001). In the Marshall et al. study, the authors argued that there was no evidence that phonological difficulties were secondary to impairments of rapid auditory processing. Debate remains about how distinct rapid serial naming is different from other aspects of phonological processing (Vaessen et al., 2009).

Challengers of the phonological theory do not dispute the existence of a phonological deficit and its contribution to reading impairment. Rather, they argue that cognitive deficits are not exclusively phonological in nature. The double-deficit theory, which is an extension of the dominant phonological deficit theory, has proposed that the core impairments are the result of both a phonological deficit and a rapid-naming deficit (Wolf & Bowers, 2000). According to these authors, rapid automatized naming was an important skill for reading development and directly influences reading performance in terms of fluency. Their investigations suggested that phonological deficits had a strong relationship with decoding accuracy, whereas naming-speed deficits were strongly associated with reading fluency, and individuals who have both deficits show greater reading impairments compared to those with a single deficit. Neurological studies using functional MRI have pointed to the key brain regions associated with phonological awareness and rapid naming, providing neuroanatomical evidence for the double-deficit hypothesis (Norton et al., 2014). These studies suggested that children with a double deficit have the greatest reduction in brain activation in regions important for both rapid naming skills and phonological awareness, even when compared with children who had single deficits (Norton et al., 2014).

One of the problems with specifically identifying the cause of dyslexia is that it is often co-morbid with other conditions (Gooch et al., 2014). Some studies have reported over 50% of individuals who met the diagnostic criteria for dyslexia also had another condition (Iversen et al., 2005; Petryshen et al., 2001). Difficulty linking letters to speech characterizes most cases, but there are other factors related to reading difficulty that could result in a diagnosis of dyslexia. It can be especially difficult to narrow down the presence of dyslexia in children because attention deficits commonly co-occur with reading problems. Some researchers have argued that phonological awareness deficits do not fully explain the breadth of impairment or severity that some individuals display (Wolf & Bowers, 2000), while others have gone so far as to assert that a definition of dyslexia should include broader areas of difficulties with organization and attention (Reid et al., 2003). Theoretical models of dyslexia are also butting up against competing notions of literacy, and that dyslexia may not exist separately from "poor readers" (Elliott & Gibbs, 2008).

Theories of the etiology of dyslexia have and are evolving with each new generation of dyslexia researchers, and the more recent theories of dyslexia tend to build on one or more of the established theories as understanding of the nature of dyslexia evolves. The next section discusses how dyslexia has been predominantly identified and diagnosed by school/educational psychologists.

Frameworks for Identification of Dyslexia

Because dyslexia has been considered to be part of a specific learning disability (SLD), most state departments of education do not have separate identification criteria for dyslexia. Instead, practitioners have been given guidance for identifying SLD, with the understanding that most students with this disability will have a form of dyslexia. There are three prevalent methods for identifying individuals with SLD that have been developed by researchers and have been adopted in education policies (Miciak & Fletcher, 2019). These frameworks are called IQ-Achievement Discrepancy, Response-to-Intervention (RTI) and Patterns of Strengths and Weaknesses (PSW). Although these models have different procedures, they all share the same core assumption that SLD is identified by unexpected underachievement as well as a weakness in specific cognitive abilities.

The IQ-Achievement Discrepancy framework was the traditional method for identifying any type of learning disability. Students could be identified in one of a few areas (e.g., Oral Language, Basic Reading, Reading Comprehension, Math Computation, Math Reasoning, and Written Expression). This method defined dyslexia by a significant discrepancy between a person’s general intellectual ability (IQ) and reading achievement levels, though this approach has been discredited by some researchers due to poor validity and sensitivity, inconsistent implementation, and poor psychometric rigor in the research that supported its use (Restori et al., 2009). Stothard et al. (2018) found most psychologists have used the IAD method.

A few states have adopted an RTI model as a method for identifying students with dyslexia in schools. This model, now referred to Multi-tiered Systems of Support or MTSS) is a staged model that has been typically made of three tiers. At the universal or first tier, all students receive high-quality, evidence-based literacy instruction (D. Fuchs & Fuchs, 2006). Students who show delayed reading skill acquisition are provided additional learning supports and their response to this intervention is monitored closely. In this way, educators are able to determine whether the reading deficit was related to lack of appropriate instruction, a slower rate of learning, or some other environmental factor that is not related to a disability. If increasing intensive interventions did not result in reasonable growth, then higher levels of support were provided (D. Fuchs & Fuchs, 2006). Students whose skills have not been sufficiently remediated by these intensive interventions were referred for a psychoeducational evaluation to investigate the nature of their literacy difficulties. Essentially, the RTI process was designed to identify students who were struggling in particular skill areas, provide evidence-based interventions, and monitor students' response to programming while making adjustments for more intensive programming as indicated. According to the "dual discrepancy" approach to identification of students with SLDs (L. S. Fuchs & Fuchs, 2007), a student must perform below the established cut-points (e.g., by median or standard deviation) in both skill level and learning slope (as determined by progress monitoring) in relation to the class or grade chosen for comparison.

The RTI model has been criticized as not sensitive enough to identify gifted students with reading disabilities due to the masking effect previously described (Volker et al., 2006). Some support exists for delaying formal special education referral until after the final tier of intervention (Bradley et al., 2007), however, others have noted that waiting to verify continued low performance will create unnecessary delays in the identification process (Council for

Exceptional Children, 2007). Thus, the RTI model is problematic for gifted students with reading disabilities who may perform in the average range academically. As noted by Morrison and Rizza (2007), “Average achievement may not constitute a problem for most students, but, for those who have the potential to score significantly higher, the problem should be clear” (p. 60). To resolve this issue, Crepeau-Hobson and Bianco (2011) proposed an integrated model that blends standard RTI practices with a comprehensive, multidisciplinary, psychoeducational evaluation in order to more accurately identify 2E students.

There are multiple types of PSW models that have operationalized dyslexia, however, the model has been most commonly defined by a combination of underdeveloped reading skills, cognitive strengths, and cognitive weaknesses in abilities that are important for developing reading skills (Flanagan & Alfonso, 2017). The PSW methods have been asserted to have theoretical rigor (Flanagan & Alfonso, 2017), however, this claim has been contested (Beaujean, 2017). Whereas IQ--Achievement discrepancy models have used a single IQ test score as a marker for general learning capacity, PSW methods require the existence of an unevenness in the development of intelligence attributes as manifested by patterns of IQ test scores. There have been four major operationalizations of PSW: (a) concordance/discordance (Hale & Fiorello, 2004); (b) discrepancy/consistency (Naglieri, 2011); (c) core-selective (Schultz & Stephens, 2015); and (d) dual discrepancy/consistency (DD/C) model (Flanagan et al., 2018). There are many similarities among the methods, but they also differ in important ways (Stuebing et al., 2012). The DD/C method has been the most common one currently used in the United States (Kranzler et al., 2018).

The DD/C model was first developed by Flanagan et al. (2018) and its name comes from the criteria required to identify learning disabilities: (a) low academic achievement test scores in at least one area along with low IQ test scores representing at least one broad ability (the dual discrepancy), (b) the low IQ test scores had to be related to the low academic achievement scores (the consistency), and (c) all other IQ test scores are average or higher (Flanagan et al., 2013). The process of learning disability identification included five levels of evaluation. The steps in this analysis included an academic ability analysis, evaluation of mitigating and exclusionary factors, cognitive ability and processing analysis, identifying a pattern of strengths and weaknesses (PSW) analysis, and an evaluation of the level of interference with learning. This final criterion was specific to establishing the potential for eligibility under special education law. The DD/C method has support from many researchers due to its reliance on the Cattell-Horn-Carroll theory of intelligence attributes (Flanagan et al., 2010; Jacobs et al., 2017) as well as its alignment with federal statutory requirements in the 2006 IDEA regulations (i.e., the "pattern of strengths and weaknesses" phrase). However, some researchers have identified several conceptual and psychometric shortcomings associated with the DD/C method (e.g., Beaujean et al., 2018).

Outside of the school setting, psychologists use the criteria from the Diagnostic and Statistical Manual of Mental Disorders (DSM) to identify SLDs, including dyslexia. The DSM category for dyslexia underwent a significant change between DSM-IV and DSM-5, sparking controversy and criticism from dyslexia advocacy groups. In the updated DSM-5 (American Psychiatric Association, [APA], 2013), dyslexia was not coded as a distinct type of SLD as it had been in the earlier version. According to the DSM-5, SLD is a type of neurodevelopmental disorder that impedes a person's ability to learn and use specific academic skills, such as reading, writing, and arithmetic. Another major shift in diagnosis criteria between DSM-IV and DSM-5 was the elimination of the 'IQ-achievement discrepancy.' According to DSM-5, individual cognitive profiles based on neuropsychological testing were more useful for understanding intellectual disabilities than a single IQ score. Briefly, these criteria include difficulty in a specific academic skill that has lasted at least 6 months, that the difficulty is substantial and quantifiable, started when the individual was young, and is not better explained by another cause (e.g., intellectual disability, vision or hearing impairment; APA, 2013). There are similarities in the definitions proposed by education law and the DSM-5 in that both recognize an underlying neuropsychological condition (e.g., basic psychological process, neurodevelopmental) that results in a significant or substantial difficulty in one or more areas of academic performance.

The Relationship Between Cognitive Abilities and Reading Skills

Given the recognized underlying neuropsychological component to reading disorders and dyslexia, it is important to understand how different cognitive abilities contribute to reading skills. The nature of the relationship between the various cognitive skills and reading deficits, and in particular the question of which cognitive impairments have been primarily associated with dyslexia, has been a source of debate (Evans et al., 2002; Vanderwood et al., 2002). A summary of the specific cognitive abilities that have been related to the reading performance are described below. Although much of the research has been conducted with typical readers, the relationships likely apply to individuals with dyslexia as well. These findings have directly informed the hypotheses in the present study.

Verbal Comprehension

Several aspects of reading are embedded in the ability to understand, use and think with spoken language, namely language development, lexical knowledge, and listening ability, all of which are important for reading acquisition and development. A large body of research literature has established a strong link between verbal ability and reading comprehension (Vellutino et al., 2004; Williams et al., 1994). The link may be bidirectional, where vocabulary and general knowledge contributed to reading abilities and vice versa.

Fluid Reasoning

Inductive logic and general sequential reasoning abilities have been shown to play a moderate role in reading comprehension (McDonough & Flanagan, 2016). Some authors have argued that novel problem-solving abilities were not strongly related to reading achievement and, therefore, did not help identify students with dyslexia (Evans et al., 2002). However, little is known about how this cognitive ability might play a role in reading for gifted students with dyslexia since there is evidence that these youth use different types of cues and strategies to draw meaning from text.

Visual Spatial

Visual-spatial attention may be a component of reading success and has been shown to predict reading acquisition (Giovagnoli et al., 2016). Furthermore, it has long been theorized that dyslexia is associated with strengths in the right-hemisphere visual spatial skills, though some researchers have failed to find any visual-spatial talent associated with dyslexia (Winner et al., 2001).

Working Memory

Working memory has been shown to be a crucial component for overall reading success in a variety of ways. To comprehend sentences, a reader must not only decode the words but also comprehend the syntax, retain the sequence of words, use contextual cues, and integrate this with existing knowledge (Paris et al., 2009). This must be done simultaneously in order for sentences to be understood. For example, when reading a long sentence, paragraph, or passage, working memory allows a reader to integrate information previously read with information that comes later. Empirical research has supported that dyslexia is related to a weakness in the ability to quickly retrieve information from memory such as sound-symbol relationships (van Viersen et al., 2016). Also, it has been proposed that during the process of reading, working memory acts as a holding area for the analysis of language that does not occur concurrently with the decoding of words (Dufva et al., 2001). As noted, individuals with dyslexia are thought to have deficits in aspects of working memory related to spoken and written language, also known as the phonological loop (Berninger et al., 2006). Hence, when working memory was impaired, individuals with dyslexia had difficulty with the temporary storage of information while engaged in other cognitive activities at the same time (Roitsch & Watson, 2019).

Processing Speed

The more rapidly and efficiently an individual can automatize basic academic or cognitive operations, the more attention and effort they have to allocate to higher level aspects of task performance, such as reading comprehension (Evans et al., 2002). Slow processing speed has been found to be a risk factor for reading problems (Shanahan et al., 2006; Willcutt et al., 2005).

Indeed, these last two areas, working memory and processing speed are often associated with dyslexia. Auditory and visual processing testing, as measured by the Coding and Digit Span sub-tests of the WISC-V, have been demonstrated to be strong indicators of a deficit area in students with dyslexia. These measures of processing were also associated with performance in reading fluency (Kaufman et al., 2015).

Gifted Students with Dyslexia

When students are identified with both giftedness and dyslexia, they may be considered twice exceptional or GWD. They demonstrate exceptional strengths and weaknesses in somewhat predictable ways. According to a fact sheet developed by the International Dyslexia Association (Identifying and Instructing the Twice Exceptional Student; IDA, 2020), students with GWD have been overlooked in the school system, have had their talents neglected in favor of remediation, or have confused diagnosticians so they did not qualify for much needed differentiated, specialized instruction to address their specific needs and strengths. The NAGC has recognized three types of students who may have this combination of exceptional strengths and weaknesses: (a) gifted students who had a learning disability that had not been identified, (b) students with a learning disability whose giftedness had not been identified, or (c) unidentified students whose gifts and disabilities were masked by average school achievement. The dyslexia diagnosis may be more often missed in children with high ability because they were "master problem solvers who can think their way around reading comprehension challenges and many common phonological awareness tests so reading challenges may appear minor or completely resolved" (Eide & Eide, 2013, p.8).

It was important to note that a student who is gifted may experience dyslexia in ways that change in expression, quality, and degree with age (IDA, 2020). According to the IDA, the underpinnings of dyslexia may be apparent as language or motor problems early in life, and then later show up as written word recognition or word decoding problems. In middle school and high school, a gifted student with dyslexia may have difficulties with fluency and comprehension. Finally, in adulthood, dyslexia may manifest in degree from mild to moderate; these deficits may result in difficulty spelling unfamiliar words or significant deficits in reading and written expression. The IDA (2020) has stressed the importance of identifying 2E students and that the dual classification was crucial to providing support and stimulation necessary to succeed.

Identification of Students Who are
Gifted with Dyslexia

Given the controversies and debate surrounding the diagnostic criteria for both giftedness and dyslexia, the identification of GWD students has been especially difficult. While several researchers have suggested frameworks and best practices for identifying GWD students (Assouline et al., 2010; Assouline & Whiteman, 2011; Foley-Nicpon & Assouline, 2020; Gilman et al., 2013; Lovett & Sparks, 2013; McCallum et al., 2013; McCoach et al., 2001; Nielsen, 2002; Ottone-Cross et al., 2017; Reis et al., 2014; Volker et al., 2006), there have been few empirical investigations. Ottone-Cross et al. (2017) found that the cognitive/ achievement discrepancy model was the most common recommended approach, with academic deficits that are 1 to 2 standard deviations below cognitive ability being the norm for identifying disability. Lovett and Sparks (2013) recommended the following identification criteria: FSIQ greater than or equal to a standard score of 120 along with achievement scores at a maximum of 85 to 90 demonstrating functioning in the lower quartile of scores. Despite these efforts to standardize an approach to identification, there is little agreement on a consistent method. In their synthesis of studies with GLD students, Lovett and Sparks (2011) found that only 5% of available articles included data from empirical research, and many of these were case studies or had very small sample sizes. They found that criteria for giftedness and academic weakness varied by study, and in their discussion, they called for more consistency in identification methods.

Even if there was an agreed upon operational definition of 2E, the assessment process would be complex, and the results may be suspect. Volker et al. (2006) created an assessment blueprint for twice exceptional learners to provide guidance for practitioners. They noted several factors to consider when evaluating gifted children with a reading disability. First, children with high general ability scores do not typically score uniformly high on the different cognitive domains or indices. For example, children who are gifted tend to score higher on the Verbal Comprehension Index (VCI) and relatively lower on the Working Memory Index (WMI) and Processing Speed Index (PSI; Wechsler, 2003). Also, working memory and processing speed tend to be normatively lower in some children with reading disabilities (Flanagan et al., 2002). However, the higher verbal ability may have a masking effect that was previously described, where the child's intellectual gifts and processing weaknesses effectively cancel each other out and lead to the child never being identified as either having giftedness or learning disabilities. Intellectually gifted children may be able to use their stronger abilities to compensate for their weaker abilities during cognitive testing itself. For example, Volker et al. (2006) noted that a child with a very strong visual memory may be able to compensate for weak processing speed by memorizing the code and performing the task faster by not having to look back at the code.

Due to the wide variability in identification criteria across studies, the specific diagnostic criteria or standardized method for diagnosis of GWD students remains unclear. This in turn may contribute to late identification and/or no identification at all (Reis et al., 2014). The main questions of concern have been how a discrepancy manifests in students who are intellectually gifted, and how the masking effect results in a pattern of strengths and weaknesses that results in the appearance of average abilities and achievement.

Use of Full-Scale Intelligence Quotient in Identifying Gifted Students with Dyslexia

As has been previously discussed, students who are 2E may fail to be identified for gifted programs in schools because of the very nature of their strengths and deficits; one exceptionality may hide the other. Advocates for students with 2E have criticized the use of a significantly high single indicator of cognitive ability (e.g., FSIQ > 130; Nielsen, 2002). Hence, similar to their Gifted-only counterparts, individuals who have a dual diagnosis of GWD may obtain artificially low FSIQ scores because the dyslexia symptoms resulted in lower performance on indicators of cognitive proficiency (i.e., Working Memory and Processing Speed indices). Some researchers have suggested it may be more appropriate to use a lower cutoff summary score such as 120 or to use a different composite score such as the GAI, VCI, or FRI from the Weschler scales which are less influenced by processing speed or working memory (Assouline et al., 2010). According to research by Flanagan and Kaufman (2004), if the VCI and the Perceptual Reasoning Index (PRI; the previous term for subtests that included fluid reasoning and visual spatial subtest) were within 23 points of each other, and either was 23 points higher than the Working Memory or Processing Speed indices, then the GAl was a "reliable and valid estimate of the child's global intellectual ability" (p. 128). A study by Nielsen (2002) recommended that students who scored 120 or above on an IQ measure should be viewed as potentially 2E; however, demanding that 2E children achieve an intelligence test score at or above 130 was inappropriate and self-defeating because it would potentially eliminate children who were gifted with a learning disability. In summary, even though some considered full-scale IQ scores as the gold standard for identifying giftedness (e.g., Lovett & Lewandowski, 2006), summary scores from these assessments may not be a valid representation of the cognitive gifts of 2E students who have diverse strengths and weaknesses. For the purposes of the present study, participants were selected for this study if they had a GAI of equal to or greater than 120.

Strengths and Weaknesses of Gifted Students with a Learning Disability

Some criteria for identifying students who are GLD have started to emerge, and in the last ten years there has been an increasing number of studies focused on various aspects of 2E assessment and identification. Students who were gifted with any learning disability demonstrated a distinct pattern of strengths and weaknesses that may assist in identifying students who have this presentation. Ottone-Cross et al. (2017; Ottone-Cross et al., 2019) investigated this combination of strengths and weaknesses by comparing a population of gifted with specific learning disability (GLD) group of students to Gifted-only and SLD-only groups using the Kaufman Test of Educational Achievement-Third Edition (KTEA-3; Singer et al., 2012) normative sample. Although the study sample included participants with any one of the eight specific learning disabilities, given that the population likely included dyslexia as the predominant disability, the results are relevant to be shared here. The authors hypothesized that the GLD students would perform similarly to the Gifted-only group on higher level processing tasks such as reading comprehension, and similarly to the SLD-only group on lower-level processing tasks such as decoding. The results of the study supported both hypotheses. Specifically, academic scores were lowest in the SLD-only group and highest in the Gifted-only group, with the performance of the gifted SLD group in the middle. More detailed analyses revealed gifted students with SLD performed more like gifted students on higher-order skill assessments, such as reading comprehension, and more similar to students with SLD on lower-order skill assessments, such as decoding. Additionally, the students with SLD demonstrated average academic performance, whereas the GLD group almost always had peaks and valleys in their academic performance (Ottone-Cross et al., 2017). These findings suggest that a better understanding of the peaks and valleys in cognitive and academic performance may help improve upon the identification methods for 2E children.

Similarly, research by Maddocks (2018, 2020) has provided support for considering patterns of test scores when identifying students who are GLD. Using the standardization sample for the Woodcock-Johnson Test of Cognitive Abilities (WJ III COG; Woodcock, 1997), Maddocks (2020) investigated the ramifications of various identification criteria for students who were identified as gifted with any learning disability. The results of this study concluded that GLD students had mean academic performance that was lower than the Gifted-only group, but was above the SLD-only group. In addition, the GLD students exhibited greater score variability than the SLD- and Gifted-only groups (Maddocks, 2020). For example, a GLD student with a VCI of 135 whose reading scores varied from 95 to 100 represents at least a two standard deviation gap between highest and lowest scores. This suggests that the variability, also known as scatter, itself may be a useful indicator of GLD group identification.

Use of Profile Analysis and Scatter Analysis

Researchers have long debated how intelligence measures should be used and interpreted in clinical practice (McGill et al., 2018; Pfeiffer et al., 2000). From the 1930s, researchers hypothesized that intelligence score subtest scatter, or patterns of high and low scores, would be a useful predictor of pathology (Harris & Shakow, 1937). Since then, controversies have surrounded the variety of ways in which clinicians make inferences about strengths and weaknesses observed in an individual's profile of scores to identify specific learning disabilities. The Cattell-Horn-Carroll theory of cognitive abilities (Schneider & McGrew, 2012), as has been previously described, has dominated contemporary approaches. This theory contends that cognitive subtest score scatter is an identifying factor for broader academic dysfunction, and that these patterns of highs and lows have statistically significant relationships with achievement scores (Feifer et al., 2014). However, some researchers have asserted that cognitive scatter identifies broader academic dysfunction at no better than chance levels (McGill et al., 2018), and that cognitive weaknesses have low positive predictive values in identifying the presence of focal academic weaknesses (Kranzler et al., 2016). Others argue that there are many reasons cognitive deficits may not lead to academic deficits (Flanagan & Schneider, 2016). Yet, the prevailing point of view among researchers is that having a cognitive weakness does increase the risk of having academic skill deficits (McGill et al., 2018).

Variability is another term that refers to the peaks and valleys in a cognitive or achievement profile. has been shown to be a common factor in the assessment profiles of students demonstrating both giftedness and a learning disability and has been suggested to be a distinguishing factor (Ferri et al., 1997). In the Ferri et al. (1997) study with a college student population, the average range of scatter, or the difference between the lowest and highest subtest scores on the WAIS-R, was 8.2 points for the GLD group and 6.9 points for the LD-only group. The highest scores ranged from 14 to 19 points and the lowest ranged from 3 to 10 points for the GLD group. This degree of scatter was slightly less than the 9- to 12-point range reported by Silverman (1989). In the Ferri et al. study, the difference in means between standard deviations of the GLD group and the LD-only group was significant with a large effect size.

More recently, Berninger and Abbott (2013) explored score profiles of students who were gifted in verbal reasoning and who also had dyslexia. Participants in their study included 31 children with average-range verbal reasoning scores (90-99), and 33 children with superior-range verbal reasoning scores (120 and above). Verbal reasoning scores were assessed using three subtests of the Verbal Reasoning Index Scores of the Wechsler Intelligence Scale for Children, 3rd Edition (WISC-III; Wechsler, 1991). The authors found that students who were gifted in verbal reasoning with dyslexia performed differently from students who were Dyslexia-only on reading and writing measures. The twice exceptional students with superior verbal reasoning and dyslexia significantly outperformed those with average verbal reasoning and dyslexia on reading, spelling, morphological, and syntactic skills. The authors concluded that, although gifted students with dyslexia may not be the very lowest readers and spellers in their classes, they were underachieving for their verbal reasoning ability and struggling more than peers in completing assignments in and out of school. Berninger and Abbott's (2013) study did not compare the students who were gifted with an SLD, to those students who were gifted without SLDs. The research aim of this study was to compare all three groups of learners (i.e., Gifted-only, Dyslexia-only, gifted with dyslexia) to look for similarities and differences among cognitive and learning profiles.

Some researchers have suggested that reading achievement scores of students who are GWD, in particular measures of reading comprehension, may vary significantly from their Gifted-only or Dyslexia-only counterparts (Eide & Eide, 2005; Ferri et al., 1997; Gilman et al., 2013; Ottone-Cross et al., 2017). As Gilman et al. (2013) observed, a student who is GWD would be expected to score highest in measures of reading comprehension and lowest in measures of timed word reading and spelling. Students with dyslexia, they reasoned, were least able to compensate for weaknesses under timed conditions. Lovett and Sparks (2013) also found that overall reading scores, such as cluster or index scores which summarized various reading subtest scores, may not adequately identify students with a learning disability and, therefore, they suggested reviewing the pattern of reading subtest scores including comprehension, decoding, and spelling. Consistent with these previous findings, the present study explored potential differences across different subtests of reading to understand how these patterns differed across groups. Overall reading scores may not be sensitive to important variations in skills and then would be less useful as an indicator of dyslexia among gifted students. As Ferri et al. (1997)

reported, “simply comparing composite scores is insufficient as extraordinary strengths and weaknesses can result in average overall or composite scores” (p.558).

Conclusion

To summarize, students identified as GWD do not tend to have achievement scores as low as those of students identified with Dyslexia-only, and their summary cognitive scores may not be as high as their Gifted-only counterparts. In practical terms, this has made the identification of this group of students very difficult as they have not always met the criteria for either exceptionality. To date, very few empirical studies have been conducted on the cognitive and achievement patterns of GWD students in a clinical population. The present research represented a continuation of previous work using retrospective data with a population of students identified as GWD students, Gifted-only, and Dyslexia-only. The primary question to be answered was whether the pattern of cognitive and achievement measures for GWD students would resemble that of Gifted-only students or Dyslexia-only groups and in what ways. Secondly, this study sought to evaluate whether indicators of variability, as measured by the average range of scatter between the highest and lowest subtest scores as well as the variance of both cognitive and achievement scores, was a common factor in the profile. Lastly, this study investigated the use of FSIQ versus GAI in the identification of giftedness among GWD students, who may obtain artificially low FSIQ scores because their dyslexia symptoms result in lower performance on WISC-V subtests measuring Working Memory and Processing Speed.

CHAPTER III

METHODS

The primary goal of this study was to explore patterns of performance on cognitive and achievement measures among youth who were clinically identified as Gifted-only, Dyslexic-only, or with a combination of both (GWD). The findings may assist school psychologists and clinicians in private settings in the identification and diagnosis of students who are GWD. The participants, procedures, instrumentation, assumptions, and analyses are reviewed in this chapter.

Participants

Archival data from one private clinic, with two locations, in a Western state were used for this study. This clinic specializes in the assessment and diagnosis of 2E students. Data were collected from self-referred families who were seeking a better understanding of their children's cognitive and learning profiles in terms of strengths and weaknesses. The entire sample consisted of 100 participants who were identified in the following ways: GWD = 36, Gifted-only = 31, Dyslexia-only = 32. As noted previously, children who had a GAI score of greater than 120 and had a diagnosis of dyslexia made up the GWD group. The sample ranged in age from 6 years to 15 years and were enrolled in Grades 1 through 10. All student testing took place in one of the clinic offices and was conducted or supervised by a licensed psychologist with experience in diagnosing learning disabilities. Data were gathered from the clinic's records covering the time period from 2017 to 2020.

Identification Criteria

The dataset was organized into three groups: GWD, Gifted-only, and Dyslexia-only. The dataset provided an indicator of dyslexia (yes or no) and giftedness (yes or no). The criterion used for diagnosis of gifted was General Ability Index (GAI) from the WISC-V of greater than or equal to 120. There has not been consensus about the best cutoff score to identify giftedness in large samples, so a cutoff score of 120 was selected because this has been recommended in previous research with 2E samples (Lovett & Sparks, 2011). The criteria used to identify dyslexia was based upon reading achievement scores that were lower than expected based on the participant's cognitive ability as defined in the DSM-5. As discussed in the literature review, this discrepancy was typically defined as reading achievement scores on the WIAT-III 1.5 times lower than the individual's predicted achievement score based on cognitive ability (Maddocks, 2018). Participants were selected for inclusion in the study if they met the previously described identification criteria as well as having complete scores on both the WISC-V and WIAT-III.

Instrumentation

The WISC-V (Wechsler, 2014) is a five-factor intelligence battery for children who are between 6 and 16 years of age. The WISC-V is the most widely used intelligence test in the world and often has served as the basis for learning disability evaluations and other issues, such as intellectual development disorder, giftedness, and autism (Oakland et al., 2016). The battery is comprised of 10 core sub-tests that have been supported by psychometric evidence in prior studies (Na & Burns, 2016). In addition to an overall score (FSIQ), the WISC-V provides a General Intellectual Ability (GAI) composite score that represents general intelligence (with less emphasis on cognitive proficiency), and correlates strongly (r = .86) with the WISC-V FSIQ. Standardized scores on the major indices (i.e., VCI, FRI, VSI, WMI, & PSI) have a mean of 100 and a standard deviation of 15. Descriptive score ranges provided in the manual included: Very Low (69 and below), Low (70-79), Low Average (80-89), Average (90-110), High Average (111-120), Superior (121-130), and Very Superior (131+).

The Weschler Individual Achievement Test-Third Edition (WIAT-III; Wechsler, 2009) is an individually administered achievement test with an age range that spans young childhood through adulthood. In this analysis both composite and subtest level scores were explored. See Table 2 for the names and descriptions of each subtest and Table 3 for the subtests that make up the composite scores. All of the subtests were administered to all children in the sample with the exception of Essay Composition, which is not included in the test battery for children who are 6 or 7 years old. As with the cognitive scores, age-standardized achievement scores were used in this study.

The WIAT-III assesses the basic domains of listening, speaking, reading, writing, and mathematics and can be used to comprehensively to assess a broad range of academic skills or selectively to test only in the areas of concern. The dataset included all Composite Scores (Oral Language, Total Reading, Basic Reading, Reading Comprehension and Fluency, Written Expression, Mathematics, and Math Fluency) as well as specific subtest scores (Listening Comprehension, Oral Expression, Word Reading, Pseudoword Decoding, Reading Comprehension, Oral Reading Fluency, Alphabet Writing Fluency, Spelling, Sentence Completion, Essay Composition, Math Problem Solving, Numerical Operations, Math Fluency--Addition, Math Fluency--Subtraction, Math Fluency--Multiplication). The Written Expression, Mathematics and Math Fluency composite and subtest measures were not included in this study.

Table 2

Descriptions of the WIAT-III Subtests

Listening Comprehension	The child looks at a set of pictures, listens to a word spoken out loud by the examiner, and then points (or states the letter that corresponds to) the picture that best illustrates the meaning of the target word. In the second component, the child listens to an audio recording of one or more sentences of a narrative or expository information, listens to the question(s) read out loud by the examiner, and then orally answers the question(s). This subtest measures listening comprehension at the level of the word, sentence, and discourse.
Reading comprehension	The child reads sentences or short passages and is then answers questions about the main idea, details, or is asked to make inferences.
Word reading	The child identifies letters, sounds, or reads words from a list.
Pseudoword decoding	The child reads nonwords from a list.
Oral Expression	The child is evaluated on his/her skills in association with expressive vocabulary, oral word fluency, and sentence repetition.
Oral reading fluency	The child is required to accurately read passages aloud under timed conditions.
Spelling	The child is required to spell a word based on definitions and its use in a sentence which are presented orally.

Note. Definitions are adapted from Caemmerer et al. (2018).

Table 3

WIAT-III Composite Scores and Subtests

	Oral Language (pre-K-12)	Total Reading (Grades 1-12)	Basic Reading (Grades 1-12)	Reading Comprehension and Fluency (Grades 2-12)
Listening Comprehension	X			
Oral Expression	X			
Word Reading		X	X	
Pseudoword Decoding		X	X	
Reading Comprehension		X		X
Oral Reading Fluency		X		X
Spelling				

According to the WIAT-III examiners manual (Wechsler, 2009), the internal consistency of all composite scores ranged from .90 to .98. Test-retest reliability ranged from .87 to .96 for composite scores. Interrater reliability was between 98% and 99% for sub-tests with objective scoring (either correct or incorrect). Regarding internal structure, correlations between related sub-tests were as expected (McCrimmon & Climie, 2011). As with the WISC-V, age standardized composite scores on the achievement measures had a mean of 100 and a standard deviation of 15, while the sub-test scores had a mean of 10 and standard deviation of 3. Thus, the psychometric properties of both the WISC-V and the WIAT-III have been found to be adequate in prior studies (Kaufman et al., 2015; Na & Burns, 2016; Raiford, 2017; Singer et al., 2012).

Data Analysis

To evaluate the research questions, an archival database was accessed by clinicians employed by a private clinic specializing in the evaluation of twice exceptional students. The database did not include any information such that the identity of the participants could be readily ascertained directly or through other identifiers. The University of Northern Colorado Institutional Review Board determined this research project to be exempt (see Appendix A). File numbers were selected for inclusion in the study if they met the previously described identification criteria as well as having complete scores on both the WISC-V and WIAT-III. The dataset was then transformed into an excel spreadsheet, which was reviewed for accuracy by visual scanning to determine that age ranges and scores were within predicted ranges.

Using SPSS version 27 General Linear Module (GLM), frequency analyses, histograms, and box plots were run to examine distributional characteristics of the data and to check for missing data. Visual inspection revealed an outlier in the Dyslexia-only group that appeared unusual for a dyslexia profile due to a higher-than-expected cognitive profile. After reviewing the source data, it was determined that this student record was misidentified, and the data were duplicated with another student record. Therefore, this Dyslexia-only student record was deleted. Another Dyslexia-only student record was missing data for all of the WIAT-III scores and was deleted. The final sample consisted of 98 participants based on the inclusion criteria for GWD, Gifted-only and Dyslexia-only as described in the methods section. The first group consisted of 36 GWD participants, the second consisted of 31 Gifted-only participants and the third consisted of 31 Dyslexia-only participants.

Demographic Comparisons

As depicted in Table 4, the demographics of each group in the sample were comparable. An ANOVA comparison of the mean ages of the three groups was not statistically significant at $\alpha < .05$. A Chi-square goodness of fit test based on unequal group sizes was used to compare the gender distribution. There were no statistically significant differences in gender between the three groups using $\alpha < .05$, and there was a low effect size ($\varphi = .10$; Cohen, 1988).

Table 4

Demographic Variables by Group Identification

	Gifted with Dyslexia	Gifted Only	Dyslexia Only	Total
n	36	31	31	98
Age				
M	9.2	10.1	9.7	9.7
SD	2.3	2.8	2.1	2.4
Range	6-15	6-15	6-15	6-15
Sex (% male)	58.3	64.5	51.6	58.2

Profile Analysis

To answer the first two research questions, a profile analysis was conducted to explore whether a statistically significant difference existed between the three groups. This statistical technique compared groups using both the shape of their score profiles and the value of the scores attained on those variables. In this study, the dependent variables were the index scores (VCI, FRI, VSI, WMI, & PSI) from the WISC-V, sub-test scores from the WIAT-III (Listening Comprehension, Reading Comprehension, Word Reading, Pseudoword Decoding, Oral Reading Fluency, and Spelling) composite scores from the WIAT-III (Oral Language, Total Reading, Basic Reading, Reading Comprehension & Fluency). For each level of analysis, the score values had the same meaning on all of the composites or sub-tests, which was a requirement for this statistical method (Tabachnick & Fidell, 2001). Essentially, profile analysis compared the means of each group and assessed the pattern of means across the selected composite and subtest scores from the WIAT-III.

Multivariate Assumptions

Prior to computing the profile analysis, several assumptions regarding multivariate normality, outliers, homogeneity of variance–covariance matrices, and linearity were addressed. Multivariate normality was considered adequate because the sample sizes were similar and the samples far exceeded the number of dependent variables (Tabachnick & Fidell, 1996). Also, because profile analysis can be sensitive to outliers, the presence of both univariate and multivariate outliers was assessed. Evaluation of frequencies and Box Plots did not find any univariate outliers, while no multivariate outliers were found using the Mahalanobis statistic. These assumptions are detailed below:

1. The independence of observations requirement assumes that each score value is independent from other score values. This means that the scores for each participant were in no way influenced by or related to the scores of other participants. For this study, each of the observations between groups was independent, because participants did not know each other, live in the same neighborhoods or attend the same schools. Therefore, each of the participants' scores were considered independent of other participants beyond chance levels. However, it is possible that there were common or shared experiences between participants in this dataset because they were sourced from the suburban Denver location. When participants are more like each other, this increases the possibility of a Type 1 error.

2. It was assumed that there was adequate sample size to perform the data analysis (Tabachnick & Fidell, 1996). The present study included three groups with more than 30 cases in each group and 10 dependent variables. An a priori power analysis using G*Power (Faul et al.,

2009) was conducted to determine the minimum sample size needed to have adequate power for conducting a mixed within- and between-group repeated measures analysis assuming a medium Cohen's f effect size of .25, $\alpha = .01$, power of .99, three groups, and seven dependent variables. A sample size of 63 was needed, which indicated that the present study's sample size of 98 is adequate.

3. It was assumed that there are no univariate or multivariate outliers in the dataset. Boxplots were used to examine univariate outliers. Multivariate outliers were evaluated using Mahalanobis distance analysis, which calculates the probability of an outlier at the $p < .001$ significance level (Leys et al., 2018; Mahalanobis, 1930). One participant's Mahalanobis distance was statistically significant ($p < .001$) and was evaluated for potential data entry error. However, all the data for this participant appeared to have legitimate values. The profile analysis results did not change with or without the case with the extreme value. Therefore, it was determined that discarding such an observation from a planned analysis was not appropriate and that it was a legitimate observation that had no reason to be altered.

4. It was assumed that there is a linear relationship between each pair of dependent variables for each group. This assumption was evaluated using Pearson's correlation matrices for each pair of dependent variables by group. In general, the results suggest that the dependent variables for WISC-V and WIAT-III subtest scores are moderately correlated which is appropriate for MANOVA (Maxwell, 2001). The dependent variables for WIAT-III composite scores were moderately to strongly correlated which suggests the results should be interpreted with caution. These results are presented in Tables 5, 6, and 7. The linear relationship assumption was also evaluated using bivariate scatter plots of the dependent variables separately for each group. If the data were linearly related, the result would be a straight diagonal line

(Huck, 2008). It was observed that most of the points for each dependent variable were close to the diagonal line, which suggests linearity.

5. It was assumed that the population covariance matrices of the data were equal across levels of the between-subjects factor. Box's M test was used to test the hypothesis that two or more covariance matrices were equal (homogeneous). The Box's M statistic was not statistically significant ($p = .21$), and therefore it was assumed that these data met the assumption of equality of covariance matrices.

6. Lastly, it was assumed there is no extreme multicollinearity, which occurs when two or more dependent variables are highly correlated to each other. To detect multicollinearity, a variance inflation factor (VIF) was used. This test measures the correlation and strength of correlation between the predictor variables in a MANOVA analysis. A value of 1 indicates there is no correlation between any of the dependent variables. According to Gareth et al. (2013), a value between 1 and 5 indicates moderate correlation between two dependent variables, but this is often not severe enough to require attention, and a value greater than 5 indicates potentially severe correlations between variables. One dependent variable, Word Reading, had a large VIF value (VIF = 5.96) indicating that it is potentially highly correlated with other variables. The correlation matrices However, according to O'Brien (2007), the rule of thumb values of the VIF of 10, 20, 40, or even higher do not, by themselves, call for the elimination of one or more variables from the analysis. Hence, a possible limitation of this study is that the variance has been inflated by the lack of independence of this variable.

Table 5

Pearson Correlations Between WISC-V Variables

		Verbal Comprehension Index	Visual Spatial Index	Fluid Reasoning Index	Working Memory Index
Gifted with Dyslexia	Visual Spatial Index	0.29			
	Fluid Reasoning Index	0.17	.53**		
	Working Memory Index	.34*	0.27	0.05	
	Processing Speed Index	0.13	0.15	0.12	0.27
Gifted-Only	Visual Spatial Index	0.22			
	Fluid Reasoning Index	0.13	.55**		
	Working Memory Index	.42*	.41*	0.13	
	Processing Speed Index	-0.04	0.06	.59**	0.15
Dyslexia-Only	Visual Spatial Index	-0.12			
	Fluid Reasoning Index	0.26	.44*		
	Working Memory Index	-0.16	0.23	0.18	
	Processing Speed Index	-0.14	0.26	0.3	0.17

* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed).

Table 6

Pearson Correlations Between WIAT-III Subtest Variables

		Listening Comprehension	Reading Comprehension	Word Reading	Pseudoword Decoding	Oral Reading Fluency	Spelling
Gifted with Dyslexia	Reading Comprehension	0.51**					
	Word Reading	0.31	0.53**				
	Pseudoword Decoding	0.14	0.13	0.48**			
	Oral Reading Fluency	0.43**	0.53**	0.68**	0.15		
	Spelling	0.25	0.48**	0.65**	0.69**	0.43**	
	Oral Expression	0.51**	0.18	0.19	0.01	0.16	0.20
Gifted-Only	Reading Comprehension	0.34					
	Word Reading	0.56**	0.50**				
	Pseudoword Decoding	0.52**	0.31	0.62**			
	Oral Reading Fluency	0.43*	0.34	0.37*	0.34		
	Spelling	0.25	0.40*	0.55**	0.70**	0.21	
	Oral Expression	0.34	0.42*	0.42*	0.37*	0.21	0.30

Table 6 (continued)

		Listening Comprehension	Reading Comprehension	Word Reading	Pseudoword Decoding	Oral Reading Fluency	Spelling
Dyslexia-Only	Reading Comprehension	0.3					
	Word Reading	-0.02	0.57**				
	Pseudoword Decoding	-0.13	0.04	0.51**			
	Oral Reading Fluency	0.14	0.57**	0.68**	0.234		
	Spelling	-0.02	0.44*	0.69**	0.48**	0.48**	
	Oral Expression	.55**	0.36*	0.13	0.11	0.25	0.03

* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed).

Table 7

Pearson Correlations Between WIAT-III Composite Scores

		Oral Language	Total Reading	Basic Reading
Gifted with Dyslexia	Total Reading	.42*		
	Basic Reading	0.3	.87**	
	Reading Comprehension & Fluency	.45*	.87**	.58**
Gifted-Only	Total Reading	.59**		
	Basic Reading	.54**	.82**	
	Reading Comprehension & Fluency	0.34	.84**	0.33
Dyslexia-Only	Total Reading	0.23		
	Basic Reading	0.05	.84**	
	Reading Comprehension & Fluency	0.32	.89**	.54**

* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed).

Univariate Assumptions

As a follow-up to the parallelism tests and to determine which dependent variables were significantly different from each other, the statistical significance of mean differences in the data were evaluated via one-way repeated measures ANOVA for each group separately. Prior to conducting these tests, an analysis of the univariate assumptions for independence, normality and sphericity were performed, as shown in Table 8.

Table 8

Univariate Tests for Normality

	Gifted with Dyslexia			Gifted-Only			Dyslexia Only		
	Shapiro Wilks *p*-value	Skewness	Kurtosis	Shapiro Wilks *p*-value	Skewness	Kurtosis	Shapiro Wilks *p*-value	Skewness	Kurtosis
Verbal Comprehension Index	0.08	0.55	-0.05	0.15	-0.39	0.80	0.40	0.30	-0.38
Visual Spatial Index	0.56	0.16	-0.23	0.73	-0.19	0.60	0.31	0.01	-0.79
Fluid Reasoning Index	0.03*	-0.46	-0.79	0.74	-0.28	0.00	0.15	0.14	0.22
Working Memory Index	0.06	-0.57	-0.50	0.26	-0.09	-0.37	0.36	0.02	-0.60
Processing Speed Index	0.57	-0.05	-0.51	0.52	0.47	0.56	0.03*	1.18	1.50
General Ability Index	0.43	-0.28	-0.28	0.33	-0.55	0.87	0.69	-0.22	-0.51
Full-Scale Intelligence Quotient	0.54	-0.41	-0.45	0.01*	-1.22	2.55	0.17	-0.06	-0.27
WIAT-III Subtest Scores									
Listening Comprehension	0.18	-0.17	-0.92	0.11	-0.45	-0.02	0.81	0.18	-0.15
Reading Comprehension	0.25	-0.09	-0.64	0.39	0.19	-1.00	0.27	0.26	0.64
Word Reading	0.25	0.40	-0.83	0.17	-0.39	1.63	0.21	-0.42	-0.27
Pseudoword Decoding	0.83	-0.05	-0.47	0.60	0.91	1.32	0.67	-0.28	-0.24
Oral Reading Fluency	0.70	-0.19	-0.64	0.56	0.61	0.82	0.12	-0.11	1.05
Spelling	0.45	0.37	0.03	0.70	0.21	-0.89	0.64	0.04	0.34
Oral Expression	0.24	0.41	-0.56	0.60	-0.03	-0.47	0.82	0.37	0.90

Table 8 (continued)

	Gifted with Dyslexia			Gifted-Only			Dyslexia Only		
	Shapiro Wilks *p*-value	Skewness	Kurtosis	Shapiro Wilks *p*-value	Skewness	Kurtosis	Shapiro Wilks *p*-value	Skewness	Kurtosis
WIAT-III Composite Scores									
Composite Oral Language	0.79	-0.21	-0.67	0.80	0.29	-0.66	0.28	0.49	-0.08
Composite Total Reading	0.44	0.14	-0.70	0.36	0.07	0.66	0.55	-0.30	-0.13
Composite Basic Reading	0.25	0.19	-0.55	0.83	0.90	1.76	0.64	0.03	-0.40
Composite Reading Comp & Fluency	0.15	-0.50	-0.39	0.52	-0.41	-0.45	0.96	-0.09	0.82

* $p < .05$ indicates significant departure from normality

Univariate analyses assume that the dependent variables have the same range of possible scores with the same score value having the same meaning on all the measures, and they are normally distributed. The dependent variables were evaluated for any departures from normality with the Shapiro-Wilks test (Shapiro & Wilk, 1965) as well as skewness and kurtosis coefficients (Table 8). A review of the literature on acceptable skew and kurtosis coefficients revealed a wide range of values. Tabachnick and Fidell (2013) found that skewness values of -0.5 to 0.5 indicated that the distribution of each variable is approximately symmetric. George and Mallery (2010) reported that kurtosis values of -2.0 to 2.0 are within an acceptable range of deviation from a normal distribution. Blanca et al. (2013) reviewed 693 psychological ability datasets with sample sizes between 10 and 30, similar to the present dataset, for normality and found that skewness and kurtosis values less than 0.75 are slightly non-normal, values in the range of 0.76-1.25 were moderately non-normal, 1.26-1.75 represented high contamination, 1.76-2.25 represented extreme contamination, while values greater than 2.25 represent a very extreme departure from normality. In the present dataset, skew and kurtosis values were within the slightly non-normal to moderately non-normal range with a few exceptions. In the Gifted-only group, Word Reading had a kurtosis value of 1.63, and Composite Basic Reading had a kurtosis value of 1.75. The examination of the Q-Q plots for these distributions supported the findings that the data for these variables were significantly non-normal. In addition, a Shapiro-Wilks test indicated that two variables violated the null hypothesis that the data were normally distributed: in the GWD group FRI ($p = .03$), and in the Dyslexia-Only group, PSI ($p = .03$). However, the central limit theorem and the body of research suggests that profile analysis is generally robust to non-normality unless the non-normality is extreme.

Analyses for Research Questions

Research Questions 1 and 2

Q1 Are there unique profiles of GWD, Gifted-only, and Dyslexia-only in the cognitive domain areas of Verbal Comprehension, Visual Spatial, Fluid Reasoning, Working Memory and Processing Speed?

Q2 Are there unique profiles of GWD, Gifted-only, and Dyslexia-only in the academic achievement areas of reading?

A profile analysis, as has been previously described, explored whether a statistically significant difference existed between the three groups in terms of parallelism, levels, and flatness. The test of parallelism was the main test of interest because it determined if the profiles between the three groups across all of the dependent variables were the same. To answer this question, a repeated measures MANOVA was used to evaluate whether there was a significant group by dependent variable interaction effect. The null hypothesis was that the profiles for the three groups are the same. For any cognitive or achievement variables for which a statistically significant interaction effect was detected, tests of levels and flatness were rendered unnecessary, which was the case in the current study where all interaction effects were statistically significant. Consequently, in lieu of tests of levels and flatness, the next step was to pinpoint what parts of the profile were causing the interaction through tests of simple main effects. Tests of simple main effects involved post hoc analysis of two-by-two interactions. The significance of the interaction was evaluated using a Bonferroni adjusted alpha which varied depending on the number of variables in the analysis. The effect size of the comparison was evaluated with partial eta squared, which estimated the amount of variance explained based on the sample. Cohen (1988) provided benchmarks to define small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), and large ($\eta^2 = 0.14$) effects.

Research Question 3

Q3 Is there a pattern of achievement subtest score variability that is unique to the GWD group?

The statistically significant interaction effects were investigated in more detail in Question 3. First, the subtest variability was calculated by measuring the mean absolute value differences between the highest and lowest achievement subtest scores. It was predicted that the GWD group would have a wider mean difference between subtests that leveraged their reasoning skills (Reading Comprehension and Listening Comprehension) versus tests that measured lower-level processing skills (Pseudoword Decoding and Spelling). The significance of the interaction was evaluated using $\alpha < .05$, and the effect size of the comparison was evaluated with partial eta squared.

Research Question 4

Q4 Is there a significant difference between FSIQ and GAI in the GWD group?

To analyze Research Question 4, a paired sample *t*-test was conducted to determine if there was a statistically significant difference between the group means for FSIQ and GAI for GWD students ($n = 36$). The assumptions for a paired sample *t*-test were met for this analysis as follows: the dependent variable was continuous, the observations were independent of one another, the dependent variable was approximately normally distributed, and the dependent variable did contain any outliers. A Shapiro-Wilks test indicated that the GAI variable did not violate the assumption of normality. The significance of the difference between means was evaluated using $\alpha < .05$.

CHAPTER IV

RESULTS

This chapter includes descriptive statistics, including overall means and standard deviations by group, and results from the four research questions. To answer the first two research questions, profile analyses were conducted in three steps: first with the cognitive ability variables, then achievement subtest variables, and finally achievement composite variables.

Descriptive Statistics

Means and standard deviations were computed for the WISC-V scores and WIAT-III subtest and composite scores (Table 9). The WISC-V index scores, and the WIAT-III subtest and composite scores have a standardized mean of 100 and a standard deviation of 15. Average scores range from 85 to 115. The FSIQ means on the WISC-V were highest for the Gifted-only (M = 124.6, SD = 8.2), followed by GWD (M = 121.1, SD = 9.7) and Dyslexia-only (M = 99.8, SD = 8.5) which was as expected based on the selection criteria for each group. The plot of mean cognitive ability and achievement scores by group (Figure 1) provides a visual representation of the pattern of means to facilitate understanding of the data analyses.

Table 9

Group Means and Standard Deviations on WISC-V and WIAT-III Measures

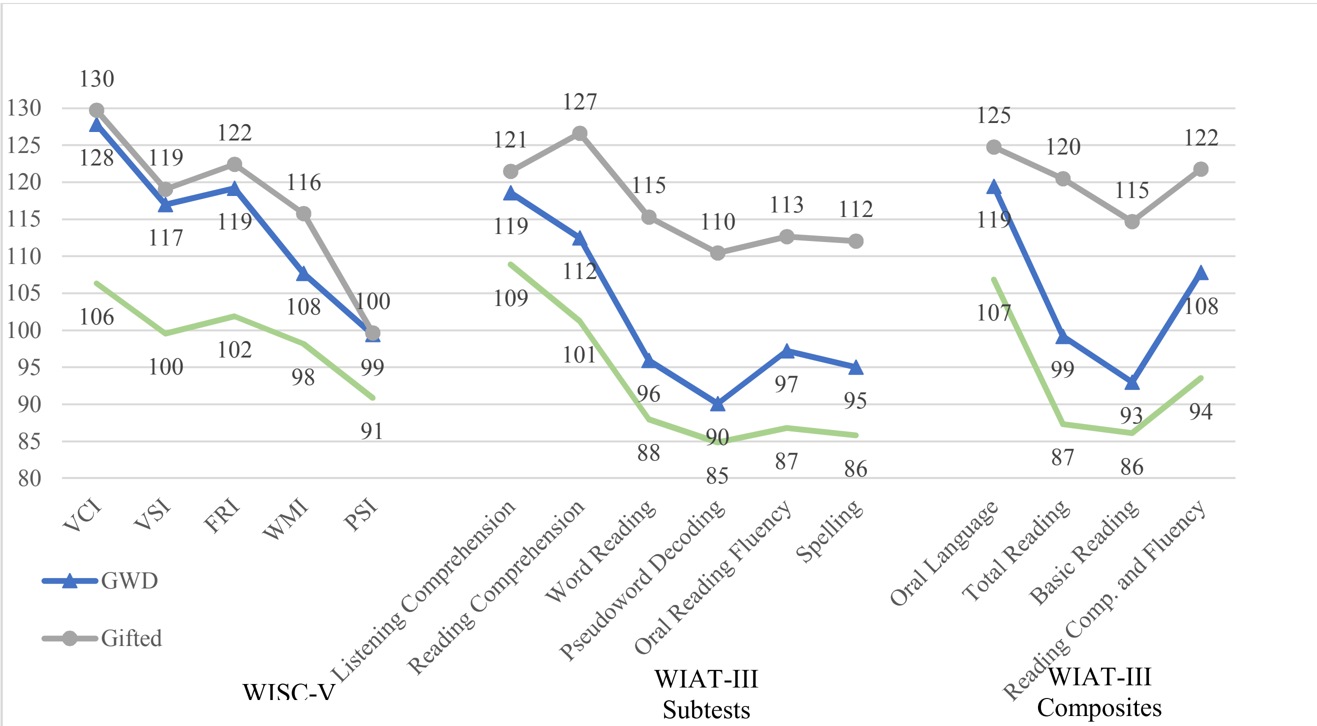
	Gifted with Dyslexia		Gifted-only		Dyslexia-only		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
WISC-V Subtest Scores								
Verbal Comprehension Index	127.8	9.8	129.7	9.5	106.4	7.3	121.6	13.7
Visual Spatial Index	117.0	14.1	119.0	13.2	99.6	10.5	112.1	15.3
Fluid Reasoning Index	119.2	13.4	122.4	11.5	101.9	12.2	114.7	15.2
Working Memory Index	107.7	12.3	115.7	9.8	98.2	9.7	107.2	12.8
Processing Speed Index	99.4	11.5	99.7	13.7	90.9	13.5	96.8	13.4
Full-Scale Intelligence Quotient	121.2	9.7	124.6	8.2	99.8	8.5	115.5	13.9
General Ability Index	125.4	9.7	127.6	8.2	103.7	8.3	119.2	13.8
WIAT-III Subtest Scores								
Listening Comprehension	118.6	12.1	121.5	8.8	108.9	10.8	116.4	11.9
Reading Comprehension	112.5	14.4	126.6	16.2	101.2	14.9	113.3	18.1
Word Reading	95.9	11.4	115.3	10.4	88.0	8.7	99.4	15.2
Pseudoword Decoding	90.1	10.1	110.4	10.5	84.8	9.3	94.7	14.6
Oral Reading Fluency	97.2	14.8	112.7	8.5	86.8	13.4	98.7	16.3
Spelling	95.0	9.7	112.1	13.6	85.8	9.5	97.5	15.3
Oral Expression	118.1	14.1	120.7	12.9	102.9	12.4	114.0	15.2

Table 9 (continued)

	Gifted with Dyslexia		Gifted-only		Dyslexia-only		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
WIAT-III Composite Scores								
Oral Language	119.4	14.8	124.8	9.8	106.9	12.4	117.2	14.5
Total Reading	99.2	11.2	120.5	10.7	87.3	9.1	101.8	16.9
Basic Reading	93.0	8.8	114.7	12.4	86.1	7.3	97.4	15.2
Reading Comp. and Fluency	107.8	14.5	121.8	10.6	93.5	13.1	107.0	17.1

Figure 1

WISC-V and WIAT-III Mean Scores by Group



Research Question 1 Results

To answer the first research question of whether the three groups differed in their pattern of performance across cognitive ability measures, a profile analysis explored whether a statistically significant difference existed between the three groups in terms of parallelism, levels, and flatness. The overall cognitive ability scores, FSIQ and GAI, were not included in the profile analysis as they are overall summary scores calculated from the index scores, and thus are too highly correlated with the composite scores to be included in this analysis. A repeated measures MANOVA was used to test for an interaction between each of the WISC-V index scores and group identification. The parallelism analysis revealed statistically significant interaction effects indicating that the three groups displayed different patterns of highs and lows across the cognitive factors (F[8, 184] = 3.42, p = .001; Wilk's Λ = .76; partial η^2 = .13). The partial eta-squared of .13 fell in the low effect size based on benchmarks suggested by Cohen (1988).

Given the statistically significant interaction in the parallelism analysis, the levels and flatness analyses were not necessary (Bulut & Desjardins, 2020). Instead, a test of simple main effects was conducted to investigate the nature of the interaction. The statistical significance of mean differences in the data were evaluated by performing within subjects effects analysis to examine differences in means via one-way repeated measures ANOVA for each group separately (Table 10). A Bonferroni correction adjusted the probability (p) values because of the increased risk of a type I error when making multiple statistical tests. The new alpha was the original alpha value ($\alpha_{original}$ = .05) divided by the number of comparisons (5), ($\alpha_{altered}$ = .05/5) = .01. Therefore, to determine if any of the five mean differences was statistically significant, the corrected *p*-value was $p \leq 01$.

On the WISC-V index measures, the GWD group's cognitive scores were not statistically significantly different from those of the gifted-only group except for the Working Memory Index (WMI), which was lower than the gifted-only group. The GWD group's cognitive scores were statistically significantly different from the Dyslexia-only group on every measure with the exception of PSI. This was also consistent with the hypothesis, as the literature suggested, that there would be no difference between the GWD group and the Dyslexia-only group on measures of processing speed. The magnitude of the mean differences was calculated through a partial Eta squared. The effect sizes ranged from low to medium with the exception of PSI, which was very low.

Table 10

One Way Repeated Measures ANOVA for WISC-V Scores by Group

WISC-V Index Scores	*F* test	*p*-value	Partial Eta Squared
Gifted with Dyslexia vs. Dyslexia-Only Group			
Verbal Comprehension Index	51.18	< .001*	.58
Visual Spatial Index	17.64	< .001*	.31
Fluid Reasoning Index	22.39	< .001*	.34
Working Memory Index	18.83	.001*	.30
Processing Speed Index	4.43	.021	.09
Gifted with Dyslexia vs Gifted-Only Group			
Verbal Comprehension Index	51.18	.66	.58
Visual Spatial Index	17.64	.80	.31
Fluid Reasoning Index	22.39	.54	.34
Working Memory Index	18.83	.008*	.30
Processing Speed Index	4.43	.99	.09

Note. All *F* tests were based on *df* = 2, 97.

*Significant *F*-test comparisons with Bonferonni-adjusted α ≤ .01.

These results were consistent with the hypotheses based on the literaure that the GWD group's scores would be similar to the Gifted-only scores on measures of reasoning (VCI, VSI, and FRI), and that the GWD group's WMI score would be lower than the Gifted-only but higher than the Dyslexia-only.

Research Question 2 Results

Achievement Subtest Variables

The same set of analyses was conducted with the achievement subtest scores as dependent variables. The test for parallelism revealed a statistically significant interaction effect indicating that the three groups displayed different patterns of highs and lows across the achievement subtest scores, ($F[12,172] = 3.48$, $p < .001$; *Wilk's* $\Lambda = .65$; *partial* $\eta^2 = .20$). The partial eta-squared fell in the medium effect size based on benchmarks suggested by Cohen (1988).

Given the statistically significant interaction in the pararellelism analysis, the levels and flatness analyses were not relevant. Instead, a test of simple main effects was conducted to investigate the nature of the interaction (Table 11). A Bonferroni correction adjusted the probability (p) values because of the increased risk of a type I error when making multiple statistical tests. The new alpha was based on the original alpha value ($\alpha_{original} = .05$) divided by the number of comparisons (7), ($\alpha_{altered} = .05/7$) = .007. Therefore, to determine if any of the seven mean differences was statistically significant, the corrected *p*-value was $p \leq .007$. In the GWD vs. Dyslexia-only group comparisons, all dependent variable means were significantly different from each other with the exception of Pseudoword reading. In the GWD vs. Gifted-only comparisons, all of the dependent variables were significantly different from each other with the exception of Listening Comprehension, Reading Comprehension, and Oral Expression. The difference between the GWD group ($M = 112.5$, $SD = 14.4$) and Gifted-only ($M = 126.6$, $SD = 16.2$) means scores for Reading Comprehension was 14.1 points. This was expected based on the literature which suggested that the mean score difference between GWD and Gifted-only on Reading Comprehension would be approximately a one standard deviation difference. The magnitude of the mean differences was calculated through a partial Eta squared, which were in the large effect size.

Table 11

One Way Repeated Measures ANOVA Comparisons for WIAT-III Subtest Scores by Group

WIAT-III Subtest Scores	*F* test	*p*-value	Partial Eta Squared
Gifted with Dyslexia vs. Dyslexia-Only Group			
Listening Comprehension	11.77	.001*	.20
Reading Comprehension	21.51	.001*	.32
Word Reading	56.66	.001*	.55
Pseudoword Reading	56.17	.087	.54
Oral Reading Fluency	32.02	<.001*	.41
Spelling	45.33	.003*	.49
Oral Expression	16.73	<.001*	.27
Gifted with Dyslexia vs Gifted-Only Group			
Listening Comprehension	11.77	.520	.20
Reading Comprehension	21.51	.009	.32
Word Reading	56.66	.006*	.55
Pseudoword Reading	56.17	<.001*	.54
Oral Reading Fluency	32.02	.004*	.41
Spelling	45.33	<.001*	.49
Oral Expression	16.73	.690	.27

Note. All *F* tests were based on $df = 2, 97$.

*Significant *F*-test comparisons with Bonferonni-adjusted $\alpha \leq .007$.

As hypothesized, the mean subtest scores of the GWD group for Listening Comprehension, Word Reading, Pseudoword Decoding, Oral Reading Fluency, and Spelling, all fell within 1 standard deviation (15 standard score points) of the dyslexia-only group. It was also hypothesized that the mean scores of students in the GWD group on Reading Comprehension would fall within 1 standard deviation of the gifted-only group; the difference between those mean scores was 14.1 standard score points, which was as hypothesized.

Achievement Composite Variables

The same analyses were conducted with the achievement composite test variables. The test for parallelism revealed a statistically significant interaction effect indicating that the three groups displayed different patterns of highs and lows across the composite achievement factors. The Wilks Lambda indicated statistically significant differences between groups on achievement composite tests ($F[6,152] = 9.02$, $p < .001$; *Wilk's* $\Lambda = .54$; *partial* $\eta^2 = .23$). The partial eta-squared fell in the large effect size. Once again, the flatness and levels analyses were not relevant, and the next step was to investigate the nature of the interaction.

The statistical significance of mean differences was evaluated by performing within-groups effects analysis to examine differences in means via one-way repeated measures ANOVA for each group separately (Table 12). A comparison of the means for Total Reading, Basic Reading and Reading Comprehension & Fluency between the GWD and Gifted-only group were significant, but the comparison of means for Oral Language was not significant. The Bonferroni adjusted p-value was the alpha-value ($\alpha_{original} = .05$) divided by the number of comparisons (4), ($\alpha_{altered} = .05/4) = .0125$. Therefore, to determine if any of the 4 correlations is statistically significant, the *p*-value must be $p \leq .0125$. The strength of the associations was calculated through a partial Eta squared. The effect sizes ranged from low to medium for all comparisons.

Table 12

One Way Repeated Measures ANOVA Comparisons for WIAT-III Composite Scores by Group

WIAT-III Composite Scores	*F* test	*p*-value	Partial Eta Squared
Gifted with Dyslexia vs. Dyslexia-Only Group			
Oral Language	16.55*	< .001*	.26
Total Reading	77.42*	< .001*	.63
Basic Reading	71.56*	.013	.61
Reading Comprehension & Fluency	30.70*	< .001*	.44
Gifted with Dyslexia vs Gifted-Only Group			
Oral Language	16.55*	.20	.26
Total Reading	77.42*	< .001*	.63
Basic Reading	71.56*	< .001*	.61
Reading Comprehension & Fluency	30.70*	.001*	.44

Note. All *F* tests were based on $df = 2, 95$.

*Significant *F*-test comparisons with Bonferonni-adjusted $\alpha \leq .0125$.

The hypothesis based on the literature was that the composite scores for the GWD group on Oral Language, Total Reading, Basic Reading and Reading Comprehension and Fluency would fall between the mean scores of the gifted-only and dyslexia-only groups. This was true for the Total Reading and Reading Comprehension & Fluency scores. However, the Basic Reading score for the GWD group was not significantly different from the Dyslexia-only group, and the Oral Language score for the GWD group was not significantly different from the Gifted-only group.

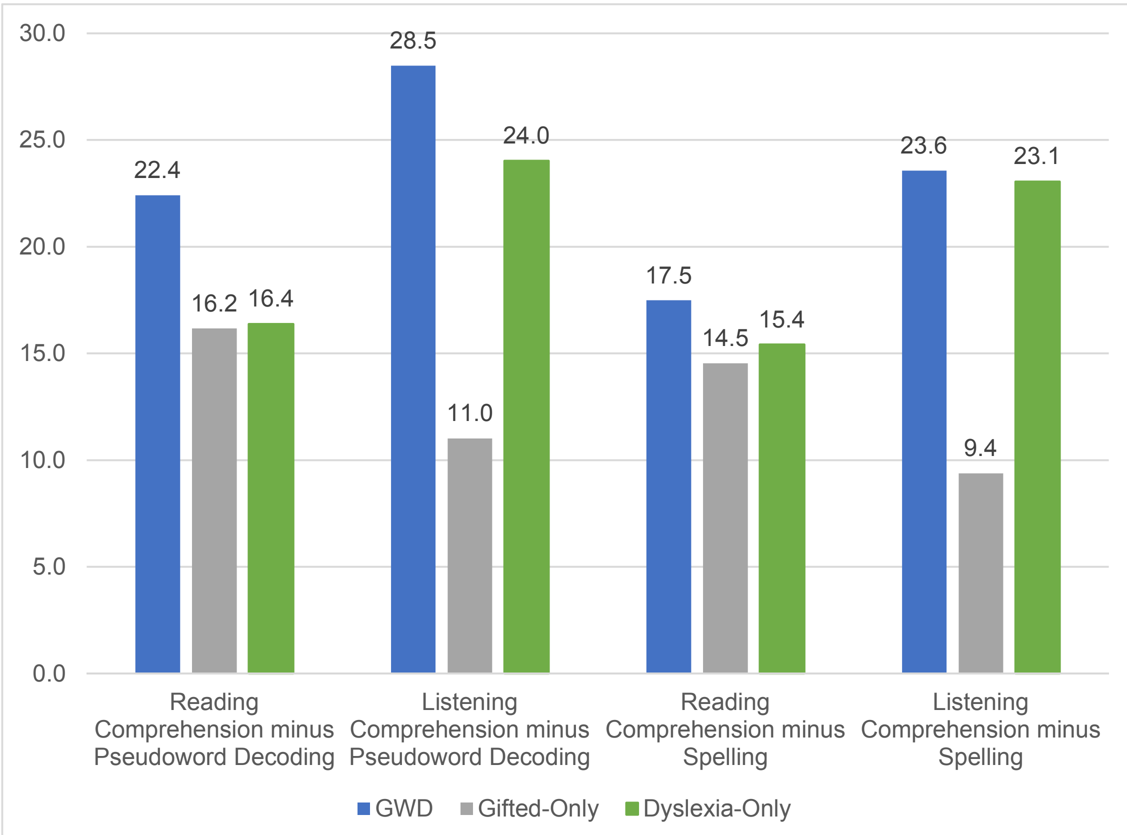
Research Question 3 Results

Research Question 3 explored the pattern of achievement subtest score variability across groups. Ottone-Cross et al. (2017) found that there was usually at least a one standard deviation (15 standard score points) difference between the highest and lowest mean scores for reading subtests. It was hypothesized based on the literature that the GWD group would have a wider range between subtests that measure reasoning skills (reading comprehension, listening comprehension) and subtests that measured decoding skills (pseudoword reading and spelling) versus the Dyslexia-only or Gifted-only groups. To answer Research Question 3, I calculated the differences between the mean scores on subtest measures, and then conducted a series of ANOVA comparisons as shown in Figure 2.

The first test was between Reading Comprehension and Pseudoword Decoding. Although the mean score differences between Reading Comprehension scores and Pseudoword Decoding scores appeared to be larger for the GWD group (M = 22.48 SD = 16.57) versus the Gifted only (M = 16.17, SD = 16.30) or Dyslexia only groups (M = 16.39, SD = 17.28), these differences were not statistically significant (F[2,93] = 1.53, p =.22; *partial* η^2 = .03). The partial eta squared fell in the low effect size. Contrary to the hypothesis, there was no significant difference between the three groups between Reading Comprehension and Pseudoword Decoding. This suggests that there was substantial overlap in the standard deviations of the test scores among the three groups.

Figure 2

Mean Score Differences between Highest and Lowest WIAT-III Achievement Subtest Score by Group



The next comparison was Listening Comprehension minus Pseudoword decoding. As predicted, the comparison of Listening Comprehension minus Pseudoword Decoding mean score differences for the GWD group (M = 28.47, SD = 14.58), Gifted-only (M = 11.07, SD = 9.65) and Dyslexia only groups (M = 24.03, SD = 15.22) were statistically significant (F[2,94] = 14.33, p < .001, *partial* η^2 = .23). The partial eta squared fell in the large effect size. The post hoc comparisons based on the Tukey test reveal greater variability between Listening Comprehension minus Pseudoword Decoding mean scores for GWD than for Gifted-only.

Variability between Listening Comprehension minus Pseudoword Decoding mean scores were also greater for Gifted-only compared with Dyslexia-only.

The next comparison was Reading Comprehension minus Spelling. The F test was not significant ($F[2,93] = .47$, $p = .63$, *partial* $\eta^2 = .01$), suggesting that there are no differences between groups on these variables. The partial eta squared fell in the small effect size.

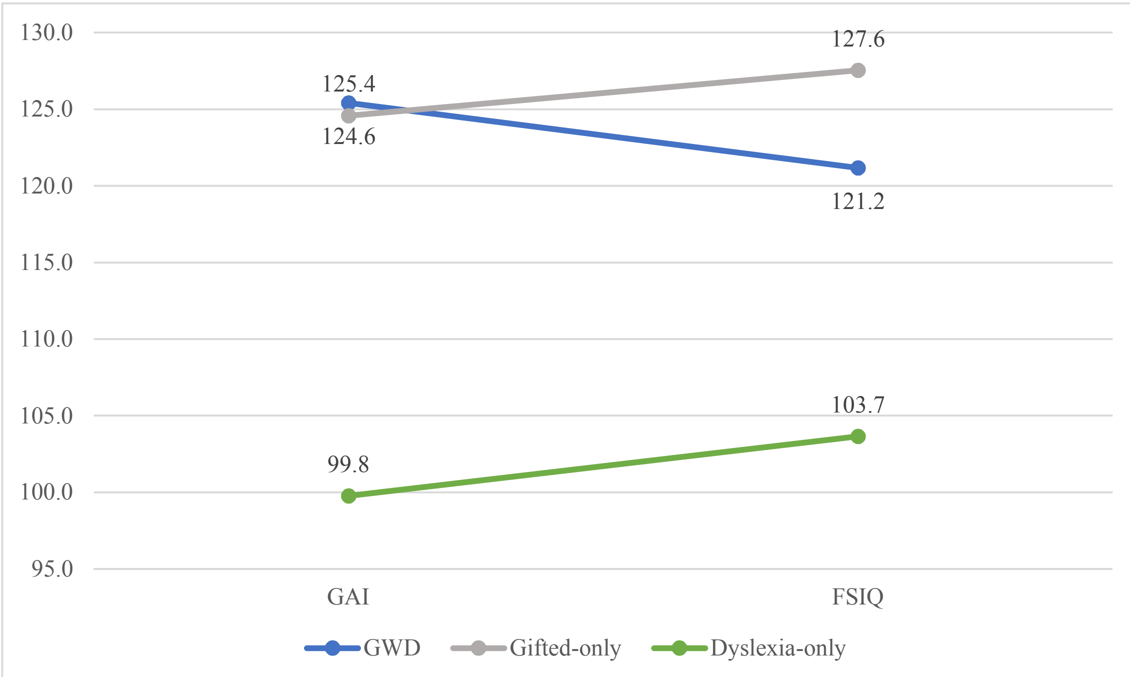
The last comparison was between Listening Comprehension and Spelling. The comparison of Listening Comprehension minus Spelling mean scores for the GWD group ($M = 23.55$, $SD = 13.47$), Gifted-only ($M = 9.39$, $SD = 14.23$), and Dyslexia-only groups ($M = 23.06$, $SD = 14.50$) were statistically significant ($F[2,95] = 10.46$, $p < .001$, *partial* $\eta^2 = .18$). The partial eta squared fell in the large effect size. The post hoc comparisons based on the Tukey test revealed, as hypothesized, greater variability between Listening Comprehension and Spelling for GWD than for Gifted-only. The variability between Listening Comprehension and Spelling was also greater for Gifted-only compared with Dyslexia-only.

Research Question 4 Results

Research Question 4 asked whether there would be a significant difference between FSIQ and GAI in the GWD group. It was hypothesized that FSIQ was likely to be depressed in the GWD group because it included their area of disability. Therefore, I predicted that FSIQ would be significantly higher than GAI for the GWD group. A paired sample t-test was conducted. The difference between the mean GAI of the GWD group was ($M = 125.42$, $SD = 9.65$), and the mean FSIQ ($M = 121.17$, $SD = 9.70$), a difference of 4.25. This difference was statistically significant ($t(35) = 6.48$, $p < .001$) and had a medium effect size (Cohen's $d = .435$). A post-hoc analysis compared of GAI and FSIQ scores for all groups, which is represented in Figure 3.

Figure 3

General Ability Index and Full-Scale Intelligence Quotient Comparisons by Group



Conclusion

With regard to the first research question regarding whether the three groups differed in their pattern of performance across cognitive ability measures, the results were consistent with the selection criteria that the GWD group's scores would be similar to the Gifted-only scores on measures of reasoning (VCI, VSI, and FRI). The results were consistent with the hypothesis that the GWD group's WMI score would be lower than the Gifted-only but higher than the Dyslexia-only, and that there would be no difference between the GWD group and the Dyslexia-only group on a measure of processing speed. The discrepancy between GAI and Processing Speed was approximately 1.5 standard deviations for both the GWD (26) and Gifted-only groups (27.9) compared with less than 1 standard deviation for the Dyslexia-only comparison group (12.8).

This suggests that GWD students' excellent verbal, visual and fluid reasoning abilities were preserved despite a diagnosis of dyslexia. Additionally, their working memory abilities are significantly stronger than their Dyslexia-only counterparts, and significantly weaker than their Gifted-only counterparts. These results are consistent with previous studies (Assouline et al., 2010) which found that processing speed and working memory skills in a GWD population are discrepant from Gifted-only counterparts.

The second research question asked whether the three groups differed in their pattern of performance across achievement measures. First, the subtest score patterns were analyzed. The pattern of highs and lows of the GWD was strikingly similar to the Dyslexia-only group, though at a higher level. In general, the GWD group outperformed Dyslexia-only on all subtest measures with the exception of Pseudoword Decoding, where there was no difference. In the GWD versus Gifted-only comparisons, the GWD group scored lower than the Gifted-only on all measures with the exception of Listening Comprehension, Reading Comprehension, and Oral Expression, where there was no difference between groups. On Total Reading and Reading Comprehension & Fluency composite measures, the GWD group's mean scores were in between those of the Gifted-only and Dyslexia-only, and each of the groups were significantly different from each other. However, the GWD group was not different from the Dyslexia-only group on Basic Reading, and the GWD group was not different from the Gifted-only group on Oral Language. This implies that the Basic Reading and Total Reading composite scores of the WIAT-III should be interpreted with caution when evaluating a potential GWD student.

The third research question explored the pattern of high and low scores among the three groups. The GWD group displayed greater variability, as measured by the difference between high and low mean scores, in reading subtest performance than the comparison groups. The mean discrepancy values differed significantly between the three groups, with some differences between the GWD and comparison groups exceeding 1 standard deviation.

The fourth research question compared the mean scores of FSIQ and GWD of the GWD group to determine if the FSIQ score was comparatively depressed because it includes areas of disability. The GAI mean score was 4.25 points higher than the FSIQ, which was significantly different. This score differential is important in light of cutoff scores for giftedness, and it provides evidence that reliance on an FSIQ may at times eliminate a GWD student from gifted and talented programming. This underscores the importance of finding students whose excellent reasoning abilities might be obscured by their disability.

CHAPTER V

DISCUSSION

There is growing interest in supporting students who are identified as GWD, but disagreements about appropriate identification criteria undermine our ability to identify and serve these students. There has been considerable debate regarding the use of discrepancy models to identify gifted students with dyslexia (Assouline et al., 2010; Lovett & Lewandowski, 2006; Lovett & Sparks, 2011). Some experts have outlined best practices in GWD identification, which identifies a model that includes a consideration of both cognitive strengths and relative achievement deficits that are empirically linked to a cognitive processing weakness (Assouline et al., 2010; Gilman et al., 2013; Hale et al., 2010). Subsequent research reviewed the best ways to use common cognitive and achievement measures for GWD identification in a nationally representative sample of students (Maddocks, 2018). Regardless of the different approaches and instruments used, there is the possibility that masking effects may obscure GWD students' giftedness and disabilities. This study explored the pattern of strengths and weaknesses of children with GWD on measures of cognitive ability and reading-related achievement measures when compared to their Gifted-only and Dyslexia-only peers. This research extends the previous work of Ottone-Cross et al. (2019) and Maddocks (2018, 2020) by comparing the subtest and composite achievement scores in a clinical sample of GWD, Gifted-only and Dyslexia-only populations, using data from commonly used psychometric instruments (WISC-V and WIAT-III).

Research Question 1

The first research question asked whether there was a unique pattern of mean scores on domain scores of the WISC-V (i.e., VCI, VSI, FRI, WMI, and PSI) across groups, and whether these would vary in specific ways depending on the cognitive area assessed. As expected, the GWD group and the Gifted-only group were not statistically significantly different from each other on measures of VCI, VSI, and FRI, suggesting that students in both groups, by definition, shared superior verbal and abstract reasoning abilities. This finding was consistent with previous research indicating that students who are GWD demonstrate strengths in reasoning, verbal, and spatial abilities that are similar to those of their gifted peers without a reading disability (Maddocks, 2020).

Previous research also suggests that GWD students differ from their Gifted-only peers on measures of cognitive proficiency as measured by the subtests on the Working Memory and Processing Speed indices (Wechsler, 2003). Dyslexia often involves weaknesses in auditory processing and retrieval fluency, a common pattern reflected by students who are GWD and who earn scores on measures of working memory that are one to three standard deviations lower than scores on their verbal measures. Students who are GWD often earn scores on measures of working memory that are one to three standard deviations lower than their performance on verbal measures (Assouline et al., 2010; Nielsen, 2002; Ottone-Cross et al., 2017; Snowling, 2013; van Viersen et al., 2016). The results from this study indicated that the GWD group mean on WMI was in between the Gifted-only and the Dyslexia-only groups, and statistically significantly different from both groups with a large effect size. This result was consistent with the hypothesis that the GWD and Gifted-only groups would differ significantly on WMI. The finding that the GWD students' WMI score was unique from either their Dyslexia-only or Gifted-only counterparts clearly differentiated the GWD profile from either of the comparison groups. The level of GWD students' depressed WMI score, relative to their cognitive reasoning strengths, may therefore serve as an important clue for diagnostic purposes.

Processing speed among students with GWD has been found to be similar to that of students with dyslexia (Ottone-Cross et al., 2019). On a measure of processing speed (PSI), the GWD group was not statistically significantly different at the .01 level from either the Gifted-only or Dyslexia-only groups, however, the effect size was in the medium range. The medium effect size suggests that the differences between the groups has practical significance. A possible reason for the lack of statistical significance is that the index score scatter, or the range of index scores within groups, rendered the magnitude of the differences between the means as trivial. Therefore, in this sample, the PSI appears to be a less reliable measure of GWD group identification.

Research Question 2

The second research question addressed whether there would be a unique pattern of performance among students with GWD as compared to their counterparts identified as Gifted-only or Dyslexia-only as related to reading achievement. Previous research has suggested that GWD students were likely to display literacy performance above that of the Dyslexia-only group, but below that of their Gifted-only counterparts (van Viersen et al., 2016). Consistent with this past work, significant differences emerged in the subtest reading scores of the three groups.

The first hypothesis was that on the subtests of Listening Comprehension, Word Reading, Pseudoword Decoding, Oral Reading Fluency and Spelling, the GWD group would be within 1 standard deviation (15 points) of the Dyslexia-only group. This finding was supported across these measures; the GWD mean scores were within 10 standard score points of the Dyslexia-only mean. Several comparisons were notable. Mean scores for Word Reading, Oral Reading Fluency and Spelling for the GWD group were in between those of the Gifted-only and Dyslexia-only. This pattern of results was consistent with the paradoxical difficulty among students with GWD who use their higher-order comprehension skills to draw on contextual cues to fill in or correct errors while reading, yet still have a high rate of errors on measures of individual word reading, fluency, and spelling.

The second hypothesis was that on the subtest scores of Reading Comprehension, the mean scores of students in the GWD group would fall within 1 standard deviation (15 standard score points) of the gifted-only group. As expected, the difference between the mean scores of the Gifted-only and GWD was 14.1 standard score points, which was within the 15-point hypothesis. It is important to note that there was no statistically significant difference between the Gifted-only and the GWD groups on their Reading Comprehension scores. This finding corroborates previous assertions that reading comprehension abilities tend to be preserved in students with GWD (Eide & Eide, 2005).

For Pseudoword Decoding, there was no difference between the GWD group and the Dyslexia-only group, suggesting that on this particular subtest, students with GWD perform more like their peers with dyslexia. This finding is consistent with Berninger and Abbott (2013) who found no difference GWD between GWD and Dyslexia-only on the CTOPP Nonword repetition subtest. Ottone-Cross et al. (2019) also found no difference between GWD and Dyslexia-only on the KTEA-3 Nonsense Word Decoding subtest. It should be noted that the Berninger and Abbott (2013) sample did not include clinically identified students with dyslexia, and Ottone-Cross et al. (2019) sample included students who were gifted with any learning disability, not exclusive to dyslexia. Thus, the results from the present study provide support for the assertion that, in a clinical sample of GWD students, superior intelligence did not eliminate the core impairments in dyslexia.

The third hypothesis was that the composite achievement scores for the GWD group on Oral Language, Total Reading, Basic Reading, and Reading Comprehension & Fluency would fall between, and be significantly different from the Gifted-only and Dyslexia-only groups. This pattern did emerge for the Total Reading and Reading Comprehension & Fluency scores. However, the Basic Reading score for the GWD group was not significantly different from the Dyslexia-only group. This was an unexpected finding because, as has been previously demonstrated, students who GWD typically perform higher than students with Dyslexia-only across all composite reading scores (e.g., Ottone-Cross et al., 2019; van Viersen et al., 2016).

There are important differences between the components of Total Reading and Basic Reading composite scores that shed light on the interpretation of these results. Composite scores are calculated based upon the sum of the subtest standard scores that make up the composite. For example, the Total Reading composite includes the subtest scores of Word Reading, Pseudoword Decoding, Reading Comprehension and Oral Reading Fluency. A post-hoc analysis revealed that the GWD group's mean scores aligned with Gifted-only group on Reading Comprehension, with the Dyslexia-only group on Pseudoword Decoding, and were squarely in between the two groups for Word Reading and Oral Reading Fluency. This pattern of highs, lows and in-between subtest scores contributes to a Total Reading score that appears "average." The Total Reading composite score, therefore, may have limited utility in identification of GWD students.

The Basic Reading Composite, which is composed of two scores, Word Reading and Pseudoword Decoding, also represented a blend of higher and lower scores for the GWD group. On these subtests, the GWD group's mean scores for Word Reading were in-between those of the Gifted-only and Dyslexia-only groups, and Pseudoword Decoding was not significantly different from the Dyslexia-only group. Pseudoword decoding skills rely on knowledge of letter-sound (grapheme-phoneme) correspondences to decode the letter strings, and as indicated above, the GWD group's superior reasoning abilities do not mask the core impairments of dyslexia related to phonic decoding skills. However, the GWD group showed relatively better performance than Dyslexia-only on Word Reading, which suggests that there may be a compensation effect.

Overall, the Total Reading and Basic Reading composite scores of the WIAT-III, by nature of the sum of a diverse range of subtests, appeared to blur the important indicators of relative strengths and weaknesses in the GWD group. GWD students demonstrate specific a specific reading profile of strengths and dyslexia-related weaknesses, and when these subtests are combined in composite achievement scores, they often appear average. These findings illustrate the difficulty of recognizing literacy difficulties in GWD students based on their Composite achievement scores.

Research Question 3

The third research question asked whether there would be a pattern of achievement subtest score variability that was unique to the GWD group. A common method for identifying students with GWD is to examine their subtest scatter on the WISC-V (Lovett & Lewandowski, 2006). Hale et al. (2008) posited that scatter is a defining characteristic of specific learning disability and that individuals with learning disabilities may have higher levels of scatter compared to normal controls. Additionally, GWD students almost always had peaks and valleys in their academic performance (Ottone-Cross et al., 2017). Therefore, it was hypothesized that there would be a larger discrepancy between subtests that leverage reasoning skills (i.e., Reading

Comprehension, Oral Language, Written Expression) versus subtests that measure lower-level processing skills (Pseudoword Decoding, Word Reading, Reading Accuracy, Reading Fluency, and Spelling) among the GWD group. It was hypothesized that the discrepancy would be significantly larger for the GWD group than for the Dyslexia-only or Gifted-only groups. Contrary to the hypothesis, there were no significant differences between the three groups when comparing Reading Comprehension and Pseudoword Decoding or Reading Comprehension and Spelling. Two comparisons did result in statistical significance. The difference between Listening Comprehension and Pseudoword Decoding was significantly larger for the GWD group than the Gifted-only group. Similarly, the difference between Listening Comprehension and Spelling was larger for the GWD group and the Gifted-only. This suggests that the variability between these subtests may be a distinguishing feature in the GWD score profile compared with Gifted-only students. This approach to evaluating the GWD pattern of strengths and weaknesses has been explored with cognitive subtest measures (Ferri et al., 1997), however, a search of the literature did not result in any findings for achievement subtest variability.

Research Question 4

Many researchers have argued that full-scale intelligence scores underestimate the verbal and reasoning strengths of students who are GWD (Assouline et al., 2006; Maddocks, 2018). The fourth research question addressed the question of whether there would be a difference between the GAI and FSIQ for the GWD group. It was hypothesized that FSIQ would be significantly lower than the GAI among participants with GWD because the overall score (FSIQ) included a common area of weakness (WMI) for this group. The results indicated that among the participants with GWD, the GAI was significantly higher than the FSIQ and that this difference had a medium effect size.

This finding corroborates the growing call for educators and psychologists to abandon the use of FSIQ as a measure of giftedness, particularly when individuals are suspected of being part of the twice exceptional population. In 2018, the NAGC WISC□V position statement warned against mandatory use of Full-Scale IQ scores for gifted identification. In fact, combining scores from all five indexes are widely discrepant results in a FSIQ that lacks meaning (Flanagan & Kaufman, 2004). As Silverman and Gilman (2020) argued, reliance on FSIQ, even when statistically uninterpretable, can exclude eligible gifted children from needed services. Instead, it is recommended that practitioners use any index score focused on reasoning or verbal abilities to identify students as gifted (NAGC, 2018). These index scores can be used to explore a variety of strengths any one of which is sufficient to document cognitive giftedness in twice exceptional students.

Implications For Practice

Every year, thousands of students languish in elementary schools because they are not fully identified as either gifted or as a student with dyslexia. Instead, they possess a combination of strengths and weaknesses that confuse both their parents and teachers. As Assouline and Whiteman (2011) noted, GWD students do indeed exist, even though they often appear average in the classroom. This study provided further support for the importance of considering distinct patterns of strengths and weaknesses on cognitive and achievement measures when identifying students as GWD. A summary of recommendations for using cognitive and achievement measures for GWD identification follows below.

First, the GAI is a preferred indicator of giftedness for GWD student identification. As has been previously argued, the WMI and PSI scores may create spuriously low estimates of a child's intellectual abilities in a GWD population which usually renders the FSIQ less meaningful as an overall ability score. In this study, FSIQ was shown to be depressed versus the GAI by approximately 4 points. This suggests that the use of FSIQ potentially masks the true areas of strength for these students. Failure to identify this unique profile may prevent GWD students from being eligible for advanced content and accelerated pace that support enrichment.

Second, achievement measures must be examined at the subtest level to properly identify students with a GWD profile. Composite reading scores such as the Total Reading and Basic Reading scores on the WIAT-III potentially mask the true areas of strengths and challenges of these learners for several reasons. As indicated in this study, the Total Reading score appeared to blur the important indicators of relative strengths (such as Reading Comprehension) and weaknesses (such as Pseudoword Decoding) in the GWD group. Hence, the results of this study strongly suggest that composite reading scores on the WIAT-III are insufficient to identify dyslexia in a gifted student. Instead, practitioners should look for patterns of relatively strong reading comprehension combined with unexpected difficulties in fluent word , spelling, and decoding.

Two achievement subtest measures, Spelling and Pseudoword Decoding are of particular importance in the GWD profile. As was discussed in the literature review, Vellutino et al. (2004) showed that spelling deficits are a useful indicator of a dyslexia. It is important to note that the Spelling subtest is not included in either of the Basic Reading or Total Reading Composite scores. From a neurological point of view, children with dyslexia have difficulty encoding phonologic and orthographic information, therefore spelling is typically impaired (Vellutino et al., 2004). In a GWD population, spelling deficits tend to be more persistent and resistant to treatment than reading deficits (Eide & Eide, 2005). Therefore, evaluating a GWD student's proficiency in spelling performance that appears far out of character when compared with the student's general ability can provide valuable diagnostic information. Of course, on its own, a low score on spelling is not sufficient to identify dyslexia in a gifted child. Clinicians must take the extra step of investigating patterns of underlying phonological dysfunction which are impeding the child's ability to spell despite appropriate instruction and support, as has been suggested by Torgerson & Torgerson (2001). Similarly, low Pseudoword Decoding scores, relative to cognitive strengths, may be one of the most noticeable manifestations of a GWD student's score profile.

Third, GWD students may be likely to have strengths in Listening Comprehension, Oral Expression and Reading Comprehension. In this study, the GWD group's Listening Comprehension, Oral Expression and Reading Comprehension were in the upper end of the average range (all means were above 112), which were well above their Dyslexia-only counterparts by at least 10 points. These strengths may be explained by GWD student's strengths in advanced reasoning skills, problem-solving skills and abstract thinking skills (Ferri et al., 1997) which in turn provide them with the ability to think conceptually and draw inferences (Mather & Jaffe, 2002). Some research has shown that that listening and reading comprehension are two closely related skills; since good readers tend to be good listeners, and good listeners tend to be good readers (Buchweitz et al., 2009). Overall, these findings provide evidence for the anecdotal observations by Eide and Eide (2013) of "stealth dyslexia" students who skip words, fill in the gaps by guessing, or rely on inference and/or their general knowledge to answer questions yet retain a paradoxically strong Reading Comprehension score.

Fourth, IQ-achievement discrepancy analysis for GWD students should evaluate academic impairment in a relative sense. Dyslexia is characterized by unexpectedly low achievement in reading and spelling (Berninger & O'Donnell, 2005). Although discrepancy models are not used as often in dyslexia identification criteria, they are still used in some states to identify students with learning disabilities. In the present study, subtest scores for students with GWD on Word Reading, Pseudoword Decoding, Oral Reading Fluency and Spelling were in the average range (between 90 and 96). However, the degree of difference between their GAI and these reading achievement subtest scores was significant. For example, the difference between the GAI and the Word Reading subtest scores for the GWD group was approximately 2 standard deviations. This substantial discrepancy is a hallmark indicator of dyslexia. Therefore, rather than comparing FSIQ to achievement composites, practitioners are encouraged to use the GAI and examine large discrepancies between this indicator of cognitive ability in contrast to specific foundational reading skills that are common weaknesses for individuals with dyslexia.

Overall, an important question in the identification of GWD students is the use of discrepancy criteria and the cutoff scores for giftedness and dyslexia. In the literature, the cutoff scores are not the same across studies, and the same is true across schools and school districts. Recent studies have shown that differences in identification methods can render very different samples of GWD students (Maddocks, 2018, 2020). In general, the dyslexia diagnosis in a gifted student requires evidence of an academic impairment. In the context of giftedness, this has become a controversial issue as many subtest achievement scores are still within the average range. The results from this study suggest that although the GWD group's achievement scores were within the average range, the degree of difference between intelligence and reading achievement is significant.

Psychologists have a crucial role in the assessment, identification and interventions for GWD students, in particular, for those who remain "hidden" due to masking effects. The aim of the was to add to the body of empirical evidence to clarify the way cognitive and achievement measures should be interpreted. Currently, there are inconsistent practices at the state and local level of how twice exceptional students are identified (Lee & Ritchotte, 2018). As Silverman and Gilman (2020) noted, the increasing number of twice exceptional students necessitates school psychologists to disentangle the confusing display of symptoms and separate the indicators of giftedness and disability. Another major concern is the referral process in schools, because teachers and administrators may not recognize signs of giftedness in students with dyslexia, and vice versa. School psychologists are in a unique position to guide the identification process due to their knowledge of a wide range of cognitive and achievement measures, expertise in disability categories, and their ability to conduct comprehensive psychological assessments. In this way, school psychologists can advocate for GWD students to cultivate their gifts and talents while ensuring the necessary remediation, and thus optimize and promote successful learning at school.

The findings of this study may also have implications for interventions for GWD students. As van Viersen et al. (2016) noted, while phonology is a common risk factor for GWD students, their relative strengths in working memory, vocabulary and spelling appear to compensate for these core deficits and provide protective factors. The authors suggest that building on these advantages by continuing to develop compensatory skills may be a more prudent approach rather than trying to address phonological deficits.

Future Research

Students who are GWD require their own diagnostic criteria that take into account their high intelligence as well as potential masking effects that are unique to reading. To date, much of the literature has focused on the identification criteria of are gifted with any learning disability. More empirical studies are needed to investigate the pattern of cognitive and reading achievement performance among students with dyslexia. Exploring these patterns across various populations such as geographic, race/ethnicity and gender will help corroborate reliable and valid methods to identify GWD students sooner, which will in turn ensure advanced content and accelerated pace in areas of strength and evidence-based interventions to remediate challenges.

Recent genetic and neurological research has shed light on the biological origins of dyslexia, and some researchers are analyzing how the anatomical differences of GWD students are different than their Dyslexia-only or Gifted-only counterparts. In a fMRI study with college students, Gilger et al. (2017) found significant differences for the surface area in the right mid-temporal gyrus in the GWD group. The mid-temporal gyrus is located on the lateral surface of the temporal lobe ventral to the superior temporal gyrus and is involved in several cognitive processes including language and semantic memory processing (Onitsuka et al., 2004). The relatively smaller surface area of the mid-temporal gyrus for individuals with dyslexia may point to the associated deficits with pseudo and real word reading ability (Eckert, 2004). These neurological underpinnings indicate that GWD students have structural characteristics that are unique to dyslexia. The interpretation of these neuroanatomical differences is complex due to many variables such as age, general brain size, white matter, pre- and post-natal experience, and thickness of cortical areas. This research points toward important questions regarding the neurological presentation of GWD students and a potential link with patterns of cognitive and achievement performance that were observed in the present study.

Future researchers may also seek to confirm the interpretability of WISC-V primary index scores before conducting the profile analysis. While subtest score variability, also known as incongruency or scatter, is common, best practices suggest that when a discrepancy of more than three points between the subtest scores that are used to derive a primary index score (e.g., VCI, VSI, FRI, WMI or PSI) exists the index score should be interpreted with caution. In the present study, WISC-V index scores of the participants were included regardless of possible incongruency among the subtests. Thus, a possible angle of research would be to investigate the effect of index score scatter on the profile analysis results.

In the present study, the measure of central tendency among participants scores was evaluated using mean values, which is usually the best measure when data is continuous and normally distributed. One limitation of the mean is that it is significantly influenced by outliers. When this happens, the median becomes a preferred measure, particularly when a dataset forms a skewed distribution. Future researchers may seek to evaluate how influential outliers are in distorting each group's mean score values. If they do not significantly distort the mean, using the mean as a measure of central tendency will be preferred.

Lastly, during the time this study was in process, an updated version of the WIAT-III achievement test (the WIAT-4) was published, with five new subtests: Phonemic Proficiency, which measures the speed and accuracy of phoneme manipulation; Orthographic Choice, which measures recognition of spelling skills; Orthographic Fluency, which measures the speed of irregular word reading; Decoding Fluency, which measures the speed of pseudoword reading; and Sentence Writing Fluency, which measures the speed of sentence composition. Reading-related Composite scores have changed to include Phonemic Proficiency, and a new Language Processing Composite score has been added. While these subtests may in theory have more clinical sensitivity to markers of dyslexia, research is needed to understand GWD student score patterns across all existing and new achievement measures. Future researchers may also consider comparing reading achievement scores from measures that are commonly used in schools such as the Kaufman Test of Educational Achievement-Third Edition (KTEA-3), Gray Oral Reading

Test-Fifth Edition (GORT-5), or the Comprehensive Test of Phonological Processing-Second Edition (CTOPP-2).

Limitations

There are several limitations to this study. An inflated VIF score for Word Reading may have rendered a possible violation of MANOVA assumptions on the homogeneity of covariance in the profile analysis, which increases the risk for a Type II error (false negative for statistical significance). However, the VIF score would not have impacted the one-way ANOVA significance scores or effect size.

This study used data from a convenience sample referred to a private practice for a neuropsychological evaluation in an urban and suburban setting in a large western state. Therefore, this population likely did not represent the economic diversity that is more common in the public school population or the samples that were included in other studies. Further, the sample size was small, so the results of this study may not generalize to a broader population. Some students might have had additional diagnoses so the effects of those (e.g., ADHD) may have impacted findings. The diagnostic approach of the clinicians at this practice may not be the same as other practices; disagreement about gifted and dyslexia identification criteria has enormous implications for the studying this population. Lastly, the lack of standardized identification criteria complicates the recruitment of appropriate samples and limits the generalizability of empirical results.

Conclusion

The aim of this research was to raise awareness about the ways that dyslexia might present in gifted students, and how giftedness might present when it is camouflaged by dyslexia. The GWD students in this study had mean GAI scores that were higher than their FSIQ scores, which has important implications for gifted identification. Key indicators of dyslexia, Spelling and Word Reading, were markedly “in the middle” between their Gifted-only and Dyslexia-only counterparts, providing evidence for a masking effect. Pseudoword Decoding scores for the GWD students was no different than their Dyslexia-only counterparts, which may be a useful marker for dyslexia identification. On the other hand, Reading Comprehension was a strength of the GWD group. Composite scores of the WIAT-III, such as Basic Reading and Total Reading, tended to cloud the picture of the “peaks and valleys” of the GWD student profile, therefore composites appeared to be less useful in identification than subtest scores. Achievement subtest scatter, or the difference between the highest and lowest subtest score related to reading, was larger for the GWD group. Taken as a whole, the GWD group had a unique profile of highs, lows and in-betweens that helped sharpen the picture of GWD cognitive and achievement strengths and weaknesses.

The results provide implications for diagnostic practice. It is crucial for educators and psychologists to recognize that students who are gifted are often underdiagnosed with dyslexia because their “average” classroom performance appears “appropriate.” Because their readings skills appear adequate, these students may not be identified as dyslexic or given the help they need to overcome their academic difficulties. Identification of a student who is GWD requires a comprehensive evaluation that includes as much information as possible about a student’s cognitive and academic profiles. These measures form the basis of comparison to determine what is average, what is above average, and what is below average achievement for different student populations.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

Date:	03/01/2021
Principal Investigator:	Anne Boris
Committee Action:	**IRB EXEMPT DETERMINATION – New Protocol**
Action Date:	03/01/2021
Protocol Number:	2102021405
Protocol Title:	Stealth Dyslexia: Cognitive and Achievement Profiles of Gifted Students with Dyslexia
Expiration Date:	

The University of Northern Colorado Institutional Review Board has reviewed your protocol and determined your project to be exempt under 45 CFR 46.104(d)(704) for research involving

Category 4 (2018): SECONDARY RESEARCH USING IDENTIFIABLE DATA OR SPECIMENS. Secondary research for which consent is not required: Secondary research uses of identifiable private information or identifiable biospecimens, if at least one of the following criteria is met: (i) The identifiable private information or identifiable biospecimens are publicly available; (ii) Information, which may include information about biospecimens, is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained directly or through identifiers linked to the subjects, the investigator does not contact the subjects, and the investigator will not re-identify subjects; (iii) The research involves only information collection and analysis involving the investigator's use of identifiable health information when that use is regulated under 45 CFR parts 160 and 164, subparts A and E, for the purposes of "health care operations" or "research" as those terms are defined at 45 CFR 164.501 or for "public health activities and purposes" as described under 45 CFR 164.512(b); or (iv) The research is conducted by, or on behalf of, a Federal department or agency using government-generated or government-collected information obtained for nonresearch activities, if the research generates identifiable private information that is or will be maintained on information technology that is subject to and in compliance with section 208(b) of the E-Government Act of 2002, 44 U.S.C. 3501 note, if all of the identifiable private information collected, used, or generated as part of the activity will be maintained in systems of records subject to the Privacy Act of 1974, 5 U.S.C. 552a, and, if applicable, the information used in the research was collected subject to the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 et seq.

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UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

You may begin conducting your research as outlined in your protocol. Your study does not require further review from the IRB, unless changes need to be made to your approved protocol.

<u>As the Principal Investigator (PI), you are still responsible for contacting the UNC IRB office if and when:</u>

- You wish to deviate from the described protocol and would like to formally submit a modification request. Prior IRB approval must be obtained before any changes can be implemented (except to eliminate an immediate hazard to research participants).
- You make changes to the research personnel working on this study (add or drop research staff on this protocol).
- At the end of the study or before you leave The University of Northern Colorado and are no longer a student or employee, to request your protocol be closed. *You cannot continue to reference UNC on any documents (including the informed consent form) or conduct the study under the auspices of UNC if you are no longer a student/employee of this university.
- You have received or have been made aware of any complaints, problems, or adverse events that are related or possibly related to participation in the research.

If you have any questions, please contact the Research Compliance Manager, Nicole Morse, at 970-351-1910 or via e-mail at nicole.morse@unco.edu. Additional information concerning the requirements for the protection of human subjects may be found at the Office of Human Research Protection website - http://hhs.gov/ohrp/ and https://www.unco.edu/research/research-integrity-and-compliance/institutional-review-board/.

Sincerely,

Nicole Morse
Research Compliance Manager

University of Northern Colorado: FWA00000784