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The General Abilities Index as a Third Method of Diagnosing Specific Learning Disabilities

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Abstract

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MA, Pacific Lutheran University 1990

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Dissertation Submitted in Partial Fulfillment

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Abstract

Many studies have investigated problems with the ability achievement discrepancy (AAD) method of diagnosing specific learning disabilities (SLDs). The definition of an SLD includes the presence of a deficit in one or more cognitive processing systems. Researchers in other studies found that the AAD method overdiagnoses English language learners and students from low socioeconomic backgrounds, and underdiagnoses students with cognitive processing deficits. Although SLD diagnostic methods have been widely researched, much less information is available regarding SLD diagnostic methods that predict important student outcomes, such as high school completion. The General Abilities Index (GAI) is an SLD diagnostic method that can identify cognitive processing deficits. This study examined the relationships between cognitive processing deficits and the GAI method, and high school completion status, performance on state standards assessments, and SLD eligibility. Using a multivariate, nonexperimental design, this study analyzed 149 datasets from records of students tested for an SLD between 1996 to 2013. A generalized linear model analysis found that several types of cognitive processing deficits predicted math and writing performance on the state standards assessment and predicted not being diagnosed with an SLD, while the GAI method failed to predict any relationship with the dependent variables. Positive social changes from this study may include improved SLD diagnostic practices and improved educational interventions that target the cognitive processing deficits. Improved educational outcomes for SLD persons may reduce the high rates of unemployment, substance abuse, and incarceration experienced by the adult SLD population.

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Chapter 1: Introduction to the Study

Introduction

Specific learning disabilities (SLDs) are one of the 13 educational disability categories defined in federal disability rights legislation (Individuals with Disabilities Education Act [IDEA], 2004; Learning Disabilities Association of America [LDA], 2010; National Center for Learning Disabilities [NCLD], 2009). In the United States, nearly 2.5 million children are diagnosed with a learning disability, making it the largest of the 13 educational disability categories (NCLD, 2009). Learning disabilities are not unique to the United States. Similar incidence rates are found in all industrialized nations, with some differences in how learning disabilities are defined (IDEA, 2004; NCLD, 2009). Despite these differences, most learning disability definitions have a common core of symptoms that include adequate intellectual abilities and significant problems learning one or more basic academic skill (Morris, Schraufnagel, Chudnow, & Weinberg, 2009; Vargo & Young, 2011). Learning disabilities are usually diagnosed during the elementary school years but can also be diagnosed in middle school, high school, and adulthood (Morris et al., 2009; Thurlow, Sinclair, & Johnson, 2002; Vanderberg & Emery, 2009). Individuals with learning disabilities struggle to learn the basic academic skills of reading, writing, or math, which affects performance in other academic subject areas (Newton & McGrew, 2010; Vanderberg & Emery, 2009).

Adults and children with learning disabilities experience an array of adverse effects. Learning disabled students have lower rates of high school completion and have less access to post high school education and training programs than nondisabled peers

(Joyce & Rosen, 2006). Learning disabled adults are also more likely to be unemployed and to develop affective illnesses than nondisabled peers (Joyce & Rosen, 2006; NCLD, 2009; Newton & McGrew, 2010; Restori, Katz, & Lee, 2009; Vanderberg & Emery, 2009). Positive social change implications resulting from the study may include improved SLD diagnostic methods that identify cognitive processing deficits, leading to improved academic interventions and improved educational and occupational outcomes for persons with SLDs.

Learning disabilities stem from impairment in one or more fundamental cognitive processing systems necessary for understanding language, retaining information, speaking, writing, reading, and performing mathematical calculations (Andersson, 2006; Berninger, 2006; IDEA, 2004; Newton & McGrew, 2010). Learning disabilities are diagnosed mainly in public school settings and less frequently in private psychology practices (IDEA, 2004; LDA White Paper, 2010). The IDEA (2004) sets forth legal guidelines for diagnosing learning disabilities in public schools. The ability achievement discrepancy (AAD) and response to intervention (RTI) methods are the SLD diagnostic procedures written into special education law (IDEA, 2004; OSPI, 2013). In addition, the state of Washington, based on IDEA (2004), permits another method of diagnosing SLDs. This method is the professional judgment approach:

> The evaluation group may also consider whether the student exhibits a pattern of strengths and weaknesses in performance, achievement, or both, relative to age, state grade level standards, or intellectual development, that is determined by the evaluation group to be relevant to the identification of a specific learning

> disability. (Office of the Superintendent of Public Instruction [OSPI], 2013, Section 392-172(A), p. 51)

The professional judgment method of SLD diagnosis is mentioned to provide an overview of all SLD diagnostic methods permitted by law; however, the focus of the current study is on the AAD and RTI methods of diagnosing SLDs. While Washington's interpretation of the professional judgment option allows evaluation groups the choice to recognize cognitive processing deficits, it does not require cognitive processing deficits to be identified in SLD diagnostic evaluations (OSPI, 2013). Other states, such as Texas and Indiana, have based their professional judgment options on the identification of cognitive processing deficits (LDA, 2014).

A growing body of research has suggested that many children are not well served by either the AAD or the RTI methods (Berninger, 2006; Kavale, 2005; LDA White Paper, 2010). Studies have indicated there are valid concerns about the reliability of learning disability diagnoses with the AAD and RTI methods, such that neither approach can stand alone as a sound diagnostic methodology (Berninger, 2006; Kavale, 2005; LDA White Paper, 2010; Newton & McGrew, 2010; Stuebing et al., 2002; Vanderberg & Emery, 2009). The AAD and RTI methods have been found to overdiagnose students who are English language learners, who belong to ethnic minority groups, or who are from low socioeconomic backgrounds. Additionally, the AAD and RTI methods often fail to diagnose students who have deficits in one or more fundamental cognitive processes (Andersson, 2010; Berninger, 2006; Dombrowski et al., 2006; Dombrowski, Kamphaus, & Reynolds, 2004; LDA White Paper, 2010). Current research findings increasingly support the need to develop SLD diagnostic procedures that recognize cognitive processing deficits however, there is little professional agreement about how to reach this goal (Andersson, 2010; Berninger, 2006; Kamphaus, Frick, & Lahey, 1991; LDA White Paper, 2010).

To address problems associated with the AAD method, I investigated a third SLD diagnostic method that recognizes cognitive processing deficits (Alloway, 2009; Andersson, 2010; Berninger, 2006; Fuchs, Hale, & Kearns, 2011). The General Abilities Index (GAI) method of diagnosing SLDs identifies cognitive processing deficits from the IQ and index scores of Wechsler intelligence scales (Prifitera, Weiss, & Saklofske, 1998; Raiford, Weiss, Rolfhus, & Coalson, 2005; Weiss, Saklofske, Prifitera, Chen, & Hildebrand, 1999). The GAI and the Wechsler intelligence scales will be discussed more thoroughly in subsequent sections of this chapter.

Organization of the Chapter

Following this section, I review the background of the learning disabilities construct, followed by a discussion of the AAD, RTI, and GAI diagnostic methods. Next, I present the purpose of the study and the research questions, followed by the theoretical foundation section. In the theoretical foundation section, I discuss the connections between cognitive processing deficits and learning disabilities and introduce the Cattell-Horn-Carroll (CHC) theory of cognitive processing systems. Following this discussion, the research design, key variables of the study, and the methodology of the study are summarized. Next, I present the definitions, assumptions, scope and delimitations, and limitations sections. I conclude Chapter 1 with a review of the positive social change implications of the study and a preview of what is to come in Chapter 2.

Background

During the 1960s, the learning disability construct emerged with an identity separate from other childhood disabilities, such as mental retardation, blindness, and deafness (National Research Center on Learning Disabilities [NRCLD], 2007). As awareness of learning disabilities grew in the 1960s, experts began to understand that learning disabilities were separate from global intellectual development (Berninger, 2006; Francis et al., 2011; Kamphaus et al., 1991; NRCLD, 2007; Vanderberg & Emery, 2009). Under the AAD diagnostic method, a learning disability is suspected when an individual's full scale IQ falls in the average or above average ranges, and basic skills test scores (reading, math, writing) are significantly lower than the full scale IQ (Andersson, 2010; Berninger, 2006; Dombrowski et al., 2006). Thus, measurement of a person's intellectual functioning, in conjunction with academic skills testing, became the basis of the learning disability diagnostic process (Flanagan, Fiorello, & Ortiz, 2010; Francis et al., 2011; NRCLD, 2007).

Prior to the mid-1990s, psychology professionals believed intelligence was best represented by a single full scale IQ score (Andersson, 2010; Berninger, 2006; Flanagan et al., 2010; Kamphaus et al., 1991). Since that time, empirical evidence has shown that intelligence consists of many interactive cognitive processes (Andersson, 2010; Berninger, 2006; Flanagan et al., 2010; Fuchs et al., 2011; Kamphaus et al., 1991; LDA White Paper, 2010). The mid-1990s meta-analysis by Wang, Haertel, and Walberg

(1993) found that metacognitive (planning, synthesizing, and problem solving) and cognitive processes (intellectual ability and application of accumulated knowledge) were the most important predictors of a student's learning success. Wang et al.'s (1993) findings were congruent with other research findings at the time, and current research findings of cognitive processing systems (Francis et al., 2011; Fuchs et al., 2011; LDA White Paper, 2010; Newton & McGrew, 2010; Paul, 2010).

Professional understanding about learning disabilities was limited until the mid-1990s, when research into the genetic and neurological aspects of learning disabilities began to expand (Hallahan & Mercer, 2007; Kamphaus et al., 1991; Newton & McGrew, 2010; Wang et al., 1993). These research efforts resulted in an accumulation of findings about the hereditary aspects of learning disabilities (Hallahan & Mercer, 2007; Paul, 2010). In addition, positron emission tomography and magnetic resonance imaging procedures (Hallahan & Mercer, 2007) began documenting anatomical differences between the brains of nonlearning disabled persons and the brains of those diagnosed with learning disabilities. These findings pointed to actual physiological differences in cognitive processing capabilities and stimulated further research into cognitive processing functions (Hallahan & Mercer, 2007).

The body of evidence connecting cognitive processing deficits and learning disabilities has expanded rapidly in recent years, resulting in diminished professional support for the notion that intelligence is best represented by a single full scale IQ (Alloway, 2009; Berninger, 2006; Flanagan et al., 2010; Fuchs et al., 2011; Hallahan & Mercer, 2007; Naglieri, Rojahn, Matto, & Aquilino, 2005; Newton & McGrew, 2010;

Wang et al., 1993). Because average to above average intelligence is necessary to receive a learning disability diagnosis, an understanding of cognitive processing systems is necessary to understand the problems associated with the AAD and RTI diagnostic methods. Cognitive processing systems are described briefly in this section and more thoroughly in Chapter 2. A more comprehensive discussion of cognitive processing systems is a massive undertaking and beyond the scope of this paper.

The term cognitive processing systems refers to the numerous neurological functions that allow us to learn and function in our environments (Naglieri et al., 2004; Newton & McGrew, 2010). These neurological functions include the ability to learn to speak and use language, to learn to read, write, and perform mathematical calculations, to retain information for later problem solving, and other such abilities (Alloway, 2009; Archibald & Alloway, 2008; Doll & Horn, 2008; LDA White Paper, 2010; Mabbott & Bisanz, 2008; Naglieri et al., 2005; Newton & McGrew, 2010). The accumulation of research findings about cognitive processing systems and learning disabilities has led to a new conceptualization of intelligence. Rather than a single full scale IQ, intelligence in the 21st century is best conceptualized by a thorough understanding of cognitive processing functions (Alloway, 2009; Naglieri et al., 2005; Newton & McGrew, 2010).

One example of a cognitive processing system is working memory, defined as the ability to hold information in short-term memory for later problem solving, to control attention, and to inhibit irrelevant associations (Alloway, 2009; Geary, Hoard, Byrd-Craven, & DeSoto, 2004; Mabbott & Bisanz, 2008; Swanson, Jerman, & Zheng, 2008). Working memory consists of four essential elements and is thought to play an important role in learning literary and numerical skills (Alloway, 2009; Archibald & Alloway, 2008; Mammarella, Lucangeli, & Cornoldi, 2010). These four elements are the central executive, the phonological loop, the visuospatial sketchpad, and the episodic buffer (Alloway, 2009; Mammarella et al., 2010). The central executive is thought to handle the functions of controlling attention, processing information, and temporarily storing visual information (Alloway, 2009; Mammarella et al., 2010). The phonological loop is thought to provide temporary storage of verbal material (Alloway, 2009; Mammarella et al., 2010). The visuospatial sketchpad is the function that maintains and manipulates representations of visual and spatial information, and the episodic buffer is the function that allows us to correlate and integrate information across several domains and memory subsystems (Alloway, 2009; Mammarella et al., 2010).

Speed of information processing is another important cognitive processing system and refers to the rate at which a person can input, conceptualize, and respond to an auditory or visual stimulus (Archibald & Alloway, 2008; Helmbold & Rammsayer, 2010; Saklofske, Zhu, Coalson, Raiford, & Weiss, 2010; Sattler, 2008). The speed of the information processing system includes the ability to rapidly manage focus and concentration, as well as the ability to efficiently organize mental information and express it in a form such as writing or speaking (Archibald & Alloway, 2008; Helmbold & Rammsayer, 2010; Sattler, 2008). Individuals with higher scores on processing speed measures often demonstrate higher full scale IQs, perform better on measures of reaction time, and are better able to inhibit impulsive responding (Sattler, 2008).

Cognitive processing deficits are the focal point of the federal definition of a learning disability:

> A disorder in one or more of the basic psychological (cognitive) processes involved in understanding or using spoken language or written language that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia. (IDEA, 2004, Section 602(30), p. 46551)

Despite this definition, the diagnostic procedures outlined in IDEA (2004) are unable to identify the cognitive processing deficits that underlie learning disabilities (Berninger, 2006; Flanagan et al., 2010; Fuchs et al., 2011; IDEA, 2004; LDA White Paper, 2010; Paul, 2010). Given the relationship between cognitive processing systems and daily functioning, it is important to make current SLD diagnostic methods in order to develop educational interventions that address the cognitive processing deficits underlying these disorders. Improved evaluation, intervention, and support techniques will likely lead to improved educational and occupational outcomes for persons with SLDs.

Problem Statement

Learning disabilities are lifelong disorders, often leading to diminished opportunities for educational and occupational successes (Berninger, 2006; NCLD, 2009; Newton & McGrew, 2010). Learning disabilities affect a person's ability to complete high school, participate in post high school education opportunities, and find gainful employment in adulthood at the same rates as the general population (Berninger, 2006;

NCLD, 2009; Newton & McGrew, 2010; Restori et al., 2009; Vanderberg & Emery, 2009). Students with learning disabilities drop out of high school at over twice the rate as nondisabled peers, and twice as many adults with learning disabilities are unemployed when compared to nondisabled peers (Berninger, 2006; Berninger & May, 2011; Morris et al., 2009; NJCLD, 2008; Restori et al., 2009). These statistics demonstrate the need for accurate diagnostic procedures that lead to effective interventions (Flanagan et al., 2010; Naglieri et al., 2005).

When a student has significant difficulty learning basic academic skills, despite educational interventions, a learning disability is often suspected (Berninger, 2006; Naglieri et al., 2005). In addition to the professional judgment option, IDEA (2004) outlines two methods for diagnosing learning disabilities that are the AAD and RTI methods. The criteria to diagnose an SLD with the AAD method is a severe discrepancy between a person's full scale IQ score (ability) and scores on a norm-referenced academic skills test (achievement; IDEA, 2004). Federal law allows states individually to select procedures for defining a severe discrepancy (IDEA, 2004). Some states use a regressed standard score equation to determine if an academic score is severely discrepant from the full scale IQ. Other states require a difference of one and one half standard deviations from the mean to determine a severe discrepancy (Berninger, 2006; IDEA, 2004; Newton & McGrew, 2010; Sattler, 2008). When individual states use different criteria to determine a severe discrepancy, it is possible to meet SLD eligibility criteria in one state, but not in another state (IDEA, 2004).

The RTI method of identifying learning disabilities uses a process of educational interventions aimed at students who fail to keep pace with state established grade level expectations (Flanagan et al., 2010; IDEA, 2004; Kavale, 2005; Mellard & Johnson, 2008). In an RTI process, all students are screened for development of basic reading, math, and sometimes writing skills (Kavale, 2005; Mellard & Johnson, 2008). Students who do not meet the established grade level benchmarks are given specific interventions aimed at improving the deficit skill to grade level expectations. At the next screening period, students who still fail to make adequate progress towards grade level benchmarks are given additional academic interventions for prespecified periods of time. If these students continue to make limited or no academic growth, an SLD diagnosis can be made, followed by implementation of special education services (IDEA, 2004; Kavale, 2005; Mellard & Johnson, 2008).

An increasing number of researchers have called for a third SLD diagnostic method that recognizes cognitive processing deficits (Flanagan et al., 2010; Fuchs et al, 2011; LDA White Paper, 2010; Naglieri et al., 2005; NCLD, 2010; Paul, 2010). The General Abilities Index (GAI) may be able to fill this gap. To address growing concerns about the AAD method, Prifitera et al. (1998) developed the GAI method for use with the WISC-III. The WISC-III GAI method was later revised for use with the WISC-IV (Raiford et al., 2005; Sattler, 2008). The WISC-III and the WISC-IV can be administered to children between the ages of 6 to 16. The WISC-III, WISC-IV, and the GAI methods are discussed briefly here and are discussed in more detail in Chapter 2.

The GAI was specifically developed to adjust full scale IQs that were depressed by low scores on one or more WISC-III and WISC-IV IQ and index scale (Prifitera et al., 1998; Raiford et al. 2005; Weiss et al., 1999). The WISC-III yields a verbal IQ (VIQ), performance IQ (PIQ), and a full scale IQ, calculated from the raw scores of five verbal domain and five performance domain subtests (Wechsler, 1991). Additionally, the WISC-III yields four index scores, which measure verbal comprehension, perceptual organization, freedom from distractibility (working memory), and processing speed abilities (Wechsler, 1991). In a similar fashion, the WISC-IV produces a full scale IQ derived from scores on four indices, which also measure verbal comprehension, perceptual reasoning, working memory, and processing speed capabilities (Wechsler, 2003). Research has indicated that one or more significantly low WISC-III and WISC-IV IQ or index score strongly suggests the presence of a cognitive processing deficit (Flanagan et al., 2010; Naglieri et al., 2005; Raiford et al., 2005; Saklofske et al., 2010; Weiss et al., 1999). Using the WISC-III as an example, a student might obtain a VIQ of 102, a PIQ of 98, and a full scale IQ of 100. Because all three scores are relatively close to 100, the full scale IQ of 100 can be viewed as representative of the student's general intelligence (Wechsler, 1991). However, a VIQ of 78 and a PIQ of 110 might also yield a full scale IQ of 100. In this situation, sole reliance on the full scale IQ would result in nonidentification of a verbal domain processing deficit, as evidenced by the VIQ of 78 (Prifitera et al., 1998; Sattler, 2008; Wechsler, 1991). These two scenarios show how a full scale IQ of 100 can fairly and unfairly represent a person's overall intelligence, and why a full scale IQ is not a good indicator of overall intellectual functioning (Naglieri et al., 2005).

Purpose of the Study

The purpose of this quantitative study was to statistically examine relationships between cognitive processing deficits and several important student outcomes. Many studies have investigated the AAD and RTI methods of diagnosing SLDs (Andersson, 2010; Berninger, 2006; Dombrowski, et al., 2006; Flanagan et al., 2010; LDA White Paper, 2010; Naglieri et al., 2005). However, few studies have examined the effect of a third diagnostic method on specific student outcomes, such as high school completion status, performance on state standards assessments, and SLD eligibility. The results of this study will add to the body of knowledge about the connections between cognitive processing deficits and SLDs and to the body of knowledge about the role of the GAI method in SLD diagnostic evaluations.

To accomplish the study's goals, I selected a generalized linear model (GLM) analysis to explore possibly significant relationships between the predictor and dependent variables. I chose a GLM analysis for the study because the sample data are independent, there are multiple continuous and categorical variables, and the variable distributions are not normal (George & Mallery, 2008; Hill & Lewicki, 2007; Littell, Stroup, & Freund, 2002).

The dependent variables for the study were high school completion status, reading, writing, and math test scores on Washington's state standards assessments, and the SLD diagnostic method (AAD, GAI, both methods, or neither method). The predictor variables were the student's grade level when tested, the amount of and types of cognitive processing deficits found in WISC-III and WISC-IV IQ and index scores, and SLD eligibility under the GAI diagnostic method.

Research Questions and Hypotheses

In this quantitative study, three research questions were posed using the same predictor variables for each. With the first question, I sought to determine if the student's grade level when tested, SLD eligibility under the GAI method, and the degree and the types of cognitive processing deficits, specifically verbal comprehension, processing speed, or working memory, predicted high school completion. With the second research question, I sought to determine if the student's grade level when tested, SLD eligibility under the GAI method, and the degree and the types of cognitive processing deficits, specifically verbal comprehension, processing speed, or working memory, predicted scores on Washington's state standards assessments. With the third research question, I sought to determine if the student's grade level when tested, SLD eligibility under the GAI method, and the degree and the types of cognitive processing deficits, specifically verbal comprehension, processing speed, or working memory, predicted SLD eligibility.

The goal of this study was to investigate a potential third method of diagnosing SLDs that recognizes the cognitive processing deficits that underlie learning disabilities (Alloway, 2009; Berninger, 2006; Fuchs et al., 2011; IDEA, 2004; Naglieri et al., 2005). To address problems associated with the AAD and RTI diagnostic methods, the current study examined if the predictor variables grade level when tested, the degree and the types of cognitive processing deficits identified in WISC-III and WISC-IV IQ and index scores, and SLD eligibility under the GAI method could predict high school completion status, test scores on state standards assessments, and SLD eligibility. I chose a GLM analysis for the current study because GLMs can analyze multiple dependent and predictor variables with nonnormal distributions and still produce accurate statistical results (Guisan, Edwards & Freund, 2002; Hill & Lewicki, 2007; Littell et al., 2002).

Research Question #1: High school completion status.

H_{0hs}: The student's grade level when tested, SLD eligibility with the GAI method, and the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, working memory, or a combination of the three do not predict high school completion.

H_{1hs}: The student's grade level when tested, SLD eligibility with the GAI method, and the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, working memory, or a combination of the three do predict high school completion.

Research Question # 2: Test scores on Washington's state standards assessments.

H_{0wsa}: The student's grade level when tested, SLD eligibility with the GAI method, and the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, working memory, or a combination of the three do not predict performance on state standards assessments.

H_{1wsa}: The student's grade level when tested, SLD eligibility with the GAI method, and the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, working memory, or a combination of the three predict performance on state standards

Research Question #3: SLD diagnostic method.

H_{0wsa}: The student's grade level when tested, SLD eligibility with the GAI method, the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, working memory, or a combination of the three do not predict the SLD eligibility.

H_{1wsa}: The student's grade level when tested, SLD eligibility with the GAI method, the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, working memory, or a combination of the three do predict SLD eligibility.

The collected predictor variable data were the student's grade level when initially tested for an SLD, SLD eligibility under the GAI method, and the degree and types of cognitive processing deficits found in WISC-III and WISC-IV IQ and index scores, specifically verbal comprehension, processing speed, and working memory deficits.

The collected dependent variable data were SLD eligibility, high school completion status, and test scores from the reading, writing, and math sections on Washington's state standards assessments. Because the study took place in Washington state, the specific state standards assessments used were the Washington Assessment of Student Learning (WASL) and the High School Proficiency Exam (HSPE; OSPI, 2009, 2010). The WASL is the original name for Washington state's standards assessment. In 2009, the WASL was renamed the Measurement of Student Progress for the third through the eighth grades tests, and the HSPE for the high school test (OSPI, 2009, 2010). To graduate with a high school diploma, students must pass the HSP (OSPI, 2010). The WASL and the HSP tests span the date ranges for the study: the 1996/1997 to the 2012/2013 school years. Both tests are criterion-referenced instruments based on Washington state's grade level expectations for K-12 students (OSPI 2009, 2010).

Theoretical Framework

The Cattell-Horn-Carroll (CHC) theory of cognitive processing systems is an empirically supported framework for understanding human cognitive functions (McGrew, 2003; Newton & McGrew, 2010; Proctor & Prevatt, 2003). CHC theory is addressed briefly in this section and will be discussed more thoroughly in Chapter 2. CHC theory is a widely researched theory of intelligence with substantial empirical support for its validity (Flanagan et al., 2010; McGrew, 2003). CHC theory is an appropriate theoretical framework for this study because of the large research base connecting cognitive processing deficits to learning disabilities (Mather & Gregg, 2006; Newton & McGrew, 2010; Naglieri et al., 2005).

CHC theory's premise is that human intelligence consists of many interactive cognitive processes (Newton & McGrew, 2010). The empirical evidence supporting CHC theory came from various longitudinal studies by researchers from different disciplines, such as the neurocognitive, genetic, developmental, and other fields of study (Daniel, 1997, as cited by Flanagan et al., 2010). CHC theory is a well-respected cognitive processing theory from which practitioners can better study, understand, and explain human cognitive functioning (Flanagan et al., 2010; McGrew, 2003; Newton &

McGrew, 2010). Many CHC research findings show that learning disabilities are directly related to deficits in cognitive processing systems (IDEA, 2004; LDA White Paper, 2010; Mather & Gregg, 2006; Newton & McGrew, 2010; Naglieri et al., 2005). CHC theory not only provides strong support for identifying cognitive processing deficits in SLD diagnoses, but has shown promise in identifying which instructional methods are optimal for different learning disabilities, such as dyslexia and dyscalculia (LDA White Paper, 2010; Naglieri et al., 2005; McGrew, 2003).

A student suspected of having a learning disability is often referred for testing to determine eligibility for special education services (IDEA, 2004, 2006). These evaluations provide parents and educators with information about the child's intellectual and academic strengths and weaknesses and lead to the development of educational interventions (Berninger, 2006; Reschly, 2005; Sattler, 2008). Identification of cognitive processing deficits can inform educators as to the specific interventions, learning strategies, and teaching methods likely to best meet the SLD student's needs (Flanagan et al., 2010; Fuchs et al., 2011).

Many professionals agree that students with learning disabilities have better chances for success when cognitive processing deficits, as well as academic skill deficits, are recognized in SLD evaluations (Fuchs et al., 2011; LDA White Paper, 2010; Naglieri et al., 2005; Newton & McGrew, 2010; Paul, 2010; Wang et al., 1993). To make sufficient academic progress, SLD students must receive appropriate educational tools and strategies that address the underlying cognitive processing deficits (LDA White Paper, 2010; Naglieri et al., 2005). The reliability of diagnostic results and the quality of interventions are likely compromised when diagnostic methods have not kept pace with research (Flanagan et al., 2010; IDEA, 2004; Kavale, Spaulding, & Beam, 2009; Sparks & Lovett, 2009). Improved SLD diagnostic procedures may lead to improved, targeted academic interventions and improved post high school outcomes for the learning disabled population (Flanagan et al, 2010; Thurlow et al, 2002; Ysseldyke et al., 2004).

Nature of the Study

I chose a multivariate, nonexperimental design for this study because there were no experimental treatments or manipulation of variables and because the research questions have multiple predictor and dependent variables (Mertler & Vannatta, 2010). The variables for the study came from data found in archived special education records from a local school district. The sample population consisted of students referred for special education testing because of a suspected learning disability. The sample was obtained using a criterion sampling method, a technique found under the purposive sampling umbrella (Palys, 2008). A criterion sampling method involves looking for cases that meet specific criteria, such as students who have been referred for special education testing due to a suspected learning disability (Palys, 2008).

Individual students were not identified or contacted for this study. Each archived file contained the student's special education academic and intellectual test scores, whether the student qualified for an SLD, and the student's grade level when initially tested for an SLD. Specific testing data collected included IQ and index scores from the WISC-III and WISC-IV tests and academic test scores from the WIAT-II or WJ-III. The student's high school completion status and scores from the WASL and the HSPE were obtained from a school district database. Specific information obtained from the database included the student's reading, math, and writing test scores from the state standards assessments, the level of test taken by each student (e.g., high school level or the lower alternative level), and the student's high school completion status.

The collected data were coded into the SPSS Version 21 software program to run the statistical analyses. A GLM analysis was used to determine significant relationships between the predictor and dependent variables. GLM analyses are often used in situations where multiple variables are included in the study, observations of the data are independent, and the data are not normally distributed (George & Mallery, 2008; Guisan et al., 2002; Littell et al., 2002). A GLM analysis is similar to linear regression but contains equations that allow for analysis of continuous and categorical independent or dependent variables with nonnormal distributions (Green & Salkind, 2008).

The dependent variables for this study were high school completion status, student test scores on the WASL and the HSPE, and SLD eligibility. The predictor variables for the study were the student's grade level when tested, the level and the types of cognitive processing deficits, specifically verbal comprehension, processing speed, working memory, or a combination of all three, and SLD eligibility under the GAI method.

Definitions

Ability-achievement discrepancy (AAD): AAD is the acronym used to refer to the ability-achievement discrepancy process of diagnosing SLDs. The AAD process uses test results from intellectual and academic skills tests to determine the presence of a severe discrepancy between ability and achievement (Doll & Horn, 2008; Dombrowski et al., 2006; LDA White Paper, 2010). The AAD process requires that a student's intellectual abilities and academic skills be documented through norm-referenced intelligence and achievement tests (Brueggemann, Kamphaus, & Dombrowski, 2008). The scores are then compared to determine the existence of a severe discrepancy (IDEA, 2004). If the difference between intellectual ability and achievement is equal to or greater than the preestablished criteria set forth by state regulations, the student meets SLD eligibility criteria (IDEA, 2004; OSPI, 2011).

Accommodations: Accommodations is the term used to refer to the variety of supports that may be needed by disabled students in order to access the school environment. Examples of accommodations include installing a wheel-chair ramp for access to buildings, allowing students extra time to complete assignments and tests, allowing use of a word processor for test and assignment completion, and other accommodations. The Americans With Disabilities Act of 1990 and the Rehabilitation Act of 1973, Section 504 are civil rights statutes that mandate accommodations for individuals with disabilities (ADA, 1990; Rehabilitation Act of 1973, Section 504).

Cognitive processing systems: Cognitive processing systems is the term used to refer the brain-based functions that allow humans to learn and function in their environments. These functions include the ability to understand language, the ability to orally express concepts and ideas using language, the ability to read and understand written symbols, the ability to use verbal and nonverbal reasoning to solve problems, the ability to compute mathematical equations, and many others (Andersson, 2010; Archibald

& Alloway, 2008; Brueggemann et al., 2009; Burns, Scholin, Kosciolek, & Livingston, 2010; Duchan, 2011; Geary et al., 2004; Helmbold & Rammsayer, 2010; Kim et al., 2010; Locascio, Mahone, Eason, & Cutting, 2010; Mabott & Bisanz, 2009; Paul, 2010).

Degree of processing deficits: Degree of processing deficits is the phrase used to refer to differences between WISC-III and WISC-IV IQ and index scores. The index scores assess individual functioning in four cognitive processing domains. These are the verbal comprehension, perceptual organization, working memory, and processing speed domains. The test manuals provides statistics for determining the amount of difference between indices needed for statistical significance at the $p < .05$ level (Wechsler, 1991, 2003).

Diagnosis: Diagnosis is the term used to refer to the process of determining SLD eligibility under AAD criteria, RTI criteria, or GAI criteria. Common terms used in legal descriptions of SLD evaluations are determined eligible for an SLD or identified as having an SLD (IDEA, 2004; OSPI, 2013). I chose to use the word diagnosis throughout the study to simplify discussions about diagnosing SLDs.

Dyslexia: Dyslexia is the term used to refer to a type of reading disability. Dyslexia has been defined as a developmental reading disorder that occurs when the brain does not recognize and process letter symbols (Flanagan et al., 2010; Newton & McGrew, 2010). Dyslexia is viewed as a particular cognitive processing disorder that impacts a person's ability to interpret and derive meaning from written communications (Flanagan et al., 2010; National Institute of Health, 2010; Newton & McGrew, 2010). Further diagnostic testing for dyslexia should be initiated when the WISC-III verbal IQ, verbal comprehension index, or the WISC-IV verbal comprehension index are significantly lower than the person's other IQ and index scores (Raiford et al., 2005).

Dyscalculia: Dyscalculia is the term used to describe a range of learning disabilities related to the acquisition of math skills. Research indicates there is no single, known math disability (Alloway, 2009; NCLD, 2010). Although dyscalculia can manifest differently in people, it is often linked to deficits in visual-spatial processing and language processing (Alloway, 2009; Fuchs et al, 2011). Visual-spatial processing deficits interfere with the individual's ability to process visual information such as math calculation problems, and language processing deficits can affect a person's ability to grasp quantitative concepts (Alloway, 2009; Francis et al., 2011; Fuchs et al., 2011; NCLD, 2010).

GAI: GAI is the acronym used to refer to the general abilities index method for identifying specific learning disabilities. The GAI was created for use with the Wechsler Intelligence Scales for Children (WISC-III and WISC-IV; Prifitera et al., 1998; Raiford et al., 2005; Weiss et al., 1991). The GAI recognizes verbal comprehension, working memory, and processing speed deficits by analyzing differences between WISC-III and WISC-IV IQ and index scores and then adjusting the full scale IQs (Prifitera et al., 1998; Raiford et al., 2005; Reynolds & Shaywitz, 2009).

GLM: GLM is the acronym used to refer to the generalized linear model method, an analytical process that is used to analyze relationships between multiple categorical and continuous variables with sample distributions that are not normal (Littell et al., 2002).

HSPE: HSPE is the acronym used for the High School Proficiency Exam, Washington's state standard assessment required for high school graduation. The test consists of four sections that are reading, math, writing and science. Students must pass each section to earn a high school diploma. The HSPE was formerly named the Washington Assessment of Student Learning (WASL). The WASL was revised in 2009 and renamed the High School Proficiency Exam in 2010 (OSPI, 2010).

IEP: IEP is the acronym used for Individual Education Program. When a student qualifies for special education services, an IEP is written to explain the specific instructional goals, objectives, and procedures that will be used to meet the student's individual educational needs. An IEP is required by IDEA (2004) when a student qualifies for special education services.

Index scores: Index scores are the WISC-III and WISC-IV composite scores for the verbal comprehension, perceptual reasoning, working memory, and processing speed domains of the tests (Wechsler, 1991, 2003).

Learning disabilities: Learning disabilities is a term used to refer to the collective cognitive processing disorders that affect major life activities such as school and work. Examples of learning disabilities include auditory processing disorders, reading and math disabilities, speed of information processing disabilities, writing disabilities, and communication disabilities (Andersson, 2010; Alloway & Archibald, 2008; Locascio et al., 2010; Swanson et al., 2008; Toll, Van der Ven, Kroesbergen, & Van Luit, 2011).

PRI: PRI is the acronym used to refer to the Perceptual Reasoning index. The PRI is one of the index scores from which the WISC-IV full scale IQ is derived. The PRI consists of three subtests that evaluate nonverbal reasoning and nonverbal problem solving (Wechsler, 2003).

PSI: PSI is the acronym used to refer to the Processing Speed index. The PSI is one of the index scores used to calculate the WISC-IV full scale IQ. The WISC-III processing speed index is not part of the IQ calculations, but is a supplemental index that also measures visual-motor speed of processing. The WISC-III and WISC-IV PSIs consist of the Coding and the Symbol Search subtests, which measure visual-motor speed of processing and the ability to quickly scan for visual details (Wechsler, 1991, 2003).

Response to intervention (RTI): RTI is the acronym used to refer to the second learning disabilities diagnostic model outlined in IDEA (2004). As referenced in IDEA (2004), RTI is a diagnostic process that uses a three-tiered approach to determine a student's need for additional interventions beyond basic instruction (LDA White Paper, 2010; Mellard & Johnson, 2008). Students participate in basic skills screenings several times during the school year. Students who fail to respond to a series of increasingly intensive educational interventions are thought to have an SLD and may be diagnosed as such on this basis alone (Mellard & Johnson, 2008; Reynolds & Shaywitz, 2009). RTI is also an acronym used to refer to the actual process of testing and intervening with students who are not learning basic academic skills at expected rates. In the current study, the acronym RTI will be used to refer to the use of RTI as a diagnostic model.

Specific learning disability (SLD): SLD is the acronym used for Specific Learning Disability. SLD is a general term, encompassing all the types of learning disabilities

(IDEA, 2004). In this dissertation, SLD will be used when referring to learning disabilities in general. .

State standards assessments: State standards assessments is a term used to refer to criterion-referenced academic skills assessments used by states to measure student progress. State standards assessments became a requirement following passage of the No Child Left Behind Act (NCLB) of 2002 (NCLB, 2002). This act required all states to set rigorous academic standards and accountability measures to improve the quality of public education. State standards assessments have also been referred to as high stakes tests, as many states use them as a requirement to obtain a high school diploma or to be promoted from grade to grade (Cortiella, 2010; Katsiyannis, Zhang, Ryan, & Jones, 2007). Each state is responsible for setting standards for basic academic skill proficiencies and for developing state standards assessments (Cortiella, 2010).

VCI: VCI is the acronym used for the Verbal Comprehension index, one of the WISC-III and WISC-IV indices. In the WISC-IV, the VCI is also used to used to calculate the full scale IQ. The VCI consists of five (WISC-III) and three (WISC-IV) subtests that measure the individual’s verbal comprehension, verbal reasoning, and verbal expression abilities (Wechsler, 1991, 2003).

WIAT-II: WIAT-II is the acronym used to refer to the Wechsler Individual Achievement Test – 2nd ed. (Wechsler, 2001). The WIAT-II is a nationally norm-referenced academic skills test. It is a common, individually administered, academic skills assessment used in public schools and measures reading, math, writing, listening comprehension, and oral expression skills. The WIAT-II was designed for use with students in kindergarten through the 12th grade (Wechsler, 2001).

WISC-III: WISC-III is the acronym used to refer to the Wechsler Intelligence Scale for Children-3rd ed., a nationally norm-referenced intellectual test for children between the ages of 6 years 0 months through 16 years 11 months (Wechsler, 1991). The WISC-III predates the WISC-IV but is still listed as a viable test for SLD diagnostic evaluations in Washington state's SLD procedure manual (OSPI, 2011).

WISC-IV: WISC-IV is the acronym used to refer to the Wechsler Intelligence Scale for Children – 4th ed., a nationally norm-referenced intellectual test for children between the ages of 6 years 0 months through 16 years 11 months. The WISC-IV yields four index scores (VCI, PRI, WMI, PSI) as well as a full scale IQ. The indices evaluate four separate domains of cognitive processing that are verbal comprehension, perceptual reasoning, working memory, and processing speed (Wechsler, 2003).

WJ-III: WJ-III is the acronym used for the Woodcock Johnson Test of Academic Achievement – 3rd ed. The WJ-III is a norm-referenced academic achievement test with very good reliability and validity. It is commonly used as an educational testing tool in special education evaluations and assesses reading, writing, math, listening comprehension, and oral expression skills (Woodcock, McGrew, & Mather, 2001, 2007).

WMI: WMI is the acronym used for the Working Memory index, one of the WISC-IV indices used to calculate the full scale IQ. The WMI consists of two subtests that measure rote auditory memory, mental flexibility, mental organization, and auditory sequencing abilities (Wechsler, 2003).

Assumptions

Intellectual and academic test scores were obtained from archived special education records. I assumed that these tests were administered and scored in accordance with standardized procedures and that the tested students demonstrated adequate testing effort unless otherwise noted by the examiner. I also assumed that the Washington state standards assessments were administered and scored in accordance with prescribed procedures (OSPI, 2009, 2011). These assumptions were necessary because the data exist in archived form, thus precluding my ability to observe real administrations of intellectual, academic, and state standards tests.

Scope and Delimitations

The current study was confined to examining the GAI method to identify working memory, verbal comprehension, and processing speed deficits within WISC-III and WISC-IV IQ and index scores. This study did not examine the effects of other cognitive processing systems such as language or visual-spatial processing deficits on state standards assessments, SLD eligibility, or high school completion status. This study examined the relationships between processing speed, verbal comprehension, and working memory deficits on the dependent variables. The study was delimited to archived special education data from public school special education records. Analysis of IQ testing results was delimited to those from WISC-III and WISC-IV administrations. WISC-III and WISC-IV full scale IQ and index scores were not included in the study's GLM analyses.

The listening comprehension or oral expression subtests from the WIAT-II and the WJ-III were not included in the study. Although the listening comprehension and oral expression skill areas are approved for use in SLD eligibility evaluations, the current study was delimited to using reading, math, and writing skills data (IDEA, 2004; Sattler, 2008). Data from the WASL and the HSPE (OSPI, 2009, 2010) were delimited to the reading, math, and writing sections of the tests. The science sections of the tests were not used in the current study.

Students represented in the sample completed high school or were of high school completion age by the end of the 2012/2013 school year. Data were collected from the records of students tested for learning disabilities between Kindergarten to Grade 12, beginning with the 1996/1997 school year. High school completion data do not reflect those students who dropped out of high school or completed a general education diploma (GED). The study's sample does not represent the public school population demographics for the state of Washington (OSPI, 2012). However, all students described in the sample shared the characteristic of low academic performance. This characteristic is shared by all students who are referred for SLD testing (NJCLD, 2009; Sattler, 2008).

Limitations of the Study

This study was limited to data obtained from administrations of the WISC-III and WISC-IV intellectual tests. The study did not use test scores from other intellectual tests to identify cognitive processing deficits, such as the Stanford Binet Intelligence Test- 5th ed. (Roid, 2003) or the Cognitive Assessment System (Edwards & Paulin, 2007; Naglieri et al., 2005). Although this study was limited to data derived from WISC-III and WISC-

IV administrations, the tests are nationally normed instruments with good reliability and validity and have been widely used in public school settings across the nation (Wechsler, 2003). Additionally, the WISC-III, WISC-IV, Stanford Binet Intelligence Test-5th ed., and the Cognitive Assessment System measure similar cognitive processing functions, such as working memory, processing speed, and verbal comprehension (Naglieri et al., 2005; Roid, 2003; Wechsler, 1991/2003).

Data from the WASL and the HSPE (OSPI, 2009, 2010) may be difficult to generalize, as the test is typically modified each year, and teachers may adjust instruction to improve student performance. Although the format of test questions may be modified annually, these criterion-referenced tests are based on the same state established grade level expectations, which should mitigate problems with generalizability (OSPI, 2011).

The sample group generally represents the ethnic and cultural demographics of public school students in the state of Washington with some exceptions (OSPI, 2003, 2012). White students are overrepresented and Hispanic students are underrepresented in the selected school district demographics, as compared to the state-wide public school demographics (OSPI, 2012). Other racial and ethnic categories represented in the school district demographics are consistent with population levels represented by the state-wide public school demographics (OSPI, 2012). However, test records selected for the study represent students who share the common characteristics of low academic achievement in reading, writing, or math, and who were tested due to a suspected SLD. Therefore, study results will be generalizable to students with low academic achievement in reading, math, or writing.

Significance of the Study

This study investigated whether the GAI diagnostic method is a viable means of identifying verbal comprehension, working memory, and or processing speed deficits by predicting high school completion, performance on state standards assessments, and predicting SLD eligibility. The GAI is an SLD diagnostic method that recognizes cognitive processing deficits from WISC-III and WISC-IV IQ and index scores (Prifitera et al., 1998; Raiford et al., 2005; Sattler, 2008). A cognitive processing deficits approach to diagnosing SLDs can improve current SLD diagnostic practices by identifying the cognitive processing deficits that interfere with learning (Flanagan et al., 2010; Fuchs et al., 2011; LDA White Paper, 2010; Naglieri et al., 2005; Paul, 2010). Education and psychology experts endorse this approach because it reflects current knowledge of the relationships between cognitive processing deficits and learning disabilities (Fuchs et al., 2011; LDA White Paper, 2010; Mather & Gregg, 2006; Naglieri et al., 2005; Newton & McGrew, 2010; Paul, 2010; Saklofske et al., 2010).

An SLD diagnostic method that recognizes cognitive processing deficits is critically important for a number of reasons. An improved SLD diagnostic method can address problems with the AAD and RTI models, which include diagnosis by failure to respond to treatment, overdiagnosis of students from diverse backgrounds, and failure to diagnose students with cognitive processing deficits (Andersson, 2010; Berninger, 2006; Dombrowski et al., 2004; Dombrowski et al., 2006; LDA White Paper, 2010; Newton & McGrew, 2010; Reynolds & Shaywitz, 2009). The lack of proper identification and support for students with SLDs often leads to poor educational and occupational outcomes (LDA White Paper, 2010; Morris et al., 2009; Thurlow et al., 2002). When compared to nondisabled peers, persons with SLDs have higher rates of unemployment as adults, are more at-risk for substance abuse and incarceration, and have higher incidence rates of anxiety and depression (Bear, Kortering, & Braziel, 2006; Morris et al., 2009; Thurlow et al., 2002). Improved diagnostic techniques may lead to better interventions that address specific cognitive processing deficits and may result in better long-term educational and occupational outcomes for persons with SLDs.

Summary

Professionals from many fields of study feel that the AAD and RTI diagnostic methods are unable to diagnose SLDs (Andersson, 2010; Berninger, 2006; Harrison et al., 2007; LDA White Paper, 2010; Naglieri et al., 2005; Newton & McGrew, 2010). Growing dissatisfaction with the AAD and RTI methods has led to increased support to find a third SLD diagnostic method that identifies cognitive processing deficits (Fuchs et al., 2011; LDA White Paper, 2010; Naglieri et al., 2005; Newton & McGrew, 2010; Saklofske et al., 2010). Study results that demonstrate significant relationships between cognitive processing deficits and the dependent variables will support efforts to make needed changes in SLD diagnostic methods. These findings may support use of the GAI method as a diagnostic tool that can recognize cognitive processing deficits, potentially lead to better educational interventions for SLD students, and thereby promote positive social change.

In Chapter 2, I present a more detailed review of the history of the SLD construct, the history of federal legislation behind the present SLD diagnostic methods, and SLD diagnostic procedures (IDEA, 2004). Additionally, I will review research related to the study's theoretical framework and the relationships between SLDs and cognitive processing deficits. I conclude Chapter 2 with a summary of the main points of the chapter and how the current study proposes to fill the research gaps identified in the literature review.

Chapter 2: Review of the Literature

Introduction

The purpose of this quantitative study was to understand the effects of cognitive processing deficits on several important student outcomes that are high school completion, performance on state standards assessments, and SLD eligibility. Professionals agree that students with learning disabilities are more likely to succeed in school when cognitive processing deficits are identified during the SLD evaluation process (Fuchs et al., 2011; LDA White Paper, 2010; Naglieri et al., 2005; Newton & McGrew, 2010; Paul, 2010; Wang et al., 1993, 1994). Despite the volume of research about the links between learning disabilities and cognitive processing deficits, there are few studies that have examined the effects of cognitive processing deficits on high school completion status, performance on state standards assessments, and SLD eligibility.

This chapter includes a review of literature about the history of the learning disabilities construct and the development of SLD diagnostic methods. Included in this section is a discussion of the current, legally sanctioned SLD diagnostic methods (AAD and RTI) and the problems associated with these techniques. Next, a discussion of learning disabilities and federal disability rights legislation is presented (IDEA, 2004). To help understand the relationships between learning disabilities and cognitive processing deficits, the Cattell-Horn-Carroll (CHC) theory of cognitive processing systems is reviewed, leading to an explanation of how cognitive processing deficits are identified from WISC-III and WISC-IV test scores (Wechsler, 1991, 2003). A review of literature about the GAI method of identifying cognitive processing deficits is also presented in Chapter 2, as well research that explains each of the study's key variables. The chapter will conclude with a summary of the literature gaps defined in Chapter 2 and the methods by which these gaps will be addressed in Chapter 3.

Literature Search Strategy

The majority of peer-reviewed articles used in the literature review were obtained from the PsycARTICLES, SAGE, and ERIC databases using the Walden library. Additional information was obtained from electronic references such as research findings posted on the Learning Disabilities of America (LDA) and the National Commission on Learning Disabilities (NCLD) websites. Articles were retrieved using search terms such as *specific learning disabilities, types of learning disabilities, the neuro-cognitive basis of SLDs, cognitive processing deficits, high school completion status for individuals with specific learning disabilities, rates of community college and university enrollment for students with SLDs, post high school and occupational outcomes for individuals with SLDs,* and *the historical background of learning disabilities.* Other search terms focused on SLD diagnostic methodologies, including the *RTI, AAD,* and *GAI* methods. Additional search terms included *learning disabled student test scores on state standards assessments.*

Other sources of electronic data included state and federal websites for the IDEA (2004), the OSPI of Washington state, and the NCLB (2002). A limited number of references were obtained from textbooks commonly used in statistics and school psychology practice (Jaccard & Becker, 2002; Mertler & Vannatta, 2010; Sattler, 2008). The literature search spanned the years 2000 through 2012, with most citations occurring after the year 2002. A small number of articles were selected from the years 1991 to 1998 due to the background information provided in the articles.

Theoretical Foundation

As humans, we automatically use many interactive cognitive processing systems to function in our environments (Andersson, 2010; Archibald & Alloway, 2008; Brueggemann et al., 2008; Burns, Scholin, Kosciolek, & Livingston, 2010; Duchan, 2011; Geary et al., 2004; Helmbold & Rammsayer, 2010; Kim et al., 2010; Locascio et al., 2010; Mabott & Bisanz, 2008; McGrew, 2003; Newton & McGrew, 2010). These cognitive processing systems allow us to:

- Learn language,
- Orally express thoughts and ideas using language,
- Read and understand written words and numerals,
- Use verbal and nonverbal reasoning to solve problems,
- Maintain cognitive attention and focus,
- Sequence information,
- Compute mathematical equations, and
- Move smoothly from one thinking task to the next (McGrew, 2003; Newton & McGrew, 2010).

Present day knowledge about cognitive processing systems is grounded in the CHC theory of cognitive processing systems and intelligence (Flanagan et al., 2010; McGrew, 2003; Newton & McGrew, 2010; Proctor & Prevatt, 2003). CHC theory is an empirically validated framework that conceptualizes human intelligence as consisting of many interactive cognitive processes (McGrew, 2003; Newton & McGrew, 2010). CHC theory is a well-researched theory of intelligence with strong empirical support for its validity (Flanagan et al., 2010). CHC theory has a solid research base linking learning disabilities to cognitive processing deficits and, therefore, is an appropriate theoretical framework for this study (Flanagan et al., 2010; LDA White Paper, 2010; Mather & Gregg, 2006; Paul, 2010).

The empirical evidence for CHC theory came from many longitudinal factor analytic studies conducted by various researchers. These researchers came from disciplines such as the neurocognitive, genetic, developmental, and other fields of study (Daniel, 1997, as cited by Flanagan et al., 2010). CHC theory provides a basis by which researchers and practitioners can better study, understand, and explain human cognitive functioning (Flanagan et al., 2010; Newton & McGrew, 2010). CHC theory provided a basis for past research efforts into cognitive processing systems and also provided a foundation for development of the constructs used in many current intellectual tests (McGrew, 2003; Newton & McGrew, 2010). CHC theory led to the development of nine central cognitive processing abilities:

- Fluid reasoning,
- Comprehension/knowledge,
- Visual-spatial processing,
- Auditory processing,
- Short-term memory,
- Long-term storage and retrieval,

- Cognitive processing speed,
- Reading and writing, and
- Quantitative knowledge capabilities (Flanagan et al., 2010; McGrew, 2003; Newton & McGrew, 2010).

Fluid reasoning refers to the mental ability we use to solve new problems, to reason, and to handle increasingly complex cognitions (McGrew, 2003; Newton & McGrew, 2010). Comprehension/knowledge refers to the ability to demonstrate and apply acquired knowledge about the language, information, and ideas of a society (McGrew, 2003; Newton & McGrew, 2010). Short-term memory refers to the ability to retain recent information for use by other cognitive systems and to maintain the information in immediate awareness (McGrew, 2003; Newton & McGrew, 2010). Visual-spatial processing refers to the ability to mentally generate, store, retrieve, and transform visual input (McGrew, 2003; Newton & McGrew, 2010). Auditory processing refers to the ability to interpret, organize, discriminate, analyze, and synthesize sounds (McGrew, 2003; Newton & McGrew, 2010). Long-term storage and retrieval refers to the ability to store and consolidate new information in long-term memory for later use (McGrew, 2003; Newton & McGrew, 2010). Cognitive processing speed is the ability to automatically and fluently perform cognitive tasks when attention and concentration are required over a period of time (McGrew, 2003; Newton & McGrew, 2010). The reading and writing domain refers to the process of learning basic reading skills, deriving meaning from printed materials, and writing complex ideas (McGrew, 2003; Newton & McGrew, 2010). The quantitative knowledge domain refers to the acquisition and application of quantitative or numerical knowledge (McGrew, 2003; Newton & McGrew, 2010).

One strength of CHC theory is that it can incorporate new research findings into existing theories of human intelligence and cognitive processing systems (Flanagan et al., 2010; McGrew, 2003, 2005; Newton & McGrew, 2010). For example, CHC theory's original nine cognitive processing abilities have grown to include many subcategories of cognitive processing abilities, and future research will likely add new data to this body of work (Flanagan et al., 2010; McGrew, 2003; Newton & McGrew, 2010).

Literature Review Related to Key Variables and Concepts

The predictor variables for this study are SLD eligibility under the GAI method, the student's grade level when tested for an SLD, and the level and types of cognitive processing deficits found in WISC-III and WISC-IV IQ and index scores. The dependent variables for the study are high school completion status, reading, writing, and math scores on Washington's state standards assessments, and SLD eligibility.

The theoretical foundation selected for the study is the CHC theory of cognitive processing systems (Flanagan et al., 2010; McGrew, 2003; Newton & McGrew, 2010). CHC theory stems from a multidisciplinary research base about cognitive processing systems, which has shown strong connections between cognitive processing deficits and learning disabilities (McGrew, 2003; Newton & McGrew, 2010). CHC theory supports the current study's premise that identification of cognitive processing deficits is necessary in order to accurately diagnose SLDs and improve educational interventions for SLD students. Improved educational interventions will potentially lead to improved educational and occupational outcomes for persons with SLDs (Berninger, 2006; Dombrowski et al., 2006; Fuchs et al., 2011; LDA White Paper, 2010; Saklofske et al., 2010).

At a recent learning disabilities conference, education, law, and psychology professionals were surveyed about SLDs and cognitive processing deficits (LDA White Paper, 2010). Ninety two percent of those surveyed supported an SLD diagnostic method that recognizes cognitive processing deficits (LDA White Paper, 2010). These experts, and others, agree that identifying cognitive processing deficits during SLD evaluations is important in order to improve educational and occupational outcomes for the SLD population (Berninger, 2006; Francis et al., 2011; Fuchs et al., 2011; LDA White Paper, 2010; Paul, 2010; Saklofske et al., 2010). An example of an improved educational outcome for SLD students is a diagnostic model that recognizes cognitive processing deficits. An SLD diagnostic model that recognizes cognitive processing deficits is important because this model can discriminate low-achieving, minority, and English language learners from students who have learning disabilities stemming from cognitive processing deficits (Francis et al., 2011; Fuchs et al., 2011; Newton & McGrew, 2010; LDA White Paper, 2010; Paul, 2010).

One example of a cognitive processing deficit is dyslexia, a cognitive processing disorder that interferes with a person's ability to learn to read and to derive meaning from printed materials (Flanagan et al., 2010; Newton & McGrew, 2010). Another example of a cognitive processing deficit is an expressive communication disorder, which impairs the person's ability to verbally express thoughts, orally synthesize and explain information, and use oral reasoning, despite having average or better intelligence (Duchan, 2011; Flanagan et al., 2010; Helmbold & Rammsayer, 2010; Sattler, 2008). Difficulties with speed of information processing, working memory functions, mental flexibility, language processing, and other cognitive processing deficits often result in lower full scale IQs, which makes it more difficult to be diagnosed with an SLD with the AAD model (Berninger, 2006; LDA White Paper, 2010; Paul, 2010; Sattler, 2008). The WISC-III and WISC-IV GAI methods (Prifitera et al., 1998; Raiford et al., 2005) may be a viable alternative to the AAD and RTI methods because the GAI can adjust full scale IQs when a cognitive processing deficit lowers the full scale IQ (Raiford et al., 2005; Saklofske et al., 2010).

The GAI method can be used when there are significant score differences between WISC-III and WISC-IV IQ and index scores (Harrison et al., 2007; Raiford et al., 2005; Sattler, 2008). When statistical adjustments are made to the full scale IQ, there is a higher likelihood that the student will qualify for special education services, because the adjusted GAI IQ can be substituted for the regular full scale IQ (Dombrowski et al., 2004; Harrison et al., 2007; McGrew, 2003; Proctor & Prevatt, 2003; Raiford et al., 2005). The GAI method will be described in more detail in the SLD Diagnostic Methodologies: GAI and Degree of Processing Deficit section.

SLDs, High School Completion, and Occupational Outcomes

Numerous studies have examined post high school outcomes for students with learning disabilities. Nationally, nearly 2.5 million children in Kindergarten through Grade 12 are diagnosed with an SLD, making it the largest of the 13 educational disability categories in federal law (IDEA, 2004; NCLD, 2009; Sattler, 2008). High school students and college-enrolled adults with SLDs demonstrate significantly lower rates of reading, writing, and basic math skills than their peers (Joyce & Rosen, 2006; NJCLD, 2008; Sparks & Lovett, 2009; Thurlow et al., 2002). Diminished academic skills interfere with the ability to make academic progress, to earn a high school diploma, to compete for employment, and to pass state standards assessments (NJCLD, 2008; Restori et al., 2009; Thurlow et al., 2002). Twenty-two percent of students with learning disabilities drop out of high school compared to 8% of non-disabled peers, 10% of students with SLDs enroll in a four year college compared to 28% of nondisabled peers, and 45% of working-age adults with learning disabilities are unemployed versus 24% of nondisabled peers (Berninger, 2006; NCLD, 2009; Restori et al., 2009; Thurlow et al., 2002).

In addition to high dropout rates, students with SLDs are more likely to experience other adverse outcomes. These include increased risk of substance abuse problems, lower earning potential, increased risk of imprisonment, and an overall less productive adulthood than nondisabled peers (Bear et al., 2006; NJCLD, 2008; Thurlow et al., 2002). Individuals with SLDs are also more prone to affective illnesses, such as depression and anxiety, than nondisabled peers (Bear et al., 2006). Affective illnesses often create further barriers to employment and life satisfaction outcomes (Bear et al., 2006; Morris et al., 2009).

Some research findings about the SLD population suggest that post high school outcomes are improving for learning disabled students, particularly in regards to college enrollment. In 1988, 16% of disabled students who enrolled in college were identified as having an SLD. In 2000, 40% of college-enrolled disabled students were diagnosed with an SLD (Joyce & Rosen, 2006). These statistics show that more SLD students are taking advantage of available supports and accommodations that help them access post high school education opportunities. Community colleges and universities continue to improve compliance with the Section 504 of the Rehabilitation Act of 1973 (Section 504, 1973), and the Americans with Disabilities Act of 1990 (ADA; ADA, 1990). These legislative acts require that post high school institutions provide equal access accommodations and supports to disabled students (Joyce & Rosen, 2006). These supports and accommodations include installing wheel chair ramps to access school facilities, allowing the use of voice-activated software to complete tests and assignments, allowing students to use word processors to complete tests and assignments, providing students with copies of lecture notes, providing curricula on tapes or CDs, and providing tutoring services (ADA, 1990; Section 504, 1973).

Although more SLD students are pursuing post high school educational opportunities, SLD students continue to struggle with basic academic skills. According to a study by Joyce & Rosen (2006), 63% of disabled students entering community college and 40% of disabled students entering universities required remedial coursework, as opposed to 43% and 34%, respectively, of nondisabled students. Many colleges and universities require remedial math and language arts courses as prerequisites to enrollment, if entrance exam scores are low (Joyce & Rosen, 2006; NCLD, 2009). This requirement for remediation is both a help and a hindrance to SLD students who may benefit from review of basic skills, but must also work harder and spend more time completing degree requirements.

SLDs, State Standards Assessments, and High-School Completion Outcomes

State standards testing emerged with passage of the No Child Left Behind Act of 2002 (NCLB, 2002). The NCLB (2002) mandated that schools demonstrate accountability for student learning by requiring passing scores on state standards assessments. The NCLB (2002) also required that all schools and all students achieve no less than passing scores on state standards assessments by the year 2014.

Most states require passing scores on state standards tests in order to obtain a high school diploma. Student test scores on state standards assessments are also used to determine a particular school's status in achieving what is called Annual Yearly Progress (AYP), one of the NCLB's (2002) accountability requirements. Until 2011, failure to achieve AYP carried a series of increasingly harsh consequences for schools. For example, after 5 years of failing to make AYP, a school could face possible reorganization by the state education agency, conversion to a charter school, or replacement of the entire school staff by the state education agency (Katsiyannis et al., 2007, NCLB, 2002).

Special education students have a significantly high failure rate on state standards assessments, and are often the cause of a school's failure to make AYP (LDA, 2007; Luke & Schwartz, 2007). For example, in Mobile County, Alabama during the 2004/2005 school year, 27 of 33 schools that failed to make AYP would otherwise have passed if the schools were not required to include test scores from special education students (Katsiyannis et al., 2007). The NCLB (2002) requirement that all students pass state standards assessments by 2014 includes not only students with learning disabilities, but also those special education students with severe and profound mental and physical disabilities (IDEA, 2004).

NCLB (2002) has been the impetus behind significant educational policy changes in the past decade. Many schools have experienced harsh penalties for failure to make AYP, and many students have failed to meet state assessment standards for high school completion. Because the 2014 deadline imposed by the NCLB (2002) is drawing near, President Obama determined it was necessary to address the requirement that all students pass state standards assessments by 2014 (NCLB, 2002). On September 23, 2011, President Obama initiated changes to NCLB (2002) as part of the reauthorization of the Act:

> The U.S. Department of Education is inviting each State educational agency (SEA) to request flexibility on behalf of itself, its local educational agencies, and schools, in order to better focus on improving student learning and increasing the quality of instruction. This voluntary opportunity will provide educators and State and local leaders with flexibility regarding specific requirements of the No Child Left Behind Act of 2001 in exchange for rigorous and comprehensive State-developed plans designed to improve educational outcomes for all students, close achievement gaps, increase equity, and improve the quality of instruction…states receiving waivers no longer have to meet 2014 targets set by NCLB (2001) but

> they must set new performance targets for improving student achievement and closing achievement gaps. (NCLB, 2002, para.1)

Although the federal government created alternatives for states to do away with the 2014 targets (NCLB, 2002), the ramifications of a decade of this policy will continue to impact schools and teachers until states can create the new education plans. Until the new state plans are created, approved, and enacted, the current procedures, such as state standards testing, will remain in place. It is important to realize that the impact of these reforms on special education students will not be known for some time.

Since the implementation of the NCLB (2002), special education students have experienced great difficulty passing state standards assessments, as do students from low-income families and students who are English language learners (Katsiyannis et al., 2007). In Washington state, 38% of regular education students passed the math assessment in 2008, while only 4% of students with learning disabilities passed. In the same year, 60% of regular education students passed the language arts section, while 12% of students with learning disabilities passed (Johnson, 2008).

Studies show that state standards tests places SLD and other disabled students at a disadvantage (Katsiyannis et al., 2007; Luke & Schwartz, 2007; Stucker, 2009). Requiring passing scores on a state standards reading test is a fair expectation for students without learning disabilities. However, a student with dyslexia will struggle to read test questions and understand test directions (Flanagan et al., 2010; National Institute of Health, 2010; Newton & McGrew, 2010). Students with SLDs and other disabilities are legally allowed to have certain accommodations when testing, such as having test questions read out loud (Section 504, 1973). However, no such accommodation is allowed on the reading sections of the state standards test (IDEA, 2004; Luke & Schwartz, 2007; OSPI, 2009/2011). Thus, students with dyslexia and other reading disorders are left to struggle through the reading test without regards to the learning disability.

Another barrier for SLD students and state standards testing is that the curricula taught in special education classes is often different from the curricula taught in regular education classes (Stucker, 2009; Ysseldyke et al., 2004). Regular education curricula are increasingly focused on state established grade level expectations to prepare students to pass state standards assessments (Katsiyannis et al., 2007). SLD students often are not exposed to the same instructional, state standards based curricula as nondisabled peers, and are therefore less prepared for the tests (Stucker, 2009; Ysseldyke et al., 2004).

Despite the historically low performance of disabled students on these tests, there are signs of improvement. In the past several years, students with SLDs have begun to improve their scores on state standards tests (Abreu-Ellis, Ellis, & Hayes, 2009; Katsiyannis et al., 2007). This improvement has been attributed to better implementation of testing accommodations in school districts, as well as better inclusion of special education students into regular education classes, along with appropriate accommodations (Luke & Schwartz, 2007; ADA, 1990). Including special education students in regular education classes increases SLD students' exposure to instruction centered around state established grade level expectations, even if SLD students' require significant accommodations to make academic progress in the regular setting (Luke &

Schwartz, 2007; OSPI, 2010). Additionally, recent revisions in special education teaching practices have resulted in better instructional alignment with state grade level expectations and regular course curricula (Ysseldyke et al., 2004).

Some of SLD students' improved performance statistics on state standards assessments must be attributed to other issues. Students with SLDs continue to drop out of high school at higher rates than nondisabled peers (Bear et al., 2006; Thurlow et al., 2002). Thus, they may not be present during state standards testing, and therefore are not represented in a school district's overall test results. Because state standards assessments often create a barrier to high school completion, some SLD students may be more discouraged about their chances of completing high school, and are more likely to have dropped out of school (Thurlow et al., 2002). The SLD students that remain in high school tend to show more motivation to succeed than the SLD group who dropped out, and are more likely to have better parent and teacher support to help them succeed in school (Katsiyannis et al., 2007).

Background of Learning Disabilities and Diagnostic Methods

One of the first written references to a learning disability occurred in 1877. Adolf Kussmaul was a 19th century German physician who wrote about a patient with word blindness (Crouch & Pataki, 2011). Dr. Kussmaul noted that this patient was unable to comprehend written words, despite having adequate eyesight and intelligence (Crouch & Pataki, 2011). Similar observations were subsequently documented. In 1886, an article in the British Medical Journal described a bright and intelligent 14-year-old boy who was unable to learn spelling and writing (LD Online, 2006). Rudolf Berlin (1896) is credited with coining the term dyslexia, derived from the Greek term for "*difficult word*" (as cited by Crouch & Pataki, 2011). In 1905, an ophthalmologist in Chicago published the first U.S. report of childhood reading difficulties (LD Online, 2006). References such as these provide evidence that SLDs have likely occurred in humans for some time, and are not merely a function of 20th century research findings.

Workforce demands related to the industrial and technological revolutions are thought to be the impetus for the growth in SLD diagnoses during the past 50 years (Berninger, 2005; Dombrowski, 2006). Due to the industrial and technological revolutions, more employers have sought workers with at least basic skills in reading, writing, and math, a trend that continues to grow (Berninger, 2006; Dombrowski, 2006). As demand for a literate workforce increased in the 19th and 20th centuries, the awareness of learning disabilities became more widespread (Berninger, 2006).

Public awareness of learning disabilities dramatically increased in the 1960s, such that parents and professionals began to form organizations to better address the educational problems experienced by handicapped children (LDA, 2005). At one such national conference in 1963, Samuel Kirk is credited with first using the term learning disabilities (LDA, 2005). During the 1960s, several national advocacy organizations were formed to address problems with the education of handicapped children, including the Learning Disabilities Association of America and the National Center for Learning Disabilities (LDA, 2005; NCLD, 2009). These agencies were, and continue to be, instrumental in lobbying for education rights for disabled children, and in conducting and funding research into SLDs.

Learning disabilities were initially referenced in federal law in 1969, with enactment of the Children with Specific Learning Disabilities Act (1969; Hallahan & Mercer, 2007). The landmark legislation, Education for All Handicapped Children Act of 1975, (U. S. Department of Education, 2007) was the first such law to guarantee a free and appropriate public education for all school children (Berninger, 2006; Restori et al., 2009; Education for All Handicapped Children Act, 1975). This law required public schools to create educational policies and programs to identify and educate disabled children at no expense to the child's family and no matter what the disabling condition (U.S. Department of Education, 2007). Since the law's inception, Congress has reauthorized the Education for All Handicapped Children Act (1969) a number of times (U.S. Department of Education, 2007). In 1990, the act was renamed the Individuals with Disabilities Education Improvement Act (IDEA) and has continued under this name through the present (IDEA, 2004).

Soon after the 1975 authorization of the Education for All Handicapped Children Act (1969), experts became concerned about the high numbers of students being diagnosed with SLDs (Hallahan & Mercer, 2007; Restori et al., 2009). Attempts to find a solution were complicated by professional disagreement about the definition of a learning disability (Brueggemann et al., 2008; Doll & Horn, 2008; Dombrowski et al., 2006; Hallahan & Mercer, 2007). At that time, a number of different diagnostic models were suggested, including a proposal to control growth of the SLD category by denying funding if it grew beyond 2% of the total number of disabled students (Restori, et al., 2009). This plan was viewed as an unacceptable solution and potentially more harmful than finding other means of defining and evaluating SLDs (Restori, et al., 2009).

The AAD method was eventually created by a national group of psychology, education, and legal professionals (Berninger, 2006; Dombrowski et al., 2006). The AAD method emerged as a compromise between the need to operationally define SLDs and the need to control the growth of the SLD category (Archibald & Alloway, 2008; Berninger, 2006; Restori et al., 2009). The AAD model was written into the Education of All Handicapped Children Act in 1977, and became the standard SLD diagnostic practice in U.S. public schools (Flanagan et al., 2010; Restori et al., 2009; U.S. Department of Education, 2007). Because the AAD model was a compromise between the legal, education, and psychology disciplines rather than grounded in research, the model has been the source of much controversy (Berninger, 2006; Dombrowski et al., 2006; LDA White Paper, 2010; Paul, 2010; Reynolds & Shaywitz, 2009).

SLD Diagnostic Methods: The AAD Method

The AAD diagnostic method requires that a student have a severe discrepancy between a full scale IQ and academic scores from a norm-referenced academic achievement test (Berninger, 2006; Francis et al., 2005; IDEA, 2004). IDEA (2004) allows states to determine their own severe discrepancy formulas. Information gathered by LD Online (2006) and the NRCLD (2007) found many differences across states as to how a severe discrepancy is determined. Thus, a student's IQ and academic scores might meet eligibility criteria for a SLD in one state, but may not meet criteria in another state.

The process of determining a severe discrepancy begins with norm-referenced, individually administered IQ and academic achievement tests (IDEA, 2004; Sattler, 2008). Raw scores from the tests are converted to standard scores that have a mean of 100 and a standard deviation of 15 (Sattler, 2008). Standard scores are obtained by comparing a student's raw test scores to the scores of same-age peers from the tests' standardization samples (OSPI, 2011; Sattler, 2008; Wechsler, 1991, 2003). After obtaining these scores, the academic and intellectual test scores are compared to determine the presence of a severe discrepancy. Some states require a difference of 20 or more points between the full scale IQ and an academic score to determine a severe discrepancy (Kamphaus et al., 1991; LD Online, 2006; Sattler, 2008). Other states use regression formula to determine the statistical significance of the score difference between a full scale IQ and an academic test score (Flanagan et al., 2010; Naglieri et al., 2005; OSPI, 2011; Sattler, 2008).

Current research about the relationships between learning disabilities and cognitive processing systems has refueled criticisms of the AAD method (Berninger, 2006; Dombrowski et al., 2006; Fuchs et al., 2011; LDA White Paper, 2010; Naglieri et al., 2005; Paul, 2010; Restori et al., 2009; Reynolds & Shaywitz, 2009). Because the AAD method requires a severe discrepancy between intellectual ability and academic test scores, the student must be exposed to school curricula long enough to fall behind peers in acquiring skills (Sattler, 2008). Professionals view this problem as a major flaw of the AAD method (LDA White Paper, 2010). Because the AAD method is based on the gap between the full scale IQ and basic skills test scores, students with cognitive processing deficits must spend at least one or two grades struggling to learn basic skills before they fall far enough behind to demonstrate a severe discrepancy (LDA White Paper, 2010; Paul, 2010; Vanderberg & Emery, 2009).

The demand for retention and mastery of basic academic skills is less intense in early grades than in later grades (Reynolds & Shaywitz, 2009). Because the educational focus in Kindergarten through the third grade is on acquisition of basic skills, some students with cognitive processing deficits may not be tested for an SLD until the fourth or later grades (Paul, 2010; Reynolds & Shaywitz, 2009; Sattler, 2008). The AAD method often fails to identify a learning disability in the early grades unless the child is achieving at or below the 9th percentile rank for their age group (Sattler, 2008). Those with more subtle learning deficits often wait a number of years before the gap between academic skills and intellectual ability scores is severe enough to meet discrepancy criteria (Berninger, 2006; Dombrowski et al., 2006).

Another criticism of the AAD method is failure to identify the cognitive processing deficits that negatively impact full scale IQs (LDA White Paper, 2010; Paul, 2010; Restori et al., 2009; Reynolds & Shaywitz, 2009). Cognitive processing deficits can depress full scale IQ and index scores from intellectual tests (Alloway, 2009; Naglieri et al., 2005; Raiford et al., 2005). For example, a student with a processing speed deficit will often obtain a significantly low score on the WISC-III and WISC-IV processing speed indices (Helmbold & Rammsayer, 2010; Newton & McGrew, 2010; Raiford et al., 2005; Saklofske et al., 2010). This student will likely have much difficulty completing tests and written assignments at a rate that is commensurate with peers, and therefore will likely fall further behind in school as time goes on (Helmbold & Rammsayer, 2010; McArthur, 2009; Newton & McGrew, 2010). Other students with cognitive processing deficits in language usually obtain lower scores on the WISC-III verbal IQ, and the WISC-III and WISC-IV verbal comprehension indices, which assess verbal expression, verbal reasoning, and verbal comprehension abilities (Archibald & Alloway, 2008; Duchan, 2011; Flanagan et al., 2010; Raiford, et al., 2005; Wechsler, 1991, 2003). These students typically struggle to learn reading and writing skills at the same rates as their peers (Flanagan et al., 2010; Newton & McGrew, 2010). Cognitive processing deficits lower the WISC-III and WISC-IV full scale IQs, because the full scale IQs are derived from a statistically weighted sum of all the WISC-III verbal and performance scale scores, and the WISC-IV index scale scores (LDA White Paper, 2010; Paul, 2010; Raiford et al., 2005; Sattler, 2008; Wechsler, 1991, 2003; Weiss et al., 2013). For example, students with verbal comprehension deficits often obtain low scores on the Vocabulary and Comprehension subtests of the WISC-III and WISC-IV. This will negatively impact the verbal IQ and the verbal comprehension index scores of the respective tests, and thus cause the overall full scale IQ score to be depressed (Wechsler, 1991/2003).

Additional criticisms of the AAD method include failure to identify students who have low average (IQs of 80 to 89) or borderline (IQs of 70 to 79) intellectual scores, because lower full scale IQs make it less likely that the student’s academic scores will meet the AAD method’s severe discrepancy criteria (Dombrowski et al., 2006; Sattler, 2008; Vanderberg & Emery, 2009). Additionally, the AAD method is unable to differentiate between students who are low-achievers and students with cognitive processing deficits (LDA White Paper, 2010; Restori et al., 2009). A student can be a low-achiever for reasons unrelated to an SLD, such as high absentee rates, emotional problems, or poor motivation towards school (Andersson, 2010; Dombrowski et al., 2006). While the behaviors of low-achieving students can adversely affect learning, the lack of academic progress will not stem from cognitive processing deficits (Andersson, 2010; Dombrowski et al., 2006; Kavale et al., 2009). One final but not insignificant problem with the AAD method is the lack of sufficient empirical evidence showing that the AAD method can accurately diagnose an SLD (Restori et al., 2009; Reynolds & Shaywitz, 2009).

SLD Diagnostic Methods: The RTI Method

Although the RTI method of SLD diagnosis is not part of this study, it is important to have an understanding of the RTI as well as the ADD diagnostic methods, because an understanding of these diagnostic methods will help illustrate the need for a third method that recognizes cognitive processing deficits.

The RTI method emerged with the reauthorization of the IDEA in 2004 (IDEA, 2004). RTI is both a philosophy of educational practice, and a means of diagnosing SLDs (Mellard & Johnson, 2008). RTI procedures are based on a three-tiered, academic intervention process that helps educators decide if a student needs extra academic instruction and support to learn basic academic skills (LDA White Paper, 2010; Marston, 2005; Mellard & Johnson, 2008; Paul, 2010).

In RTI, students participate in basic skills screenings several times during the school year (Marston, 2005). RTI theory suggests that most students will meet state established grade level expectations with regular classroom instruction. In RTI terminology, this group falls into the Tier 1 category (Burns et al., 2010; Marston, 2005; Mellard & Johnson, 2008). Students who do not meet grade level standards are provided with additional academic interventions, such as extra instruction, drill, and practice in the deficient skill area. Students who receive extra interventions are in the group entitled Tier 2, and are considered to be academically at-risk (Burns et al., 2010; Marston, 2005; Mellard & Johnson, 2008). At the second annual screening, it is expected that those who scored in the at-risk range will have made significant progress towards achieving grade level standards (LDA White Paper, 2010; Paul, 2010). Students who do not reach this goal will continue to receive intensive educational interventions for a specified time. This group of students is in the Tier 3 category, and is considered to be significantly at-risk for school failure (Marston, 2005; Mellard & Johnson, 2008). Tier 3 students receive academic interventions that are more frequent and intensive than those received in Tier 2 (Marston, 2005).

It should be noted that there are no empirically validated recommendations for the optimal length of any Tier 1, 2, or 3 interventions (Andersson, 2010; LDA White Paper, 2010; Paul, 2010). Individual schools and districts usually determine the length and intensity of interventions based several factors, such as staff time and available personnel (Andersson, 2010; LDA White Paper, 2010; Mellard & Johnson, 2008; Paul, 2010). Across school districts, and school buildings within a district, there is a lack of consistency in the length and types of RTI-based interventions received by students. The lack of consistency in the length and type of interventions is one of the major concerns about using RTI as an SLD diagnostic method (LDA White Paper, 2010; Paul, 2010).

Depending upon a student's response or lack of response to the interventions, the student could remain in the Tier 3 intervention process for an unspecified period of time (Marston, 2005). One reason for this could be that the student is moving slowly towards meeting grade level benchmarks for a particular skill, and school professionals feel the student needs more time to respond to the intervention (Kavale et al., 2008; Mellard & Johnson, 2008). Or, school professionals could decide that keeping the student in a Tier 3 level is a better intervention than referring the student for special education (Burns, Dean, & Klar, 2004; Burns et al., 2010; Kavale et al., 2009; Marston, 2005; Mellard & Johnson, 2008). Most often, students who fail to respond to Tier 3 interventions are thought to have an SLD, will be diagnosed with an SLD, and will likely be referred for special education services (Mellard & Johnson, 2008; Reynolds & Shaywitz, 2009).

The IDEA (2004) regulations state that school districts may use a student's failure to respond to Tier 3 interventions as the sole criteria for diagnosing an SLD. There is no requirement to conduct any additional diagnostic testing, or to identify any cognitive processing deficits (Marston, 2005; Mellard & Johnson, 2008; LDA White Paper, 2010; Paul, 2010). Critics of this approach suggest that diagnosing an SLD with the RTI method is like diagnosing a brain injury from headache symptoms, based on the patient's failure to respond to increasing doses of aspirin and ibuprofen (LDA White Paper, 2010).

RTI is viewed by many as a reasonable and even effective approach to addressing student learning difficulties (Marston, 2005; Reynolds & Shaywitz, 2009). In fact, best practice policies recommend that students receive a series of interventions before being referred for special education testing (IDEA, 2004; Sattler, 2008). Because an SLD can be diagnosed by failure to respond to interventions, professionals in the fields of education, law, and psychology have become increasingly concerned about diagnosing an SLD without a comprehensive evaluation (Kavale et al., 2009; LDA White Paper, 2010; Newton & McGrew, 2010; Paul, 2010; Reynolds & Shaywitz, 2009). These concerns include using RTI to diagnose SLDS without adequate empirical support, concerns that RTI cannot identify cognitive processing deficits, and concerns about the lack of consistency in RTI interventions between states, school districts, and even between schools in the same district (LDA White Paper, 2010; NJCLD, 2010). Additional concerns are that RTI interventions are geared towards a skill deficit rather than addressing possible cognitive processing deficits that underlie learning disabilities, and that the RTI diagnostic method oversimplifies the complex nature of an SLD (LDA White Paper, 2010; Paul, 2010). Oversimplifying the complexities involved in an SLD discounts the importance of understanding cognitive processing deficits and creating interventions targeted to the specific deficits. When cognitive processing deficits are not recognized, the quality and effectiveness of interventions will likely be impaired, and the student will be unlikely to benefit from instruction based solely on remediation (Flanagan et al., 2010; LDA White Paper, 2010; Mellard & Johnson, 2008; Paul, 2010). Many professionals feel that the RTI diagnostic method is an unproven hypothesis with the potential to do great harm (Berninger, 2006; Dombrowski et al., 2006; LDA White Paper, 2010; Reynolds & Shaywitz, 2009; Thurlow et al., 2002).

When used to diagnose an SLD, RTI focuses on just two dimensions of a student's academic performance, which are reading and math skills (Paul, 2010). RTI, as applied to the skill of writing, requires much more complex evaluation processes than those used to assess reading and math skills (LDA White Paper, 2010; Mellard & Johnson, 2008). Additionally, data supporting the effectiveness of RTI writing interventions are more scarce than data supporting the effectiveness of RTI reading and math interventions (McCurdy, Skinner, Watson, & Shriver, 2008; Paul, 2010). For this reason, writing skill interventions are infrequently and inconsistently used in RTI practice (McCurdy et al., 2008; Paul, 2010).

Those who support using RTI as an SLD diagnostic method believe that failure to respond to Tier 3 interventions is sufficient evidence to decide a student has an SLD (IDEA, 2004; Marston, 2005; Mellard & Johnson, 2008). Under the RTI method, comprehensive information about a student's cognitive processing strengths and weaknesses is deemed unnecessary to diagnose the student with an SLD, to place the student in a special education program, and to administer remedial instruction based on lack of response to the interventions (Mellard & Johnson, 2008; LDA White Paper, 2010; Paul, 2010; Reynolds & Shaywitz, 2009).

The IDEA (2004) suggested a third possibility for diagnosing an SLD in the Final Regulations for Implementation of IDEA 2004 (34 CFR Parts 300 and 301; Federal Register, 2006). This section permits, but does not require, school districts to consider “a pattern of cognitive strengths or weaknesses, or both, relative to intellectual development if the evaluation group considers such information relevant to the identification of SLD” (p. 46651). This legislation opened the door for an alternative method of diagnosing SLDs that recognizes cognitive processing strengths and weaknesses. Experts agree that there are many existing, technically sound, and reliable tests that can identify deficits in cognitive processing systems (Edwards & Paulin, 2007; LDA White Paper, 2010; Naglieri et al., 2005; Roid, 2003). However, these testing instruments have yet to be operationalized or sanctioned for use with existing SLD evaluation procedures on a basis that is acceptable to legal, educational, and psychology professionals (Naglieri et al., 2005).

While some American states allow for SLD diagnostic procedures that specify identification of cognitive processing deficits, the majority of U.S. states do not (LDA, 2014). Although experts recommend a new SLD diagnostic method that can recognize cognitive processing deficits, any new method will need to be compatible with the procedures outlined in IDEA (2004). Special education services are funded by the federal government, and school districts are subject to compliance with special education law (IDEA, 2004; LDA White Paper, 2010; Naglieri et al., 2005; Paul, 2010). An important benefit of using the GAI diagnostic method is that it can be used with the AAD method by adjusting the full scale IQs when cognitive processing deficits are present (Prifitera et al., 1998; Raiford et al., 2005; Saklofske et al., 2010; Wechsler, 1991/2003).

The GAI, and the Degree and Type of Processing Deficit

The GAI was initially developed for use with the WISC-III to allow for greater flexibility when interpreting IQ test scores (Prifitera et al., 1998; Wechsler, 1991). The WISC-III GAI provided a means of measuring intelligence that was free from working memory and processing speed demands (Prifitera et al., 1998). The WISC-III GAI was used when there were significant score differences between verbal and performance IQs due to low scores on the Arithmetic (working memory) or Coding (processing speed) subtests (Raiford et al., 2005; Weiss et al., 1991). Creation of the WISC-III GAI was an important step in recognizing cognitive processing deficits, and how these deficits affect full scale IQs (Prifitera et al., 1998; Raiford et al., 2005; Sattler, 2008).

Like the WISC-III GAI, the WISC-IV GAI yields a full scale IQ that is sensitive to the influences of verbal comprehension, working memory, and processing speed deficits (Edwards & Paulin, 2007; Harrison et al., 2007; Prifitera et al., 1998; Raiford et al., 2005). Research suggests that verbal comprehension, working memory, and or processing speed functions are often significantly impaired in the general SLD population, while reasoning and thinking abilities are intact (Berninger, 2006; Edwards & Paulin, 2007; Geary et al., 2004; Harrison et al., 2007; LDA White Paper, 2010; Paul, 2010). Working memory, verbal comprehension, and processing speed deficits have been implicated in many types of learning disabilities, including dyslexia, dyscalculia, disorders of written language, and other SLDs (Alloway, 2009; Flanagan et al., 2010; Geary et al., 2004; Newton & McGrew, 2010). Working memory, verbal comprehension, and processing speed deficits often show up in IQ profiles during the SLD evaluation process (De Clercq-Quaegebeur et al., 2010; Helmbold & Rammsayer, 2010). In many adults and children with SLDs, impairment in the speed of information processing, language and print processing, verbal comprehension, and the ability to hold and manipulate large amounts of information in working memory are the primary causes of educational and occupational difficulties, rather than the intellectual capacity for learning (Berninger, 2006; Flanagan et al., 2010; Geary et al., 2004; Harrison et al., 2007; Wang et al., 1993/1994). SLD students are typically able to make academic progress when compensatory learning strategies are taught in conjunction with course content, and when the SLD student has appropriate accommodations to use in class (Alloway, 2009; Harrison et al., 2007; Vanderberg & Emery, 2009).

Because the AAD method can adversely impact an SLD student's full scale IQ, and thus eligibility for special education services, some professionals have labeled the AAD's built-in scoring bias as the "*Mark Penalty*" (Dumont & Willis, 1999; LDA White Paper, 2010). This term is derived from a biblical passage that states, "For he that hath, to him shall be given and he that hath not, from him shall be taken even that which he hath" (quoted by Dumont & Willis, 1999, from Mark 4:25, King James Version). Given the AAD and RTI methods of diagnosing SLDs, the "*Mark Penalty*" implies that an SLD student's cognitive processing deficits often depresses the full scale IQ score, thus disqualifying the student from establishing eligibility for special education services. As stated in the biblical passage, much is taken from he or she who has the least.

In a study by Konold and Canivez (2009), WISC-IV full scale IQs and WISC-IV GAI IQs predicted academic achievement scores on the WIAT-II, with large and statistically significant criterion-related correlations. Coefficients ranged from .75 to .87 for the WISC-IV full scale IQ, and from .71 to .84 for the WISC-IV GAI IQ. The results of the Konold and Canivez (2009) study show that WISC-IV full scale and GAI IQs are equally reliable predictors of academic performance. In a related study, researchers found that the WISC-IV GAI is an accepted SLD diagnostic method used in Canadian schools (Saklofske et al., 2010). These findings indicate that the WISC-III and WISC-IV GAIs are important diagnostic tools in a comprehensive evaluation process, particularly when best practice principles are followed, such as taking time thoroughly to understand the referred student's academic problems (Saklofske et al., 2010). Additional best practice principles include conducting a comprehensive review of the student's learning history, and having a thorough understanding of the constructs tested by each WISC-III and WISC-IV IQ and index score (Flanagan et al., 2010; Saklofske et al., 2010).

While the WISC-III and WISC-IV full scale IQs provide an estimate of global cognitive functioning, the GAI IQs provide additional information about a person's unique verbal comprehension, processing speed, and working memory systems (Prifitera et al., 1998; Wechsler, 1991/2003). Harrison et al. (2007) studied 381 adults assessed for learning and or attention problems between 1998 and 2005. Adults with significant cognitive processing deficits such as SLDs, brain injuries, and attention deficit hyperactivity disorders demonstrated more substantial differences between Wechsler Adult Intelligence Scale – 3rd ed. (WAIS-III) GAI and full scale IQs than did those participants with more psychologically based conditions, such as depression, anxiety, and post-traumatic stress disorder. While depression, anxiety, and other mood disorders have been found to impact performance on IQ tests (Nelson & Harwood, 2010), Harrison et al.'s (2007) research suggests that IQ and index score differences will be more substantial when actual cognitive processing deficits are present.

To calculate the WISC-III GAI, the Arithmetic subtest score (working memory) is excluded from the verbal IQ scale, and the Coding subtest score (processing speed) is excluded from the performance IQ scale (Prifitera & Saklofske, 1998). The full scale IQ is recalculated by adding the scale scores for the eight remaining WISC-III subtests (Vocabulary, Similarities, Information, Comprehension, Block Design, Picture Completion, Picture Arrangement, and Object Assembly). The reconfigured full scale IQ score is then used with the WISC-III GAI IQ tables provided in the book "WISC-III Clinical Use and Interpretation: Scientist-Practitioner Perspectives" (Prifitera et al., 1998, p. 20 - 21).

The WISC-III GAI is recommended when the Arithmetic subtest score is significantly different from the mean of the remaining verbal scale subtest scores, and when the Coding subtest score is significantly different from the mean of the remaining performance scale subtest scores (Prifitera et al., 1998). The WISC-III GAI is also recommended when there are significant differences between the verbal and performance IQ scores (Prifitera et al., 1998). Table B.1 in the WISC-III Administration and Scoring Manual contains the scale score differences needed for statistical significance between IQ and index scores, as well as the score differences needed for statistical significance between the VCI, POI, FDI (WMI), and the PSI (Wechsler, 1991). For example, the required score difference for statistical significance ($p < .05$) between the VIQ and the

PIQ for a 9-year-old student is 12 points (Wechsler, 1991). Thus, a 9-year-old student with a verbal IQ of 100 and a performance IQ of 88 has a statistically significant score difference between verbal and performance IQs (12 scale points, $p < .05$). In this example, use of the WISC-III GAI would be appropriate in order to adjust the full scale IQ.

The WISC-IV Technical Report No. 4 (Raiford et al., 2005) outlines the criteria for deciding when to use the WISC-IV GAI:

> The practitioner may want to consider using the GAI in a number of clinical situations not limited to, but including the following conditions: A significant and unusual discrepancy exists between the VCI and WMI, a significant and unusual discrepancy exists between the PRI and PSI, a significant and unusual discrepancy exists between WMI and PSI, or significant and unusual inter-subtest scatter exists within WMI and or PSI. (Raiford et al., 2005, p. 3)

To calculate the WISC-IV GAI, the scaled scores for the VCI and the PRI are added together, the WMI and PSI scores are excluded, and the resulting score is used to determine the GAI IQ (Raiford et al., 2005). When a full scale IQ is depressed due to a working memory or processing speed deficit, the WISC-IV GAI process removes the influence of these deficits by excluding the WMI and PSI from the GAI IQ (Raiford et al., 2005). For example, given a WISC-IV VCI of 118, a PRI of 115, a WMI of 89, and a PSI of 78, the full scale IQ score would be significantly impacted by the lower WMI and PSI scores, because there are “significant and unusual discrepancies between the VCI and WMI, and the PRI and PSI” (Raiford et al., 2005, p. 3). Table 1 in the WISC-IV

Technical Report No. 4 contains precalculated GAI IQs based on the sum of scaled scores from the VCI and PRI scales (Raiford et al., 2005). For example, if the sum of the VCI and the PRI equals 63 points, Table 1 of the WISC-IV Technical Report No. 4 (Raiford et al., 2005) shows a GAI equivalent IQ of 103, which falls at the 58th percentile rank. If the sum of the VCI and PRI equals 64 points the GAI equivalent IQ will be 104, which falls at the 55th percentile rank. Without the use of the GAI method, the WISC-IV full scale IQ score would be depressed by eight or more points (Raiford et al., 2005).

The WISC-IV Administration and Scoring Manual (Wechsler, 2003) includes calculations to help determine a significant and unusual discrepancy between IQ and index scores. These are called the base-rate percentages and critical-values statistics (Raiford et al., 2005; Wechsler, 2003). The base-rate percentages and critical-value statistics are based on the chronological age of the tested student (Raiford et al., 2005; Wechsler, 2003). Critical-value statistics specify the between-index score differences necessary for statistical significance ($p < .05$), such as the difference between the VCI and PRI (Wechsler, 2003). Base-rate percentages are the percentage of persons, by age group, in the standardization sample who obtained the same or greater score discrepancies between indices (Raiford et al., 2005; Wechsler, 2003). Sattler (2008) recommends that a base-rate of 10% to 15% occurrence is appropriate to determine statistical significance at the $p < .05$ level (Wechsler, 1991, 2003).

The WISC-III and WISC-IV Administration and Scoring Manuals (1991, 2003) provide computed critical-value statistics and base-rate percentages for the different chronological age ranges of the tests (Wechsler, 1991/2003). Tables B.1 in the WISC-III and WISC-IV Administration and Scoring Manuals (Wechsler, 1991, 2003) provide the critical-value statistics necessary to determine statistical significance (between scale scores) by the individual's chronological age, and Tables B.2 in both manuals provide the base-rate percentage of occurrence in the standardization sample, also by chronological age (Wechsler, 1991, 2003). For example, if the difference between the WISC-IV VCI and the PRI scaled scores is 20 points and the student is age 8 years 7 months, Table B.1 in the WISC-IV manual shows that the critical-value is 13 points and the base-rate is 10%. Thus, the difference between the VCI and the PRI scaled scores is considered statistically significant at the $p < .05$ level, because the difference (20 scale points) is greater than the critical-value statistic (13 scale points) and occurred in only 10% of the standardization sample (Raiford et al., 2005; Sattler, 2008; Wechsler, 2003).

For the current study, the WISC-III GAI process described by Prifitera et al. (1998) was used as a basis to diagnose SLD students in the sample who were tested with the WISC-III, and to determine the type and degree of cognitive processing deficit (Wechsler, 1991). The WISC-IV GAI process described in the WISC-IV Technical Report No. 4 (Raiford et al., 2005) was used as a basis to diagnose SLD students in the sample who were tested with the WISC-IV, and to determine the degree and type of cognitive processing deficits (Raiford et al., 2005; Wechsler, 2003). Statistically significant differences ($p < .05$) between WISC-III and WISC-IV IQ and index scores were used to determine when to apply the GAI method with the sample data (Raiford et al., 2005; Wechsler, 1991, 2003).

For the current study, the critical-value and base-rate percentage processes were used to identify cognitive processing deficits, and to determine the type and the degree of cognitive processing deficits in the sample data (Raiford et al., 2005; Wechsler, 1991/2003). Given a WISC-IV VCI of 118, a PRI of 115, a WMI of 89, and a PSI of 78, the full scale IQ score would be adversely affected by the lower WMI and PSI scale scores (VCI / WMI = 29 points; PRI / PSI = 37 points) because there are "significant and unusual discrepancies between the VCI and WMI, and the PRI and PSI" (Raiford et al., 2005, p. 3). In this example, working memory and processing speed deficits are identified by the lower index score, and by critical-value and base-rate percentages criteria (Raiford et al., 2005; Wechsler, 1991, 2003). This example illustrates the means by which the predictor variable, type of cognitive processing deficit, will be determined. The number of scale points found between the different indices will be used to determine the predictor variable, degree of cognitive processing deficit. For example, when the difference between the VCI and WMI is 29 scale points and the WMI is the lower score, the type of cognitive processing deficit is a working memory deficit, and the degree of cognitive processing deficit is the 37 scale points between the indices (Raiford et al., 2005).

Grade-Level When Tested for an SLD

One of the predictor variables in the current study is the student's grade level when first tested for an SLD. Grade level when tested was chosen as a predictor variable because students represented in the sample were in different grades when diagnosed with an SLD. A student diagnosed with an SLD in Grade 2 will spend more time receiving special education services than a student who is diagnosed in Grade 8; thus there may be a significant relationship between grade level when tested and high school completion status, SLD eligibility, and state standards performance (Vanderberg & Emery, 2009). Additionally, the grade level when tested was chosen as a predictor variable because the focus of classroom instruction varies from grade to grade. In Kindergarten through the third grade, classroom instruction is focused on the acquisition of basic academic skills, such as phonemic awareness, reading fluency, word decoding skills, basic number sense, and basic addition and subtraction skills (Morgan, Frisco, Farkas, & Hibel, 2010; Wanzek, Wexler, Vaughn, & Cuillo, 2010). According to the National Reading Panel (as cited in Wanzek et al., 2010), students become better readers when they receive consistent and direct instruction in phonological awareness, phonics, and other fundamental literacy skills in the early grades. Mastery of these skills paves the way for learning higher level skills, such as reading fluently, understanding vocabulary, and inferring meaning from text (Wanzek et al., 2010).

Special education reading instruction for SLD students typically focuses on remediation of phonological awareness, word decoding skills, and reading fluency, regardless of the grade placement (Morgan et al., 2010; Wanzek et al., 2010). However, studies have shown that SLD students receiving special education services in the fourth through the 12th grades have better educational outcomes when taught compensatory strategies for learning, rather than remediation of basic skills (Abreu-Ellis et al., 2009; Wanzek et al., 2010). In the fourth grade, reading instruction shifts from "learning to read, to reading to learn" (Wanzek et al., 2010, p. 16). An SLD student with dyslexia, who has problems with basic reading skills, is now expected to read textbooks to find information. These students will struggle in school unless they are taught compensatory strategies, such as locating the main idea in a passage, learning to summarize paragraphs and book chapters, learning how to infer meaning from text, and learning to discriminate essential from non-essential information (Solis, Cuillo, Pyle, Hassaram, & Leroux, 2010; Wanzek et al., 2010).

Hughes and Smith (as cited in Abreu-Ellis et al., 2009) reported that the focus of mathematics instruction in the third to the fourth grades shifts from teaching basic number sense (e.g. counting, adding, subtracting, and multiplication skills), to teaching students to solve higher-level mathematics problems. Third and fourth grade SLD students, who have not mastered basic math skills, will struggle to progress in the math curriculum unless taught compensatory strategies and allowed certain accommodations, such use of a calculator (Abreu-Ellis et al., 2009; Solis et al., 2010). Abreu-Ellis et al. (2009) found that college students who were diagnosed with an SLD during Kindergarten through Grade 12 demonstrated better basic academic skills, better test taking strategies, and reported higher levels of self-confidence than students who were not diagnosed until they reached college. This finding suggests that diagnosing SLDs in the early grades can have a beneficial effect on post high school educational opportunities (Abreu-Ellis et al, 2009; Vanderberg & Emery, 2009).

Gaps in the Literature

There are many research studies focused on problems with the AAD and RTI diagnostic methods, however there are comparatively few studies about a third method of diagnosing SLDS that acknowledges cognitive processing deficits (Berninger, 2006; Flanagan et al., 2010; LDA White Paper, 2010). Some studies suggest the WISC-III and WISC-IV GAI methods as possible diagnostic alternatives that can recognize cognitive processing deficits (De Clercq-Quaegebeur et al., 2010; Prifitera et al., 1998; Raiford et al., 2005; Saklofske et al., 2010). Other studies have pointed to intelligence tests, such as the Cognitive Assessment System, the Stanford Binet Test of Intelligence-5th ed., and the Kaufman Assessment Battery for Children-2nd ed. as possible third method diagnostic tools (Naglieri et al., 2005; Newton & McGrew, 2010; Reschly, 2005). What appears to be missing are studies that can demonstrate how these assessments improve upon the status quo AAD method.

One advantage of the GAI method is that it can be used with the AAD method, which is important for several reasons (Raiford et al., 2005; Sattler, 2008). The AAD method is embedded in federal law, and all public schools in the U.S. must adhere to the law's procedural guidelines (IDEA, 2004). While there is widespread support for a cognitive processing approach to diagnosing SLDs, implementation of a diagnostic method that is not compatible with the AAD method may have to wait until federal law can be rewritten to include the new diagnostic procedure (LDA White Paper, 2010; Paul, 2010). Because special education funding for local school districts is dependent upon compliance with federal law, diagnostic methods that are not part of the law may risk limited acceptance (IDEA, 2004). Attempts to amend or change federal regulations can be time consuming, with no guarantee that the proposed changes will survive the legislative process (IDEA, 2004). The GAI method is unique among other cognitive processing assessment methods because it works with the AAD method, but takes the extra steps of identifying cognitive processing deficits found in WISC-III and WISC-IV profiles, and mitigating the effect of lowered IQ and index scores on the full scale IQ (De Clercq-Quaegebeur et al., 2010; Raiford et al., 2005; Saklofske et al., 2010). Thus, the GAI method may be more easily adapted into existing procedures, and thus may be a more viable option for a third diagnostic method.

Research shows that identifying cognitive processing deficits in SLD evaluations can improve diagnostic accuracy (Alloway, 2009; Flanagan et al., 2010; Fuchs et al., 2011; Geary et al., 2004; Konold & Canivez, 2009; Reschly, 2005; Thurlow et al., 2010). An SLD diagnostic method that can identify cognitive processing deficits, such as the GAI, may be able to predict high school completion status, performance on state standards assessments, and SLD eligibility (Reschly, 2005; Thurlow et al., 2010). Results from the current study that connect cognitive processing deficits to high school completion and other outcomes, may help legitimize the GAI as a third diagnostic method.

Summary and Conclusions

Andersson (2010) and Dombrowski et al.'s research (2004, 2006) has shown that the AAD method often underdiagnoses SLDs when students have cognitive processing deficits, and overdiagnoses SLDs when students are English language learners, members of ethnic minorities, and are from low socio-economic backgrounds. The federal definition of an SLD states that learning disabilities are the result of one or more deficits in cognitive processing systems, yet the AAD method is unable to recognize any cognitive processing deficits (IDEA, 2004; LDA White Paper, 2010; Naglieri et al., 2005). SLD diagnostic practices have not kept pace with current research, despite many studies that support identification of cognitive processing deficits (LDA White Paper, 2010; Paul, 2010).

There is a call for a third method of diagnosing SLDs that can identify cognitive processing deficits, however, research has yet to pinpoint a particular alternative to the AAD and RTI methods (Berninger, 2006; Flanagan et al., 2010; LDA White Paper, 2010; Naglieri et al., 2005; Paul, 2010; Reynolds & Shaywitz, 2009). The GAI method may be able to fill this gap. The GAI recognizes cognitive processing deficits, and can be used with the AAD method by adjusting full scale IQs when cognitive processing deficits are present (IDEA, 2004; Prifitera et al., 1998; Raiford et al., 2005). One way of determining if the GAI is a viable alternative to the AAD method is statistically to examine the relationships between the GAI diagnostic method, and high school completion status, performance on state standards assessments, and SLD eligibility (Prifitera et al., 1998; Raiford et al., 2005; Reschly, 2005). The results of this study will add to the body of knowledge about SLD diagnostic practices, and the relationships between cognitive processing deficits and several important student outcomes.

Chapter 3: Research Method

Introduction

The purpose of this quantitative study was to examine the GAI method of diagnosing SLD as a possible alternative to the AAD method. To accomplish this goal, I sought to determine if the predictor variable, SLD eligibility under the GAI method, could predict high school completion status, performance on state standards assessments, and SLD eligibility. The results of this study will add to the body of knowledge about cognitive processing deficits, learning disabilities, and SLD diagnostic methods (Flanagan et al., 2010; Newton & McGrew, 2010).

In Chapter 3, the research design and rationale section describes the process by which the study's research questions are to be analyzed. In this section, I explain the reasons behind the design selection and the statistical analysis method by which the sample data will be analyzed. I describe the sampling method used to obtain the sample, and provide a rationale for the selected method. The sample population is described, and the procedures by which access to the sample data was obtained. Data resulting from norm-referenced and criterion-referenced test administrations are part of what was collected to derive the study's variables. These test instruments are explained, including the authors, the purposes of the tests, and the reliability and validity of test results. The predictor and dependent variables for the study are operationally defined, and the manner in which the variable data are to be coded into the SPSS Version 21.0 software program is explained. The data analysis plan is then detailed, including the statistical method used to analyze the data, and how the results of the analysis will be interpreted. Following the research design and rationale section, I will address potential external and internal validity threats to the results of the study's analyses. Next, I will discuss the ethical procedures used to protect sample data. Chapter 3 concludes with a summary of the information presented in the chapter and a transition to Chapter 4.

Research Design and Rationale

In this study, the research dependent variables were high school completion status, reading, writing, and math scores on Washington's state standards assessments, and SLD eligibility. The research predictor variables were the grade level when tested for a SLD, the type and level of cognitive processing deficits, and SLD eligibility with the GAI method. A multivariate, nonexperimental design was selected for the study. Nonexperimental designs are often used in social science and medical research to investigate the extent that one variable can predict another (Harrison et al., 2007; Mertler & Vannatta, 2010). A nonexperimental design is appropriate for this study because data were gathered from archived special education records and no treatment conditions or manipulation of variables were proposed in the study design (Jaccard & Becker, 2002; Littell et al., 2002; Mertler & Vannatta, 2010).

A GLM was used to analyze the data collected for the study and to determine possibly significant relationships between the predictor and dependent variables. GLMs are used in situations where multiple variables are included in the analysis, observations of the data are independent, and the data are not normally distributed (George & Mallery, 2008; Hill & Lewicki, 2007; Quinn & Keough, 2001). GLMs are similar to linear regression, but include equations that allow for analysis of continuous and categorical predictor or dependent variables when the assumptions of normality have been violated (Guisan et al., 2002; Littell et al., 2002; Quinn & Keough, 2001). Hastie and Tibshirani (1990) stated that "unlike a linear regression analysis, GLMs do not force data into unnatural scales and thereby allow for non-linearity and non-constant variance structures in the data while still producing reliable parameter estimates and *p* values" (as cited by Guisan et al., 2002, p.2).

The nature of the current study was to determine if the GAI diagnostic method may be a viable alternative to the AAD method of SLD diagnoses. To address this question, the predictor variable, SLD eligibility under the GAI method, was analyzed to determine if it could predict the dependent variables, which are high school completion status, reading, writing, and math scores on Washington's state standards assessments, and SLD eligibility. A period of several weeks was required for reviewing, collecting, and encoding the data into the SPSS Version 21 software program. The data collection resource and time considerations associated with this study were relatively minimal, as the data already existed in archived records and no variables were manipulated for the study.

The predictor variable data were collected from archived special education records from a local school district. The predictor variables were the student's grade level when tested, the degree and types of cognitive processing deficits, and SLD eligibility under the GAI method. Data collected to construct the predictor variables included the learning disability diagnostic method used in the SLD evaluation, whether the student was SLD eligible under the AAD or GAI methods, the grade level when initially tested for an SLD, IQ and index scores from the WISC-III and WISC-IV IQ tests, and scores from the WJ-III and WIAT-II academic tests.

The dependent variable data were collected from electronic databases from a local school district. Specific information collected from the databases included the student's test scores on the reading, math, and writing sections of the WASL and the HSPE, whether the student took the regular state standards assessment, or a lower grade-level assessment, and whether the student completed high school. Because the study took place in Washington state, the specific state standards assessments used are the WASL and the HSPE (OSPI, 2009, 2010).

Quantitative data were collected from archived special education records and academic databases from a local school district. Each archived special education file contained the student's academic and intellectual test scores, whether or not the student qualified for special education services under the SLD category, the student's chronological age when initially tested, and the student's grade level when initially tested. Specific data collected from the archived files included IQ and index scores from the WISC-III and WISC-IV, standardized scores on the reading, math, and writing sections of the WIAT-II and or WJ-III, the student's chronological age at the time of testing, and the student's grade level when initially tested for a SLD. Of these data, only the grade level when tested is a straightforward predictor variable. The student's WISC-III, WISC-IV, WIAT-II, and WJ-III scores and the student's chronological age were used to configure the remaining predictor variables, which are the types and degree of cognitive processing deficit found in the WISC-III and WISC-IV IQ and index scores, and whether the student qualified for an SLD using the AAD method, the GAI method, or both. The process of configuring these variables is discussed in more detail in the data collection section.

Methodology

Setting and Sample

A criterion sampling method, found under the purposive sampling umbrella, was used in this study because the data collected were specific to the intent of the study, the study design was nonexperimental, and the data were in archived form (Jupp, 2006; Palys, 2008). The sample for the current study was selected from a group of students who were tested for an SLD between the 1996/1997 and 2012/2013 school years. Based on study criteria, these students had to be of high school completion age by the 2012/2013 school year and had to have taken the WASL or the HSPE (OSPI, 2009, 2010). The archived special education records of these students had to include data needed to diagnose an SLD, as described by state and federal regulations for SLD eligibility (IDEA, 2004; OSPI, 2011; Sattler, 2008). These data included WISC-III and WISC-IV IQ and index scores, reading, math, and writing scores from the WIAT-II or WJ-III academic tests, the student's chronological age at the time of testing, and the student's grade level at the time of testing.

The date ranges, 1996/1997 to 2012/2013, were selected to be sure students represented in the sample were of high school completion age by the end of the 2012/2013 school year. Student information such as name, date of birth, and other identifying information were not collected during the data gathering process. School district officials and the researcher signed the Data Use and Confidentiality Agreements (see Appendices A and B) prior to the data collection process. After reviewing the archived records, personal information linked to individual students was removed from the collected information, and a number system was used to label each dataset. These datasets were stored on a thumb drive in a separate location from the data analysis. Collected data will be kept for five years and will be destroyed when this time frame has passed. When the research study is approved by Walden University, I will share the results and recommendations from the study with the school district from which the data were gathered.

Sample size calculations help researchers determine the number of datasets or participants needed to reject the null hypotheses (Littell et al., 2002; Quinn & Keough, 2001). I used a G*Power 3.1.3 a priori power analysis for a linear multiple regression design (fixed model, r^2 deviations from zero), with four predictor variables to determine the number of datasets needed for sufficient statistical power (University of Duesseldorf, 2012). The alpha level was set at $p < .05$ with .95 power and a medium effect size of .15, resulting in a recommended sample size of 129. I decided to increase the sample size to 150 in order to ensure adequate reliability of study results. The data collection process resulted in 149 complete data sets.

Research Questions and Hypotheses

The SPSS 21.0 software program was used to analyze all data. The following research questions guided this study:

Research Question #1: High school completion status.

Do the grade level when tested, the degree and the types of cognitive processing deficits found in the cognitive profile, specifically verbal comprehension, working memory, and or processing speed, and SLD eligibility under the GAI method predict high school completion?

H_{0hs}: The grade level when tested, the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, and or working memory, and SLD eligibility under the GAI method do not predict high school completion.

H_{1hs}:. The grade level when tested, the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, and or working memory, and SLD eligibility under the GAI method do predict high school completion

Research Question # 2: Test scores on State Standards Assessments.

Do the grade level when tested, the degree and the types of cognitive processing deficits found in the cognitive profile, specifically verbal comprehension, working memory, and or processing speed, and SLD eligibility under the GAI method predict passing scores on the WASL and the HSPE (OSPI, 2009, 2010)?

H_{0wsa}: The grade level when tested, the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, and or working memory, and SLD eligibility under the GAI method do not predict passing scores on the WASL and the HSPE (OSPI, 2009, 2010).

H_{1wsa}: The grade level when tested, the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, and or working memory, and SLD eligibility under the GAI method do predict passing scores on the WASL and the HSPE (OSPI, 2009, 2010).

Research Question # 3: SLD Eligibility.

Do the grade level when tested, the degree and the types of cognitive processing deficits found in the cognitive profile, specifically verbal comprehension, working memory, and or processing speed, and SLD eligibility under the GAI method predict SLD eligibility?

$H_{0sld:}$ The grade level when tested, the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, and or working memory, and SLD eligibility under the GAI method do not predict SLD eligibility.

H_{1sld}: The grade level when tested, the degree and types of cognitive processing deficits, specifically verbal comprehension, processing speed, and or working memory, and SLD eligibility under the GAI method do predict SLD eligibility.

Data Collection

The data collection process commenced after approval by Walden's Institutional Review Board (IRB) committee was received. The data collection timeline was estimated at approximately seven to 21 days, depending on researcher time, access to school district records, access to school district databases, and possible missing data from the selected archived records requiring a search for additional records. Once collected, the data were coded into the SPSS Version 21.0 software program.

The dependent variable data were gathered according to the following procedure. High school completion status and reading, writing, and math test scores on the WASL and the HSPE (OSPI, 2009, 2010) were obtained from school district electronic databases. The high school completion status variable was documented as (1) yes, or (2) no, so the high school completion variable has two levels. Scores from the WASL and the HSPE (OSPI, 2009, 2010) were gathered by documenting each student's test scores on the reading, math, and writing sections of the tests. The performance on state standards assessment variable has three levels to account for reading, math, and writing scores.

The SLD eligibility variable was collected by reviewing the IQ, index, and academic test scores from WISC-III, WISC-IV, WIAT-II, and WJ-III test administrations. The IQ and index scores were compared with the academic test scores to determine SLD eligibility under the AAD method, using discrepancy tables published by Washington state (SLD Guide, 2011). WISC-III and WISC-IV IQ and index scores were examined to determine if any differences between scores met criteria for applying the GAI method. Where appropriate, the adjusted GAI IQ was used with the academic test scores and discrepancy tables to determine SLD eligibility. The SLD eligibility variable has four levels, which are SLD eligible using the AAD method, SLD eligible using the GAI method, SLD eligible using both methods, or no SLD eligibility using either diagnostic method.

Predictor variable data were gathered according to the following procedures. The data were stored in archived files, requiring review of each archived record to collect IQ and index scores from WISC-III and WISC-IV tests, and reading, writing, and math scores from the WIAT-II or WJ-III. Additional predictor variable data collected were the student's chronological age at the time of testing, whether the student was diagnosed with an SLD, and the student's grade level when tested for an SLD. The IQ, index and academic test scores were used to determine SLD eligibility under the AAD method, and to determine SLD eligibility under the GAI method when cognitive processing deficits were present. WISC-III and WISC-IV IQ and index scores were also used to determining the degree and types of cognitive processing deficits. The SLD eligibility process is discussed below, followed by an explanation of how the GAI method and the degree and the types of cognitive processing deficits were determined.

SLD Eligibility

WISC-III and WISC-IV full scale IQ scores were used to determine the severe discrepancy score required for SLD eligibility, according to the following procedure. The severe discrepancy score refers to the minimum academic skills score needed to document a severe discrepancy between intellectual ability (full scale IQ) and academic achievement (Francis et al., 2005; Sattler, 2008; SLD Guide, 2011). Washington state's severe discrepancy scores are based on a regressed standard score equation (OSPI, 2011). Using this algorithm, a severe discrepancy score is calculated for each possible full scale IQ, resulting in an academic criterion score that is tied to that IQ score (OSPI, 2011). Washington state's SLD Guide (OSPI, 2011) contains a table showing the academic criterion scores for each full scale IQ score, ranging from an IQ of 69 to an IQ of 145 (OSPI, 2011). For example, the discrepancy table shows that a full scale IQ of 100 has a severe discrepancy score of 82 (OSPI, 2011). The severe discrepancy score of 82 means that the student with a full scale IQ of 100 must obtain a reading, writing, or math score that falls at or below 82 to be diagnosed with an SLD. In the current study, the student's WISC-III and WISC-IV full scale IQ scores and reading, math, and writing test scores will be examined with Washington's discrepancy tables to determine SLD eligibility for each student (IDEA, 2004; OSPI, 2011).

GAI full scale IQs are derived from adjusted WISC-III and WISC-IV IQ and index scores when there is a statistically significant difference ($p < .05$) between IQ or index scores based on critical-value statistics and base-rate percentages (Prifitera et al., 2005; Raiford et al., 2005; Wechsler, 1991, 2003). The steps to calculate a WISC-III or WISC-IV GAI IQ and the GAI IQ tables can be found in the WISC-III Interpretation and Scoring Guide, and the WISC-IV Technical Report No. 4 (Prifitera et al., 1998; Raiford et al., 2005). The GAI procedure will be explained in more detail in the next section. Procedures for using the critical-value statistic and base-rate percentages can be found in the WISC-III and WISC-IV Administration and Scoring Manuals (Wechsler, 1991, 2003).

The critical-value represents the minimum between-IQ and between-index score differences needed for statistical significance ($p < .05$), and the base-rate percentage represents the percentage that the score difference occurred in the standardization sample, by age group (Wechsler, 1991, 2003). For example, given a WISC-III verbal IQ of 89, a performance IQ of 105, and a full scale IQ of 96 for an 11 year old child, the difference between the verbal IQ and the performance IQ is 16 points. In this instance, the critical-value statistic for the minimum score difference needed for statistical significance is 13 points, and the base-rate percentage is 11% (Wechsler, 1991). The base-rate of 11%

represents the percentage of same-age peers from the standardization sample that scored 16 points between verbal and performance IQs (Wechsler, 1991). If a base-rate percentage falls between 10% to 15%, and the score difference (e.g., 16 points) meets or exceeds the critical-value statistic, the difference is considered statistically significant ($p < .05$), and indicative of a cognitive processing deficit (Sattler, 2008; Wechsler 1991, 2003). In the example above, it is likely that the verbal IQ of 89 is indicative of a verbal-domain cognitive processing deficit of some kind (Prifitera et al., 19998; Saklofske et al., 2010; Sattler, 2008).

In the current study, WISC-III and WISC-IV full scale IQs were used to determine the presence of a severe discrepancy (AAD and GAI methods). The WISC-III and WISC-IV IQ and index scores were also used to determine the types and degree of cognitive processing deficits using critical-value statistics and base-rate percentages (Wechsler 1991, 2003). After the degree and types of cognitive processing deficits in the sample were identified and the SLD eligibility method was determined (AAD, GAI, no eligibility), the data were organized into the following four groups that are (1) SLD eligible using the AAD method, (2) SLD eligible using the GAI method, (3) SLD eligible using the AAD and GAI methods, and (4) not SLD eligible under either method. The following sections describe the specific procedures used for documenting SLD eligibility under these four groups.

SLD Eligible Using the GAI Method

The following procedure describes how an SLD is diagnosed with the GAI method. To calculate a GAI IQ, the WISC-III and WISC-IV full-scale IQs and reading, writing, and math test scores are compared to determine if a severe discrepancy is present (SLD Guide, 2011). When there are statistically significant differences ($p < .05$) between IQ and index scores, these full scale IQs are adjusted to GAI IQs. To determine when it is appropriate to use the GAI method, the differences between IQ and index scores are analyzed with the critical-value statistics and base-rate percentages (Tables B.1 and B.2 in the WISC-III and WISC-IV Administration and Scoring Manuals; Wechsler, 1991, 2003). These scores differences can occur between the WISC-III VIQ and PIQ, and the WISC-IV VCI, POI, WMI, or PSI (Prifitera et al., 1998; Raiford et al., 2005; Wechsler, 1991, 2003). If a score difference between the VIQ and PIQ of the WISC-III, or any combinations of the indices of the WISC-IV, meets critical-value and base-rate percentage criteria, it is appropriate to use the GAI method (Prifitera et al., 1998; Raiford et al., 2005). Once the GAI IQ is determined, it can be used with Washington's severe discrepancy tables in place of the regular full scale IQ (SLD Guide, 2011). It is important to use a GAI IQ when there are significant and unusual score differences between IQs and indices, because these differences will depress the full scale IQ and the student will be less likely to be diagnosed with an SLD (Raiford et al., 2005; Sattler, 2008). The GAI IQ tables are located in the WISC-III Scoring and Interpretation Guide (Prifitera et al., 1998) and the WISC-IV Technical Report No. 4 (Raiford et al., 2005).

SLD Eligible Using the AAD Method

The following procedure describes how an SLD is diagnosed with the AAD method. The WISC-III or WISC-IV full scale IQs, and test scores from the reading, math, and writing assessments, are used with the Washington's severe discrepancy tables

(SLD Guide, 2011). For example, a WISC-IV full scale IQ of 100 yields a severe discrepancy score of 82 (SLD Guide, 2011). AAD criteria is met if the student obtains a score of 82 or lower on the math, reading, or writing subtests of the WIAT-II or WJ-III.

SLD Eligible Using Both the AAD and GAI Methods

In the current study, the critical-value and base-rate procedures were used to examine the score differences between WISC-III and WISC-IV IQ and index scores (Prifitera et al., 1998; Raiford et al., 2005; Wechsler, 1991, 2003). If the critical-value and base-rate analyses did not result in statistically significant differences between IQ and index scores, the regular full scale IQs, academic tested scores, and the discrepancy tables were used to determine a severe discrepancy under the AAD method (SLD Guide, 2011).

If the critical-value and base-rate analysis showed statistically significant differences between IQ and index scores, a GAI IQ replaced the WISC-III and WISC-IV full scale IQs. The GAI IQs were then used with the academic test scores and the severe discrepancy tables to determine SLD eligibility under the GAI method (Prifitera et al., 1998; Raiford et al., 2005; SLD Guide, 2011).

Not SLD Eligible Under AAD or GAI Methods

An SLD will not be diagnosed (GAI or AAD methods) when WISC-III or WISC-IV full scale IQ or GAI IQ comparisons with academic testing data do not show a severe discrepancy, using Washington's severe discrepancy tables (SLD Guide, 2011). For example, if the full scale or GAI IQ is 100, Washington's discrepancy table shows a minimum academic standard score of 82 (SLD Guide, 2011). If the student has a reading, math, or writing score of 82 or lower, he or she can be diagnosed with an SLD. If the student has a reading, math, or writing score of 83 or higher, he or she cannot be diagnosed with an SLD under the AAD or GAI methods (IDEA, 2004; Prifitera et al., 1998; Raiford et al., 2005; Sattler, 2008; SLD Guide, 2011).

Grade Level When Tested and Chronological Age

The grade level when tested and the chronological age of tested students are noted on the testing protocols found in the archived records. Chronological age at the time of testing is required to determine which age-group from the test's sample will be used to compare the student's performance (Wechsler, 1991, 2003). The chronological age of a tested student was also used with the critical-value statistics and base-rate percentages procedures to determine the types of cognitive processing deficits (Prifitera et al., 2008; Raiford et al., 2005; Wechsler, 1991, 2003). The grade level when tested will be used as a predictor variable for the current study, and is found on the test protocols from the archived records. The grade level when tested variable has 13 levels and is coded as (1) Kindergarten, (2) first grade, (3) second grade, and so forth.

Degree of Cognitive Processing Deficit

The degree of cognitive processing deficit was collected by documenting the actual points between WISC-III verbal and performance IQ scores, and WISC-III and WISC-IV indices, such as 20 scale points between the VCI and PRI, or 15 points between the WMI and VCI. Critical-value statistics and base-rate percentages determine the statistical significance of these score differences (Wechsler, 1991, 2003).

Types of Cognitive Processing Deficits

The critical-value statistics and base-rate percentages were used to determine the types of cognitive processing deficits for the current study (Wechsler, 1991, 2003). Score differences between IQs and indices were analyzed using critical-value and base-rate procedures to establish the statistical significance ($p < .05$) of the difference in scores (Wechsler, 1991, 2003). For example, given a statistically significant difference between the VCI and the WMI, with the lower score belonging to the VCI, it can be concluded that a verbal comprehension deficit is present. Intellectual testing data for individuals represented in the sample was analyzed according to this procedure to identify the types of cognitive processing deficits in the sample. The types of cognitive processing deficits predictor variable has seven levels that are (1) WMI deficit, yes or no, (2) PSI deficit, yes or no, (3) VCI deficit, yes or no, (4) WMI and PSI deficits, yes or no, (5) WMI and VCI deficits, yes or no, (6) VCI and PSI deficits, yes or no, and (7) VCI, PSI, and WMI deficits, yes or no.

Data Analysis

The SPSS Version 21.0 software program was used to analyze the relationships among variables. Sample data for the study came from archived special education records of students tested for an SLD between the 1996/1997 to the 2012/2013 school years. A GLM analysis was used to find potentially significant relationships between the predictor and dependent variables. GLMs contain algorithms that can account for multiple variables with nonnormal distributions, and still produce reliable estimates of regression coefficients, beta, and *p* values (Hibel et al., 2010).

Data that represent the dependent variables, high school completion status and reading, math, and writing scores on the WASL and the HSPE, were analyzed according to the following procedures. The high school completion status variable was measured on a nominal scale because the answer to the research question requires a yes or no response. The variable levels were coded as (1) yes and (2) no (Jaccard & Becker, 2002).

The dependent variable, performance on the WASL or the HSPE (OSPI, 2009, 2010) was measured according to the following procedure. Reading, math, and writing scores were coded with a numerical system as follows: (1) pass the state standards assessment, (2) fail the state standards assessment, (3) pass the alternative state standards assessment, (4) fail the alternative state standards assessment. Reading, math, and writing scores were recorded as obtained by each student in the sample. This variable was measured on an ordinal scale because it is possible to obtain a score of absolute zero on these tests (Jaccard & Becker, 2002).

The dependent variable SLD eligibility was recorded after determining SLD eligibility under the AAD or GAI methods, as described in previous sections of this chapter. The SLD eligibility variable was coded into the following groups: (1) SLD eligible under the AAD method (yes or no), (2) SLD eligible under the GAI method (yes or no), (3) SLD eligible under both diagnostic methods (yes or no), and (4) not SLD eligible under either method (yes or no). This variable has four levels and was measured on a nominal level because a yes or no response is required (Jaccard & Becker, 2002).

The predictor variable, types of cognitive processing deficits, was analyzed using critical-value statistics and base-rate percentage procedures to determine the statistical significance and rate of occurrence for specific score differences between IQ and index scores (Prifitera et al., 1998; Raiford et al., 2005; Wechsler, 1991, 2003). Tables B.1 and B.2 in the WISC-III and WISC-IV Administration and Scoring Manuals provide the information for determining the statistical significance of the IQ and index score differences (Wechsler, 1991, 2003). For example, if a score difference between WISC-III and WISC-IV IQ and index scores was statistically significant ($p < .05$) and occurred in less that 15% of the sample by age group, the lower IQ or index score would identify the type of cognitive processing deficit (Prifitera et al., 1991; Raiford et al., 2005; Sattler, 2008). Given a WISC-IV VIQ of 80 and a PIQ of 100, the 20-point difference would be statistically significant ($p < .05$). If the difference occurred in less than 15% of the sample by age, the lower VIQ score would represent a verbal comprehension processing deficit (Raiford et al., 2005; Sattler, 2008; Wechsler, 2003). The types of cognitive processing deficits variable has four levels and was coded as follows: (1) verbal comprehension deficit (yes or no), (2) working memory deficit (yes or no), (3) processing speed deficit (yes or no), and (4) one or more cognitive processing deficit (yes or no). The types of cognitive processing deficits variable was analyzed on a nominal scale of measurement because the types of cognitive processing deficits are not determined by the rank order of data, and the data do not represent equidistant points between scale elements (Jaccard & Becker, 2002).

The predictor variable, SLD eligibility under the GAI method, was determined by identifying IQ and index score differences and then using the critical-value and base-rate procedures (Wechsler, 1991, 2003). If the IQ or index score differences met criteria for statistical significance and occurred in less than 15% of the IQ test's sample (by age), then the regular full scale IQ were converted to a GAI IQ. Then, the GAI IQ was used with academic test scores to determine a severe discrepancy using the discrepancy tables (SLD Guide, 2011; Wechsler, 1991, 2003). Students represent in the sample were grouped into two categories that were: (1) SLD eligible under the GAI method, and (2) Not SLD eligible under the GAI method. This variable has two levels and was measured on a nominal scale (Jaccard & Becker, 2002).

The predictor variable, degree of cognitive processing deficit, was determined by recording the actual score differences between WISC-III and WISC-IV IQ and index scores, such as the difference between the WISC-III VIQ and PIQ, and between the VCI, POI, FDI/WMI, or PSI (Prifitera et al., 1998; Raiford et al., 2005; Wechsler, 1991, 2003). This variable was measured on an ordinal scale, because the score differences between IQ and index scores represent the severity (degree) of the cognitive processing deficit (Jaccard & Becker, 2002). The degree of cognitive processing deficit has six levels and was coded as: (1) VIQ/PIQ difference, (2) VCI/POI difference, (3) VCI/WMI (FDI) difference, (4) VCI/PSI difference, (5) POI/WMI (FDI) difference, and (6) POI/PSI difference. Score differences were recorded as they actually occurred, and a score of zero was recorded in cases where no differences were detected.

The predictor variable, grade level when tested for a SLD, was obtained from the testing protocols located in the archived special education records. The grade level when tested for an SLD variable was gathered from the selected archived records for all students represented in the sample. This predictor variable was measured on an ordinal scale because the grade levels indicate the order of appearance of the information that is being analyzed (Jaccard & Becker, 2002). The grade level when tested variable was coded as: (1) Kindergarten, (2) Grade 1, (3) Grade 2, (4) Grade 3, (5) Grade 4, and so forth. This variable has 13 levels representing the Kindergarten through 12^{th} grades.

Instrumentation: State Standards Assessments, IQ, and Academic Tests

The WASL and the HSPE (OSPI, 2009, 2010) are criterion-referenced tests based on the Essential Academic Learning Requirements established by Washington state's education agency (OSPI 2009, 2010). Each grade has a set of academic achievement expectations. The WASL and the HSPE measure student performance against these state established learning standards (OSPI, 2009, 2010).

The process for administering the WASL and the HSPE is explained in detail on the website of the Office of the Superintendent of Public Instruction (OSPI, 2009, 2010). Test administration procedures are controlled to the extent possible to ensure maximum testing consistency and to safeguard test materials. Tests are administered in classrooms and are proctored by the classroom teacher. Tests are given over a period of several weeks and additional time is allowed for test make-up sessions (OSPI, 2009, 2010).

The tests are to be administered in a uniform fashion (OSPI, 2009, 2010). For example, each 10th grade class will read the same directions for the test, and will begin and end the reading section test at the same day and time. Following the prescribed testing window, test booklets are sent to Washington's Office of the Superintendent of Public Instruction to be scored. The reading, math, and science tests have a minimum passing score of 400 (OSPI, 2009, 2010). The writing test has a minimum passing score of 17 (OSPI, 2009, 2010). After scoring, test results are available to school districts via a database, and paper copies are placed in student cumulative records.

Information about the validity and reliability of the WASL and the HSPE can be found on the state education agency's website. The Assessment Division of the state education agency recently published a report entitled Washington Comprehensive Assessment Program Technical Report (OSPI, 2011). According to this report, test questions for the WASL and the HSPE are designed to evaluate student mastery of state established grade level standards (OSPI, 2011). The report differentiates between norm-referenced tests and criterion-referenced tests, stating that the WASL and the HSPE are examples of well-designed criterion-referenced tests. The report contains information about the statistical procedures used to ensure that (1) test items are aligned with state established grade level standards, and that (2) test items meet a high level of freedom from gender and ethnicity bias (OSPI, 2011). The report indicates that the WASL, the HSPE, and the Measurement of Student Progress (state standards test used for Grades 3 to 8) have adequate reliability and validity:

> The tests and content strands are reliable measures of the constructs with reasonable measurement error. The alpha coefficients for overall tests and by content strands reveal acceptable levels of internal consistency and the standard errors of measurement are sufficiently large to warrant judicious interpretation for some groups or score types when evaluating test scores and making decisions about individual student scores. The scoring of constructed-response items by raters is sufficiently reliable. Inter-rater data indicate that scorers applied

> consistent scoring standards defined by the scoring rubrics. The decisions and inferences made about the students are defendable with decision accuracy indices around the critical cut point for all tests, ranging from 0.85 to 0.93 and corresponding decision consistency indices in the 0.79 to 0.91 range (p. 137).

The report further notes that these tests are continually evaluated by the Assessment Division to ensure quality of content related to state grade level standards (OSPI, 2011).

The WISC-III and WISC-IV are individually administered IQ tests commonly used in public school and private office settings to diagnose SLDs (Sattler, 2008; Wechsler, 1991, 2003). The WISC-III and WISC-IV are well-researched intellectual tests with good reliability for subtests scores, IQ scores, index scores, and the full scale IQs (Sattler, 2008; Wechsler, 1991, 2003). Reliability coefficients range between .88 for the to .97 for the full scale IQs (Wechsler, 1991, 2003). To administer a test, the examiner and examinee occupy a quiet room for the test administration, which takes approximately two hours. The student's raw test scores are compared to those of same-age peers from the test's standardization sample, which shows the standardized IQ and index scores. The WISC-III provides seven scores and the WISC-IV produces five scores. For the WISC-III these are the VIQ, the PIQ, the full-scale IQ, the VCI, the PRI, the FDI (WMI), and the PSI (Wechsler, 1991). For the WISC-IV these are the full scale IQ, the VCI, the PRI, the WMI, and the PSI (Wechsler, 2003). For the current study, the full scale IQ and index scores were not part of the data analysis, but were used to derive predictor and dependent variables.

The WIAT-II and the WJ-III produce standard scores for reading, writing, and math subtests (Sattler, 2008; Wechsler, 2001; Woodcock et al., 2001, 2007). The WIAT-II and WJ-III are norm-referenced academic tests that are individually administered to students (Sattler, 2008; Wechsler, 2001; Woodcock et al., 2001, 2007). The reading, writing, and math subtest standard scores from the WJ-III and the WIAT-II were used to diagnose SLDs with the AAD and GAI methods. These academic subtest scores were not otherwise analyzed in this study.

Threats to Validity

According to Zaccai (2004), the internal validity of a study refers to the data collection process and any errors in the gathering and coding of sample data. The external validity of a study refers to the generalizability of study results. For the current study, data were collected using the criterion sampling method (Jupp, 2006). The criterion sampling method is a method of gathering sample data based on one or more shared characteristic, as opposed to a random sampling method (Jupp, 2006; Palys, 2008). For the current study, the common characteristic shared by all students represented in the sample was that of having been tested for an SLD between the 1996/1997 to the 2012/2013 school years. Sample data were gathered from archived special education records from a local school district. This type of data collection process presents a low level of threat to internal validity. The sample share the common characteristic of having been tested for an SLD with the WISC-III or the WISC-IV intellectual tests, and the same data were collected from all archived records. Significant findings resulting from the study will not be generalizable to all K – 12 students, however the results from the study will generalizable to all students who struggle with some aspect of learning, and who are referred for SLD testing.

Zaccai (2004) refers to bias as a number of systematic errors that may distort the results of the study, such as selection bias and information bias. According to Sackett (1979, as cited by Zaccai, 2004), selection bias refers to errors in the selection of participants who are included and not included in the study. Selection bias may be a threat to the validity of this study because of the problems associated with the AAD (and the RTI) methods of diagnosing SLDs. Neither method can recognize cognitive processing deficits during SLD evaluations, and the AAD method often misdiagnoses students with learning disabilities (Berninger, 2006; Dombrowski et al., 2006; LDA White Paper, 2010; Naglieri et al., 2005; Paul, 2010). Therefore, some students in the sample were likely diagnosed with an SLD but did not show any cognitive processing deficits. Despite these potential threats to validity, the sampling and data collection processes used in the study may mitigate selection bias to some degree. The process of using the GAI method and identifying cognitive processing deficits in the sample will distinguish students with cognitive processing from those without cognitive processing deficits. For example, study results may show that some students in the sample who were previously diagnosed with an SLD do not have cognitive processing deficits. And, study results may show that a number of students in the sample who were not diagnosed with an SLD may be eligible when the GAI method is applied to IQ and index scores.

Information bias refers to errors that are made when sample data are misclassified or are unequal in some way (Sackett 1979, as cited by Zaccai, 2004). Information bias occurs most often in studies where human subjects are used, a treatment condition is applied, or there are differences in the application of treatment conditions for the control and treatment groups. For the current study, the threat of information bias is low because human subjects were not involved in the data collection or data analysis processes.

Ethical Procedures

The Walden Institutional Review Board (IRB) approved the current study's proposal on April 8, 2013. The IRB approval number is 04-08-13-0099879. The data collection process began after receiving IRB approval. For the current study, data from archived special education records and school district databases were collected. This type of research represents a low level of risk to the students represented in the sample. Individual students were not contacted for the study. High school completion data and test scores on the reading, math, and writing sections of the WASL and the HSPE were located in secured school district databases. Archived special education records were stored in a secure location at the school district's administration office. Archived special education records were reviewed to determine if they contained SLD testing data from the 1996/1997 through the 2012/2013 school years. Records selected for the sample contained IQ and index scores from WISC-III or WISC-IV test administrations, test protocols with the student's chronological age and grade level at the time of testing, and reading, writing, and math scores from the WIAT-II or WJ-III. Datasets from the archived records were coded with a numbering system, and the number codes were stored on a thumb drive dedicated for the data collection process. The thumb drive was kept in a secure, locked location in the school district administration offices until the data collection process was completed. No personal identifying information such as name, age, gender, address, phone number, or other identifiers were used in the storage or processing of the data.

Summary

This study used the criterion sampling method to select students represented in the sample. The selection criteria were confined to students who were tested for an SLD with the WISC-III or WISC-IV intelligence tests from the 1996/1997 to 2012/2013 school years. This quantitative study sampled 149 datasets from archived special education records of the selected students. All data were analyzed using SPSS Version 21.0 software program. A multivariate, nonexperimental design was used to organize and analyze the collected data. The predictor variables for the study were the grade level when tested for an SLD, the degree and types of cognitive processing deficits, and SLD eligibility under the GAI method. The dependent variables were high school completion status, performance on Washington's state standards assessments, and SLD eligibility.

Following the introduction section, Chapter 4 begins with an explanation of how the actual variable coding process differed from what was proposed in Chapter 3. The demographics of the population from which the sample was derived are presented, along with demographics of Washington state's K – 12 population for comparison. Next, the results of the statistical analyses will be explained, including the descriptive statistics, assumptions related to sample distributions, probability values, confidence intervals, and effect sizes. Tables displaying study results are included in the Results section and organized by each research question. Chapter 4 will conclude with a summary of the analysis results pertinent to each research question, and a transition to Chapter 5.

Chapter 4: Results

Introduction

The purpose of this quantitative study was to investigate the GAI method as a viable alternative to the AAD method of diagnosing SLDs. The GAI method can identify cognitive processing deficits during the SLD evaluation process and can be used with SLD discrepancy tables to determine SLD eligibility (Prifitera et al., 1998; Raiford et al., 2005; SLD Guide, 2011). An additional goal of this study was to determine if cognitive processing deficits can predict high school completion status, SLD eligibility, and performance on state standards assessments.

There are three research questions for the current study, and each predictor and dependent variable has two or more levels. The research questions determined if the predictor variables (the student's grade level when tested for an SLD, the degree and types of cognitive processing deficits, and SLD eligibility under the GAI method) predicted the dependent variables (high school completion, performance on state standards assessments, and SLD eligibility). The null hypotheses are that the student's grade level when tested, the degree and types of cognitive processing deficits, and SLD eligibility do not predict high school completion status, performance on state standards assessments, and SLD eligibility.

IDEA (2004) is the disability rights law where the procedures for diagnosing SLDs are outlined (IDEA, 2004; LDA White Paper, 2010). A definition of learning disabilities is embedded in the legislation: Learning disabilities come from deficits in one or more basic cognitive processing functions (IDEA, 2004). However, the AAD and RTI diagnostic methods outlined in IDEA (2004) do not recognize cognitive processing deficits (IDEA, 2004). Many current research studies support the view that SLDs are the result of specific cognitive processing deficits (LDA White Paper, 2010; McGrew, 2003; Newton & McGrew, 2010; Naglieri et al., 2005; Proctor & Prevatt, 2003). While many professionals agree that the identification of cognitive processing deficits must become part of SLD evaluations, there is little professional agreement about how to do this (Berninger, 2006; LDA White Paper, 2010; Naglieri et al., 2005; Newton & McGrew, 2010; Paul, 2010).

In Chapter 4, I will describe the data collection process and time frame and explain the how the data collection and coding processes differed from what was proposed in Chapter 3. A description of the sample, obtained from archived special education records, comes next, followed by a review of the school district and state demographics of K-12 students. In the next section of Chapter 4, I will report the descriptive statistics that describe the sample, the results of the statistical analyses, and discuss how these findings relate to each research question and hypothesis. The data presentations will include tables that display frequency and descriptive statistics and that highlight the findings of the statistical analyses. Chapter 4 will conclude with a transition to Chapter 5.

Data Collection

The data collection process began the last week of April 2013 and was completed the last week of June 2013. A G*Power effect size analysis (University of Düsseldorf, 2012) resulted in a recommended $N = 129$ for this study. I chose to expand the recommended sample size to $N = 150$ to improve effect size results from the analyses. The actual number of datasets collected was $N = 149$. The data collection process took 9 weeks to complete due to my work schedule, availability of school district personnel, and the need to file an IRB Request for Change in Procedures form. The Request for Change in Procedures form is addressed in more detail in the following section.

Data for the current study were collected from archived special education records from the school district located in the northeast part of Washington state. Data were collected from the records of students who were tested for an SLD at some point in their school careers and who were of high school completion age by the end of the 2012/2013 school year. It should be noted that the data reflecting high school completion status may have been affected by students who were of the age to complete high school by the end of the 2012/2013 school year but were taking longer to complete high school requirements, who may have dropped out of school, or who may have been held back a grade in elementary school.

Archived records selected for this study contained sufficient information to meet study criteria. The study criteria included WISC-III or WISC-IV IQ, index and subtest scores, academic test scores from the WIAT-II or WJ-III, the student's grade level and chronological age when tested for an SLD, and whether or not the student was diagnosed with an SLD under the AAD method. Data for the dependent variable SLD eligibility were obtained from WISC-III and WISC-IV test scores, and scores from norm-referenced academic skills tests. Data for this variable were used to diagnose SLDs under the AAD and GAI methods from the IQ, subtest, and index scores, the academic test scores, and Washington's discrepancy tables (SLD Guide, 2011).

The WISC-III and WISC-IV IQ and index scores were used to adjust full scale IQs when there were significant and unusual score difference between indices or between IQ scores (Prifitera et al., 1998; Raiford et al., 2005). Once a full scale IQ was adjusted, the GAI IQ was used with Washington's discrepancy tables to determine SLD eligibility (Prifitera et al., 1998; Raiford et al., 2005; SLD Guide, 2011). Data for the dependent variables, high school completion status and test scores on Washington's state standards assessments, were obtained from the school district database containing high school completion data and reading, math, and writing test scores from the WASL and the HSPE (OSPI, 2009, 2010).

Data for the predictor variable, grade level when tested, were obtained from intellectual and academic test protocols found in the archived records. The predictor variables, SLD eligibility under the GAI method and the degree and types of cognitive processing deficits, were gathered by documenting the score differences between WISC-III and or WISC-IV IQ and index scores, and determining whether the score difference met critical-value and base-rate percentage criteria (Wechsler, 1991, 2003).

SLD eligibility under the GAI method variable was calculated by using critical-value and base-rate procedures with IQ and index score differences to determine statistically significance ($p < .05$; Wechsler, 1991, 2003). If the IQ and index score differences met critical-value and base-rate criteria, the full scale IQ was replaced with a GAI IQ and used with Washington's discrepancy tables (Prifitera et al., 1998; Raiford et al., 2005; SLD Guide, 2011). If the WIAT-II or WJ-III academic scores fell at or below the criterion score associated with the GAI IQ, the student was determined SLD eligible under the GAI method.

Data for the predictor variables, degree, and types of cognitive processing deficits, were calculated by using critical-value and base-rate procedures with IQ and index score differences to determine statistical significance ($p < .05$; Wechsler, 1991, 2003). Critical-value and base-rate procedures are used with the GAI diagnostic method when a significant and unusual discrepancy between IQs and or index scores occurs (Prifitera et al., 1998; Raiford et al., 2005). If the score difference was statistically significant (critical-value = $p < .05$) and occurred in 10% or less of the sample for that age group (base-rate), the GAI method could then be applied to obtain a GAI IQ (Prifitera et al., 1998; Raiford et al., 2005; Wechsler, 1991, 2003).

Cognitive processing deficits are also identified by comparing IQ and index score differences using the critical-value and base-rate procedures (Wechsler, 1991, 2003). When there is a significant and unusual score difference, based on critical-value and base-rate procedures, the lower score is representative of a cognitive processing deficit (Raiford et al., 2005; Saklofske et al., 2010; Sattler, 2008; Wechsler, 1991, 2003). For example, if a student obtained a low score on the VCI index in comparison to his or her other indexes, and the critical-value and base-rate procedures showed score the difference was significant, a verbal comprehension processing deficit would be indicated (Wechsler, 1991, 2003).

Data Collection Discrepancies

During the data collection process, the researcher found that many of the selected archived records contained only administrations of the WISC-III rather than the WISC-IV. Students who were tested for an SLD prior to 2003, the year the WISC-IV was published, would have been tested with the WISC-III. Limiting the data collection to just WISC-IV IQ and index scores would have resulted in a smaller *N*, because the selection criteria for the sample spanned the years 1996/1997 to 2012/2013. Therefore, I determined that IQ and index scores from the WISC-III would need to be included in the study data to maintain the *N* for the study.

Experts agree that the WISC-III and WISC-IV tests measure similar cognitive constructs, and that both tests provide results that can be meaningfully interpreted (Allen et al., 2010; Raiford et al., 2005; Wechsler, 1991, 2003). Allen et al. (2010) reported that the WISC-III and WISC-IV tests retained the essential constructs and factors identified in earlier versions of the Wechsler tests. Raiford et al. (2005, p. 3) stated that the "WISC-IV provides a full scale IQ score and a four-index framework similar to that of the WISC-III…based on theory and supported by clinical research and factor-analytic results". Based on these findings, and because the WISC-III and the WISC-IV have their own GAI methods, I determined it was appropriate to include WISC-III IQ and index scores in the sample data.

Evidence of a third cognitive processing deficit emerged during the data collection process. Many verbal IQ (VIQ) and verbal comprehension index (VCI) scores from the archived records were low, when compared to the other IQ and index scores.

The low VIQ and VCI scores indicated that verbal comprehension deficits were more common in the sample than anticipated. Verbal comprehension processing deficits are often found in reading and language disorders, and are evidenced by low WISC-III and WISC-IV VIQ or VCI scores (Flanagan et al., 2010; National Institute of Health, 2010; Newton & McGrew, 2010; Sattler, 2008). Thus, I determined it was appropriate to add the verbal comprehension processing deficit to the sample data. The decision to add WISC-III IQ and index scores, and the verbal comprehension processing deficit to the study required filing a Request to Change Procedures form with Walden's IRB (see Appendix A).

Differences between the data collection and coding methods described in Chapter 3, and the actual collection and coding methods, are presented in the next section of this chapter. In Chapter 3, data for the dependent variable high school completion status were to be gathered according to the following procedure. High school completion data would be collected for each archived record by perusing school district databases. High school completion status was to be coded with a yes or no response, and was to have had two levels. However, examination of the database revealed a third high school completion condition, the Certificate of Individual Achievement (CIA; OSPI, 2011). The CIA is a high school completion certificate for students with educational disabilities who cannot meet the academic requirements for a high school diploma (OSPI, 2011).

Students who complete high school with a CIA will have individual education plans (IEPs) or accommodation plans (IDEA, 2004; Section 504, 1973). Due to educational disabilities, these students have difficulty demonstrating grade level performance in one or more basic academic skills, and will have great difficulty passing the reading, math, and writing sections of the WASL or the HSPE(OSPI, 2009, 2010).

Passing the WASL or the HSPE is required to earn a high school diploma (OSPI, 2009, 2010). Students with IEPs or Section 504 plans can take a lower grade level version of the state standards assessment, such as the fourth or fifth grade levels of the tests (IDEA, 2004; OSPI, 2011; Section 504). If the student earns a passing score on these lower level tests, the student is eligible to receive a CIA (OSPI, 2011). For example, a student with dyslexia may never learn to read well enough to pass the HSPE, however the student may be able to pass the fourth grade level of the reading test. While this student could not pass the high school version of the test and thus receive a high school diploma, the student would be awarded a CIA (OSPI, 2011). .

Review of the archived records showed that many students in the sample completed high school with a CIA. Therefore, the CIA option was added as a variable level to the high school completion variable. The high school completion variable data were collected and coded with three levels that are: (1) completed high school with a diploma (met minimum skill requirements and standards as required by Washington state), (2) failed to complete high school, and (3) completed high school with a CIA (OSPI, 2011).

In Chapter 3, the proposed data collection and coding process for the variable performance on Washington's state standards assessments included collecting test scores from a district database and coding the scores into three variables. These three variables were to reflect actual scores from the reading, math, and writing sections of the state standards tests. This dependent variable was to have had three levels. However, the data collection process showed that each grade level of the state standards tests used the same test scores. For example, the passing score for the Grade 4 reading test is 400, and the passing score for the Grade 10 reading test is also 400 (OSPI, 2009, 2010). Therefore, using actual test scores would not distinguish which level of the test was taken, such as the fifth grade level or the high school level. The analysis of the variable, student performance on state standards assessments, needed to include the level of the test taken by each student in the sample.

The actual data collection and coding process for the state standards assessment variable resulted in three variables, each with multiple levels. There is one variable each for the reading, math, and writing tests, and each variable was coded with four levels in order to distinguish the level of the state standards test that was taken. Each variable has levels that indicate if the student passed or failed the regular (Grade 10) state standards tests, or if the student passed or failed the below grade level (alternative test) state standards tests. The reading and math tests use the same scoring system, so the variable levels for the reading and math tests were coded with the following score groupings: (1) 0 to 399 - fail Grade 10 reading/math test, (2) 400 to 525 - pass Grade 10 reading/math test, (3) 0 to 399 - fail alternative reading/math test, and (4) 400 to 525 - pass alternative reading/math test. The state standards writing test uses a different scoring scale, so the writing variable levels were coded as follows: (1) 0 to 16 - fail Grade 10 writing test, (2) 17 to 26 - pass Grade 10 writing test, (3) 0 to 16 - fail alternative writing test, and (4) 17 to 26 - pass alternative writing test.

In Chapter 3, the data collection and coding processes for the third dependent variable, SLD eligibility, were to be gathered according to the following procedures. WISC-III and WISC-IV full scale IQ and index scores, and reading, math, and writing scores from the WIAT-II or WJ-III were collected to establish SLD eligibility for the AAD and the GAI diagnostic methods. The SLD eligibility variable was to have been divided into four levels which were: (1) SLD eligible using the AAD method, (2) SLD eligible using the GAI method, (3) SLD eligible with both diagnostic methods, and (4) no SLD eligibility under either method.

The collection process for the SLD eligibility variable did not differ from what was proposed in Chapter 3, however the number of cases for the first level, SLD eligible with the AAD method, was quite small (n = 3). The small number of cases would have skewed the statistical analysis, and the SPSS Version 21.0 does not process fewer than five cases for a given dataset. Therefore, the three case for the eligible with the AAD method variable level were absorbed into a new variable level, entitled SLD eligible under the AAD and GAI methods. The actual levels for the SLD eligibility variable were coded as: (1) SLD eligible under the AAD and GAI diagnostic methods, (2) SLD eligible under the GAI method, and (3) not eligible under either method.

The data collection process for the predictor variable, grade level when tested, was the same as described in Chapter 3. This variable was to be coded into 13 levels, with each level representing one grade from Kindergarten to Grade 12. Because there were two few cases for several cells, the grade levels were grouped into separate categories to increase the *n* for each grouping. These groupings are (1) Kindergarten to Grade 3, (2) Grade 4 to Grade 7, and (3) Grade 8 to Grade 12.

The predictor variable data, SLD eligibility under the GAI method, were collected as described in Chapter 3. As stated in Chapter 3, this variable was coded into two levels: (1) SLD eligible under the GAI method, and (2) not SLD eligible under the GAI method.

In Chapter 3, the data for the predictor variable, degree of cognitive processing deficit, were to be collected by documenting the actual scale points between WISC-III and WISC-IV IQs and indices, such as 20 scale points between the VCI and PRI, and so forth. The degree of cognitive processing deficit was to have been coded by recording the actual scale points between IQ and index scores, however this process resulted in many datasets with too few cases. Given this problem, the actual coding of this variable resulted in four levels of grouped data with a range of scale point differences. These levels are: (1) 1 to 10 points, (2) 11 to 22 points, (3) 22 to 33 points, and (4) 34 to 54 points.

In Chapter 3, data for the types of cognitive processing deficits was to be gathered according to the following procedures. The critical-value and base-rate procedures were used to establish the statistical significance ($p < .05$) of the score differences between WISC-III and WISC-IV IQ and index scores (Wechsler, 1991, 2003). The types of cognitive processing deficits was to have been coded into seven levels, however preliminary data coding efforts showed that the WMI/PSI, WMI/VCI, and the VCI/PSI cognitive processing deficit combinations did not contain enough cases to run the analysis. To remedy this problem, the WMI/PSI, WMI/VCI, and the VCI/PSI cognitive processing deficits were grouped into one level. The regrouped types of cognitive processing deficit variable was coded into five levels that are: (1) WMI deficits, (2) PSI deficits, (3) VCI deficits, (4) Combined type of deficits (i.e., a combination of WMI, PSI, or VCI deficits), and (5) no cognitive processing deficit.

Description of the Sample

The sample for this study was selected from a semi-rural school district located in the northeast part of Washington state. The sample consisted of 149 datasets obtained from archived special education records. The sample was drawn from the population of students who were tested for an SLD between the 1996/1997 to 2012/2013 school years, and who were of age to complete high school by the end of the 2012/2013 school year.

Demographic data for the school district and for the state-wide school populations were compared (Table 1). Comparison of these two groups showed that many ethnic minority categories were of similar sizes. For example, American Indian/Alaskan Natives are represented in 1% to 2%, respectively, of the school district and state-wide school populations (OSPI, 2011). However, the school district has 20% more white students than the state-wide school population. Additionally, the school district population contains fewer Black/African American, Asian/Pacific Islander, and Hispanic students than are shown in the state-wide school population (OSPI, 2012). While there are some dissimilarities between the two population distributions, the differences are not viewed as so large that study results could not be generalized to the state-wide population.

Table 1

School District and State-wide Demographics for K – 12 Students

Ethnic group	District %	State wide %
White	79	59
Hispanic	9	20
Two or More Races	7	6
Asian/Pacific Islander	2	8
Black/African American	1	5
American Indian/Alaskan Native	1	2

Because low academic achievement is the main referral criteria for SLD testing, SLD students share the common characteristic of low academic achievement in reading, writing, and or math, regardless of race, ethnicity, or socio-economic status (IDEA, 2004; Sattler, 2008). Thus, study results can be generalized to students who have problems learning one or more basic academic skill and who may be referred for SLD testing (IDEA, 2004).

Results

Descriptive Statistics

Descriptive statistics were calculated for the study's ordinal variables, which are the three levels of the dependent variable, performance on state standards assessments (Table 2). The variable levels are the reading, math, and writing conditions. The median for the reading and math variables (*Mdn* = 3.00) refers to students in the sample who took the lower grade level of the WASL or HSPE. The median statistic of 3.00 indicates that most of the sample did not pass the reading and math assessments. The median for the writing variable (*Mdn* = 2.00) refers to students who took regular version of the state standards writing assessment, indicating that most students in the sample passed the regular writing standards assessment.

Table 2

Median and Standard Deviations for the Performance on State Standards Assessments

Tests	*Mdn*	*SD*
Reading Scores	3.00	1.09
Math Scores	3.00	1.18
Writing scores	2.00	.90

The frequency and percent for the predictor variables were calculated (Table 3). As shown in Table 3, very few students represented in the sample were tested for an SLD in Grades 8 to 12, and most students in the sample were tested for an SLD between Kindergarten and Grade 5. According to these statistics, most of the sample has a cognitive processing deficit of some kind, and over half of the sample was eligible for an SLD under the GAI method.

Table 3

Frequency and Percent of the Predictor Variables

Predictor variables	*n*	%
Grade level when tested		
K – 3rd Grade	79	53
4th – 7th Grade	54	36
8th – 12th Grade	16	11
Type of CPD*		
Working Memory	21	14
Processing Speed	14	9
Verbal Comprehension	28	19
Combined CPD	25	17
No CPD	61	41
Degree of CPD		
Significant	88	59
Nonsignificant	61	41
SLD eligible with the GAI		
Yes	89	60
No	60	40

Note. **CPD = Cognitive Processing Deficit*

Frequency rates for the dependent variables, high school completion and SLD eligibility, were calculated (Table 4). Only 12 students from the sample earned a high school diploma. Most students in the sample received a CIA. Less than one half of the students in the sample did not complete high school (42%). This percentage may include students who dropped out of high school, or who were taking longer to complete high school requirements.

Thirty-seven percent of students in the sample were not eligible for an SLD under either the AAD or GAI diagnostic categories. Being ineligible for an SLD may have occurred for several reasons. Some students in the sample may have been misdiagnosed, a frequent problem with the AAD method (Berninger, 2006; Dombrowski et al., 2006;

Flanagan et al., 2010). Some students may have been tested for an SLD, failed to qualify under the AAD method, and the evaluation group determined they were SLD eligible under the *professional judgment* process (IDEA, 2004). The *professional judgment* process is permitted in special education regulations. The professional judgment process may be used when the evaluation group reaches a collective decision that the testing data does not represent the student's overall academic performance, and the evaluation group is able to document the reasons for using the professional judgment option (IDEA, 2004; OSPI, 2011).

Table 4

Frequency and Percent of the Dependent Variables

Dependent variables	*n*	%
High school completion status		
Diploma	12	8
CIA	74	50
Did not complete	63	42
SLD eligibility		
AAD and GAI	77	52
GAI	17	11
Neither AAD or GAI	55	37

Frequency rates were calculated for the performance on state standards assessment variable (Table 5). In the state of Washington, all students must pass the WASL or the HSPE to earn a high school diploma (OSPI, 2011). Students who have IEPs or Section 504 plans (IDEA, 2004; Section 504, 1973) may be allowed to take a lower grade level of the state standards test, based on what is documented in the IEP or Section 504 plan (IDEA, 2004; Section 504, 1973). Students who take an alternative, lower grade level version of the test can obtain a CIA, but not a high school diploma.

Over one half of the sample took an alternative, lower grade level version of the reading and math tests, while just under one half took the alternative, lower grade level version of the writing assessment.

Table 5

Frequency and Percent of State Standards Assessments

State standards subtest scores	*n*	%
Reading test scores		
Fail Grade 10, 225 – 399	27	18
Pass Grade 10, 400 – 525	25	17
Fail Alt.* Test, 225 – 399	61	41
Pass Alt. Test, 400 – 525	36	24
Math test scores		
Fail Grade 10, 225 – 399	43	29
Pass Grade 10, 400 – 525	12	8
Fail Alt. Test, 225 – 399	58	39
Pass Alt. Test, 400 – 525	36	24
Writing test scores		
Fail Grade 10, 0-16	45	30
Pass Grade 10, 17-24	39	26
Fail Alt. Test, 0-16	65	44

Note. *Alt. = Alternative, lower grade level version of the state standards assessment.

Statistical Assumptions

To answer the research questions, I used a GLM analysis with the SPSS Version 21.0 statistical software program. A GLM analysis was selected for the current study because the sample data are not normally distributed and there are multiple dependent and predictor variables (Ballinger, 2004; Green & Salkind, 2008; Littell et al., 2002; Quinn & Keough, 2001). GLMs have the statistical capability to examine the main effects of each predictor variable on the dependent variables, and still produce reliable parameter estimates and *p* values (Littell et al., 2002).

A Kendall's tau-*b* correlation coefficient was used to compute a correlational analysis for the study's predictor variables. Kendall's tau-*b* is the appropriate correlation coefficient to use when determining the strength of association for categorical variables (SAS Institute, Inc., 1999). Multicollinearity is the term used to describe high correlations among predictor variables, which can skew the results of the statistical analysis if not addressed (Green & Salkind, 2008; Hill & Lewicki, 2007). The results of the Kendall's tau-*b* correlation analysis showed that the predictor variables, degree of cognitive processing deficit and type of cognitive processing deficit, were strongly correlated, τ_b (6) = -.510, p = .000. Based on these results, the variable, degree of cognitive processing deficit, was eliminated from the analysis because of multicollinearity with the type of cognitive processing deficit variable. The degree of cognitive processing deficit variable was excluded from the analysis for several reasons. Preliminary analyses with the degree of cognitive processing deficit variable resulted in data analysis warnings. However, these warnings did not occur when the degree of cognitive processing deficits variable was excluded from the analysis.

Statistical Analyses Findings

In a GLM analysis, the omnibus model test produces statistics that show how well the chosen model tests the null hypothesis (George & Mallery, 2008; Scheremellah-Engel, Moosbruger, & Muller, 2003). If the omnibus test is significant ($p < .05$), the null hypothesis can be rejected (Green & Salkind, 2008; Tabachnik & Fidell, 2001). Omnibus test results that meet or exceed the set alpha level indicate that the selected model has identified statistically significant differences between the dependent and predictor variables, when controlling for the predictor variables (George & Mallery 2008). In other words, the model test calculates the relationships between the dependent and predictor variables, but does not calculate the relationships between the dependent variable and the levels of the predictor variables (Green & Salkind, 2008).

The nature of the dependent variable helps determine which distribution and measurement scale should be selected for the analysis (Green & Salkind, 2008). In this study, the dependent variables have more than two levels, are measured on a nominal scale, and the variable distributions are not normal. Therefore, I selected the multinomial distribution with a cumulative logit link function model as the best fit to analyze the dependent variables (George & Mallery, 2013; Green & Salkind, 2008; Tabachnik & Fidell, 2001).

In the SPSS Version 21.0's GLM analysis, the researcher can select the estimation of the population variability method, also called the scale parameter estimation method (Tabachnick & Fidell, 2001). In the SPSS Version 21.0, the scale parameter estimation methods are the maximum-likelihood method and the Pearson and Deviance methods (Tabachnick & Fidell, 2001). The maximum-likelihood method estimates the population variability *with* the model effect statistics, while the Pearson and Deviance methods estimate the population variability *from* the model effect statistics (George & Mallery, 2013; Tabachnick & Fidell, 2001). According to George and Mallery (2013), the Pearson chi-square statistic method of parameter estimation should be selected when using the multinomial distribution model in order to obtain the most error free results. This is because the Pearson chi-square method compares the observations from each dataset in the sample with the outcome predicted by the model (George & Mallery, 2013).

In a GLM analysis, the parameter estimates are reported along with CIs and alpha levels (Hill & Lewicki, 2007). Parameter estimates, sometimes called beta values (β), represent the main findings for the predictor variables and levels, and provide an indication of the strength of the relationship with the dependent variable (Hill & Lewicki, 2007). The beta value represents the correlation between the observed and predicted values of the variables, and positive or negative β values (+ or -) indicate the directionality of the parameter estimate results (Hill & Lewicki, 2007; Tabachnick & Fidell, 2001). For example, a positive β value means that for every increase in the value of the predictor variable, there is a corresponding increase in the dependent variable. A negative β value means that for every increase in the predictor variable there is a corresponding decrease in the dependent variable, and a zero β value means that for every increase of the predictor variable there is no corresponding change in the dependent variable (Green & Salkind, 2008). The 95% CIs imply that the true value of β falls between the upper and lower CI levels.

Research Question 1

A GLM analysis for the first research question was conducted to determine the relationship between high school completion status, and SLD eligibility under the GAI method, the types of cognitive processing deficits, and the grade level when tested (Table 6). The multinomial logit model was selected to test the model fit for the analysis (Hill & Lewiki, 2007). The omnibus test for the high school completion variable was significant,

X^2 (7, N = 149) = 96.39, p = .000, when controlling for the three categorical predictor variables. As shown in Table 6, the levels for the predictor variables did not meet the set alpha ($p < .05$), despite the statistically significant result from the omnibus test. The lack of statistical significance for the predictor variable levels does not necessarily mean that the null hypothesis should fail to be rejected. As shown in Table 6, the processing speed deficit was not statistically significant but showed a large negative effect size (ß = -1.16). This suggests that learning disabled students with processing speed deficits may have more difficulty completing high school than students without processing speed deficits. The lack of statistical significance for the processing speed variable level could be related to the small number of cases (n = 14; see Table 3). Most levels of the variable, types of cognitive processing deficits, had 20 or more cases per cell. A larger sample size may have been able to better account for uneven distributions among the variables and their levels (Gliner et al., 2002). Nonetheless, the results of this analysis show that no levels of the predictor variables resulted in regression coefficients that reached the set alpha level ($p < .05$), therefore, the most conservative decision was to fail to reject the null hypothesis for the first research question.

Table 6

Generalized Linear Model Analysis of High School Completion Status

Predictor variables	ß	95% CI	*p*
Type of cognitive processing deficits			
Working Memory	0[a]*	.	.
Processing Speed	-1.16	[-3.20, .88]	.264
Verbal Comprehension	-.04	[-1.74, 1.66]	.961
Combined CPD	-.85	[-2.52, .81]	.316
No CPD	-.58	[-3.40, 2.24]	.686
Grade level when tested			
K to Grade 3	0[a]*	.	.
Grade 4 to Grade 7	-.21	[-1.22, .80]	.681
Grade 8 to Grade 12	.36	[-1.32, 2.03]	.677
General abilities index eligible			
Yes	0a*	.	.
No	.42	[-2.17, 3.01]	.753

Note. * O[a] = Set to zero because this parameter is redundant, meaning that all other levels of the variable are compared to this level.

Research Question 2

A generalized linear model analysis was conducted to determine the relationships between the reading section of the performance on state standards assessment variable and the predictor variables, SLD eligibility under the GAI method, the types of cognitive processing deficits, and the grade level when tested for an SLD (Table 7). The model selected for the performance on state standards assessments reading condition was the multinomial logit model, because the dependent variable has multiple levels and is measured on a nominal level. The omnibus test for the reading state standards assessment reading condition analysis was statistically significant, X^2 (7, N = 149) = 98.99, p = .000, indicating that the null hypothesis can be rejected for the reading condition. As shown in Table 7, the Grade 8 to Grade 12 variable level moderately predicted failure to obtain a passing score on the state standards reading assessment (p = .059). While the set alpha ($p < .05$) was not met, the moderately significant alpha, combined with the large negative effect size statistic (ß = -1.148), provided reasonable evidence to conclude that being tested for an SLD in Grades 8 to 12 predicted failure to pass the state standards reading assessment, and thus the null hypothesis was rejected. As noted in the literature review, the grade when a student is diagnosed with an SLD can have an impact on academic success. According to Abreu-Ellis et al. (2009) and Vanderberg and Emery (2009), students who were diagnosed with an SLD in earlier grades had better overall basic skills and learning strategies than students who were not diagnosed with an SLD until after high school. There were no significant findings or large effect sizes for the GAI diagnostic method or type of cognitive processing variables.

Table 7

Generalized Linear Model Analysis of the Reading State Standards Assessment

Predictor variables	ß	95% CI	*p*
Type of cognitive processing deficit			
Working Memory	0^{a}*	.	.
Processing Speed	.73	[-.80, 2.25]	.351
Verbal Comprehension	.67	[-.55, 1.89]	.279
Combined Type	.70	[-.52, 1.93]	.262
No CPD	-.29	[-2.41,1.83]	.788
Grade level when tested			
K to Grade 3	0^{a}*	.	.
Grade 4 to Grade 7	-.12	[-.87, .63]	.750
Grade 8 to Grade 12	-1.15	[-2.34, .05]	.059**
General abilities index eligible			
Yes	0^{a}*	.	.
No	.073	[-1.96, 2.10]	.944

Note. *O^{a} = Set to zero because this parameter is redundant, meaning that all other levels of the variable are compared to this level.

A GLM analysis was conducted to determine the relationships between the performance on state standards math assessment and the predictor variables, SLD eligibility under the GAI method, the types of cognitive processing deficits, and the grade level when tested for an SLD (Table 8). The model selected for the state standards assessment math condition analysis was the multinomial logit model. The predictor variable, SLD eligible with the AAD diagnostic method (yes or no), was added to the analysis to ensure an appropriate fit for the model. This variable was measured on a nominal scale and has two levels: (1) SLD eligible under the AAD method, and (2) not SLD eligible under the AAD method. The omnibus test for the math state standards assessment analysis was significant, $X^2 (8, N = 149) = 17.54$, $p = .025$, indicating that at least one predictor variable was related to the dependent variable, thus the null hypothesis was rejected. There were no significant findings for the grade level when tested or the SLD eligible under the GAI method variables. As shown in Table 8, the processing speed type of cognitive processing deficit variable was a significant predictor of failure to pass the state standards math assessment, with a large negative effect size (ß = -1.926). This finding is consistent with findings reported in the literature review. Processing speed deficits have been implicated in math-based learning disabilities and well as written language-based learning disabilities (Newton & McGrew, 2010).

Also shown in Table 8, the combined type of cognitive processing was not a significant predictor of failure to pass the state standards math assessment ($p = .098$) however, there was a large negative effect size for this variable (ß = -1.168). This finding suggests there may be a significant relationship between having more than one cognitive processing deficit and failing the state standards math assessment.

Table 8

Generalized Linear Model Analysis of the Math State Standards Assessment

Predictor variables	ß	95% CI	*p*
Type of cognitive processing deficit			
Working Memory	0a*	.	.
Processing Speed	-1.93	[-3.51, -.34]	.017**
Verbal Comprehension	-.98	[-2.31, .34]	.145
Combined Type	-1.17	[-2.55, .22]	.098
No CPD	-.40	[-2.37, 1.58]	.694
Grade level when tested			
K to Grade 3	0a*	.	.
Grade 4 to Grade 7	.30	[-.47, 1.09]	.439
Grade 8 to Grade 12	.53	[-.71, 1.76]	.403
General abilities index eligible			
Yes	0a*	.	.
No	-.24	[-2.01,1.53]	.791
Ability Achievement Eligible			
Yes	0a*	.	.
No	.42	[-.32, 1.16]	.265

Note. * Oa = Set to zero because this parameter is redundant meaning that all remaining levels of the variable are compared to this level.
** $p < .05$

A GLM analysis was conducted to determine the relationships between the writing section of the performance on state standards assessment variable and the predictor variables, SLD eligible under the GAI method, the types of cognitive processing deficits, and the grade level when tested for an SLD (Table 9). The model selected for the state standards assessment writing analysis was the multinomial logit model. The omnibus test for the state standards assessment writing analysis was significant, X^2 (7, N = 149) = 34.98, p = .000, suggesting that at least one predictor variable was related to the dependent variable (Tabachnick & Fidell, 2001).

As shown in Table 9, the verbal comprehension processing deficit moderately predicted failure to pass the state standards writing test (p = .058), with a large negative effect size (ß = -1.083). The results of this finding are consistent with research about verbal comprehension processing deficits. Verbal comprehension processing functions are fundamental to the processes of learning and using written and spoken language (Flanagan et al., 2010; Newton & McGrew, 2010). This finding suggests that students with verbal comprehension processing deficits will have more difficulty passing the state standards writing assessment than students with other types of cognitive processing deficits.

The predictor variable, no SLD eligibility under the GAI method, also moderately predicted a passing score on the state standards writing assessment (p = .057), with a large positive effect size (ß = 1.34; see Table 9). These results suggest that students in the sample who do not have cognitive processing deficits were more likely to pass the state standards writing assessment than others in the sample. This finding is also consistent with what was presented in the literature review. Students without cognitive processing deficits do not meet the definition of an SLD. Because these students do not have cognitive processing deficits, they are more likely to obtain passing scores on academic skills tests (Andersson, 2010; Berninger, 2006; Dombrowski et al., 2006; Dombrowski et al., 2004; Flanagan et al., 2010). Based on the results of the writing condition analysis and the omnibus test, the null hypothesis for the writing condition of the second research question was rejected.

Table 9

Generalized Linear Model Analysis of the Writing State Standards Assessment

Predictor variables	ß	95% CI	*p*
Type of cognitive processing deficit			
Working Memory	0[a]*	.	.
Processing Speed	-.62	[-1.93, .70]	.354
Verbal Comprehension	-1.08	[-2.20, .04]	.058
Combined Type	-.72	[-1.91, .47]	.233
No CPD	-1.33	[-2.88, .23]	.095
Grade level when tested			
K to Grade 3	0[a]*	.	.
Grade 4 to Grade 7	.34	[-.35, 1.03]	.335
Grade 8 to Grade 12	.72	[-.32, 1.77]	.175
General abilities index eligible			
Yes	0[a]*	.	.
No	1.34	[-.04, 2.72]	.057

Note. * O[a] = Set to zero because this parameter is redundant meaning that all other levels of the variable are compared to this level.

Research Question 3

A GLM analysis was conducted to determine the relationships between the SLD eligibility variable and the predictor variables, SLD eligible under the GAI method, the types of cognitive processing deficits, and the grade level when tested for an SLD (Table 10). The model selected for the SLD eligible analysis was the multinomial logit model. The omnibus test for the SLD eligible variable was significant, X^2 (7, N = 56.93), p = .000, indicating that the model fit was good and that at least one predictor variable was related to the dependent variable. There were no significant findings for the grade level when tested or the SLD eligibility under the GAI method variables.

As shown in Table 10, the verbal comprehension processing deficit moderately predicted no SLD eligibility (*p* = .067) with a large negative effect size (β = -1.337). Also shown in Table 10, the combined type processing deficit level significantly predicted no SLD eligibility (*p* = .013), with a large negative effect size (β = -1.839). Based on these findings and the results of the omnibus test, the null hypothesis for the third research question was rejected.

The analysis for the third research question showed that the verbal comprehension and the combined type cognitive processing deficits predicted no SLD eligibility. As reported in the literature review, the AAD diagnostic method often underdiagnoses SLDs when students have cognitive processing deficits (Andersson, 2010; Berninger, 2006; Dombrowski et al., 2006; Dombrowski et al., 2004; LDA White Paper, 2010). Most students in the sample were diagnosed with an SLD using the AAD method, and students represented in the sample with verbal comprehension and the combined types of cognitive processing deficits were much less likely to be diagnosed with an SLD. While the literature reported diagnostic problems with the AAD method, the findings for the third research question analysis were not anticipated.

Table 10

Generalized Linear Model Analysis of the SLD Eligibility Variable

Predictor variables	ß	95% CI	*p*
Type of cognitive processing deficit			
Working Memory	0[a]*	.	.
Processing Speed	-.78	[-2.47, .91]	.364
Verbal Comprehension	-1.34	[-2.77, .09]	.067
Combined Type	-1.84	[-3.30, -.38]	.013
No CPD	-.70	[-2.70,1.30]	.490
Grade level when tested			
K to Grade 3	0[a]*	.	.
Grade 4 to Grade 7	.09	[-.71, .89]	.825
Grade 8 to Grade 12	1.09	[-.26, 2.43]	.114
General abilities index eligible			
Yes	0[a]*	.	.
No	-.94	[-2.70, .83]	.299

Note. * O[a] = Set to zero because this parameter is redundant meaning that all other levels of the variable are compared to this level.

Summary

In the current study, I attempted to find evidence to support use of the GAI method of diagnosing SLDs as an alternative to the AAD diagnostic method. To accomplish this goal, I used a GLM analysis to determine relationships between the dependent variables, high school completion status, performance on state standards assessments, and SLD eligibility, and the predictor variables, SLD eligible under the GAI method, the types of cognitive processing deficits, and the grade level when tested for an SLD. The analysis for the first research question did not produce statistically significant results, so the null hypothesis failed to be rejected. However, the processing speed deficit analysis produced a large negative effect size suggesting that processing speed deficits may be a factor in failing to complete high school. Future research into processing speed deficits and high school completion is recommended to clarify this finding.

As presented in the literature review, numerous studies connect cognitive processing deficits to different types of learning disabilities (Flanagan et al., 2010; Newton & McGrew, 2010). Consistent with the CHC theory of cognitive processing systems (Flanagan et al., 2010; Newton & McGrew, 2010), results of the current study showed that cognitive processing deficits were able to predict performance on state standards assessments, and to predict no SLD eligibility. The processing speed deficit was a significant predictor of failure to pass the math state standards assessment, and the verbal comprehension processing deficit was a moderate predictor of failure to pass the state standards writing assessment. The combined type of cognitive processing deficits was a significant predictor of not being diagnosed with an SLD, and the verbal comprehension deficit moderately predicted not being diagnosed with an SLD. In support of these findings, and as was reported in the literature review, many studies about the AAD method of diagnosing SLDs have found that the AAD method frequently underdiagnoses students who have cognitive processing deficits and overdiagnoses students from ethnic minorities and low socioeconomic backgrounds (Andersson, 2010; Berninger, 2004; Dombrowski et al., 2006; LDA White Paper, 2010).

Chapter 5 will begin with a review of the purpose and nature of the current study, and a reminder of why the study was conducted. I will summarize the key statistical findings from Chapter 4, and will discuss the relevance of the findings in relation to research from the literature review. The limitations of the current study will be reviewed, and recommendations for future research studies will be presented. The positive social change implications resulting from the study will be presented, followed by a discussion of the study's theoretical implications. I conclude Chapter 5 with a summary of the study's findings in relation to the theoretical framework, and pertinent research findings from the literature review.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The current study stemmed from the need to find a method of diagnosing SLDs that can also identify cognitive processing deficits. The current SLD diagnostic models, the AAD and RTI methods, are unable to identify cognitive processing deficits (Berninger, 2006; Dombrowski et al., 2004; Dombrowski et al., 2006; Flanagan et al., 2010). There are many studies about problems with the AAD and RTI methods of diagnosing SLDs. However, there is comparatively little research about an SLD diagnostic method that recognizes cognitive processing deficits and can predict important student outcomes (LDA White Paper, 2010; Paul, 2010). To address this gap in the literature, I sought to determine if the GAI diagnostic method was a viable alternative to the AAD method. I used a GLM analysis to determine if the GAI method could predict high school completion status, performance on state standards assessments, and SLD eligibility (IDEA, 2004; Naglieri et al., 2005; Saklofske et al., 2010). The analysis results showed statistically significant relationships between cognitive processing deficits and the dependent variables. Specifically, the processing speed, verbal comprehension, and combined types of cognitive processing deficits predicted failure to pass the math and writing state standards assessments. Additionally, the verbal comprehension and the combined types of cognitive processing deficits predicted no SLD eligibility. The results of the analysis also showed a moderately significant relationship, and large negative effect size, between the grade level when tested variable, and failure to pass the state standards reading test.

For the first research question, a large negative effect size was produced for the processing speed deficit variable, suggesting that processing speed deficits may predict failure to complete high school. However, lack of a statistically significant alpha level led to failure to reject the null hypothesis. The null hypotheses were rejected for the second and third research questions.

There were no significant findings for the predictor variable level, SLD eligible under the GAI method. Therefore, the viability of the GAI method as an alternative to the AAD method could not be determined from the current study's results. The GAI method is capable of identifying cognitive processing deficits (Prifitera et al., 1998; Raiford et al., 2005; Saklofske et al., 2010) and will continue to be useful for diagnosing SLDs under certain conditions. The results of the current study, however, could not confirm the GAI as a viable diagnostic alternative to the AAD method.

Interpretation of the Findings

Theoretical Framework

The findings from the current study are consistent with the Cattell-Horn-Carroll (CHC) theory of cognitive processing systems, the study's theoretical framework (Newton & McGrew, 2010). CHC theory is a well researched theory of cognitive processing systems that connects deficits in cognitive processing systems with specific learning disabilities (IDEA, 2004; LDA White Paper, 2010; Mather & Gregg, 2006; Newton & McGrew, 2010; Naglieri et al., 2005). These cognitive processing systems allow us to understand language, orally express concepts and ideas using language, read and understand written words and numerals, move smoothly from one thinking task to the next, and other such functions (Newton, 2003, Newton & McGrew, 2010).

CHC theory has a multidisciplinary research base that connects learning disabilities to cognitive processing deficits (Flanagan et al., 2010; LDA White Paper, 2010; Mather & Gregg, 2006; Paul, 2010). The empirical evidence for CHC theory came from many longitudinal factor analytic studies, conducted by researchers from disciplines such as the psychology, genetic, developmental, and other fields of study (Daniel, 1997, as cited by Flanagan et al., 2010). The research behind CHC theory led to the development of nine central cognitive processing abilities that are:

- Fluid reasoning,
- Comprehension/knowledge,
- Visual-spatial processing,
- Auditory processing,
- Short-term memory,
- Long-term storage and retrieval,
- Cognitive processing speed,
- Reading and writing, and
- Quantitative knowledge abilities. (Flanagan et al., 2010; McGrew, 2003; Newton & McGrew, 2010).

The results of the current study are connected to several of these nine cognitive processing abilities, which are the cognitive processing speed, comprehension/knowledge, and reading and writing abilities.

The findings of this research study have extended knowledge in the field of SLD diagnostic practices by analyzing the predictive capabilities of the types of cognitive processing deficits, the grade level when first tested for an SLD, and SLD eligibility under the GAI method, on high school completion status, performance on state standards assessments, and SLD eligibility. The study results, organized by pertinent findings, are discussed in the following sections.

Processing Speed Deficit

The processing speed deficit was significantly related to the performance on state standards assessments dependent variable. The processing speed deficit variable was able to predict failure to pass the state standards math assessment, which added information to the discipline about processing speed deficits and learning disabilities (Flanagan et al., 2010; Geary et al., 2004; Harrison et al., 2007; Newton & McGrew, 2010; Wang et al., 1993, 1994). Many research studies have shown that impairment in the speed of information processing is often the main cause of educational and occupational difficulties for persons with SLDs, rather than the person's learning potential (Berninger, 2006; Flanagan et al., 2010; Geary et al., 2004; Harrison et al., 2007; Wang et al., 1993, 1994). Processing speed deficits have been implicated in math-based learning disabilities, as well as written-language-based learning disabilities (Newton & McGrew, 2010). The acquisition of math skills requires fluency in memorizing and recalling mathematical procedures and facts (Geary et al., 2004; Newton & McGrew, 2010). Problems with the automatic retrieval of this information are related to problems learning and using higher-level math skills to solve mathematical problems (Flanagan et al., 2010; Geary et al., 2004; Newton & McGrew, 2010).

In CHC theory, the cognitive processing speed ability refers to the speed with which mental processes can be carried out, and the ability to automatically and fluently perform cognitive tasks with sustained focus over a period of time (McGrew, 2003; Newton & McGrew, 2010). SLD students with processing speed deficits often have significant difficulty keeping up with class assignments, and typically take longer to complete tests (Butnik, 2013; Helmbold & Rammsayer, 2010; McArthur, 2009). As time passes, these lags in performance accumulate, causing the student to fall farther behind in school (Butnik, 2013). Processing speed deficits may even have a negative effect on a student's ability to complete high school. The analysis for the first research question found that processing speed deficits may be able to predict failure to complete high school, based on the large effect size statistic resulting from the analysis. While this result suggests that processing speed deficits may predict failure to complete high school, the null hypothesis could not be rejected due to the lack of statistical significance. However, a relationship of sorts does seem to be present.

Results from this study have shown that processing speed deficits can predict failure to pass the state standards math assessment and may predict failure to complete high school, thereby adding to the body of evidence about the connections between cognitive processing deficits and learning disabilities.

Verbal Comprehension Deficit

Verbal comprehension processing abilities are subsumed in the CHC theory's comprehension/knowledge and reading/writing cognitive processing abilities (Flanagan et al., 2010; Helmbold & Rammsayer, 2010; National Institute of Health, 2010; Newton, 2003; Newton & McGrew, 2010). Comprehension/knowledge abilities are responsible for the functions that allow humans to learn and apply acquired knowledge about the language, information, and concepts of a society; reading/writing abilities are responsible for the functions that allow human to learn basic reading skills, deriving meaning from printed materials, and to write complex ideas (McGrew, 2003; Newton & McGrew, 2010). Consistent with CHC theory and research presented in the literature review, the writing condition analysis for the second research question showed that the verbal comprehension processing deficit moderately predicted failure to pass the state standards writing assessment, with a large negative effect size. Verbal comprehension processing deficits are often present in dyslexia, a type of learning disability that interferes with the process of learning to read and write (Flanagan et al., 2010; Newton & McGrew, 2010). Verbal comprehension deficits have also been implicated in disorders of written language (Dombrowski et al., 2006; Flanagan et al., 2010; LDA White Paper, 2010; Naglieri et al., 2005; Newton & McGrew, 2010).

The analysis for the third research questions, SLD eligibility, showed that the verbal comprehension cognitive processing deficit moderately predicted no SLD eligibility, with a large negative effect size. In the current research study, students with verbal comprehension deficits were less likely to be diagnosed with an SLD than others in the sample. This finding is consistent with research about the problems with the AAD method of diagnosing SLDs (Dombrowski et al., 2006; Flanagan et al., 2010; Fuchs et al., 2011; Mather & Gregg, 2006; Naglieri et al., 2005; Newton & McGrew, 2010). Most students represented in the sample were tested for an SLD with the AAD diagnostic method, and received special education services for all or part of their K – 12 school years. As reported in the literature review, the AAD diagnostic method frequently underdiagnoses students with cognitive processing deficits, thus preventing them from accessing the educational supports necessary to progress in school (Berninger, 2006; Dombrowski et al., 2006; Fuchs et al., 2011; Johnson, 2008; LDA White Paper, 2010; Thurlow et al., 2002). Results from this study have shown that the verbal comprehension processing deficit can predict failure to pass the state standards writing assessment and predict no SLD eligibility, thereby adding to the body of evidence about the connections between cognitive processing deficits and learning disabilities.

Combined Type Processing Deficit

Combined type of cognitive processing deficits (or multiple processing deficits) have been linked to conditions such as dyslexia and reading disabilities (Flanagan et al., 2010; Helmbold & Rammsayer, 2010). The term, combined type of cognitive processing deficits, refers to the presence of one or more cognitive processing deficit, based on the nine cognitive processing abilities from CHC theory (Newton, 2003; Newton & McGrew, 2010). For example, individuals with dyslexia often have deficits in verbal comprehension abilities and also deficits in auditory processing abilities (Flanagan et al., 2010; Helmbold & Rammsayer, 2010; Newton & McGrew, 2010). The combined type of cognitive processing deficits variable represents students in the sample with more than one cognitive processing deficit in their cognitive profiles. Some students in the sample had working memory deficits and processing speed deficits, while others had processing speed deficits and verbal comprehension deficits.

The math condition analysis for the second research question produced a large negative effect size for the combined type of cognitive processing deficit; however the set alpha was not reached ($p < .05$). While the set alpha was not met, this finding suggests there may be a significant relationship between having more than one cognitive processing deficit and obtaining a failing grade on the state standards math assessment. Working memory, processing speed, and verbal comprehension deficits have been implicated in math-based learning disabilities as well as written language-based learning disabilities (Newton, 2003; Newton & McGrew, 2010). Future research efforts about the academic effects of combined or multiple cognitive processing deficits may provide beneficial information about interventions that help these students achieve academic success.

The analysis for the third research question, SLD eligibility, yielded statistically significant findings with a large negative effect size for the combined type of cognitive processing deficit variable. Students in the sample with more than one kind of cognitive processing deficit were much less likely to be diagnosed with an SLD than others in the sample. This finding is consistent with research reported in the literature review. The AAD diagnostic method underdiagnoses SLDs in students with cognitive processing deficits (Berninger, 2006; Dombrowski et al., 2006; Fuchs et al., 2011; LDA White

Paper, 2010). Verbal comprehension, processing speed, working memory, and other cognitive processing deficits have been implicated in specific learning disabilities, such as dyslexia and dysgraphia (Flanagan et al., 2010; Geary et al., 2004; Helmbold & Rammsayer, 2010; Newton & McGrew, 2010). The ethics of continuing to use SLD diagnostic methods that cannot recognize cognitive processing deficits are questionable (Berninger, 2006; Dombrowski et al., 2006; Fuchs et al., 2011; LDA White Paper, 2010; McGrew, 2003; Naglieri et al., 2005; Saklofske et al., 2010).

Grade Level When Tested for an SLD

The reading condition analysis for the second research question, performance on state standards assessments, did not result in statistically significant findings for any predictor variable. However, being tested for an SLD in Grades 8 to 12 moderately predicted failure to pass the state standards reading assessment with a large negative effect size. While results of this analysis were not statistically significant, the large negative effect size, combined with the moderate alpha level, suggested that being tested for an SLD in Grades 8 to 12 increases the likelihood of failing to pass the state standards reading assessment.

This finding is consistent with what was presented in the literature review. The length of time a student receives special education services seems to have a bearing on SLD student performance. For example, Vanderberg and Emery (2009) found that students who were diagnosed with an SLD in the fourth grade showed better long-term outcomes than students who were not diagnosed until Grade 7 or later. Students who received special education services in the fourth through the 12th grades (i.e., diagnosed with a SLD in earlier grades) received more educational benefit from being taught compensatory learning strategies, rather than receiving remedial instruction in the deficit skill area (Abreu-Ellis et al., 2009; Wanzek et al., 2010). Abreu-Ellis et al. (2009) found that college students who were diagnosed with an SLD during the Kindergarten through the 12th grade years demonstrated better basic academic skills, better test-taking strategies, and increased academic self-confidence than students who were not diagnosed until they reached college. The results of these studies indicate that being diagnosed with an SLD in the primary and intermediate grades can have a positive impact on post high school education opportunities, particularly when the SLD diagnosis is accompanied by instruction in research-based compensatory strategies (Abreu-Ellis et al., 2009; Vanderberg & Emery, 2009).

Eligibility Under the GAI Method and Working Memory

The SLD eligibility under the GAI method predictor variable was not a significant predictor of any dependent variable in the current study. The viability of the GAI diagnostic method, as an alternative to the AAD method, was neither confirmed nor disconfirmed from the study results. While the null hypotheses for the SLD eligibility under the GAI method variable failed to be rejected for all three research questions, this does not mean that the GAI diagnostic method has no place as an SLD diagnostic tool. The GAI diagnostic methods continues to be important alternatives to the AAD diagnostic method, particularly when there are certain score differences between IQ and index scores (Prifitera et al., 1998; Raiford et al., 2005; Saklofske et al., 2010; Wechsler, 1991, 2003). The results of the current study, however, failed to show that the GAI diagnostic method has sufficient reliability to become the third SLD diagnostic method, based on the ability to predict important student outcomes. While the GAI diagnostic method can identify cognitive processing deficits, and was used to identify cognitive processing deficits in the study's sample (Prifitera et al., 1998; Raiford et al., 2005; Saklofske et al., 2010), study results did not show evidence that the GAI diagnostic method could predict important student outcomes, such as high school completion, SLD eligibility, and performance on state standards assessments. Study results showing that the GAI method could predict important student outcomes would have indicated that the GAI was an SLD diagnostic method that could identify cognitive processing deficits, and predict important student outcomes. Such findings would have provided supportive evidence that the GAI may be a viable alternative to the AAD method on a wide-spread basis.

In the current study, the working memory deficit was not a significant predictor of any dependent variable. The results of the study neither confirmed nor disconfirmed the role of working memory processing deficits in SLD students. Short-term or working memory is one of the nine central cognitive processing abilities from CHC theory (Newton, 2003; Newton & McGrew, 2010), and has been identified as a fundamental deficit in several types of learning disabilities (Geary et al., 2004). In the current study, no student in the sample had just a working memory processing deficit. The working memory processing deficit occurred in conjunction with other processing deficits, such as verbal comprehension or processing speed. The working memory processing deficit was represented in the combined type of cognitive processing deficits variable.

Limitations of the Study

The current study focused on the effects of verbal comprehension, processing speed, and working memory deficits on the dependent variables. Other types of cognitive processing deficits, such as language or visual-spatial processing deficits, were not included in the study. The current study sought to determine if the GAI diagnostic method was a viable alternative to the AAD diagnostic method because the GAI method can recognize cognitive processing deficits (Prifitera et al., 1998; Raiford et al., 2005; Wechsler 1991, 2003). Because the GAI methods were developed for use with the WISC-III and WISC-IV tests (Prifitera et al., 1998; Raiford et al., 2005), other intellectual tests such as the Stanford Binet Intelligence Test- 5th ed. (Roid, 2003), or the Cognitive Assessment System (Edwards & Paulin, 2007; Naglieri et al., 2005) were excluded from the study. While the study was limited to data derived from WISC-III and WISC-IV administrations, these tests are nationally normed instruments with good reliability and validity, and have been widely used in public school settings across the nation (Wechsler, 1991, 2003). Generalization of the study's findings will be most valid if confined to individuals who were tested for SLDs using the Wechsler tests (Wechsler 1991, 2003). However, because the Wechsler tests, as well as the Stanford Binet Intelligence Test- 5th ed. (Roid, 2003), and the Cognitive Assessment System (Edwards & Paulin, 2007; Naglieri et al., 2005) measure similar constructs, the results of the current study could be generalized to SLD students tested with these other instruments.

The size of the sample presented some limitations. The sample size was just over the recommended 129 datasets ($N = 149$). While the power analysis for the study suggested that 129 datasets were adequate to achieve sufficient statistical power, a number of data cells were found to contain small numbers of cases. These small cells required that some variable levels be reconfigured, and other variable levels be combined. For example, there were only eight cases for the variable level SLD eligible under the AAD method. More students in the sample qualified for an SLD when both the AAD and GAI methods were applied, than qualified under the AAD method alone. To address the problem of a too few cases per cell, these eight cases were combined with the SLD eligible under the GAI method, to form the SLD eligible under the GAI and AAD method variable level. The reasons why more students in the sample qualified for an SLD using both the AAD and GAI methods were not explored in the current study.

Another example of too few cases for certain data cells was the combined type of cognitive processing deficit variable level. Initially, the working memory variable level was coded as a single variable level, as were the other processing deficits. However, very few students had only working memory deficits. Students who did show working memory deficits also had other cognitive processing deficits. So, the combined types of cognitive processing deficits variable level was formed.

Test scores from the WASL and the HSPE (OSPI, 2009, 2010) may be difficult to generalize as the tests are typically revised each year, and teachers may adjust instruction to improve student performance. Although the format of test questions may be modified annually, these criterion-referenced tests are based on the same state established grade level expectations (OSPI, 2011). Because the test questions are based on state established grade level expectations, any problems generalizing study results should be somewhat mitigated. The results of the study can be generalized to Washington's state standards assessments, but may not be generalizable to the standards assessments developed by other U. S. states.

For several predictor variables, the analysis resulted in large effect size statistics, but nonsignificant alpha levels. The processing speed deficit had a large negative effect size for the high school completion status variable, but did not reach the set alpha. The combined type of cognitive processing deficit analysis produced a large negative effect size for the math condition of the state standards assessment, but the set alpha level was not reached. While the processing speed and combined type cognitive processing deficits have been linked to specific learning disabilities, these findings should be interpreted with caution, because the set alphas were not met (Abreu-Ellis, 2009; Berninger, 2006; Berninger & May, 2011; NJCLD, 2008; Restori et al., 2009; Thurlow et al., 2002). More research is needed to determine the effects of processing speed and combined type cognitive processing deficits on high school completion status and failure to pass the state standards math assessment.

Recommendations

The analysis for the first research question, high school completion status, indicated that processing speed deficits have an adverse effect on completing high school, but the results were not statistically significant. This could be related to the small number of cases for the processing speed deficit cell (n = 14). Other cognitive processing deficit levels had 20 or more cases per cell. Based on findings from the current study, additional research about the relationship between processing speed deficits and high school completion is recommended. Processing speed deficits have been implicated in many academic problems, however, research studies that investigate the effect of processing speed deficits on high school completion are less common. Future research findings that show a stronger link between processing speed deficits and high school completion could lead to new intervention strategies that prevent failure to complete high school, and possibly improve high school drop out rates.

Findings from the current study also showed that students in the sample with more than one cognitive processing deficit were less likely to pass the state standards math assessment, based on a large negative effect size. However, this result was not statistically significant. Additional research about multiple cognitive processing deficits and performance on state standards assessments could lead to important developments of educational interventions that address the needs of students who have multiple cognitive processing deficits. Additionally, recognizing multiple cognitive processing deficits early in a student's academic life could lead to interventions that help the student learn compensatory strategies to adapt to the processing deficits, thereby improving overall academic performance.

More research is needed about the types of interventions that are most effective for different cognitive processing deficits. When a student with a processing speed deficit receives the same remedial writing instruction as a student with a verbal comprehension deficit, the educational needs of the first student will not be met. In recent years, special education instructional practices have improved to include better alignment with the core curriculum, and more focus on teaching compensatory learning strategies (Luke & Schwarz, 2007; Stucker, 2009; Ysseldyke et al., 2004). When special education instruction is aligned with the state's grade level expectations, SLD students will be better prepared to pass the state standards assessments (Katisyannis et al., 2007).

Special education, as well as regular education teachers, do not usually receive training about cognitive processing deficits and learning disabilities. This lack of training affects the quality and specificity of special education instruction, leading to little improvement in SLD students' academic functioning (LDA White Paper, 2010; Abreu-Ellis et al., 2002; Vanderberg & Emery, 2009). Teacher training programs would benefit from research about specific types of interventions and learning strategies that are best for the different types of cognitive processing deficits. This information could help educators improve special education teacher training and help school district officials plan appropriate professional development trainings for special education staff.

More research is needed about an SLD diagnostic method that can recognize cognitive processing deficits. Some states have already revised SLD diagnostic procedures to include recognition of cognitive processing deficits; Texas and Indiana are two examples of states that have revised their SLD diagnostic procedures (LDA, 2014). The Learning Disabilities Association of America (2014) reported that 21 U.S. states have revised their SLD diagnostic procedures to include recognition of cognitive processing deficits. However, neither Texas nor Indiana use the same SLD diagnostic approach (LDA, 2014). It is possible that there is no need to develop a single, SLD diagnostic method that recognizes cognitive processing deficits. Future research that explores several SLD diagnostic processes that recognize cognitive processing deficits may be able to address this question.

Research about the problems with the AAD and RTI methods, and misdiagnosed SLDs is recommended. Existing research findings about the problems with the AAD and RTI diagnostic models are alarming (Berninger, 2006; Dombrowski et al., 2006). Failure to diagnose SLDs in students with cognitive processing deficits, and misdiagnosing students from ethnic minority groups and low socio-economic backgrounds can cause real, life-changing problems for these individuals. If school districts in Washington and other states examine their archived special education files, the impact of these diagnostic errors would have a more personal impact than data from national statistics. These diagnostic errors would illuminate the problem on a local level. The identification of SLD diagnostic problems on a local level may stimulate more interest in changing SLD diagnostic practices.

As reported in the literature review, the AAD and RTI diagnostic methods have led to high numbers of misdiagnosed SLDs (Andersson, 2010; Berninger, 2006; Dombrowski et al., 2006; Flanagan et al., 2010; Fuchs et al., 2011; LDA White Paper, 2010, Naglieri et al., 2005). Those with cognitive processing deficits are underdiagnosed, and those from ethnic minority groups and low socioeconomic backgrounds are overrepresented in the SLD population. One important research gap is the lack of information about what happens to the lives of the individuals with cognitive processing deficits who were not diagnosed with an SLD, and the lives of those who were misdiagnosed with an SLD due to ethnicity and low socioeconomic status. This lack of information constitutes a significant knowledge gap about the real, life-altering problems associated with misdiagnosed SLDs.

The findings from the current study illuminated the need for additional research efforts that could improve special education instructional strategies, and develop academic interventions specific to the different cognitive processing deficits. The results generated by the current study also added evidence to the body of research about SLD diagnostic methodologies that can recognize cognitive processing deficits. Cognitive processing deficits were found to predict student performance on state standards assessments, and to predict failure to be diagnosed with an SLD. The GAI is an SLD diagnostic method that can identify cognitive processing deficits, and is compatible with the existing, legally sanctioned AAD diagnostic method. Therefore, the GAI diagnostic method can be used without requiring much change to current legislation and current SLD diagnostic practices. However, use of the GAI diagnostic method, as an alternative to the AAD method, was not supported by the research findings from this study.

Positive Social Change Implications

The positive social change implications from the results of the current study are substantial. The National Center for Learning Disabilities (NCLD) found that approximately 2.5 million students in the U.S. are diagnosed with learning disabilities (NCLD, 2009, 2014). Research presented in the literature review, and the findings from the current study, suggests that students with cognitive processing deficits are underrepresented in this statistic, and that students who are English language learners, who are from low socio-economic backgrounds, and who are from ethnic minority groups are overrepresented in this statistic (Andersson, 2010; Berninger, 2006; Dombrowski et al., 2004; Dombrowski et al., 2006; Kamphaus, & Reynolds, 2004; LDA White Paper, 2010). Studies have found that many students classified as having SLDs do not meet the *deficits in cognitive processing* criteria of the federal definition of an SLD because they do not show evidence of cognitive processing deficits (Berninger, 2006; Flanagan et al., 2010; Fuchs et al., 2011; IDEA, 2004; LDA White Paper, 2010; Newton & McGrew, 2005; OSPI, 2011). Consistent with this information, 41% of students in the current study did not display cognitive processing deficits in their cognitive profiles, yet were diagnosed with an SLD. Conversely, the results of the current study found that students with the verbal comprehension and the combined types of cognitive processing deficits significantly predicted failure to be diagnosed with a SLD. Based on the results of the current study, and research presented in the literature review, it can be concluded that a substantial number of individuals with cognitive processing deficits are not diagnosed with SLDs. Ramifications of this include lack of access to appropriate educational instruction, and to the civil rights protections afforded by disability rights legislation (IDEA, 2004; Section 504, 1973). Just as important, there may be a substantial number of individuals within the SLD population who were misdiagnosed. Diagnosing SLDs for individuals without cognitive processing deficits will have exposed these individuals to the adverse academic, occupational, and social consequences that are part of the SLD person's life experience (Flanagan et al., 2006; Mather & Gregg, 2006; Naglieri et al., 2005; NJCLD, 2009; Paul, 2010; Thurlow et al., 2002; Ysseldyke et al., 2004).

Identifying or developing SLD diagnostic methods that recognize cognitive processing deficits will lead to positive social change on the individual and societal levels. Positive social change might first occur by identifying cognitive processing deficits sooner than later is a student's educational career. Appropriate interventions and accommodations that teach these students learning strategies and techniques for school success should follow the SLD diagnoses. Improved SLD diagnostic practices would lead to improved academic interventions, because the processing deficits that underlie the SLD will be identified. The state of Texas has changed SLD diagnostic practices to include identification of cognitive processing deficits, paired with interventions that are specific to the different deficits (LDA, 2014). Improved SLD diagnostic practices will also lead to lower rates of misdiagnosed SLDS. The benefits of this will be felt on the individual as well as societal levels (Berninger, 2006; Flanagan et al., 2010; Fuchs et al., 2011). Reliable SLD diagnostic practices and interventions will lead to improved educational outcomes for individuals with SLDs. Improved educational outcomes will lead to better access to post high school educational opportunities, which will have an impact on occupational success. When accurate SLD diagnostic practices lead to improved educational and post high school opportunities, the rates of incarceration, substance abuse, and mental health problems will likely start to decline. Without improved SLD diagnostic practices, large numbers of SLD students will continue to struggle to pass state standards assessments, obtain high school diplomas, and access post high school educational opportunities. Subsequently, these SLD students will face adulthoods with higher rates of unemployment, substance abuse, incarceration, and emotional disorders than nondisabled peers (Flanagan, Ortiz, Alfonzo, & Mascolo, 2006; Mather & Gregg, 2006; Naglieri et al., 2005; Paul, 2010; Ross, 2005; Thurlow et al., 2002; Ysseldyke et al., 2004).

Theoretical Implications

In the past couple years, a number of American states have revised their SLD diagnostic practices to include recognizing cognitive processing deficits (LDA, 2014). Currently, 21 states have implemented diagnostic practices that call for identification of cognitive processing deficits in SLD evaluations, such as the states of Texas and Indiana (LDA, 2014). Both states have included procedures for identifying cognitive processing deficits in their SLD diagnostic practices, and for providing academic interventions that are targeted to address specific cognitive processing deficits (Flanagan et al., 2006; LDA, 2014). Texas, Indiana, and other states that have made these improvements in SLD diagnostic practices, have provided a roadmap for other states that are interested in aligning SLD diagnostic practices with current research (LDA, 2014).

Positive social changes will come from adapting SLD diagnostic practices that identify cognitive processes, and from the development of specific academic interventions focused on the specific cognitive processing deficits (LDA, 2014). In many states and schools, special education interventions are focused on remedial instruction in the deficit skill areas, usually without regard to or awareness of the student's particular type of learning disability (Flanagan et al., 2010; Ross, 2005; Solis et al., 2011; Vanderberg & Emery, 2009; Wanzek et al., 2010). SLD students with writing deficits typically receive remedial writing instruction (sentence structure, vocabulary, grammar, punctuation) to improve general writing skills, however, the cause of the writing problems is often not identified (Helmbold & Rammsayer, 2010). Problems learning to write can come from disorders such as dyslexia, a verbal comprehension processing deficit, or a processing speed deficit (Helmbold & Rammsayer, 2010; McCurdy et al., 2008; Vanderberg & Emery, 2009). For example, the intervention strategies specific to verbal comprehension deficits or dyslexia-based SLDs might include instruction in vocabulary, spelling, and language. Students with SLDs caused by processing speed deficits might only need to use a word processor to improve writing performance, or be allowed extra time to complete assignments (Berninger & May, 2011; Flanagan, Ortiz, Alfonzo, & Mascolo, 2006; Locasio et al., 2010; NIH, 2010; Ross, 2005). Thus, identification of the types of cognitive processing deficits is crucial to SLD student success.

When SLD students use learning accommodations to participate in the regular curriculum, they tend to perform better on important outcomes, such as on state standards assessments (Flanagan et al., 2006; IDEA, 2004; Mather & Gregg, 2006; Ross, 2005). For example, dyslexic students can listen to textbooks and other reading material on CDs or electronically, and students with dyscalculia and working memory deficits can learn higher level math skills if allowed to use calculators (Flanagan et al., 2006). Teaching students with SLDs to use learning strategies and technological supports can lead to more SLD student participation in the regular school curriculum (Ross, 2005).

Conclusion

The purpose of the current study was to determine if the GAI diagnostic method was a viable alternative to the AAD method of diagnosing SLDs. The GAI method was selected for the current study because the GAI diagnostic method can identify cognitive processing deficits and be used with existing SLD diagnostic procedures (IDEA, 2004; SLD Guide, 2011). There are several reasons why this is important. Research about the AAD method of diagnosing SLDs has identified significant problems with the method, such as underdiagnosing students with cognitive processing deficits, and underdiagnosing those who are from ethnic minorities and low socioeconomic backgrounds (Berninger, 2006; Dombrowski et al., 2006; Flanagan et al., 2006). Individuals with SLDs experience an array of adverse educational, occupational, and emotional effects resulting from inadequate diagnostic procedures, as well as inadequate academic interventions that ignore the cause of the SLD (Abreu-Ellis, 2009; Flanagan et al., 2010; Ross, 2005; Solis et al., 2011; Vanderberg & Emery, 2009; Wanzek et al., 2010). In order to improve educational and occupational outcomes for the SLD population, diagnostic practices need to be accurate and lead to appropriate, targeted academic interventions.

The results of the current study produced evidence of the need to find SLD diagnostic methods that recognize cognitive processing deficits (Berninger et al., 2006; Dombrowski et al., 2006; Flanagan et al., 2010; LDA White Paper, 2010; Morris et al., 2009; Naglieri et al., 2005; Paul, 2010). Processing speed, verbal comprehension, and the combined type of cognitive processing deficits significantly predicted failure to pass the state standards math and writing tests, and predicted that students in the sample would not be diagnosed with an SLD. These results have added to the body of knowledge about cognitive processing deficits and learning disabilities. The findings from the current study also support literature findings about the problems with the AAD and RTI diagnostic methods. However, the GAI method of diagnosing SLDs was not found to be a predictor of high school completion, performance on state standards assessments, or SLD eligibility. So, the study results could not confirm the GAI a viable alternative SLD diagnostic method to the AAD method.

Despite the inconclusive findings for the GAI diagnostic method, the results of this study, and what was presented in the literature review, clearly support the need to recognize cognitive processing deficits in the SLD diagnostic process. Positive social changes for the SLD population will not occur without the first step of finding SLD diagnostic methods that recognize cognitive processing deficits (Andersson, 2010; Berninger, 2006; Dombrowski et al., 2006; Dombrowski et al., 2004; LDA White Paper, 2010).

The positive social changes that would come from improved SLD diagnostic practices are substantial. Research that examines the relationships between cognitive processing deficits, high school completion status, and performance on state standards assessments could lead to educational interventions that will improve school success for SLD students. SLD diagnostic practices that recognize cognitive processing deficits will help address the serious problems with the AAD diagnostic method, such as high rates of misdiagnosis and ineffective educational interventions (Berninger, 2006; Dombrowski et al., 2006; Flanagan et al., 2006; LDA White Paper, 2010). When SLD students receive appropriate academic interventions, other educational and life outcomes will improve. These improvements include relief from low rates of high school completion, and increased rates of unemployment, incarceration, substance abuse problems, and mental health problems for persons with SLDs (Bear et al., 2006; Francis et al., 2011; Fuchs et al., 2011; Joyce & Rosen, 2006; LDA White Paper, 2010; Morris et al., 2009; Nelson & Harwood, 2010; Ross, 2005; Thurlow et al., 2002). Without changes in SLD diagnostic practices, the positive social changes for the SLD population will likely not occur.

References

Abreu-Ellis, C., Ellis, J., & Hayes, R. (2009). College preparedness and time of learning disability identification. *Journal of Developmental Education, 32*(3), 28-38. Retrieved from http://iws.collin.edu/dweasenforth/Calderwood/JDE%2032-3_Abreau-Ellis, Ellis&Hayes.pdf

Alloway, T. (2009). Working memory, but not IQ predicts subsequent learning in children with learning difficulties. *European Journal of Psychological Assessment, 25*(2), 92-98. doi:10.1027/1015-5759.25.2.92

Americans With Disabilities Act of 1990, Pub. L. No. 101-336, 104 Stat. 328 (1990). Retrieved from http://www2.ed.gov/about/offices/list/ocr/docs/hq9805.html

Andersson, U. (2010). Skill development in different components of arithmetic and basic cognitive functions: Findings from a 3-year longitudinal study of children with different types of learning difficulties. *Journal of Educational Psychology*, *102*(1), 115-134. doi:10.1037/a0016838

Archibald, L.M., & Alloway, T. P. (2008). Comparing language profiles: Children with specific language impairment and developmental coordination disorder. *International Journal of Language and Communication Disorders*, *43*(2), 165-180. doi:10.1177/0022219408315815

Ballinger, G.A., (2004). Using generalized estimating equations for longitudinal data analysis. *Organizational Research Methods, 7*(2), 127-150. doi: 10.1177/1094428104263672

Bear, G.G., Kortering, L.J., & Braziel, P. (2006). School completers and noncompleters with learning disabilities: Similarities in academic achievement and perceptions of self and teachers. *Remedial and Special Education, 27*(5), 293-300. doi:10.1177/07419325060270050040

Berninger, V. (2006). Research-supported ideas for implementing reauthorized IDEA with intelligent professional psychological services. *Psychology in the Schools, 43*(7), 781-794. doi:10.1002/pitts.20188

Berninger, V. W., & May, O. M. (2011). Evidence-based diagnosis and treatment for specific learning disabilities involving impairments in written and/or oral language. *Journal of Learning Disabilities*, *44*(2), 167-183. doi: 10.1177/0022219410391189

Brueggemann, A.E., Kamphaus, R.W., & Dombrowski, S.C. (2008). An impairment model of learning disability diagnosis. *Professional Psychology: Research and Practice*, *39*(4), 424-430. doi:10.1037/0735-7028.39.4.424

Burns, M.K., Scholin, S. E., Kosciolek, S., & Livingston, J. (2010). Reliability of decision-making frameworks for response to intervention for reading. *Journal of Psychoeducational Assessment, 28*(2), 102-114. doi: 10.1177/0734282909342347

Burns, M.K., Dean, V.J., & Klar, S. (2004). Using curriculum-based assessment in the responsiveness to intervention diagnostic model for learning disabilities. *Assessment for Effective Intervention*, *29*(47), 47-56. doi:10.1177/073724770402900304

Butnik, S. M. (2013, May). *Understanding, Diagnosing, and Coping with Slow Processing Speed,* Twice Exceptional Newsletter. Retrieved from http://www.2enewsletter.com/article_2013_05_slow_processing.html

Cortiella, C. (2010). *Implications of high-stakes testing for students with learning disabilities.* Retrieved from http://www.greatschools.org/special-education/legal-rights/886-high-stakes-testing-learning-disabilities.gs?page=all

Crouch, E.D., & Pataki, C. (2011). *Reading learning disorder*. Retrieved from http://emedicine.medscape.com/article/1835801-overview

De Clercq-Quaegebeur, M., Casalis, S., Lemaitre, M. P., Bourgois, B., Getto, M., & Vallee, L. (2010). Neuropsychological profile on the WISC-IV of french children with dyslexia. *Journal of Learning Disabilities, 43*(6), 563-574. doi:10.1177/0022219410375000

Doll, B., & Horn, C. (2008). Stop and think: Is an impairment model of learning disabilities true progress? Comment on Brueggemann, Kamphaus, and Dombrowski (2008). *Professional Psychology: Research and Practice, 39*(4), 421-434. doi:10.1037/0735-702.39.4.431

Dombrowski, S.C., Kamphaus, R.W., & Reynolds, C.R. (2004). After the demise of the discrepancy: Proposed learning disabilities diagnostic criteria. *Professional Psychology: Research and Practice*, *35*(4), 364-372. doi:10.1037/0735-7028.35.4.364

Dombrowski, S.C., Kamphaus, R. W., Barry, M., Brueggemann, A., Cavanagh, S., Devine, K., Hekimoglu, L., …Vess, S. (2006). The Solomon effect in learning disabilities diagnosis: Can we learn from history? *School Psychology Quarterly*, *21*(4), 359-374. doi:10.1037/h0084128

Duchan, J. (2011). *A history of speech-language pathology – nineteenth century: Word blindness and word deafness*. Retrieved from http://www.acsu.buffalo.edu/~duchan/new_history/hist19c/subpages/wordblindness.html

Dumont, R., & Willis, J. (1999). *The mark penalty*. Retrieved from http://alpha.fdu.edu/psychology/WISCIV_Substitution.htm

Edwards, O., & Paulin, R.V. (2007). Referred students' performance on the Reynolds Intellectual Assessment Scales and the Wechsler Intelligence Scale for Children-Fourth Edition. *Journal of Psychoeducational Assessment, 24*(4), 334-340.

Flanagan, D.P., Ortiz. S.O., Alfonso, V.C., & Mascolo, J.T. (2006). *The achievement test desk reference: A guide to learning disability identification*, 2nd Ed. New York, NY: John Wiley & Sons.

Flanagan, D. P., Fiorello, C. A., & Oritz, S. O. (2010). Enhancing practice through application of Cattell-Horn-Carroll theory and research: A "third method" approach to specific learning disability identification. *Psychology in the Schools, 47*(7), 739-759. doi:10.1002/pitts.20501

Francis, D.J., Fletcher, J.M., Stuebing, K.K., Lyon, G.R., Shaywitz, B.A., & Shaywitz, S.E. (2011). Psychometric approaches to the identification of ld: IQ and achievement scores are not sufficient. *Journal of Learning Disabilities, 38*(2), 98-108. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15813593

Fuchs, D., Hale, J.B., & Kearns, D.M. (2011). The importance of a cognitive processing perspective: An introduction. *Journal of Learning Disabilities, 44*(2), 99-104. doi:10.1177/0022219411400019

Geary, D.C., Hoard, M.K., Byrd-Craven, J., & DeSoto, M.C. (2004). Strategy choices in simple and complex addition: contributions of working memory and counting knowledge for children with mathematical disability. *Journal of Experimental Child Psychology*, *88*, 121-151. doi:10.1016/j.jecp.2004.03.002

George, D., & Mallery, P. (2013). *IBM SPSS statistics step by step: A simple guide and reference – 13th edition.* Upper Saddle River, NJ: Pearson.

Green, S. B. & Salkind, N. J. (2008). *Using SPSS for windows and macintosh: Analyzing and understanding data – 5th edition.* Upper Saddle River, NJ: Prentice Hall.

Guisan, A., Edwards, T.C. Jr., & Hastie, T. (2002). Generalized linear & generalized additive models in studies of species distributions: Setting the scene. *Ecological Modeling*, 157, 89-100. Retrieved from http://www.cnr.usu.edu.

Hallahan, D.P., & Mercer, C.D. (2007). *Learning disabilities summit: Building a foundation for the future white papers*. Retrieved from http://www.nrcld.org.ldsummit.hallahan3.html

Harrison, A.G., DeLisle, M.M., & Parker, K.C. (2007). An investigation of the general abilities index in a group of diagnostically mixed patients. *Journal of Psychoeducational Assessment*, *26*(3), 247-259. doi: 10.1177/0734282907304032

Helmbold, N., & Rammsayer, T. (2010). Timing performance as a predictor of psychometric intelligence as measured by speed and power tests. *Journal of Individual Differences, 27*(1), 20-37. doi:10.1027/1614-0001.27.1.20

Hill, T. & Lewicki, P. (2007). *Statistics: Methods and applications*. Tulsa, OK: Statsoft.

Individuals with Disabilities Education Act of 2004. *Final regulations,* (34 CFR Parts 300 and 301; Federal Register, 2006). Retrieved from http://idea.ed.gov/explore/view/p/,root,regs

Jaccard, J., & Becker, M. A. (2002). *Statistics for the behavioral sciences-4th edition*. Belmont, CA: Wadsworth

Johnson, C. (2008). Post-school outcomes for students in the state of Washington, USA, receiving special education services. *Journal of the International Association of Special Education*, *9*(1), 78-88, Retrieved from http://www.iase.org

Joyce, D., & Rosen, E. (2006). *Transitioning high school students with learning disabilities into post secondary education: Assessment and accommodations. NASP Communiqué, 35*(3). Retrieved from http://www.nasponline.org/publications/cq/cq353postsec.aspx

Jupp, V. (2006). *The sage dictionary of social research methods*. Thousand Oaks, CA: Sage Publications Inc.. doi:10.4135/9780857020116

Justice, L. (Ed.). (2009). Increasing your statistical edge: Dealing with nested data structures. *American Journal of Speech-Language Pathology, 18*(3), 210-211. doi:10.1044/1058-0360(2009/ed-03)

Kamphaus, R.W., Frick, P.J., & Lahey, B.B. (1991). Methodological issues and learning disabilities diagnosis in clinical populations. *Journal of Learning Disabilities*, *24*(10), 613-618. doi:10.1177/002221949102401004

Katsiyannis, A., Zhang, D., Ryan, J.B., & Jones, J. (2007). High-stakes testing and students with disabilities: Challenges and promises. *Journal of Disability Policy Studies*, *18*(3), 160-167. doi:10.1177/10442073070180030401

Kavale, K.A. (2005). Identifying specific learning disability: Is responsiveness to intervention the answer? *Journal of Learning Disabilities, 38*(6), 553-562. doi:10.1177/00222194050380061201

Kavale, K. A., Spaulding, L. S., & Beam, A. P. (2009). A time to define: Making the specific learning disability definition prescribe specific learning disability. *Learning Disability Quarterly, 32*(1), 29-49. doi:10.1234/12345678

Kim, Y., Petscher, Y., Schatschneider, C., & Foorman, B. (2010). Does growth rate in oral reading fluency matter in predicting reading comprehension achievement? *Journal of Educational Psychology*, *102*(3), 652-667. doi: 10.1037/a0019643

Konold, T. R., & Canivez, G. L. (2009). Differential relationships between WISC-IV and WIAT-II scales: An evaluation of potentially moderating child demographics. *Educational and Psychological Measurement, 70*(4), 613-127. doi:10.1177/001316440935568

Learning Disabilities Association of America, (2014). *SLD Evaluation: Linking Cognitive Assessment Data to Learning Strategies.* Retrieved from http://www.ldaamerica.org.

Learning Disabilities Association of America, (2010). *The learning disabilities association of america's white paper on evaluation, identification, and eligibility criteria for students with specific learning disabilities.* Retrieved from http://www.ldanatl.org/pdf/LDA%20White%20Paper%20on%20IDEA%20Evaluation%20Criteria%20for%20SLD.pdf

Learning Disabilities Association of America (2005). *History of LDA.* Retrieved from http://www.ldanatl.org/about/history.asp

Littell, R.C., Stroup, W.W., & Freund, R.J. (2002). *SAS for linear models – 4th edition.* Cary, NC: SAS Institute, Inc.

LD Online (1999). *Visual and auditory processing disorders*. Retrieved from hppt://www.ldonline.org/article/6390/

LD Online (2006). *Timeline of learning disabilities.* Retrieved from http://www.ldonline.org/article/11244/

Locascio, G., Mahone, E. M., Eason, S. H., & Cutting, L. E. (2010). Executive dysfunction among children with reading comprehension deficits. *Journal of Learning Disabilities, 43*(5), 441-454. doi:10/1177/0022219409355476

Luke, S.D., & Schwartz, A. (2007). Assessment and accommodations. *Evidence for Education*, *2*(1), 1-11. Retrieved from http://nichcy.org/research/ee/assessment-accommodations

Mabbott, D. J., & Bisanz, J. (2008). Computational skills, working memory, and conceptual knowledge in older children with mathematics learning disabilities. *Journal of Learning Disabilities,. 41*(1), 15-28. doi: 10.1177/0022219407311003

Mammarella, I.C., Lucangeli, D., & Cornoldi, C. (2010). Spatial working memory and arithmetic deficits in children with nonverbal learning difficulties. *Journal of Learning Disabilities, 43*(5), 455-468. doi:10.1177/0022219409355482

Marston, D. (2005). Tiers of intervention in responsiveness to intervention: Prevention outcomes and learning disabilities identification patterns. *Journal of Learning Disabilities, 38*(6), 539-544. doi:10.1177/002221940503800610

Mather, N., & Gregg, N. (2006). Specific learning disabilities: Clarifying, not eliminating, a construct. *Professional Psychology: Research and Practice, 37*(1), 99-106. doi:10.1037/0735-7028.37.1.99

McCurdy, M., Skinner, C., Watson, S., & Shriver, M. (2008). Examining the effects of a comprehensive writing program on the writing performance of middle school students with learning disabilities in written expression. *School Psychology Quarterly, 23*(4), 571-586. doi:10.1037/1045-3830.23.4.571

McGrew, K. (2003). Cattell-Horn-Carroll (CHC) definition project. Institute for Applied Psychometrics, LLC. Retrieved from http://www.iapsych.com/chcdef.htm

Mellard, D.F., & Johnson, E.S. (2008). *A practitioner's guide to implementing response to intervention.* Thousand Oaks, CA: Corwin Press. Retrieved from http://www.corwin.com/booksProdDesc.nav?prodId=Book231650

Mertler, C.A., & Vannatta, R.A. (2010). *Advanced multivariate statistical methods-4th ed.* Glendale, California: Pyrczak Publishing.

Morris, M. A., Schraufnagel, C. D., Chudnow, R. S., & Weinberg, W. A. (2009). learning disabilities do not go away: 20-to 25-year study of cognition, academic achievement, and affective illness. *Journal of Child Neurology*, *24*(3), 323-332. doi:10.1177/0883073808324216

Naglieri, J.A., Rojahn, J., Matto, H.C., & Aquilio, S.A. (2005). Black-white differences in cognitive processing: A study of the planning, attention, simultaneous, and successive theory of intelligence. *Journal of Psychoeducational Assessment, 23*, 146-160. doi:10.1177/073428290502300204

National Center for Learning Disabilities (2010). *Dyscalculia*. Retrieved from the LD.Org website: http://ncld.org/ld-basics/ld-aamp-language/ld-aamp-math/what-is-dyscalculia

National Institute of Health (2010). *Dyslexia: a developmental reading disorder*. Retrieved from http://www.ncbi.nlm.nih.gov/pubmedhealth/pmhooo2379/

National Joint Commission on Learning Disabilities (2008). *Adolescent literacy and older students with learning disabilities*. Retrieved from http://www.ldonline.org/article/25031/

Nelson, J. M., & Harwood, H. (2010). Learning disabilities and anxiety: A meta-analysis. *Journal of Learning Disabilities*, *44*(1), 3-17. doi: 10.1177/0022219409359939.

Newton, J.H., & McGrew, K.S. (2010). Introduction to the special issue: current research in Cattell-Horn-Carroll-based assessment. *Psychology in the Schools, 47*(7), 621-633. doi:10.1002/pits.20495

No Child Left Behind (NCLB) Act of 2001, Pub. L. No. 107-110, § 115, Stat. 1425 (2002). Retrieved from http://www2.ed.gov/nclb/landing.jhtml

Office of the Superintendent of Public Instruction, Washington State (2011). *Washington comprehensive assessment program: Grades 3 – 8, high school* (Technical Report, 2011). Retrieved from http://www.k12.wa.us/assessment/pubdocs/WCAP2011SpringAdministrationTechnicalReport.pdf

Office of the Superintendent of Public Instruction, Washington State (2010). *High school proficiency exam*. Retrieved from http://www.k12.wa.us/Assessment/StateTesting/HSPE.aspx

Office of the Superintendent of Public Instruction, Washington State (2010). *Measurement of student progress*. Retrieved from http://www.k12.wa.us/Assessment/StateTesting/MSP.aspx

Office of the Superintendent of Public Instruction, Washington State (2011). SLD guide (2011). Retrieved from www.k12.wa.us/SpecialEd/pubdocs/SLD_Guide.pdf

Office of the Superintendent of Public Instruction, Washington State (2009). *Washington assessment of student learning.* Retrieved from http://www.k12.wa.us/Assessment/WASL/default.aspx

Office of the Superintendent of Public Instruction, Washington State (2003). *Washington state report card.* Retrieved from http://reportcard.ospi.k12.wa.us/summary.aspx

Office of the Superintendent of Public Instruction, Washington State (2011). *Washington state report card.* Retrieved from http://reportcard.ospi.k12.wa.us/summary.aspx

Paul, D. (June, 2010). *Comprehensive assessment and evaluation of students with learning disabilities: A paper prepared by the national joint commission on learning disabilities*. Retrieved from http://www.ldonline.org/about/partners/njcld/?theme=print

Palys, T. (2008). *The sage encyclopedia of qualitative research methods*. Lisa M. Given (Ed.). Sage: Thousand Oaks, CA, Vol.2, p. 697-698. Retrieved from http://www.sfu.ca/~palys/Purposive%20sampling.pdf

Prifitera, A., & Saklosfke, D. H. (1998). *WISC-III clinical use and interpretation: Scientist practitioner perspectives*. San Diego, CA: Elsevier

Proctor, B., & Prevatt, F. (2003). Agreement among four models used for diagnosing learning disabilities. *Journal of Learning Disabilities, 36*(5), 459-406. doi:10.1177/00222194030360050701

Raiford, S.E., Weiss, L.G., Rolfhus, E., & Coalson, D. (2005). *Technical report no.4: Wechsler Intelligence Scale for Children-Fourth Edition: General Ability Index.* Retrieved from http://www.pearsonassessments.com/HAIWEB/Cultures/en-us/Productdetail.htm?Pid=015-8979-044&Mode=resource

Reynolds, C.R., & Shaywitz, S.E. (2009). Response to intervention: Ready or not? Or, from wait-to-fail to watch-them-fail. *School Psychology Quarterly*, *24*(2), 130-145. doi:10.1037/a0016158

Reschly, D. J. (2005). Learning disabilities identification: Primary intervention, secondary intervention, and then what? *Journal of Learning Disabilities, 38*(6), 510-515. doi:10.117700222194050380060601

Restori, A.F., Katz, G.S., & Lee, H.B. (2009). A critique of the IQ/achievement discrepancy model for identifying specific learning disabilities. *Europe's Journal of Psychology, 4*, 128-145. Retrieved from http://dx.doi.org/10.5964/ejop.v5i4.244

Roid, G. H. (2003). *Stanford Binet Test of Intelligence-5th ed., Examiner's Manual.* Austin, Texas: PRO-ED, Inc.

Ross, I.M. (2005). Proceedings from the Center on Disabilities (2005) Conference on Technology and Persons with Disabilities. Retrieved from http://techld.net

Saklofske, D.H., Zhu, J., Coalson, D.L., Raiford, S.E., & Weiss, L.G. (2010). Cognitive proficiency index for the Canadian edition of the Wechsler Intelligence Scale for Children-Fourth Edition. *Canadian Journal of School Psychol*ogy, *25*(3), 277-286. doi:10.1177/0829573510380539

Sattler, J. (2008). *Assessment of children: Cognitive foundations-5th edition*. La Mesa, California: Jerome M. Sattler, Publisher, Inc.

Scheremelle-Engel, K., Moosebrugger, H., & Muller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online, 8(2), 23-74.* Retrieved from http://www.mpr-online.de

Section 504 of the Rehabilitation Act of 1973, Pub. L. No. 93-112, 87 Stat. 355. Retrieved from: http://www.epa.gov/civilrights/sec504.htm

Solis, M., Ciullo, S., Pyle, N., Hassaram, B., & Leroux, A. (2011). Reading comprehension interventions for middle school students with learning disabilities:

A synthesis of 30 years of research. *Journal of Learning Disabilities, 20*(10), 1-15. doi:10.1177/0022219411402691

Sparks, R. L., & Lovett, B. J. (2009). College students with learning disability diagnoses: Who are they and how do they perform? *Journal of Learning Disabilities, 42*(6), 494-510. doi:10.1177/0022219409338746.

Steubing, K.K., Fletcher, J.M., LeDoux, J.M., Lyon, G.R., Shaywitz, S.E., & Shaywitz, B.A. (2002). Validity of IQ-discrepancy classifications of reading disabilities: A meta-analysis. *American Educational Research Journal, 30*(2), 469-518. doi:10.3102/00028312039002469

Stucker, H. (2009). *The trouble with high-stakes testing*. Retrieved from http://www.ncld.org/at-school/general-topics/test-taking/the-trouble-with-high-stakes-testing

Swanson, H.L., Jerman, O., & Zheng, X. (2008). Growth in working memory and mathematic problem solving in children at risk and not at risk for serious math difficulties. *Journal of Educational Psychology*, *100,* 343-380. doi:10.1037/0022-0663.100.2.343

Thurlow, M.L., Sinclair, M.F., & Johnson, D.R. (2002). Students with disabilities who drop out of school – Implications for policy and practice. *National Center of Secondary Education and Transition Publication*. Retrieved from http://www.ncset.org.publications/viewdesc.asp?id=425

Toll, S. W. M., Van der Ven, S. H. G., Kroesbergen, E. H., & Van Luit, J. E. H. (2011). Executive functions as predictors of math learning disabilities. *Journal of*

Learning Disabilities, 44(6), 521 – 532. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/21177978

U.S. Department of Education (2007). *Special education and rehabilitation services archived: A 25 year history of the IDEA*. Retrieved from http://www2.ed.gov/policy/speced/leg/idea/history.html

U.S. Department of Education (2011). *ESEA flexibility: overview*, *para.1*. Retrieved from http://www.ed.gov/sea/flexibility

U.S. Department of Education (2011). *States begin reporting uniform graduation rates, reveal more accurate high-school completion outcomes*. Retrieved from http://www.ed.gov/news/press-releases/states-begin-reporting-uniform-graduation-rate-reveal-more-accurate-high-school-

University of Duesseldorf Department of Experimental Psychology (2012). *G*Power3 statistical analysis*. Retrieved from http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3/

Vargo, F.E., & Young, N.D. (2011). What are learning disabilities? *Learning Disabilities Worldwide.* Retrieved from http://www.ldworldwide.org/what-are-learning-disabilities

Vanderberg, B., & Emery, D. (2009). A longitudinal examination of the remediation of learning disabilities: IQ, age at diagnosis, school SES and voluntary transfer. *International Journal of Special Education, 24*(1), 45-42. Retrieved from http://www.internationaljournalofspecialeducation.com

Wang, M. C., Haertel, G. D., & Wahlberg, H. J. (1993). What helps students learn? *Educational Leadership, 51*(4), 74-79. Retrieved from http://content.ebscohost.com.ezp.waldenulibrary.org

Wanzek, J., Wexler, J., Vaughn, S., & Ciullo, S. P. (2010). Reading interventions for struggling readers in the upper elementary grades: A synthesis of 20 years of research. *Reading and Writing: An Interdisciplinary Journal, 23*(8), 889–912. doi:10.1007/s11145-009-9179-5

Wechsler, D. (2003). *Wechsler Intelligence Scale for Children-Fourth Edition, Administration and Scoring Manual.* San Antonio, TX: The Psychological Corporation.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001/2007). *The Woodcock-Johnson Test of Academic Achievement – Third Edition*. Itasca, IL: Riverside Publishing.

Ysseldyke, J., Nelson, R.J., Christenson, S., Johnson, D.R., Dennison, A., Triezenberg, H., Sharpe, M.,…Hawes, M. (2004). What we know and need to know about the consequences of high-stakes testing for students with disabilities. *Exceptional Children*, *71*(1), 2 -14. Retrieved from http://www.freepatentsonline.com/article/Exceptional-Children/124134287.html

Zaccai, J.H. (2004). How to assess epidemiological studies. *Postgraduate Medicine Journal, 80,* 140-147. doi: 10.1126/pgmj.2003.012633

Appendix A: Sample Confidentiality Agreement

Name of Signer: Kristin M. Sims September, 2012

During the course of my activity in collecting data for this research: “The General Abilities Index as a Third Method of Diagnosing Learning Disabilities”, I will have access to information, which is confidential and should not be disclosed. I acknowledge that the information must remain confidential, and that improper disclosure of confidential information can be damaging to the participant. By signing this Confidentiality Agreement I acknowledge and agree that: I will not disclose or discuss any confidential information with others, including friends or family. I will not in any way divulge, copy, release, sell, loan, alter or destroy any confidential information except as properly authorized. I will not discuss confidential information where others can overhear the conversation. I understand that it is not acceptable to discuss confidential information even if the participant’s name is not used. I will not make any unauthorized transmissions, inquiries, modification or purging of confidential information. I agree that my obligations under this agreement will continue after termination of the research that I will perform. I understand that violation of this agreement will have legal implications. I will only access or use systems or devices I’m officially authorized to access and I will not demonstrate the operation or function of systems or devices to unauthorized individuals. Signing this document, I acknowledge that I have read the agreement and I agree to comply with all the terms and conditions stated above.

Signature: ____ Date:____________

Appendix B: Sample Letter of Agreement

Letter of Agreement

To the Walden Institutional Review Board (IRB):

I am familiar with *Kristin Sims'* research project entitled *"The General Abilities Index Method of Diagnosing Specific Learning Disabilities"*. I understand the school district's involvement to be: Providing archival data regarding special education evaluation results, results of WASL and HSPE scores, high school completion status of identified sample participants and access to archived cumulative file data, and providing access to the District's link to the Office of Public Education's database for individual student high school transcripts and high school completion status. I understand that this research will be carried out following sound ethical principles and that participant involvement in this research study is strictly voluntary and provides confidentiality of research data, as described in the protocol. Therefore, as a representative of [*agency name*], I agree that *Kristin Sims'* research project may be conducted at our agency/institution.

Sincerely, [name and title of agency/institutional authority]

Curriculum Vitae: Kristin Sims-Cutler

Objective:

Psychotherapy services for individuals and families; academic and behavioral evaluations, and educational consultation for children ages birth through 21.

Education:

Graduate Student, Ph.D. General Psychology-Educational Psychology track, Walden University, 2004 to June, 2014.

School Psychologist: ESA School Psychologist Certification. Eastern Washington University, 1996.

M.A. in Counseling, Pacific Lutheran University, School Counselor ESA Certification, 1990.

Bachelor of Fine Arts and Secondary Teacher Certification, Pacific Lutheran University, 1978.

Experience:

Licensed Mental Health Counselor in private practice, Spokane, WA, 2002 to the present.

School Psychologist **-** East Valley School District, Spokane, WA, 2002 to 2013.

Adjunct Instructor – Whitworth College, Spokane, Washington, 2007 to the 2011.

Assessment Specialist – Northwest Behavioral Health Clinic (NW-BHC), Spokane, WA, 2007 through 2009.

School Psychologist - Central Valley School District, Greenacres, Washington, 1996 through 2002.

Behavior Therapist - St. Luke's Pediatric Outpatient Clinic, Spokane, Washington, 2002 to 2004.

Therapist, Substance Abuse Treatment Program - Community Colleges of Spokane, 1993 to 1995.

Professional Associations:

Washington State Association of School Psychologists

National Association of School Psychologists

International OCD Foundation