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Assessing the Relationship Among Models for Diagnosing Specific Learning Disabilities

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ASSESSING THE RELATIONSHIP AMONG MODELS FOR DIAGNOSING SPECIFIC LEARNING DISABILITIES

By

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Dedicated to the memory of my grandfathers, William Perer and Victor Shifrin, who always emphasized the value of education.

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ABSTRACT

Learning disabilities affect nearly 5% of the school aged population and make up approximately 50% of all special education students. While there are many models used to make a specific learning disability diagnosis, none are without their detractors. For years, the Simple Discrepancy Model was the most widely used method for the assessment of learning disabilities yet recent research has relegated this model suspect. Due to these findings the Individuals with Disabilities Education Act of 2004 has stipulated that while a school district may still use the Simple Discrepancy Model they cannot require its use. Consequently, there are several prominent models currently utilized. Along with the Simple Discrepancy Model they are the Regression Model, the Low Achievement Model, the Aptitude-Achievement Consistency Model, and the Concordance-Discordance Model. Previous research has indicated that within a college population different models used to diagnose learning disabilities are not interchangeable. Yet of concern, school districts often appear to choose a specific model without the forethought that would warrant such an important decision.

The present study examined the five aforementioned models within a grade 1-10 population to examine the frequency, level of agreement, and level of association between the models. 150 subjects were examined from the same Northwest section of Florida. The results indicate that the Low Achievement and Concordance-Discordance models identify significantly more subjects as compared to the Simple Discrepancy, Regression, and Aptitude-Achievement Consistency models. Furthermore, the Simple Discrepancy and Regression Models revealed the highest level of agreement (86%) whereas the Simple Discrepancy and the Concordance-Discordance Models revealed the lowest (41%). When the five models were compared in sets of two for a total of ten comparisons the results indicated that the Simple Discrepancy and Regression models showed the strongest association. On the other hand, when strict criteria were implemented it was noted that eight of the ten comparisons did not demonstrate a clinical level of association. These results indicate that when the five models were compared they often diagnosed different students and thus should not, in most cases, be used interchangeably.

Keywords: *Learning disability, Learning disability assessment, Learning disability models*

CHAPTER I: INTRODUCTION

While the definition regarding what constitutes a specific learning disability has been debated for years, it is generally accepted that a SLD is a neurological disorder which in turn affects the way information is processed (LD Online, 2008; Learning Disabilities Association of America, 2008; National Center for Learning Disabilities, 2008). When this type of processing deficit leads to an 'unexpected underachievement,' an SLD diagnosis may be warranted. Historically, a learning disability diagnosis was determined based on a significant discrepancy between one's intelligence and a specific area of achievement (e.g. reading). However, due to vast evidence that the 'Aptitude-Achievement Discrepancy Model' is inadequate (Fletcher, Lyon, Fuchs & Barnes, 2007) the Individuals with Disabilities Education Act (IDEA) of 2004 has modified the protocol for a 'high stakes' SLD determination. Consequently, practitioners now have the option of choosing from several viable models to aid them with an SLD diagnosis. Fletcher (2007) stated that there are currently four prominent models used to make such a determination: Aptitude-Achievement Discrepancy, Low Achievement, Intra-individual, and Response to Intervention. While all models have their proponents and detractors, it has been illustrated that they often diagnose significantly different members of the population (Proctor & Prevatt, 2003, Sparks & Lovett, 2009). Therefore, the type of model utilized to aid in an SLD determination should not be made lightly.

Social Significance

A learning disability diagnosis has significant ramifications. From special education eligibility to social stigma, a learning disability determination often has a considerable impact on its recipients. Currently, approximately 5% of the school based population has a documented learning disability (Center for Disease Control, 2003; DSM-IV-TR, 2000; Learning Disabilities Outline, 2008; Lyon, 1996). Yet, as mentioned in the Introduction of Chapter One, many current methods used to diagnose an SLD do not consistently identify students across models.

A recent survey by Eileen Ahearn (2008), supported by the U.S. Department of Education, revealed that states often differ with regard to the models they allow their practitioners to use for an SLD diagnosis. Furthermore, most states allow their school personnel to choose from one of several prominent models. And yet it appears that many psychologists, school psychologists, special education teachers, and others responsible for determining the type

of model to be used are doing so in a haphazard manner. By determining whether prominent models used to determine specific learning disabilities in the grade 1-10 population identify similar or differing students, it is the hope that this study sheds some light on the consequences of choosing one model over another.

Importance of Study

By comparing and contrasting longstanding models such as the Aptitude-Achievement Discrepancy Models and the Low Achievement Model with the newer, more theoretically based Intra-Individual Models such as the Aptitude-Achievement Consistency Model and the Concordance-Discordance Model, I believe that the results of a study such as this could be interesting and informative. For example, if the models identify different populations with specific learning disabilities, then practitioners would know that these models are not interchangeable, and that they would need to weigh many factors such as a possible over- or under-identification of learning disability diagnoses, alignment with current LD theory, etc., before choosing a specific model. However, if the models identify a similar population, then the argument to use one model over another may be irrelevant.

CHAPTER II: LITERATURE REVIEW

Introduction

> Specific Learning Disability: A disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations. This term includes such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. This term does not include children who have learning problems that are primarily the result of visual, hearing, or motor disabilities; mental retardation; or environmental, cultural or economic disadvantage (Dumont Willis, 2010).

A learning disability is a specific type of neurological disorder presumed to be due to a central nervous system dysfunction which affects the way information is processed (LD Online, 2008; Learning Disabilities Association of America, 2008; National Center for Learning Disabilities, 2008). These processing deficits may interfere with one's ability to learn and/or acquire basic skills such as reading, often referred to as dyslexia; writing, often referred to as dysgraphia; or math, often referred to as dyscalculia. Furthermore, they may compromise one's ability to adequately obtain certain types of higher level skills such as organization, time planning, and abstract reasoning (Learning Disabilities Association of America, 2008).

The following are some general facts regarding learning disabilities: The special education diagnostic category of 'Learning disabilities' currently represents approximately half of all students that receive special education services in the United States (Donavon & Cross, 2002). According to the National Institute of Health, as cited in LD OnLine (2008), approximately fifteen percent of the United States population has some type of learning disability. Furthermore, as previously mentioned, approximately 5% of the school based population has a documented learning disability (Center for Disease Control, 2003; DSM-IV-TR, 2000; Learning Disabilities Outline, 2008; Lyon, 1996). The most typically seen types of learning disability involve difficulties with reading and language skills. Approximately 80-90% of individuals with learning disabilities have issues with reading (Kavale & Reese, 1992; LD OnLine, 2008; Lerner, 1989; Lyon, Fletcher, Shaywitz, Torgesen, Wood, et al., 2001). Furthermore, approximately two out of every five students who receive special education

services in the United States have been identified due to reading difficulties (President's Commission on Excellence in Special Education, 2002 as cited in Fletcher et al., 2007). It has been shown that learning disabilities often run in families (LD OnLine, 2008). Comorbid disorders often accompany learning disabilities such as Attention-Deficit/Hyperactivity Disorder (ADHD) (LD OnLine, 2008). A learning disability is a lifelong disability, and while remediation may prove effective, the learning disability itself cannot be cured. According to LD OnLine (2008):

> Learning disabilities should not be confused with other disabilities such as mental retardation, autism, deafness, blindness, and behavioral disorders. None of these conditions are learning disabilities. In addition, they should not be confused with lack of educational opportunities like frequent changes of schools or attendance problems. Also, children who are learning English do not necessarily have a learning disability.

Deficit(s) in information processing are at the core of a learning disability. The first step in 'processing' involves getting information into the brain in the form of impulses which are transmitted by neurons (LD Online, 2008). This endeavor has been termed 'input' (LD Online, 2008; Learning Disabilities Association of America, 2008). 'Inputing' information normally occurs through the eyes, which is called 'visual perception' or 'visual input', or through the ears, which is called 'auditory perception' or 'auditory input'. If an individual has difficulty in one of these areas, which does not relate to visual problems such as nearsightedness, farsightedness or hearing problems, it may be a cause of a learning disability (LD Online, 2008).

After information is 'inputed', the information must then be 'integrated'. The term 'integration' has been referred to as 'making sense' out of the information. In order to integrate information three tasks must be carried out. First, the information must be placed into its proper order, which has been termed 'sequencing' (LD Online, 2008). An example of a sequencing disorder may be when one hears a story but in retelling it does so in the wrong order. The second integration step involves 'abstraction' (LD Online, 2008). Abstraction involves understanding information beyond its literal meaning. An example of an abstraction disorder may be when one has difficulty inferring the meaning of words or concepts. The third and final integration step involves 'organization'. The process of organization involves integrating the information into complete thoughts or concepts, i.e., organizing the information. An example of

an organizational disorder may be when one has difficulty organizing papers, notebooks, his environment, his time, etc. (Learning Disabilities Association of America, 2008).

Once the information is integrated it must next be stored into 'memory'. There are three types of memory which each play a pivotal role. 'Working memory' refers to the ability to retain information in immediate awareness while simultaneously performing a mental operation with the aforementioned information (Mather & Woodcock, 2001). The next aspect of memory is referred to as 'short-term memory'. Short-term memory is used to retain information for a limited period of time (Learning Disabilities Association of America, 2008). During short-term memory the information is eventually either forgotten or placed into 'long-term memory'. Long-term memory is the final category of memory. Long-term memory involves retaining information for an extended period of time (Learning Disabilities Association of America, 2008). A deficit with one or more aspects of memory may lead to a learning disability.

The final stage in processing information is referred to as 'output'. An output disability may manifest itself as either a 'language output disability' and/or a 'motor output disability'. A language output disability refers to expressing information through words. There are two types of language used during communication: 'spontaneous' and 'demand'. When one is initiating what is said, this is referred to as spontaneous language. When one is using demand language they are responding to a request, such as a question that was posed. A motor output disability refers to a deficit with a specific type of muscle activity. Like a language output disability, this may also manifest itself in two ways, i.e., through a 'fine motor disability' or through a 'gross motor disability'. A fine motor disability refers to a deficit integrating small muscle groups. A gross motor disability refers to a deficit coordinating large muscle groups. Consequently, an individual with a processing deficit will have difficulty with one or more of the aforementioned modalities, i.e., with 'input', 'integration', 'memory', and/or 'output' (LD Online, 2008; Learning Disabilities Association of America, 2008).

According to LD Online (2008), if there is a processing deficit in one of the aforementioned areas, i.e., input, integration, memory, and/or output, this deficit may be manifested in one or more of the specific processing deficits as defined below:

Table 1

List of Processing Deficits

Processing Deficits	**Manifestations**	
Auditory Sequencing	Confusion with number sequences, lists or lists of directions. Hearing ninety-four instead of forty-nine.	
Auditory Memory	Difficulty remembering what was heard, difficulty remembering important items from a lecture. Spells poorly.	
Visual Sequencing	Problems in using a separate answer sheet. Loses place easily. Problems with reading. Reversing or misreading numbers of letters. Reading words incorrectly. Difficulty with equations.	
Visual Memory	Difficulty remembering what was seen. Reading comprehension. Difficulty with math equations. Poor recall of information.	
Dysgraphia	Inability to form letters correctly-students cannot read their own writing.	
Visual Motor Integration	Mechanical problems in test taking. Difficulty copying from board or book. Spaces poorly. Poor written work. Unorganized.	

Table 1 – Continued

Processing Deficits	Manifestations	
Auditory Discrimination	Often seems to misunderstand. Trouble telling differences between similar sounds or words-seventeen for seventy. Seems to hear but not to listen.	
Auditory Figure Ground	Trouble hearing sounds over background noises.	
Visual Figure Ground	Trouble seeing an image within competing background. Picking one line of print from another while reading.	
Visual Discrimination	Seeing the difference between two similar objects	
Spatial Orientation	Loses materials. Late to class. Difficulty with oral reading. Unorganized homework. Difficulty judging time.	
Expressive Language	Difficulty expressing themselves. May sound "cynical".	
Receptive Language	Appears to be "not listening". Incomplete work.	
Organization	Incomplete assignments. Unorganized notebook/notes.	

Note. From: http://www.ldonline.org/article/6376

As will be discussed in more detail in the 'Current Definitions and Trends' section, it should be noted that the presence of a processing deficit in and of itself does not constitute a learning disability. Learning disabled individuals are assumed to represent a subgroup of individuals with unexpected underachievement (Fletcher et al., 2007). Therefore, for a learning disability diagnosis to be proclaimed, the individual must have a processing deficit which *adversely affects an area of achievement*. *The Diagnostic and Statistical Manual of Mental Disorders – Fourth edition - Text Revision (DSM-IV-TR; APA, 2000)* defines four categories of what it terms 'Learning Disorders'. They are as follows:

* Reading Disorder
* Mathematics Disorder
* Disorder of Written Expression
* Learning Disorder Not Otherwise Specified

Furthermore, the DSM-IV-TR (2000) describes the diagnostic features of a learning disorder as follows:

> Learning Disorders are diagnosed when the individual's achievement on individually administered, standardized tests in reading, mathematics, or written expression is substantially below that expected for age, schooling, and level of intelligence. The learning problems significantly interfere with academic achievement or activities of daily living that require reading, mathematical, or writing skills. A variety of statistical approaches can be used to establish that a discrepancy is significant. Substantially below is usually defined as a discrepancy of more than 2 standard deviations between achievement and IQ. A smaller discrepancy between achievement and IQ (i.e., between 1 and 2 standard deviations) is sometimes used, especially in cases where an individual's performance on an IQ test may have been compromised by an associated disorder in cognitive processing, a comorbid mental disorder or general medical condition, or the individual's ethnic or cultural background. If a sensory deficit is present, the learning difficulties must be in excess of those usually associated with the deficit. Learning Disorders may persist into adulthood (pp. 49-50).

It should be noted, however, that almost all services stemming from a specific learning disability diagnosis occur within the school environment. In addition, state regulations generally supersede a diagnosis obtained via the Diagnostic and Statistical Manual guidelines.

Consequently, it may be prudent to focus on school based evaluation procedures in lieu of those obtained through the DSM (Proctor, personal communication, 2009).

Furthermore, according to U.S. Federal regulations (as cited in Fletcher et al., 2007) that date back to 1977, there are seven distinct types of learning disabilities. They are: 1) listening comprehension (receptive language), i.e., greater than expected difficulty processing what one hears due to a processing deficit, 2) oral expression (expressive language), i.e., greater than expected difficulty with oral/expressive processing due to a processing deficit, 3) basic reading skills (decoding and word recognition), i.e. greater than expected difficulty reading/decoding specific words due to a processing deficit, 4) reading comprehension, i.e., greater than expected difficulty comprehending what one is reading due to a processing deficit, 5) written expression, i.e., greater than expected difficulty expressing oneself though written language due to a processing deficit, 6) mathematics calculation, i.e., greater than expected difficulty with basic mathematical calculations due to a processing deficit, and 7) mathematics reasoning, i.e., greater than expected difficulty with mathematical reasoning and logic due to a processing deficit.

Furthermore, for a learning disability diagnosis to be rendered, the underachievement must not primarily be the result of "visual, hearing, or motor handicaps, or mental retardation, or emotional disturbance, or of environmental, cultural, or economic disadvantage" (U.S. Office of Education, 1977, p. 65083). While an individual may have one of the aforementioned impairments in conjunction with a learning disability, the underachievement must not *primarily be the result* of one of these impairments.

Prevalence rates

Throughout the years, many learning disability definitions have been proposed, yet there has not been a universal consensus (Tucker, Stevens & Ysseldyke, 1983 as cited in Kavale & Forness, 2000). Due to the lack of a universal definition of what constitutes a learning disability, its actual prevalence rate is unknown (Lyon, 1996). While some researchers argue that learning disabilities are over diagnosed, others have taken the contrary point of view (Lyon, 1996). There are seemingly valid and invalid reasons for the dramatic increase in learning disability identification rates. Some sound reasons stem from improved research, a broader definition of what constitutes a reading disability with an emphasis on phonological awareness, as well as an increase in the identification of learning disabilities in girls. Some unsound reasons may stem

from vague and broad definitions, inadequate teacher preparation, as well as specific financial incentives that all result in the over identification of learning disabilities (Lyon, 1996).

With this being said, as stated in Chapter One, approximately five percent of the school aged population has a specific learning disability (Center for Disease Control, 2003; DSM-IV-TR, 2000; Learning Disabilities Outline, 2008; Lyon, 1996). Lyon (1996) notes that the identification of learning disabilities has increased dramatically during the past 20 years. For example, learning disabilities now account for approximately one half of all students who receive special education in the United States (Donovan & Cross, 2002). Furthermore, since P.L. 94-142 (now IDEA) passed in 1975, the prevalence of learning disability diagnoses has increased approximately 150% (Kavale & Forness, 2000). This increase is even more startling when compared with other special education rates. For example, the prevalence rates for Mental Retardation and Social Emotional Disturbance are approximately 1% and .75%, respectively (Kavale & Forness, 2000). Possible explanations for this dramatic rise in diagnoses may stem from greater knowledge regarding what constitutes a learning disability, an increase in attention given to the cause, a milder stigma than in the past, misdiagnosis, as well as a desire to qualify due to the amount of services, i.e., interventions and accommodations, that come with qualifying for this particular disability category.

Although the topic of 'Comorbidity' will be covered more extensively in the following section, briefly stated, according to the Center for Disease Control (2003) 5.3% of boys and 3.8% of girls between the ages of five and seventeen solely have a learning disability with no other comorbid disabilities. Furthermore, boys are more likely to have a diagnosis of a learning disability than girls with or without comorbid disabilities (Center for Disease Control, 2003). This may stem from biological differences between males and females or, as some have put forth, the hypothesis that boys are more often diagnosed because they can be more of a distraction in class. For example, boys are more likely to act out, and consequently their teachers are more apt to push for a special education placement. A diagnosis of a specific learning disability accounts for 52.4% of all students defined as having a disability for individuals between the ages of 6-21 (Learning Disabilities Outline, 2008). Furthermore, if an individual has a comorbid health care need, the prevalence of a learning disability increases. For example, learning disabilities affect 2.7 million typical children as opposed to 3.3 million who posses a specific comorbid health care need (Altarac & Saroha, 2007). This is due to the fact that if one

has certain types of disorders (i.e., ADHD, OCD, etc.) he/she is more likely to have a learning disability than a student who does not possess a comorbid disorder.

As previously noted, according to U.S. Federal regulations (as cited in Fletcher et al., 2007) there are seven distinct types of learning disabilities. They are: 1) listening comprehension, i.e., receptive language, 2) oral expression, i.e., expressive language, 3) basic reading skills, i.e., decoding and word recognition, 4) reading comprehension, 5) written expression, 6) mathematics calculation, and 7) mathematics reasoning. These distinct types of learning disabilities often co-occur with one another as well as with disorders in attention, social skills, and emotional disorders. Consequently, as discussed earlier, there is a higher likelihood of comorbidity with an individual possessing a learning disability as opposed to a general member of the population (Fletcher et al., 2007).

It was also previously mentioned that difficulty with reading plays a major role in the identification of learning disabilities. For example, 80-90% of students with learning disabilities displayed difficulties with reading (Lerner, 1989; Lyon et al., 2001). Furthermore, approximately 40 percent of students receiving special education in the United States were identified due to reading difficulties (President's Commission on Excellence in Special Education, 2002).

Without a universal definition that provides explicit criteria, learning disability prevalence rates are merely guesses (Kavale & Forness, 2000). Consequently, discrepancies and changes in prevalence may have more to do with identification criteria than with the nature of the condition (Forness, 1985; Gelzheiser, 1987). For example, in a study conducted by Proctor and Prevatt (2003), the researchers illustrated that by using different models/criteria to identify learning disabilities, differing numbers of students are identified. Specifically, by comparing four models commonly used to identify learning disabilities (simple discrepancy, intra-individual, intellectual Aptitude-Achievement, and underachievement) Proctor and Prevatt revealed that the simple discrepancy model diagnosed significantly more subjects as compared to the other three models in question. This study consisted of 170 clinic-referred university students and consequently had adequate power. However, only two of these subjects were Asian-American and all of the subjects were recruited from two universities and three community colleges. Consequently, the results may not generalize to specific populations. However, the procedure section was clear and concise and the results section, which consisted of

a McNemar test, a frequency analysis, a Phi coefficient, and a contingency table was well developed.

Furthermore, a study conducted by Sparks and Lovett (2009) also found that by using different models/criteria to identify learning disabilities, different numbers of students were identified. However, in the Sparks and Lovett study the researchers examined three different IQ-achievement discrepancies (1.0 to 1.49 SD, 1.5 to 1.99SD, and > 2.0 SD), as well as the criteria used in the DSM-IV and a category for chronic educational impairment beginning in childhood. Similarly to the Proctor and Prevatt study, these researchers also found that the IQ-achievement discrepancy model diagnosed significantly more cases of LD than the other models. However, the Sparks and Lovett study did also reveal that many students with a *previous* LD diagnosis did not qualify under any of these models as well. This study consisted of 378 college students and consequently had adequate power. However, all of the participants were recruited from two universities with most of them (n = 336) coming from a Midwestern state university composed mostly of undergraduate students. Hence, the results of this study may not generalize to specific populations. The procedure section was brief and clear and the results section, which consisted of similar analyses to the 2003 Proctor and Prevatt study (i.e. frequency analysis, McNemar test, and Phi coefficients) was well presented.

Comorbid Conditions

When conducting a learning disability assessment it can often be advantageous for the evaluator to be aware of comorbid LD conditions to aid one in making a proper diagnosis. According to Rutter (1974), Willcutt and Pennington (2000), and Gregg and Deshler (2009), learning disabilities are often associated with other psychological difficulties. For example, psychological issues such as demoralization, low self-esteem, and social skills deficits may all correlate with learning disabilities (DSM-IV-TR, 2000). A learning disability may also produce feelings of anxiety, and inadequacy and shame (Johnson, 2005). Between ten and twenty-five percent of individuals with an Attention-Deficit/Hyperactivity Disorder, Conduct Disorder, Oppositional Defiant Disorder, Dysthymic Disorder or a Major Depressive Disorder, have also been noted to have a comorbid learning disorder (DSM-IV-TR, 2000).

Furthermore, Gregg and Deshler (2009) makes the following observations: The high comorbidity rate between LD and ADHD has been understood for some time. Adolescents and

adults with a learning disability are nearly two times as likely to possess a Generalized Anxiety Disorder than those without a learning disability. While the relationship between a Major Depressive Disorder and LD is tenuous, common symptoms of the adolescent and adult LD population include loneliness, a poor self-concept, and a loss of hope.

In a study by Wilson, Armstrong, Furrie and Walcot (2009) it was noted that individuals with learning disabilities, whose age ranged from fifteen to forty-four, were more than two times as likely to report high levels of depression, anxiety, distress, suicidal thoughts, visits to a myriad of mental health professionals, as well as a poorer overall level of mental health as compared to subjects without disabilities. Furthermore, it was noted that males with learning disabilities reported higher levels of depressive episodes, anxiety disorders, and mental health visits whereas females with learning disabilities reported higher levels of distress, suicidal thoughts, as well as general mental health relative to individuals without disabilities. However, in general, learning disabilities were not discovered to be more detrimental to the mental health of one gender.

In addition, Huntington and Bender's (1993) review of the literature from 1984 to 1993 demonstrated adolescents with learning disabilities have a lower academic self concept, higher levels of trait anxiety, increased levels of somatic complaints, and high rates of depression and suicide. The comorbid link between learning disabilities and depression was examined by Livingston (1985) and he hypothesized three potential relationships. One possibility is that one's depression causes or exacerbates learning difficulties. A second possibility is that learning difficulties cause or exacerbate depression. And Livingston's final hypothesis was that a specific brain dysfunction can potentially lead to depression and learning difficulties in some children. There is also some evidence that developmental delays in language as well as Developmental Coordination Disorders may occur in association with learning disabilities (DSM-IV-TR, 2000). One of the most common comorbid disorders associated with learning disabilities, specifically a reading disability, is Attention-Deficit/Hyperactivity Disorder (Beitchman & Young, 1997; Biederman, Newcorn & Sprich, 1991).

The drop-out rate for students identified as having a learning disability is approximately 40% (DSM-IV-TR, 2000). As Johnson (2005) pointed out, when a student receives significant negative feedback from school it is likely to have a detrimental impact on their emotional, social and family functioning. In addition, adults with learning disabilities may have significant difficulties with their vocation and social adjustment (DSM-IV-TR, 2000).

Clearly, there may be a comorbid underlying cognitive processing abnormality that may precede or be associated with a learning disability (DSM-IV-TR, 2000). This should not be unexpected as a specific learning disability is defined as a "disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written…" (Dumont Willis, 2010). The 'basic psychological processes' referred to in the IDEA definition may very well be a type of 'cognitive processing abnormality' as referred to in the DSM-IV-TR. In addition, a genetic predisposition, perinatal injury, and/or a variety of neurological or other general medical conditions may also be associated with a learning disability. However, it should be noted that the presence of one or more of the comorbid conditions does not necessitate a learning disorder (DSM-IV-TR, 2000). And finally, learning disabilities are associated with a significant number of medical conditions including, but not limited to, fetal alcohol syndrome, lead poisoning, and/or fragile X syndrome (DSM-IV-TR, 2000).

Intervention

As will be discussed in great detail later in this literature review, there are several prominent models that are currently being used to diagnose learning disabilities. However, many of the models aid the evaluator to largely differing degrees in terms of directing intervention. For example, a Low-achievement model may simply identify an individual with a learning disability based on an achievement deficit below a certain benchmark (e.g. 16^{th} percentile). While this information may aid the practitioner by letting him or her know the specific achievement area of deficit, it doesn't assist greatly with specific remediation/intervention. On the other hand, an Intra-Individual model diagnoses a learning disability based largely on processing strengths and weaknesses. Consequently the practitioner may have more specific information when it comes to planning for intervention. For example, if the testing illustrates that a learning disability is due to an auditory processing deficit, interventions may be based more heavily on visual and tactile stimuli if, for example, the practitioner was trying to focus on the student's strengths as opposed to weaknesses. Therefore, while there are many factors that need to be considered before choosing a specific model for diagnosing a learning disability, clearly the issues surrounding intervention, which will be delineated below, need to be considered.

Difficulties with Intervention

When a student is struggling academically, the normal protocol is to administer some type of intervention in an effort to ameliorate the area of need. Unfortunately, while many interventions may prove effective under controlled settings, they often prove ineffective in the real world. Some possible reasons for the lack of generalization are due to a complex school environment and classroom makeup, lack of teacher preparation as well as poor teacher commitment, the composition of the student base, and inadequacy of resources available (Denton, Vaughn & Fletcher, 2003). Furthermore, alternative methods of intervention, such as resource rooms, have also proven to be somewhat ineffective (Fletcher et al., 2007). Other wide scale studies which have examined the effects of special education have illustrated only slight improvement in reading and math in grades 3-6 (Hanushek, Kain & Rivkin, 1998).

There have been many other issues regarding the role of interventions in aiding individuals with learning disabilities. Research has shown that a number of interventions are predicated on clinical intuition and other non-empirically supported foundations which also hamper progress (Fletcher et al., 2007). Many research studies which examine the efficacy of interventions are based on a heterogeneous group of learning disabled students which leads to difficulties with replication (Fletcher et al., 2007). At times, research uses methods that incorporate several treatment modalities which may lead to uncertainty regarding which intervention component affected change (Zigmond, 1993). A large number of studies are of a brief duration (Beriniger, 2004). Consequently, if the intervention produces limited results, one cannot be sure if it is solely due to the ineffectiveness of the intervention or if the lack of adequate time is playing a role (Fletcher et al., 2007). At times, certain intervention studies are confounded by previous and concurrent interventions (Fletcher et al., 2007). A significant amount of research has not separated specific intervention effects from confounding teacher and/or clinician effects. Consequently, such variables as teacher experience and preparation, the teacher student relationship, etc., may be influencing change (Lyon & Moats, 1997). Furthermore, it has been noted that the fidelity regarding the implementation of the intervention is often in question (Berninger, 2004). It is also often unclear how often many of these 'intervention' studies generalize to real world settings (Fletcher et al., 2007). Moreover, at times follow up studies reveal a decrease in intervention gains presumably due to a change in setting (Lyon & Moats, 1997). According to Denton et al. (2003) as cited in Fletcher et al. (2007) a

possible remedy to this decrease in gains would be to conduct intervention research in a less controlled environment.

Another difficulty surrounding intervention revolves around a concept known as 'Aptitude-Treatment Interaction' (ATI). This theory states that particular treatments/interventions are either more or less effective for specific individuals due to their specific abilities. While the ATI theory continues to garner large support from many in the special education community, this commitment may be without scientific merit. After years of research with ATI, Cronbach finally concluded, "Once we attend to interactions, we enter a hall of mirrors that extends to infinity" (Cronbach, 1975, p. 119). This sentiment, proposed by Cronbach, is maintained by many who support a response to intervention approach (which will be discussed in detail in the 'Evaluation Procedures' section) to the identification of learning disabilities (Hale, Kaufman, Naglieri & Kavale, 2006). However, it should be noted that a countering viewpoint which supports an Aptitude-Treatment Intervention effectiveness is held by many in the field (Hale, et al., 2006).

Prevention

There is a large amount of research indicating that early intervention/prevention programs in general education are effective (Fletcher et al., 2007). However, these programs are not readily utilized (Fletcher et al., 2007). If these programs were implemented on a large scale the number of students who emerge as eligible for special education in future years could potentially be dramatically reduced (Fletcher et al., 2007). Fletcher et al. (2007) continue to state that the first step in the prevention process is to add to the time and effort given to assistance in the academic area of concern. To accelerate remediation it may also be necessary to engage in academic endeavors outside of school. The template for success, according to Fletcher et al. (2007), is now in place through the provisions set forth by IDEA, 2004. This legislation states that students should not be given a diagnosis of a learning disability without appropriate instructional opportunities. By using a model that incorporates Response to Intervention, which is endorsed by IDEA, 2004, struggling students should partake in a multi-tiered process which begins within the confines of general education and could eventually lead to more stringent interventions. While the culmination of this process may very well be a special education placement the emphasis is on intervention and prevention. As Fletcher et al. (2007) point out,

"The key is to embrace prevention when possible and to be prepared to respond with intensive specialized remediation when preventative efforts prove inadequate (p. 264).

Methods to Improve Intervention

Even with the utilization of the procedures set forth in IDEA, 2004 such as RTI, multi-tiered levels of intervention, strong fidelity, focusing on screening, progress monitoring, and prevention, research based instruction and intervention will not meet the needs of all students who struggle academically (Fletcher et al., 2007). The research clearly demonstrates that even with high levels of treatment fidelity an unacceptable amount of students with learning disabilities fail to make adequate progress (Fletcher et al., 2007). A key component to improving the implementation and utilization of interventions is through screening and progress monitoring. Careful screening measures aides in identifying struggling students at an early stage when appropriate interventions are often the most effective. Furthermore, screening technology is now available to aid in the assessment of reading difficulties (Donovan & Cross, 2002). This is important as reading difficulties play an essential role for a preponderance of students with learning difficulties. Furthermore, progress monitoring for students who exhibit academic struggles is critical (Fletcher et al., 2007). Routine progress monitoring for students displaying academic difficulties may provide a greater impact than any other intervention as it provides an ongoing and immediate feedback which allows interventions to be modified if need be (Fletcher et al., 2007). Despite the aforementioned difficulties with finding and implementing appropriate interventions for students with learning disabilities Fletcher et al. (2007) provide ten general principles for instructing, and in effect providing interventions, for students with learning disabilities. They are as follows:

1) Increase the time on task – Interventions for students with learning disabilities should complement instructional opportunities as opposed to replacing them.
2) The instructional approach should be explicit, well organized, and be able to provide ample opportunity for review of previously mastered content. – This principle applies to both foundational as well as higher order processes.
3) Self –regulation strategies – Students should monitor their own academic performance and progress as well as set their own goals.

4) Peer mediation – This may provide an effective method for scaffolding instruction, creating structure, and to support practice.
5) Continue to work on higher-order processes – This should be encouraged even when a student has a weakness with a foundational skill. In other words teachers should promote higher-order processes in combination with those fundamental skills.
6) Academic improvements are specific to the material that is taught – In other words, interventions should stress academic content. Research has shown that academic interventions are most effective for the learning disabled population. Furthermore, interventions based on processing deficits, brain functioning, vision, etc., without focusing on specific academic skills often do not result in improved outcomes for the learning disabled population.
7) Instructional programs and interventions should be integrated – In other words it is essential to teach all aspects of a skill for true progress to be made. For example, when instructing in the area of reading, it would be a best practice to teach word recognition, fluency, and comprehension as each is an essential component to reading effectively as opposed to simply concentrating on one or two of the components.
8) Research must account for the heterogeneity of the learning disabled population – When providing an intervention one must keep in mind the multifaceted nature of learning disabilities, i.e., learning disabilities with a comorbid ADHD diagnosis.
9) Frequent monitoring is essential – Progress should be closely monitored with the goal of informing intervention. Furthermore, an appropriate intervention should be implemented as soon as possible.
10) Systematically integrate interventions within general education – Best practices revolves around a least restrictive environment which entails including an intervention within a general education setting whenever possible.

The ultimate goal of providing an intervention for a student with a learning disability should be to provide an experience that will ultimately aid them in overcoming the barrier that is prohibiting success (Fletcher et al., 2007).

ADA, IDEA and Section 504

Americans with Disabilities Act

Approximately twenty-six years after the inception of the Civil Rights Act of 1964, the Americans with Disabilities Act (ADA) of 1990 was passed which in essence gave individuals with disabilities comparable rights to women and minorities (LD Online, 2008). The goal of this federal law is simply to aid in the elimination of discrimination against individuals who possess disabilities, including learning disabilities (LD Online, 2008; National Joint Committee on Learning Disabilities, 1992). This act states that individuals with disabilities have access to and are accommodated in employment, transportation, public accommodations, government activities, as well as with communication (National Joint Committee on Learning Disabilities, 1992). The Americans with Disabilities Act of 1990 specifically defines a disability as "a physical or mental impairment that substantially limits one or more of the major life activities of an individual" (ADA 1990 as cited in National Joint Committee on Learning Disabilities, 1992). The legislation does list specific learning disabilities as one of the possible physical or mental impairments and furthermore, learning is included as a major life activity. Thus, specific learning disabilities are covered under the ADA and individuals who are discriminated against according to the terms of the ADA now have legal recourse. Under this law, one is covered if:
1) There is a legitimate disability.
2) One is perceived as possessing a disability.
3) One is related to, or associated with, an individual with a disability (LD Online, 2008). For example, the mother of a student with a learning disability may not be discriminated against because her employer fears that her performance may be adversely affected due to her son's difficulties.

However, it should be noted that Price, Gerber and Mulligan (2007) stated that individuals with learning disabilities underuse the support provided by the ADA as compared to individuals with other disabilities. Consequently, while the ADA has set forth legal protection for individuals with learning disabilities, they are often left dormant.

Individuals with Disabilities Education Act

In 1975, Congress passed what was originally known as the Education for All Handicapped Children Act to ensure that schools would serve the needs of students with

disabilities (National Center for Learning Disabilities, 2008). This law has undergone several changes over the past thirty-three years and in 1990 its name was changed to The Individuals with Disabilities Education Act (IDEA). The most recent adaptation to IDEA occurred in 2004. As stated in the Learning Disabilities Association of America (2008), there are six main components to IDEA. They are as follows:

1) Free Appropriate Public Education (FAPE) – IDEA states that each student with a disability who is eligible for special education services is entitled to a free appropriate public education.
2) Appropriate evaluation – IDEA states that each student suspected of possessing a disability is entitled to an appropriate evaluation.
3) Individualized Education Program (IEP) – IDEA states that in order to comply with the regulation that each student with a disability receives an appropriate and individualized education, the IEP team must develop a written document that specifies the distinctive educational needs of its students.
4) Least Restrictive Environment – IDEA states that each student with a disability receives his/her education in the least restrictive environment.
5) Parent and Student Participation in Decision Making – IDEA states that parents and students (as deemed appropriate) take part in each component of the special education process.
6) Procedural Safeguards – IDEA states that the rights of students with disabilities, as well as their parents' rights, are protected.

Furthermore, the 2004 reauthorization of IDEA had a significant impact on the way students with suspected learning disabilities may be identified. The reauthorization specifies that school systems may not require the use of a severe discrepancy between intellectual ability and achievement for determining whether or not a student has a learning disability. School systems must permit the use of procedures that assess whether students respond adequately to scientific research-based intervention. School systems may allow other research-based actions (IDEA, 2004). Consequently, IDEA, 2004 strives to accept current research which indicates a reduced focus on IQ tests while emphasizing the role of instruction (Fletcher et al., 2007). However, it should be noted that according to Marquette University law professor, Paul Secunda, the key word is 'discretion.' Professor Secunda emphasizes that it is up to the individual state's

discretion to decide which type, or types, of learning disability eligibility criteria its school systems may use. While many school systems are heading in the direction of RTI, there are still a large percentage of states which use a type of discrepancy based procedure and many school systems are also now using a combination of RTI and discrepancy based models. In other words, if a student fails to respond to scientifically based instruction, the school system may then go to testing to ensure that the lack of response is due to, for example, a learning disability as opposed to mental retardation, emotional disturbance, etc. (P. Secunda, personal communication, 2009).

Section 504 of the Rehabilitation Act of 1973

Section 504 is a civil rights law that makes it illegal to discriminate on the basis of a disabling condition by entities that receive or benefit from federal assistance (LD Online, 2008). This statue was designed for individuals who have, or have had, a physical or mental impairment that substantially limits a major life activity or is regarded as having a physical or mental impairment by others. A 'major life activity' may include: walking, seeing, hearing, speaking, breathing, learning, working, caring for oneself, and performing manual tasks. If a student has difficulty learning, i.e., has a learning disability, but does not qualify for special education under the auspices of IDEA, he/she may qualify under Section 504. It should be noted that students do not require special education services to qualify for accommodations under section 504. For example, a student who is no longer eligible for services under IDEA may be entitled to services through Section 504. Furthermore, similarly to the ADA, individuals who are discriminated against according to the terms of Section 504 now have legal recourse.

History

> Without a historical perspective, the uniqueness of present-day contributions and discoveries tends to be overemphasized. But in fact these contributions represent extensions, modifications, verifications, or duplications of previously observed phenomena or stated positions. Unless we use the past as points of reference and guides, investigators of [learning disabilities] may either recommit past follies or rediscover the contributions of their professional progenitors when they should instead extend and correct the works of those who pioneered before them (Weiderholt, 1974, p.1).

As Torgesen (1991) stated, the study of intra-individual and inter-individual differences in learning and cognition has its roots in early Greek civilization. However, for all intents and purposes, the study of learning disabilities truly began in what Hallahan and Mock (2003) called the 'European Foundation Period' which spanned from 1800-1920. One impetus for this undertaking was the need to understand why some children and adults were displaying individual differences in learning with specific deficits, primarily in spoken and written language, while obtaining apparent average intelligence and no adverse adaptive functioning (Doris, 1993; Hammill, 1993; Kavale & Forness, 1985; Morrison & Siege, 1991; Rutter, 1982; Satz & Fletcher, 1980; Torgesen, 1991 as cited in Fletcher et al., 2007). It was during the European Foundation Period that several European physicians began to explore the association between brain injury and specific adverse behaviors such as deficits in spoken language (Hallahan & Mock, 2003). Yet the first piece of work that has a true bearing on the nature and conceptualization of today's schema of a learning disability stems from the European physician, Franz Joseph Gall (Wiederholt, 1974). Prior to Gall, there was an assumption that the brain was "a single organ from which flowed viral energy under the influence of the will into parts of the body" (Head, 1926, p.3 as cited in Hallahan & Mock, 2003). Gall's observations led to the new notion that separate areas of the brain were responsible for controlling specific functions (Hallahan & Mock, 2003). Gall's efforts led to other important insights as well. For example, as Hammill (1993) stated, Gall's work with patients that were unable to speak but were able to put their thoughts down on paper through written language led to the notion of specific cognitive strengths and weaknesses that were a function of brain damage. Gall went on to hypothesize that this brain damage could impair some areas of functioning without affecting others. Gall's insight was the force behind today's theory that individuals with learning disabilities display specific, as opposed to generalized, deficits. As Hammill (1993) went on to discuss, Gall also stated that it was important to rule out other possible conditions such as mental retardation, blindness, etc., to ensure that these were not the reason for the patient's difficulties. Fletcher et al. (2007) argued that this insight by Gall was the forerunner to today's 'exclusion' criteria within the current prominent definitions of learning disabilities.

Following Gall's groundbreaking work, several leading physicians of the time continued to explore the theory that brain damage could impact specific human functions. For example, in the 1820's John Baptiste Bouillaud began performing autopsies with brain injured patients which

supported Gall's hypothesis that brain functioning was localized (Hallahan & Mock, 2003). Following Bouillaud, Pierre Paul Broca also used autopsies to posit that brain activity controlled specific functioned as opposed to generalized ability (Fletcher et al., 2007; Hallahan & Mock, 2003). More specifically, Broca discovered that speech abilities stem from the inferior left frontal lobe (Hallahan & Mock, 2003). Subsequent to Broca's efforts, Carl Wernicke stated that one's receptive language abilities could be impacted despite having all other cognitive or linguistic abilities intact (Fletcher et al., 2007). As experimentation with language disorders advanced, an interest in related reading disorders developed (Hallahan & Mock, 2003). In 1877, Adolph Kussmaul commented on a case conducted by Van den Abeele in which Van den Abeele stated that a person may be 'text-blind', i.e., unable to read adequately, despite having sufficient sight and intellect (Hallahan & Mock, 2003). Kussmaul altered the term 'text-blind' to 'word blindness' to describe this specific type of reading disability (Hallahan & Mock, 2003). Subsequently, Berlin, a German ophthalmologist, coined the term 'dyslexia' for a reading condition that he believed to be of neurological origin as opposed to Kussmaul's 'word blindness' (Anderson & Meier-Hedde, 2001). Inspired by the work of his predecessors, a French physician named John Hinshelwood followed a patient with reading difficulties from 1894 until his death in 1903. The autopsy, performed by Hinshelwood, indicated that the left angular gyrus of the brain was the root of the reading disability (Hallahan & Mock, 2003). Eventually in 1917 Hinshelwood would publish *Congenital Word-Blindness* in which he noted that males were more prone to this condition than females as well as the potential for the heritability (Hallahan & Mock, 2003).

By the early part of the 20th century there was mounting research that could be attributed to a specific type of learning difficulty (Fletcher et al., 2007). Hynd and Willis (1988) summarized the field to this point with the following five observations: 1) The type of learning problem was congenital in nature. 2) The specific learning difficulties affected males more than females. 3) The learning difficulties were not homogeneous in nature. 4) The difficulties may stem principally from left-hemisphere central language processes. 5) These difficulties were not adequately addressed through typical classroom instruction. By 1918, every state had laws stating that education was obligatory for all children (Hallahan & Mock, 2003). A major theme of this time period was literacy (Hallahan & Mock, 2003). This goal was challenging as many

children lacked the skills to read and as a result remediation became essential. Consequently, there was a great deal of effort focused on reading disabilities (Hallahan & Mock, 2003).

The next major stage in the history of learning disabilities is what Hallahan and Mock (2003) refer to as the 'U.S. Foundation Period' that lasted from 1920-1960. At the beginning of this time period Samuel Torrey Orton, a neuropathologist at the State Psychopathic Hospital in Iowa, began assessing students with learning difficulties and observed that many of these children had low reading achievement but paradoxically had either near average or above average intellect. This observation led Orton to surmise that IQ was not always indicative of overall intellectual capacity (Hallahan & Mock, 2003). Orton's hypothesis is indicative of many of today's leading reading researchers (Siegel & Ryan, 1989). Orton's work was based, in large part, on the work of Hinshelwood. However, Orton eventually disagreed with several of Hinshelwood's findings (Hallahan & Mock, 2003). For example, Orton believed that reading disabilities were as prevalent as 10% of the school population whereas Hinshelwood believed it was closer to 1 per 1,000 (Orton, 1937). Furthermore, Orton speculated that the epidemiology for reading disorders involved more than just the angular gyrus as Hinshelwood had postulated (Orton, 1937). And finally, Orton hypothesized that the brain stored mirror visual images. Orton went on to say that individuals with reading disabilities were unable to assert visual dominance and thus were incapable of suppressing these aforementioned mirrored visual images. According to Orton, the inability to suppress these images led to the reversal of letters and words. Orton labeled this occurrence 'strephosymbolia' stating that while these individuals could see the letters and words they, in essence, twisted the symbols (Hallahan & Mock, 2003). Orton's theory of dyslexia has since been disproven (Torgesen, 1991). In actuality, his work has perpetuated the falsehood that individuals with reading disabilities see things backward (Hallahan & Mock, 2003). Yet despite these shortcomings Orton's work served to move the field forward and has consequently had a largely positive effect on the study of learning disabilities. The end result of Orton's effort was one that spurred and influenced research, lobbying groups, as well as instruction (Fletcher et al., 2007).

An associate of Orton's named Marion Monroe originated a synthetic phonetic approach to reading which she published in *Children Who Cannot Read* in 1932 (Hallahan & Mock, 2003). Yet one of Monroe's most important contributions came indirectly from the work she did with a colleague named Samuel Kirk. Due in large part to Monroe's guidance Kirk fashioned

two important ideas that have helped shape the field of learning disabilities. For one Kirk stated that children with disabilities have intra-individual differences, i.e., they have significant personal cognitive strengths and weaknesses, and secondly, Kirk proposed that assessment is an essential component in shaping instruction (Hallahan & Mock, 2003).

It was during this time period that research began to expand to disabilities beyond reading. For example, Kurt Goldstein, among others, began to examine perception, perception-motor, and attention disabilities (Hallahan & Mock, 2003). While working as a physician in a hospital with brain injured soldiers from World War I, Goldstein observed that there were a host of unwanted behaviors that accompanied specific types of brain injuries (Goldstein, 1936, 1939, as cited in Hallahan & Mock, 2003). Goldstein's work served as a platform for researchers interested in relating his work to children (Hallahan & Mock, 2003). Two key figures in this endeavor were Alfred Strauss, a neuropsychiatrist, and Heinz Werner, a developmental psychologist (Hallahan & Mock, 2003). Strauss and Werner's work involved children with mental retardation. The children were placed into two groups. The first group entailed children with exogenous mental retardation who were presumed to have a brain injury and the other group was made up of children with endogenous mental retardation which was presumed to be of a familial etiology. Based on their work, Strauss and Werner discovered that the exogenous group displayed more forced responsiveness to visual and auditory stimuli (Werner & Strauss, 1939b, 1940, 1941, as cited in Hallahan & Mock, 2003). Furthermore, Strauss and Kephart found that the exogenous group was more likely to be disinhibited, impulsive, erratic, and unaccepted socially as compared to their endogenous counterparts (Strauss & Kephart, 1939 as cited in Hallahan & Mock, 2003). The result of these efforts was the conclusion that mental retardation was a heterogeneous state (Hallahan & Mock, 2003). Furthermore, Strauss and Lehtinen (1947) reported that the endogenous children with mental retardation actually exhibited similar outcomes to some children without mental retardation. Strauss and his contributors concluded that the children with average intelligence who displayed learning and behavioral difficulties were suffering from what they termed 'minimal brain injury' or 'MBI' (Fletcher et al., 2007). It was from the work of Strauss's group that the concept of 'minimal brain dysfunction' or 'MBD' would emerge. A key component of MBI/MBD was that it could be identified through the behavioral information alone with no evidence of physical or neurological dysfunction. As Strauss and Lehtinen succinctly stated:

> When no mental retardation exists, the presence of psychological disturbances can be discovered by the use of some of our qualitative tests for perceptual and cognitive disturbances. Although the [physical] criteria may be negative, whereas the behavior of the child in question resembles that characteristic for brain injury, and even though the performances of the child on our tests are not strongly indicative of brain injury, it may still be reasonable to consider the diagnosis of brain injury (1947, p. 112).

Strauss and his cohort left an indelible mark on the field of learning disabilities (Doris, 1993; Hammill, 1993). Torgesen (1991) summarized three major advances brought upon by the Sraussian movement. 1) The way a child approaches a learning task can facilitate knowledge regarding how an individual learns. 2) Teaching should reflect processing strengths and weaknesses. 3) Students who struggle due to deficient processing may be aided by focusing on their cognitive processing strengths as opposed to their processing weaknesses. Following Strauss and others, William Cruickshank propelled the field forward by stressing specific characteristics of the learner as well as intervention as opposed to etiology (Fletcher et al., 2007). However, arguably Cruickshank's most important contribution was taking the research done with students with mental retardation and connecting it to the learning disabled population (Hallahan & Mock, 2003).

According to Hallahan and Mock (2003) the work of Cruickshank marked the end of the U.S. Foundation Period and brought the field of learning disabilities into the 'Emergent Period' which would last from 1960-1975. It was during this time period that parents and teachers came together to form organizations to advocate for children with learning disabilities. Furthermore, lawmakers became aware of this disorder and researchers advanced the use of specific interventions to aid this population (Hallahan & Mock, 2003). Despite the knowledge of some of the specific characteristics of individuals with learning disabilities, it wasn't until 1962 that the term 'learning disability' first appeared in print. In *Educating Exceptional Children* Samuel Kirk (1962) defined a learning disability as:

> a retardation, disorder, or delayed development in one or more of the processes of speech, language, reading, writing, arithmetic, or other school subject resulting from a psychological handicap caused by a possible cerebral dysfunction and/or emotional or behavioral disturbances. It is not the result of mental retardation, sensory deprivation, or cultural and instructional factors. (p. 263)

Following this written proposal of a learning disability, Kirk expounded on this definition in a 1963 lecture to a group of parents at the Exploration into Problems of Perceptually Handicapped Children conference. It was here that Kirk stated:

> I have used the term "learning disabilities" to describe a group of children who have disorders in the development of language, speech, reading, and associated communication skills needed for social interaction. In this group, I do not include children who have sensory handicaps, such as blindness, because we have methods of managing and training the deaf and blind. I also excluded from this group children who have generalized mental retardation. (pp. 2-3, as cited in Fletcher et al., 2007).

In 1965 a former student of Kirk's named Barbara Bateman delivered the following definition of learning disabilities.

> Children who have learning disorders are those who manifest an educationally significant discrepancy between their estimated potential and actual level of performance related to basic disorders in the learning process, which may or may not be accompanied by demonstrable central nervous system dysfunction, and which are not secondary to generalized mental retardation, educational or cultural deprivation, severe emotional disturbance, or sensory loss. (1965, p. 220, as cited in Hallahan & Mock, 2003, as cited in Kavale & Forness, 2000).

Bateman's definition is most notable primarily due to the notion of the achievement-aptitude discrepancy which has been inextricably linked to the definition of learning disabilities for years and has recently been a topic of much debate. Furthermore, the concept of learning disabilities could now be understood as a learning failure that was unexpected, thus linking a learning disability with underachievement (Kavale & Forness, 2000).

As the field of learning disabilities continued to advance, the federal government began to get involved and funded a project entitled 'Minimal Brain Dysfunction: National Project on LD in Children.' This project included three task forces, two of which were used to define a learning disability. Because Task Force I was comprised of medical professionals and Task Force II was made up of educators, the two Task Forces produced strikingly different definitions (Hallahan & Mock, 2003). Task Force I termed the disorder as 'minimal brain dysfunction' and defined it as a disorder affecting:

> children of near average, average, or above average general intelligence with certain learning or behavioral disabilities ranging from mild to severe, which are associated with deviations of functions of the central nervous system. These deviations may manifest themselves by various combinations of impairment in perception, conceptualization, language, memory, and control of attention, impulse, or motor function. Similar symptoms may or may not complicate the problems of children with cerebral palsy, epilepsy, mental retardation, blindness or deafness. These aberrations may arise from genetic variation, biochemical irregularities, perinatal brain insults, or other illnesses or injuries sustained during the years which are critical for the development and maturation of the central nervous system or from unknown causes. The definition also allows for the possibility that early sensory deprivation could result in central nervous alteration which may be permanent. During the school years, a variety of learning disabilities is the most prominent manifestation of the condition which can be designated by this term. (Clements, 1966, pp. 9-10)

Task Force II was unable to come up with a uniform consensus on their definition and consequently proposed two separate definitions. The first definition, which emphasized Kirk's earlier concept of intra-individual differences, which as mentioned previous stated children with learning disabilities have significant personal cognitive strengths and weaknesses, (Hallahan & Mock, 2003), is as follows:

> Those (1) who have educationally significant discrepancies among their sensory-motor, perceptual, cognitive, academic, or related developmental levels which interfere with the performance of educational tasks; (2) who may or may not show demonstrable deviation in central nervous system functioning; and (3) whose disabilities are not secondary to general mental retardation, sensory deprivation, or serious emotional disturbance. (Haring & Bateman, 1969, pp. 2-3)

The second definition, which emphasized Monroe and Bateman's discrepancy hypothesis (Hallahan & Mock, 2003), is as follows:

> Children with LD are those (1) who manifest an educationally significant discrepancy between estimated academic potential and actual level of academic functioning as related to dyfunctioning (sic) in the learning process; (2) may or may not show demonstrable deviation in central nervous system functioning; and (3) whose disabilities are not

> secondary to general mental retardation, cultural, sensory, and/or educational deprivation or environmentally produced deprivation or environmentally produced serious emotional disturbance. (Haring & Bateman, 1969, p. 3)

While the first definition places an emphasis on Kirk's notion that individuals with a learning disability have significant personal cognitive strengths and weaknesses the second definition places on emphasis on Monroe and Bateman's discrepancy hypothesis which states that a learning disability is manifested by a significant discrepancy between one's estimated academic potential and actual level of academic functioning, i.e., a significant discrepancy between one's ability and achievement.

As the two Task Forces were developing their respective definitions, the federal government approved and signed the Education of the Handicapped Act in 1966. Now that learning disabilities were federally recognized a definition was necessary to establish a new category of special education (Hallahan & Mock, 2003). This was accomplished through the National Advisory Committee on Handicapped Children (NACHC) in 1968. The NACHC was chaired by Kirk and consequently was quite similar to his 1962 definition. It read as follows:

> Children with special (specific) LD exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken and written language. These may be manifested in disorders of listening, thinking, talking, reading, writing, spelling, or arithmetic. They include conditions which have been referred to as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia, etc. They do not include learning problems that are due primarily to visual, hearing or motor handicaps, to mental retardation, emotional disturbance, or to environmental disadvantage. (U.S. Office of Education, 1968, p. 34)

Following this report from the NACHC, as well as the development of the Division for Children with LD (DCLD) of the Council for Exceptional Children, Congress enacted the Children with Specific LD Act which was legislation that specifically included individuals with learning disabilities. Furthermore, this act included a working definition of a learning disability into federal law (Martin, 1987, as cited in Hallahan & Mock, 2003).

As the Emergent Period came to an end there was a feeling that, despite several missteps, the time period contributed greatly to the field of learning disabilities (Weiderholt, 1974). As explained by Hallahan and Mock (2003) the field then moved into the 'Solidification Period'

which spanned from 1975-1985. Hallahan and Mercer (2001) described the Solidification Period as a calm that would precede a later period of turbulence (as cited in Hallahan & Mock, 2003). One of the first major developments of this time period was the signing of the Education for All Handicapped Children Act (EAHCA) into law by Gerald Ford. One of the essential components of the EAHCA was the requirement that all school districts provide a free and appropriate public education to its students. This included students with learning disabilities (Hallahan & Mock, 2003).

Following the 1975 signing of the EAHCA, in 1977 the U.S. Office of Education defined a learning disability as follows:

> The term "specific learning disability" means a disorder in one or more of the psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, speak, read, write, spell, or to do mathematical calculations. The term does not include children who have LD which are primarily the result of visual, hearing, or motor handicaps, or mental retardation, or emotional disturbance, or of environmental, cultural, or economic disadvantage. (U.S. Office of Education, 1977, p. 65083)

This definition, proposed by the U.S. Office of Education, is very similar to the 1968 definition given by the National Advisory Committee on Handicapping Conditions (NACHC). Furthermore, this definition, with minor alterations, is essentially the same definition used for learning disabilities today (Hallahan & Mock, 2003)

The National Joint Committee on LD (NJCLD) disagreed with the aforementioned definition put forth by the NACHC and proposed a definition that excluded the 'psychological process' clause. Apparently, the NACHC was not convinced that the term 'psychological process' adequately described the difficulty that the learning disabled individual has with the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. The NJCLD definition is as follows:

> LD is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual and presumed to be due to central nervous system dysfunction. Even though LD may occur concomitantly with other handicapping conditions (e.g., sensory impairment, mental

> retardation, social and emotional disturbance) or environmental influences (e.g., cultural differences, insufficient-inappropriate instruction, psychogenic factors), it is not the direct result of those conditions or influences. (Hammill, Leigh, McNutt & Larsen, 1981, p. 336)

Hallahan and Mock (2003) defined the time period between 1985-2000 as the 'Turbulent Period'. As Hallahan and Mock (2003) pointed out, if the Solidification Period was considered the calm before the storm, the 'storm' was represented by the Turbulent Period. Between 1974 and the 1998-1999 school year the number of students identified as learning disabled doubled (Hallahan & Mock, 2003). Throughout this time period there were a number of learning disability definitions put forth in an effort to bring some sort of cohesion to the field (Hallahan & Mock, 2003). For example, in 1986, what is now referred to as the LD Association of America promulgated a definition that stressed that a learning disability is a lifelong condition. It went on to state that a learning disability may have an adverse effect on such things as self-esteem, one's educational outcome, one's vocation, ability to socialize, and/or their daily living (Association for Children with LD, 1986). An important aspect of this definition was that there was not an 'exclusion clause'. Apparently the committee felt that if an individual met their definition's learning disability criteria that this was sufficient for a learning disability diagnosis even if the 'disability' was due to a type of exclusionary criteria such as one noted in NJCLD definition. Following the definition from the Association for Children with LD the Interagency Committee on LD put forth a definition that was comparable to the NJCLD definition with two notable exceptions. For one, the Interagency Committee on LD's definition added social skills deficits as a category of learning disability as well as listing attention deficit disorder as a type of potential comorbid condition (Hallahan & Mock, 2003). Following the definition put forth by the Interagency Committee on LD, the NJCLD revised its definition to make it more synonymous with the lifelong character of learning disabilities which is stated in the Learning Disabilities Association of America definition as well as distancing itself from the social skills deficit found in the definitions from the LDA and ICLD. The new NJCLD definition read as follows:

> LD is a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction, and may occur across the

> lifespan. Problems of self regulatory behaviors, social perception, and social interaction may exist with LD but do not by themselves constitute a LD. Although LD may occur concomitantly with other handicapping conditions (for example, sensory impairment, mental retardation, serious emotional disturbance) or with extrinsic influences (such as cultural differences, insufficient or inappropriate instruction), they are not the result of those conditions or influences. (National Joint Committee on LD, 1988, p.1)

Incredibly, in spite of the numerous and various definitions promulgated between the years of 1975 and 1997, at the beginning of the twenty-first century the definition of a learning disability was essentially the same as when it was proposed by Samuel Kirk in 1962 (Hallahan & Mock, 2003).

While the definition of a learning disability remained the same, in 2004, through the Individuals with Disabilities Education Act (IDEA), the United States Congress altered the regulations set forth in 1977 (Fletcher et al., 2007). For example, the reauthorization of IDEA specified that 1) the use of IQ tests for the identification of a learning disability was now optional (as there was recent empirical evidence to illustrate that the use of IQ testing did not significantly aid in distinguishing between individuals with and without learning disabilities in every case, and that there may be more effective ways to determine a learning disability in certain cases), 2) that all states have to allow school districts to use identification models that incorporate response to instruction (Fletcher et al., 2007). Following the 2004 IDEA statute, the Office of Special Education and Rehabilitation Services (OSERS), which is a division of the U.S. Department of Education, put forth federal regulations in an effort to adjust the policy for the identification of learning disabilities (Fletcher et al., 2007). These rules stem from recent evidence that an IQ-achievement discrepancy may have questionable validity in the identification of learning disabilities. For, as stated earlier when discussing the rationale for making IQ testing optional, there was also recent empirical evidence to illustrate that the use of IQ-Achievement discrepancy testing did not significantly aid in distinguishing between individuals with and without learning disabilities in every case, and that there may be more effective ways to determine a learning disability in certain cases. Furthermore, these new changes emphasize the value of response to instruction (Fletcher et al., 2007). It should be noted that there are a number of groups that disagree with one or more of the modified 2004 IDEA regulations. However, there does seem to be overwhelming support for the movement toward empirically supported decision making

procedures, i.e., the majority of researchers and practitioners support the most recent modifications to IDEA (Fletcher et al., 2007).

Current Definitions and Trends

As previously stated, the United States Congress altered the regulations for determining a learning disability as set forth in 1977 through the Individuals with Disabilities Education Act (IDEA) in 2004 (Fletcher et al., 2007). The most current research was the impetus for this advancement in the field. For example, researchers have recently come to the conclusion that the previously garnered IQ-achievement discrepancy model, which examines the discrepancy betweens one's ability, as measured by an IQ score, and achievement, as usually measured by a standardized measure of academic attainment, was ineffective in adequately identifying learning disabilities (Fletcher et al., 2007; Fletcher, Morris & Lyon, 2003; Kavale & Flanagan, 2007; Lovett & Gordon, 2005; Siegel, 1999; Sternberg & Grigorenko, 2002). As Vellutino, Scanlon and Lyon (2000) succinctly stated:

> the IQ-achievement discrepancy does not reliably distinguish between disabled and non-disabled readers. Neither does it distinguish between children who were found to be difficult to remediate and those who are readily remediated prior to initiation of remediation, and it does not predict response to remediation (p. 235).

Furthermore, Brueggemann, Kamphaus and Dombrowski (2008) stated:

> Some of the most widely cited shortcomings of the discrepancy model are its lack of reliability and validity, its lack of relevance to treatment (Velluntino et al., 1996), and its inability to indentify children who are in need or remediation versus those who are not (Stanovich, 2005). Additionally, it is associated with delayed access to intervention (Stuebing et al., 2002) and the Mathew effect, whereby deficient reading skills result in depressed IQ test scores, thus reducing the likelihood of the child experiencing a discrepancy and therefore receiving an LD classification (Stanovich, 1986).

In addition, Fuchs, Mock, Morgan and Young (2003) stated that due to a longstanding concern regarding the identification and definition(s) of learning disabilities, along with federal efforts to do away with the IQ-achievement discrepancy model, there has been a push to identify alternative methods of identification.

The No Child Left Behind (NCLB) Act of 2001 (Public Law 107-110) is a United States federal law that reauthorized several federal programs with the goal of improving the performance of U.S. primary and secondary schools by raising the standards of accountability for states, school districts, and schools, as well as providing parents more flexibility in choosing which schools their children will attend. Furthermore, it re-authorized the Elementary and Secondary Education Act of 1965 (ESEA). The Act was passed in the House of Representatives on May 23, 2001, United States Senate on June 14, 2001, and signed into law on January 8, 2002. Further changes to NCLB were set forth in 2004. To aid in accomplishing these aforementioned new standards, NCLB has advocated for a new method of remediating learning difficulties, and if necessary, diagnosing learning disabilities. One of the most popular new methods has been termed, 'Response to Intervention' (Fuchs et al., 2003).

Response to Intervention (RTI) is a service delivery model of academic intervention intended to offer early assistance to students who are experiencing difficulties with one or more areas of learning. It is seen as an alternative to the IQ-Achievement discrepancy model which has been criticized by some as ineffective (Fletcher et al., 2007) as well as a 'wait-to-fail' method of identifying children in need. Furthermore, RTI is seen as a data-based process of aiding students and potentially identifying them for special education services if need be. RTI attempts to avert academic difficulties through early intervention. Specific empirical interventions are then followed by monitoring the progress of the students in need. If the data illustrate that the intervention(s) are proven to be ineffective then they are modified or intensified. Students who do not demonstrate a response to scientifically based interventions are then deemed to be in need of special education services (Fuchs & Fuchs, 2006).

In summation, while these findings can be considered contentious among some, there is a definite move toward a response to intervention model throughout the school systems in the United States.

Evaluation Procedures

It has been said that the most severe issue with the study of learning disabilities is its difficulties with definition (Fletcher et al., 2007). There have been many proposed definitions of what constitutes a learning disability throughout the years (see 'History' Section above). As Fletcher, Denton and Francis (2005) stated, one possible reason for the multitude of definitions

revolves around the difficulty in defining learning disabilities. This difficulty may stem from two main issues. For one, a learning disability is an unobservable latent variable which makes it difficult to measure as opposed to, for example, an intellectually deficiency which have criteria that are more clearly defined. And secondly, learning disabilities exist on a continuum and consequently do not stand alone as a discrete category (Ellis, 1984). (However, some may state that this argument may hold true for many of the other disorders in the DSM-IV-TR as well.) With this being said, the most widely accepted current definition comes from the Individuals with Disabilities Education Act, 2004. As mentioned in the Introduction, it states that a specific learning disability is:

> A disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations. This term includes such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. This term does not include children who have learning problems that are primarily the result of visual, hearing, or motor disabilities; mental retardation; or environmental, cultural or economic disadvantage (Dumont Willis, 2010).

Another issue that has plagued the study of learning disabilities has centered around identification. For years the aptitude-achievement discrepancy model was the standard from which a learning disability was identified. In other words, a student needed to demonstrate a severe discrepancy between his aptitude (usually determined by an IQ test) and his achievement in a specific academic area. However, due to a growing dissatisfaction with the 'discrepancy model' stemming from what many have deemed its ineffectiveness (Fletcher, et al., 2007; Torgeson, 2004) IDEA, 2004 has made groundbreaking changes to the identification process of specific learning disabilities. For example, IDEA (2004) now states that school systems:

> Must not require the use of a severe discrepancy between intellectual ability and achievement for determining if a child has a specific learning disability ... must permit the use of a process based on the child's response to scientific, research-based intervention and may permit the use of other alternative research-based procedures for determining whether a child has a specific learning disability…" (Special Education in Texas, 2010).

Furthermore, learning disabilities are often diagnosed by a process of exclusion. If a student demonstrates a disability that adversely affects his education, and the child has not been diagnosed with mental retardation, a hearing or motor disability, does not demonstrate an emotional disturbance, and does not demonstrate environmental, cultural, or economic disadvantages, the student will likely be diagnosed with a learning disability (Wrightslaw, 2008). The results of the ambiguity regarding the definition of what a learning disability is, the lack of protocol specificity surrounding the identification, compiled with the new identification regulations set forth by IDEA, 2004 have given credence to several models which all propose to best identify a specific learning disability. Fletcher et al., (2007) identifies four primary models for identifying learning disabilities. They are 1) aptitude-achievement discrepancy; 2) Low achievement; 3) Intra-individual differences; and 4) Response to Intervention (RTI). Other prominent models for identifying learning disabilities are the 'Aptitude-Achievement Consistency Model', 'Concordance-Discordance', and 'Discrepancy/Consistency' models. Consequently, these seven models will be discussed below.

Aptitude-Achievement Discrepancy

Despite the aforementioned changes made to IDEA, 2004, the Aptitude/Achievement Discrepancy Model is still the most widely used approach for identifying learning disabilities (Fletcher et al., 2007; Proctor & Prevatt, 2003). One reason given for its appeal is the simple nature of assessing IQ and academic achievement to assess if a significant discrepancy exists between the two (Fletcher et al., 2007). In the Simple Discrepancy Model, the practitioner examines the relationship between the individual's intellectual quotient (IQ) and his/her areas of achievement. If a predetermined point differential is found (e.g., one standard deviation), then according to the Simple Discrepancy Model, a learning disability diagnosis may be warranted. The Simple Discrepancy Model may vary in the necessary magnitude of the discrepancy (e.g., one state may require a one standard deviation discrepancy between the IQ and achievement scores, whereas another may require two standard deviations), as well as the requirement of an additional cognitive processing deficit. For example, in Florida, the Simple Discrepancy Model for identifying a learning disability required either a 1 or 1 ½ standard deviation discrepancy between IQ and achievement, as well as evidence of a "processing deficit". In some districts, this

was as operationalized as a one standard deviation discrepancy between IQ and one area of cognitive processing (e.g., memory, processing speed, etc).

A second type of Ability/Achievement Discrepancy is one that accounts for regression to the mean. As mentioned above, the Simple Discrepancy Model simply considers a point differential when determining a learning disability diagnosis. However, a Regression-Based Discrepancy Model further assesses whether the IQ score is above or below the mean (i.e., 100) and statistically compensates for the achievement score by altering the point differential necessary to qualify. For example, if an individual demonstrates a higher than average IQ he/she would require a larger IQ- achievement point differential than an individual with a lower than average IQ. A regression to the mean is a statistical tendency of a data series to gravitate towards the center of a distribution, provided it starts on either end of the distribution and is free to fluctuate (BusinessDictionary.com, 2009).

However, a preponderance of research has indicated that the Ability/Achievement Discrepancy Models do not reliably differentiate between students with and without learning disabilities (Brueggemann et al., 2008; Fletcher et al., 2007; Velluntino et al., 2000.)

Findings such as these played a large role in the adaptation of the IDEA, 2004 protocol for identifying learning disabilities, which is a move away from using Aptitude-Achievement Discrepancies to diagnose LD.

Low Achievement

The Low Achievement Model involves the identification of learning disabilities based solely on low achievement alone (Siegel, 1992). For example, while the figure is often arbitrary, many practitioners will designate any achievement score which falls below the twentieth percentile as the benchmark for LD qualification purposes (Fletcher et al., 2007). Surprisingly, studies have revealed that a Low Achievement Model does not identify meaningfully different types of learning disabled students as compared to the Aptitude-Achievement Discrepancy Model (Fletcher et al., 2007). While these findings may appear to bring credibility to the Low Achievement Model, Fletcher et al. (2007) argues that this model does not represent the true meaning of 'unexpected underachievement' which is an essential component for identification. For example, Fletcher et al (2007) argue that if an individual simply demonstrates low achievement it may simply be due to a low aptitude and therefore expected, as opposed to

'unexpected.' Furthermore, Lyon et al. (2001) asks how one can differentiate between underachievers whose low achievement is due to emotional disturbance, economic disadvantage, or inadequate instruction as opposed to a true learning disability that is due to a deficit in one or more of the cognitive processes that underlie achievement. Furthermore, the IDEA, 2004 regulations stipulate that a learning disability diagnosis should not be given if the achievement deficit is due to an emotional disturbance, economic disadvantage, etc. However, one might argue that this argument could be made for any of the learning disability models.

Intra-Individual Model

The Intra-Individual Model for identifying learning disabilities is based on the assessment of cognitive and achievement strengths and weaknesses. More specific models that are subsumed under the "Intra-Individual Differences" model -- such as the Aptitude-Achievement Consistency Model developed by Flanagan (2006), the Concordance-Discordance Model developed by Hale and Fiorello (2004), and the Discrepancy-Consistency Model developed by Naglieri (1999) -- have been gaining in popularity (Hale, Flanagan & Naglieri, 2008). Because by definition, learning disabilities are associated with specific cognitive impairment, this model examines an individual's cognitive profile to determine if its peaks and valleys can potentially account for one's underachievement. Presumably, the learning disabled individual will have many areas of cognitive strength as well as weaknesses in one or more specific cognitive processes (Fletcher et al., 2007). For example, an individual may find that all of their cognitive abilities fall within the average or above average range but they have a specific deficit with processing speed which manifests itself in a reading disability.

Proponents of the Intra-Individual Model argue that understanding differences in cognitive processes will lead to advancement in intervention. (Please see the example referenced in the literature review). However, this hypothesis is not supported by some research. For example, Reschly and Tilly (1999) found that there is a lack of evidence illustrating that instruction which addresses specific cognitive skills positively affects academic outcomes.

Aptitude-Achievement Consistency Model

The Aptitude-Achievement Consistency Model for identifying learning disabilities was promulgated by Flanagan, Ortiz, Alfonso, and Mascolo in 2006. This model is based on the

Cattell-Horn-Carroll (CHC) theory of human cognitive abilities (McGrew, 1997), as well as the current learning disabilities literature and the relationship between cognitive abilities, processes, and academic skills (Hale, Flanagan & Naglieri, 2008). In essence, the Aptitude-Achievement Consistency model has six stages which all need to be executed properly for a learning disability diagnosis to be given. These 'stages' are as follows:

1) Inter-Individual Academic Analysis

The individual must demonstrate one or more academic ability deficiencies. For example, performance in a major academic ability such as reading, writing and/or math must fall below normal limits, as defined by a score that is at least one standard deviation below the population mean.

2) Evaluation of Exclusionary Factors

The underperformance in stage one cannot be primarily due to an exclusionary factor such as a sensory impairment, emotional disturbance, inadequate instruction, limited language proficiency, poor motivation, etc. If one or more of these 'exclusionary factors' does exist a learning disability diagnosis may still be given as long as the exclusionary factor is not the primary cause of the underachievement.

3) Inter-Individual Cognitive Analysis

The individual must demonstrate one or more cognitive processing deficits that fall below normal limits, as defined by a score that is at least one standard deviation below the population mean, and that is related to the academic ability deficit from stage one. For example, a deficit in the area of processing speed which adversely affects the related area of reading achievement would meet this requirement. In addition, cognitive and academic abilities which are not related to the area of dysfunction must be within or above normal limits, in order to prevent a person who has overall low cognitive abilities and commensurately low achievement from receiving a diagnosis of SLD.

4) Reevaluation of Exclusionary Factors

The cognitive and/or academic underperformance cannot be primarily due to an exclusionary factor such as a sensory impairment, emotional disturbance, inadequate instruction, limited language proficiency, poor motivation, etc. If one or more of these 'exclusionary factors' does exist, a learning disability diagnosis may still be given as long as the exclusionary factor is not the primary cause of the underachievement.

5) Integrated Ability Analysis

The individual must demonstrate underachievement that can be determined through a lower than average aptitude-achievement consistency (i.e., below average processing speed and reading achievement) with non-related abilities within or above normal limits (i.e., visual spatial skills).

6) Evaluation of Interference with Functioning

The individual must demonstrate a history of difficulties during childhood related to the current deficient academic area and documentation of the current deficit related to daily activities that require the skill in question.

If all six stages are properly satisfied, according to the Aptitude-Achievement Consistency Model a learning disability diagnosis may be warranted (Flanagan, Keiser, Bernier & Ortiz, 2003).

Concordance-Discordance Model

The Concordance-Discordance Model was developed by Hale and Fiorello (2004) to be used within the confines of their Cognitive Hypothesis Testing (CHT) approach. The CHT method relies on multiple data sources as well as multiple assessment measures to ensure concurrent, ecological, and treatment validity (Hale, Flanagan & Naglieri, 2008). Furthermore, the CHT method can be used to develop interventions to facilitate treatment, which rebuts the argument that aptitude-treatment interventions lack efficacy (Hale et al., 2008). The Concordance-Discordance Model utilizes the standard error of difference, which measures potential differences in cognitive and achievement abilities (Anastasi & Urbina, 1997). The standard error of difference is defined as "A statistical index of the probability that a difference between the statistical means of two samples is greater than zero." (The American Heritage Medical Dictionary, 2009) and is symbolized as SED= $SDv2\text{-}r_{xx}$ - $r_{w.}$ If the standard error of difference demonstrates significant discrepancies between cognitive assets and cognitive deficits, as well as significant discrepancies between cognitive assets and achievement deficits, the first part of the LD diagnosis is satisfied. Then, if the standard error of difference goes on to demonstrate that the cognitive asset is not related to the achievement deficit, and that the cognitive deficit is related to the achievement deficit, then according to this model a learning disability diagnosis may be appropriate (Hale et al., 2008). There are two potential benefits to

this model. For one, it meets both the statutory and regulatory requirements of IDEA, as do the other processing strengths and weaknesses models discussed. Secondly, it has been shown to successfully improve intervention (Fiorello, Hale & Synder, 2006).

Discrepancy/Consistency Model

The Discrepancy/Consistency Model was first developed by Naglieri in 1999 for use with his Cognitive Assessment System (Naglieri & Das, 1997). This model, which was modified by Silverstein (Hale et al., 2008), uses an ipsative approach to determine within individual variability that is greater than expected. Scores that are significantly higher than the individual's average are considered strengths, whereas those that are significantly lower are considered a weakness. For example, when all of an individual's cognitive processes are compared using an ipsative approach one may notice that his visual/spatial skills may be relatively higher than his other abilities and would thus be considered a strength whereas the individual's working memory may be relatively lower and would thus be considered a weakness. According to the Discrepancy/Consistency Model, in order to ensure that an individual has a disorder in one of the basic psychological processes, there must be significant variability, as defined by the specific assessment manual, between the cognitive processes, and the lowest cognitive score must be consistent with the achievement deficit. Furthermore, the cognitive deficit must be a low score when compared to both the individual's mean score as well as his norm group (Hale et al., 2008). Finally, when inclusionary as well as exclusionary criteria are also satisfied, a learning disability diagnosis may be applicable (Hale et al., 2008).

According to a report by Eileen M. Ahearn (2008) that was supported by the U.S. Department of Education, states have different eligibility requirements for specific learning disabilities as allowed for by the Individuals with Disabilities Education Act of 2004. Ahearn separated the state eligibility requirements into three categories.

1) States that require the use of RtI and do not allow Ability/Achievement Discrepancy Models (six states fell into this category).
2) States that allow either RtI or Ability/Achievement Discrepancy Models and leave the choice up to the local education agency (LEA) (26 states fell into this category; furthermore, Intra-Individual Models could plausibly be considered 'discrepancy' models) (Hale, personal communication, 2009).

3) States that allow either RtI, Ability/Achievement Discrepancy Models, OR *any other research based alternative to be used in establishing eligibility for SLD* (10 states fell into this category and this would include Intra-Individual Models).

There were several other states that could conceivably use an Intra-Individual Model but they indicated that their eligibility requirements were still being developed (Ahearn, 2008).

Furthermore, Dr. Flanagan (personal communication, 2009) indicated that there are three states that are widely using her Aptitude-Achievement Consistency Model as well as approximately eight more states where many districts are using her model. Dr. Flanagan stated that her model is gaining acceptance in Canada, saying, "Bottomline: there's much interest in districts who have started to implement RTI but who understand that cognitive assessment is important for differential diagnosis - therefore, they want to use the consistency model."

Similarly, Dr. Hale (personal communication, 2009) also indicated that his model is gaining acceptance, specifically in Pennsylvania, Michigan, and Oregon. However, he added that many school psychologists who are using his model are calling it a "discrepancy approach" in order to be consistent with their state guidelines.

Response to Intervention

As previously touched upon in the 'Current Definitions and Trends' section, an alternative to the previously cited methods for identifying learning disabilities (i.e., Aptitude-Achievement Discrepancy, Low Achievement, Intra-Individual, Aptitude-Achievement Consistency, Concordance-Discordance, Discrepancy/Consistency), Response to Intervention (RTI) is a data based process of academic intervention used to provide academic assistance to students who are demonstrating learning difficulties (LD Online, 2008). RTI promulgates a method of early intervention, recurrent progress measurements, as well as an increasingly intensive research based form of instructional support for those students who do not make adequate progress (LD Online, 2008). If students do not demonstrate an effective response to intervention they are likely to have a neurologically based learning disability and consequently are candidates for special education (Fletcher et al., 2007). Consequently, RTI stresses that one of the main criteria for identifying learning disabilities is a lack of an adequate response to proper instruction as well as appropriate intervention(s) (Fletcher et al., 2007). A key concept of RTI stipulates that a learning disability diagnosis does not need to be rendered in order for a

student to receive an intervention which was a serious misgiving of previous methods. By waiting to intervene until a learning disability diagnosis was given critics argued that the system had to wait for the student to fail in order to provide services. With RTI, interventions are first given to struggling students in an attempt to avoid failure and consequently a special education label. As Fletcher et al. (2007) state, the goal of RTI is to augment the educational opportunities for all students in need in an attempt to prevent a diagnosis. In the event that a student does not respond to adequate instruction and research based interventions, and the student does not meet certain exclusionary criteria, an unexpected underachievement is deemed to have occurred. Under these circumstances the student in question is then eligible for a comprehensive evaluation which, depending on the outcome, may qualify him/her for a special education diagnosis. Current research has also illustrated that those who do not respond to adequate instruction and interventions typically demonstrated more severe difficulties in several areas tied to reading (Fletcher et al., 2007). Consequently, one can infer that through the RTI process there will be fewer, but more severe, cases of learning disabilities uncovered. It has also been argued that because RTI is based on measuring progress through multiple attempts over time, the results may be more reliable than previous methods which were based on a single assessment (Fletcher et al., 2007). Finally, it should be noted that RTI is not normally applicable to college students as methods such as tracking interventions and progress, as well as multiple assessments, are not always practical in a post K-12 setting. Consequently, in a higher education environment it is the norm to use a non-RTI model, i.e., Discrepancy, Low Achievement, Intra-Cognitive, Aptitude-Achievement, Concordance-Discordance, Discrepancy/Consistency, etc.

While conducting a learning disability evaluation there are several other thoughts that the diagnostician may want to keep in mind. These aforementioned models of assessment inevitably lead to many learning disability diagnoses. However, as Fletcher et al. (2007) point out, there are five distinct subgroups of learning disabilities which are most prevalent. Three of these groups fall under a 'reading disability' category. They are:

1) Reading disability – word recognition
2) Reading disability – fluency
3) Reading disability – Comprehension

The other two prominent categories involve Math and Written expression. They are:

4) Math disability – all inclusive

5) Written expression – involving spelling, handwriting, and/or composition.

As mentioned previously, a study conducted by Proctor and Prevatt (2003) did indicate that identification rates can vary depending on the type of model administered. And finally, before conducting a learning disability assessment, it is important to ascertain that the individual has reached a level where he is at least expected to have begun to develop the academic skills in question (Fletcher et al., 2007). However, it may be appropriate to administer certain neuropsychological or other cognitive assessments to younger children in an attempt to identify those at risk (Fletcher et al., 2007). Consequently, it is generally inappropriate to identify a learning disability in preschoolers, and even first graders, due to issues surrounding reliability and the limited floors of many of the achievement tests for young children (Shaywitz, Escobar, Shaywitz, Fletcher & Makuch, 1992). When learning disability assessments are deemed appropriate, Fletcher et al. (2007) have stated that the use of extensive cognitive, neuropsychological, and/or intellectual assessments are generally unwarranted as they lack evidence that said assessments contribute meaningfully to intervention. Furthermore, Fletcher et al. (2007) have stated that these assessments do not provide information that is not readily available through achievement tests.

Most Widely Used Evaluation Procedures

Based on the new language from IDEA, 2004 there is clearly a shift toward RTI. However, a Response to Intervention Adoption Survey by The Counsel of Administrators of Special Education (2008) reveals that there are still a large percentage of school systems across the United States that have yet to move to a response to intervention model. For example, this survey indicates that in March of 2008, only 60% of school districts were either piloting, in the process of implementing, or were currently using a response to intervention method. This leaves 40% of school systems presumably using a non-RTI method for diagnosing and making eligibility learning disability determinations. The survey goes on to state that RTI is currently more prevalent in elementary schools than middle or high schools. RTI is most often used for reading issues as opposed to math and behavior difficulties. At the time of this study only 13% of school districts had fully implemented RTI into daily use. School systems that are planning on implementing RTI plan to do so more readily in elementary schools as opposed to middle schools, and more readily in middle schools as opposed to high schools. From highest to lowest,

of school systems that are using RTI, it has been implemented for reading (84%), math (53%), behavior (44%), writing (30%), language (26%), other (19%) (Response to Intervention Adoption Survey, 2008).

As one can see from the information above there appear to be a large number of school districts that are not currently using RTI, as well as many school districts that may not use RTI for the foreseeable future, if ever. Furthermore, as stated previously, because IDEA, 2004 does not require RTI, many school systems may continue to use discrepancy based models, in isolation, or in partnership with RTI. While there are several prominent non-RTI models that are used to diagnose and make learning disability eligibility determinations, as noted in the 'Introduction' section, Fletcher et al. (2007) state that there are currently three models, which are the most prominent alternatives to RTI. They are (1) Aptitude-Achievement Discrepancy; (2) Low Achievement; and (3) Intra-Individual differences. It appears that these three models are most widely used by school systems in lieu of RTI.

Critical Analysis of the Literature

Positive Research Outcomes

As previously mentioned, the field has struggled to find a universally accepted definition for a specific learning disability. This inconsistency has led to difficulties with assessment, diagnosis, and intervention. However, the recent push towards response to intervention through the provisions put into place by IDEA, 2004 have begun to address some of these concerns. With an emphasis on intervention, as opposed to diagnosis, it is the hope that a response to intervention model will aid all students who struggle academically.

Learning disabilities have been shown to manifest themselves in a multitude of ways. While they have been studied in earnest for several decades the area of reading disabilities has received the most attention. This is assumed to be the case because 80%-90% of individuals with learning disabilities demonstrate reading difficulties (Kavale & Reese, 1992; Lerner, 1989). Consequently, while more work still needs to be done, research on reading disabilities has significantly outpaced the research on other learning disabilities to date.

As previously mentioned, there is some debate regarding the efficacy of many of the interventions for learning disabilities. However, there has been a recent effort to ensure that all interventions are research based and empirically validated. As stated in IDEA (2004), a

provision for a diagnosis of a specific learning disability stipulates that there must be scientific, research based interventions that have proven ineffective. This emphasis on empirically validated interventions has been a positive recent development for the field.

Gaps in Content

While the definitions of a specific learning disability have been maligned for years it continues to remain controversial. One of the main sticking points is that it is primarily an 'exclusionary' definition (Fletcher et al, 2007). Consequently, one of the reasons a learning disability is difficult to define is it is often characterized by what it is not, as opposed to what it is. More research needs to be conducted in an effort to tangibly define the construct of a learning disability.

There has been considerable research surrounding reading disabilities. Conversely, the other major learning disability categories of math and written language have been given less attention. As mentioned above, this may be due to the prevalence of reading difficulties within the learning disabled community. However, this does not change the fact that more research needs to be conducted to adequately aid those individuals with math and written language disabilities.

While the area of assessment regarding individuals with learning disabilities has been researched extensively, there is still no uniform consensus on which evaluation procedures are most appropriate. Currently, IDEA (2004) simply states that one must not be required to rely on an aptitude-achievement discrepancy model or a response to intervention model. Furthermore, IDEA (2004) states that there must be a comprehensive evaluation. Consequently, there is much debate surrounding which measures and models of assessment should be utilized as part of a comprehensive evaluation. This ambiguity results in a variety of assessment techniques which leads to varying diagnoses.

There has been some research with respect to the various models used to identify individuals with learning disabilities (See Proctor & Prevatt, 2003; Sparks & Lovett, 2009). However, this research needs to be expanded upon. For example, by examining the multitude of models currently accessible to assess learning disabilities, the field may be able to gain a greater understanding of how different models lead to differing conclusions. Furthermore, there has been little to no research conducted to assess how these models differ with regard to qualifying

individuals of varying characteristics. For example, do certain models qualify more individuals with higher intelligence levels, with diagnosed depression, with ADHD, with low academic motivation, etc? It should also be noted that despite an extensive literature review there does not appear to be any current research assessing the relationship among models for diagnosis specific learning disabilities within a K-12 population. By furthering research it may be possible to shed some light on questions such as these.

Research Questions

After conducting a thorough review of the learning disability literature, the following research questions are deemed in need of consideration.

1) Under which model is a student most likely, and least likely, to be diagnosed with a specific learning disability?
2) What is the level of agreement among the different diagnostic models regarding a specific learning disability diagnosis?
3) What are the relationships among the different models? (In other words, what is the interrelationship between models in terms of strength of association and/or effect size.)

The models to be compared include the:

* Aptitude/Achievement Simple Discrepancy Model
* Aptitude/Achievement Regression-Based Model
* Aptitude-Achievement Consistency Model
* Concordance-Discordance Model
* Low Achievement Model

CHAPTER III: METHODOLOGY

Introduction

Chapter One addressed the significance of a learning disability diagnosis and the ramifications of possible inconsistent diagnoses based on differing prominent models. Chapter Two addressed the pertinent extant literature and further documented specific gaps in the literature. Chapter Three will address the methods involved in conducting this study.

Research Questions:

Previous research has indicated that a specific learning disability diagnosis may depend on the specific model utilized in the college population (Proctor & Prevatt, 2003; Sparks & Lovett, 2009). The current study will attempt to add to the literature by assessing this issue within a grade 1-10 population. As mentioned at the end of Chapter Two, in an attempt to shed some light on this issue, the following research questions are proposed:

1) Under which model is a student most likely, and least likely, to be diagnosed with a specific learning disability?
2) What is the level of agreement among the different diagnostic models regarding a specific learning disability diagnosis?
3) What are the relationships among the different models? (In other words, What is the interrelationship between models in terms of strength of association and/or effect size.)

The models to be compared include the:

- Aptitude/Achievement Simple Discrepancy Model
- Aptitude/Achievement Regression-Based Model
- Aptitude-Achievement Consistency Model
- Concordance-Discordance Model
- Low Achievement Model

Sample/Data Collection

The data utilized for this analysis were obtained from an on-campus clinic which is affiliated with a large, Southeastern University. As part of its responsibilities, this clinic evaluates K-12 students from surrounding school districts to aid in specific learning disability determinations. Permission was obtained to code specific information, such as cognitive and

achievement data, for future research. With regard to the current study, the age, sex, grade, ethnicity and cognitive and achievement records for 150 grade 1-10 subjects from this dataset were examined in an attempt to answer the aforementioned research questions.

Procedure

All participants utilized for this research were evaluated at an evaluation center affiliated with a large, Southeastern University. The participants generally are referred from one of approximately twenty neighboring school districts. Referring institutions are required to complete a packet containing pertinent information used for the pending assessment such as the presenting issue, a developmental history, etc. Depending on the referral question one or more of several assessments may be utilized. However, for the purposes of this study only subjects that were referred for a possible learning disability diagnosis and that have been administered the core battery from the Wechsler Intelligence Scale for Children (Wechsler, 2003) and selected subtests from the Woodcock-Johnson-III Tests of Achievement (Woodcock, McGrew, & Mather, 2001a) and Cognitive Abilities (Woodcock, McGrew, & Mather, 2001b) were utilized.

The typical evaluation takes between four to six hours and is generally completed on one day. All assessments are completed by interns, practicum students or residents under the supervision of a licensed psychologist.

Data Analysis

Frequency Analysis (Question One)

With regard to question one, 'Under which model is a student most likely, and least likely, to be diagnosed with a specific learning disability', a frequency analysis will be conducted. This analysis will simply illustrate the number and percentage of subjects that qualify for a specific learning disability under each of the five aforementioned models being examined.

McNemar Test (Question Two)

With regard to question two, 'What is the level of agreement among the different diagnostic models regarding a specific learning disability diagnosis,' a McNemar test will be conducted.

The McNemar test assesses the degree of significance between two correlated proportions. An example of this may be found in a situation where the two proportions are based on the same population or on matched-pair samples (Concepts and Applications of Inferential Statistics, 2010). Furthermore, the McNemar test is a non-parametric analysis that, when applicable, may be appropriate for different types of studies. For example, the McNemar test may be used to evaluate two groups of subjects that are either correlated or otherwise related. A second manner of use for the McNemar test is to compare the same subjects before and after a particular research endeavor. This type of analysis should be conducted with dichotomous variables and is applied with a 2 × 2 contingency table (McNemar, 1969; Statistics Solutions, personal communication, 2010).

The table below shows an example of how data will be entered comparing two LD models:

Table 2

McNemar Test Data Example

Low Achievement	Concordance Discordance Model		
Model	Diagnosed LD	Not Diagnosed LD	Totals
Diagnosed LD	A	B	A + B
Not Diagnosed LD	C	D	C + D
Totals	A + C	B + D	A + B + C + D

Note. The letters represent frequencies.

As illustrated in the table above, a McNemar Test will be conducted for each pair of LD models. One LD model will be the columns and other LD model will be the rows. The frequencies of individuals diagnosed as LD and those not diagnosed as LD will be entered in the table for each pair of LD models as illustrated.

Furthermore, in a McNemar test, the row total is equal to the column total. For example:

(A+B)= (A+C)

(C+D)= (B+D)

In a case such as this, one would cancel the A and D equation with the result being B=C. This is the basis of the McNemar test. In an equation such as this, one would calculate the McNemar test as:

$$\chi^2 = \frac{(B-C)^2}{B+C}$$

df = 1

In this analysis, the chi-square statistic has one degree of freedom.

The McNemar test examines the hypothesis that the total count in each row is equal to the count in the corresponding column. This would occur, for example, if the number of students diagnosed with LD according to the Low Achievement Model (the total number of cases in row 1) were the same as the number diagnosed using the Concordance Discordance model (in column 1).

To test for significance when using a McNemar test a chi-square table should be utilized. In this case, the McNemar test should produce a calculated value and this value should be compared to the chi-square table value. If, for example, the McNemar value is greater than the chi-square value then significance would be achieved and the null hypothesis would be rejected (Concepts and Applications of Inferential Statistics, 2010; McNemar, 1969; Statistics Solutions, personal communication, 2010).

For the present study the McNemar test will be used to assess the frequency of specific learning disability diagnoses for each pair of the five models being assessed. An example was illustrated in the table above. A reduced alpha level of .005 will be used (.05/10) to determine statistical significance due to the multiple comparisons.

Phi Coefficient (Question Three)

With regard to question three, 'What are the relationships among the different models,' a Phi Coefficient will be utilized to determine the interrelationship between the models in terms of strength of association and effect size.

The Phi Coefficient is a type of measure that is used to calculate the degree of association between two binary variables and is quite similar to a correlation coefficient in this regard (Children's Mercey, 2009; McNemar, 1969). This measure was specifically designed for the comparison of dichotomous variables (Encyclopedia of Statistical Sciences, 2009).

In the current study a phi coefficient will be utilized with each pair of models assessed to determine the models' strength of association and effect sizes. The table below illustrates how data will be entered for each pair of LD models:

Table 3

Phi Coefficient Data Example

	Aptitude/Achievement		
Aptitude-Achievement Consistency Model	Simple Discrepancy Model: Diagnosed LD	Simple Discrepancy Model: Not Diagnosed LD	Totals
Diagnosed LD	A	B	A + B
Not Diagnosed LD	C	D	C + D
Totals	A + C	B + D	A + B + C + D

Note. The letters represent frequencies.

Using the data above, phi will be determined using the following formula:

$$\phi = \frac{AD - BC}{\sqrt{(A + C)(B + D)(A + B)(C + D)}}$$

This phi value will be used to determine the strength of association between each pair of LD models. In assessing the association, as a general rule:

- -1.0 to -0.7 strong negative association.
- -0.7 to -0.3 weak negative association.
- -0.3 to +0.3 little or no association.
- +0.3 to +0.7 weak positive association.
- +0.7 to +1.0 strong positive association.

(Children's Mercy, 2009).

After the phi coefficient is determined and assessed it will then be squared in order to determine the effect size. In assessing the effect size, as a general rule:

According to Cohen and Cohen (1988) poor practical significance is signified with a value below .25, moderate practical significance is achieved with values between .25-.49 and strong practical significance is achieved with values above .5.

CHAPTER FOUR: RESULTS

This study evaluated similarities and differences between five prevalent models currently used for making a Learning Disability determination under the Individuals with Disabilities Education Act (IDEA). The Aptitude-Achievement Simple Discrepancy Model, Aptitude-Achievement Regression-Based Model, Low Achievement Model, Aptitude-Achievement Consistency Model, and the Concordance-Discordance Model were all compared using 150 grade 1-10 participants to assess the frequency of diagnosis using each model, the level of agreement between specific models, and the relationship between models in terms of their strength of association. This was accomplished by conducting a frequency analysis, a McNemar Test, and by using Phi Coefficients. The purpose of using the frequency analysis was to determine, using absolute values, which of the models identified the most and the fewest subjects with a learning disability diagnosis. The purpose of the McNemar test was to determine the level of diagnostic agreement between the models. The Phi Coefficients were used to determine the strength of association between the models.

Scoring, Data Entry, and Reliability

All cognitive evaluations were conducted by either doctoral level psychologists, or by school psychology graduate students under the direct supervision of doctoral level psychologists. Participants were referred to the clinic from 20 North Florida school districts between the years of 2003-2008. Participants were selected by date of assessment (starting with the earliest assessments of 2003). Generally participants were referred for an assessment due to learning and/or behavioral concerns and because their home district did not have the adequate resources to evaluate the students in a timely fashion. At the time of referral an 'information packet' was included with a detailed history including demographic information. All participants were given the Weschler Intelligence Scale for Children (Wechsler, 2003) and selected subtests from the Woodcock-Johnson Test of Cognitive Abilities – Third Edition (Woodcock, McGrew, & Mather, 2001b) and the Woodcock-Johnson Test of Achievement – Third Edition (Woodcock, McGrew, & Mather, 2001a). While the subtests varied due to the referral question in most cases the WJ-III cognitive clusters/subtests consisted of: Long-term Retrieval (Visual-Auditory Learning and Retrieval Fluency), Processing Speed (Visual Matching and Decision Speed), Phonemic Awareness (Sound Blending and Incomplete Words), and Short-term Memory (Numbers

Reversed and Memory for Words). Similarly, while the WJ-III achievement subtests varied with regard to the referral question as well, in most cases they consisted of: Letter-Word Identification, Reading Fluency, Calculation, Math Fluency, Spelling, Writing Fluency, Passage Comprehension, Writing Samples, Applied Problems, and Word Attack. (WJ-III subtests assessing 'Oral Expression' and 'Listening Comprehension' were not administered). Testing generally took place on one day and took between four to six hours to complete. Consent for all evaluations was given by the participants' parent(s) or guardian. Participants were included in this study if their assessment consisted of all necessary subtests and conversely they were excluded if any of the aforementioned data was missing. Data entry, through an Excel spreadsheet, was conducted by a school psychology graduate student under the supervision of the PI. All 750 diagnoses "by proxy" were conducted by a school psychology graduate student under the supervision of the PI, and then again independently by the PI. (It should be noted that technically these 'diagnoses' are not to be used for special education qualification purposes but the term 'diagnosis' is being used for the purposes of this study). All diagnoses were hand calculated using the following criteria:

- Aptitude-Achievement Simple Discrepancy Model: A positive LD diagnosis was assessed if the Full Scale IQ was at least 15 points higher than any of the following WJ-III achievement areas:

Written expression

Comprised of 'Writing Fluency' and 'Writing Samples':

Writing Fluency measures the child's skill in formulating and writing simple sentences quickly. The child is required to write sentences relating to a given stimulus picture that includes a set of three words. This test has a 7-minute time limit. Writing Samples measures the child's skill in writing responses to a variety of demands. The child is asked to produce written sentences that are evaluated with respect to the quality of expression. The child is not penalized for any errors in basic writing skills, such as spelling or punctuation (Mather & Woodcock, 2001).

Basic reading

Comprised of 'Word Attack' and 'Letter-Word Identification':

Word Attack measure the child's skill in applying phonic and structural analysis skills. The initial item requires him/her to produce the sounds for single letters. This test requires the child to pronounce letter combinations that are phonically consistent, or regular, patterns in English orthography but are non-words or low-frequency words. Letter-Word Identification measures the ability to identify letters and words. For this test, the child is not required to know the meaning of any word (Mather & Woodcock, 2001).

Reading fluency

Comprised of the 'Reading fluency' subtest:

"Reading Fluency measures the ability to quickly read simple sentences, decide if the statement is true, and then circle Yes or No. The child is asked to complete as many items as possible within a 3-minute time limit" (Mather & Woodcock, 2001).

Reading Comprehension

Comprised of the 'Passage Comprehension' subtest:

Passage Comprehension measures the ability to understand what he or she reads. Some items involve use of pictures. The items become increasingly difficult and require the child to read a short passage and identify a missing key word that makes sense in the context of the passage (Mather & Woodcock, 2001).

Mathematics calculation

Comprised of the 'Calculation' and 'Math Fluency' subtests:

Calculation measures the ability to perform mathematical computations. The items require the child to perform addition, subtraction, multiplication, and division operations. Math Fluency measures the child's ability to solve simple addition, subtraction, and multiplication facts quickly. The child is presented with a series of simple arithmetic problems to complete in a 3-minute time limit (Mather & Woodcock, 2001).

Mathematics problem solving

Comprised of the 'Applied Problems' subtest:

Applied Problems measures the ability to analyze and solve math problems. To solve the problems, the child is required to listen to the problem, recognize the procedure to be followed, and then perform relatively simple calculations. Because many of the

problems include extraneous information, the child needs to decide not only the appropriate mathematical operations to use but also what information to include in the calculation (Mather & Woodcock, 2001).

- Aptitude-Achievement Regression Based Model:

For a positive LD diagnosis the same criteria were used as the aforementioned Aptitude-Achievement Simple Discrepancy Model with the exception that the WISC FSIQ/WJ-III discrepancy figure was determined by the Washington State guidelines for the 'Identification of Students with Specific Learning Disabilities' (See Appendix B).

- Low Achievement Model:

A positive LD diagnosis was assessed if any of the following WJ-III achievement areas had a standard score that was equal to or below '85' (16^{th} percentile):

Written expression

Basic reading skill

Reading fluency skills

Reading comprehension

Mathematics calculation

Mathematics problem solving

- Aptitude-Achievement Consistency Model

As stated in Chapter Two, the Aptitude-Achievement Consistency model has six stages which all need to be executed properly for a learning disability diagnosis to be given. These 'stages' are as follows:

1) Inter-individual Academic Analysis

The individual must demonstrate one or more academic ability deficiencies. For example, performance in a major academic ability such as reading, writing and/or math must fall below normal limits, as defined by a score that is at least one standard deviation below the population mean.

2) Evaluation of Exclusionary Factors

The underperformance in stage one cannot be primarily due to an exclusionary factor such as a sensory impairment, emotional disturbance, inadequate instruction, limited language proficiency, poor motivation, etc. If one or more of these 'exclusionary factors' does exist a

learning disability diagnosis may still be given as long as the exclusionary factor is not the primary cause of the underachievement.

3) Inter-individual Cognitive Analysis

The individual must demonstrate one or more cognitive processing deficits that fall below normal limits, as defined by a score that is at least one standard deviation below the population mean, and that is related to the academic ability deficit from stage one. For example, a deficit in the area of processing speed which adversely affects the related area of reading achievement would meet this requirement. In addition, cognitive and academic abilities which are not related to the area of dysfunction must be within or above normal limits, in order to prevent a person who has overall low cognitive abilities and commensurately low achievement from receiving a diagnosis of SLD.

4) Reevaluation of Exclusionary Factors

The cognitive and/or academic underperformance cannot be primarily due to an exclusionary factor such as a sensory impairment, emotional disturbance, inadequate instruction, limited language proficiency, poor motivation, etc. If one or more of these 'exclusionary factors' does exist a learning disability diagnosis may still be given as long as the exclusionary factor is not the primary cause of the underachievement.

5) Integrated Ability Analysis

The individual must demonstrate underachievement that can be determined through a lower than average aptitude-achievement consistency (i.e., below average processing speed and reading achievement) with non-related abilities within or above normal limits (i.e., visual spatial skills).

6) Evaluation of Interference with Functioning

The individual must demonstrate a history of difficulties during childhood related to the current deficient academic area and documentation of the current deficit related to daily activities that require the skill in question.

If all six stages are properly satisfied, according to the Aptitude-Achievement Consistency Model a learning disability diagnosis may be warranted (Flanagan et al., 2003).

- Concordance-Discordance Model:

The Concordance-Discordance Model utilizes the standard error of difference, which measures potential differences in cognitive and achievement abilities (Anastasi & Urbina, 1997).

The standard error of difference is defined as "A statistical index of the probability that a difference between the statistical means of two samples is greater than zero." (The American Heritage Medical Dictionary, 2009) and is symbolized as SED= SDv2-r_{xx} - $r_{w.}$ If the standard error of difference demonstrates significant discrepancies between cognitive assets and cognitive deficits, as well as significant discrepancies between cognitive assets and achievement deficits, the first part of the LD diagnosis is satisfied. Then, if the standard error of difference goes on to demonstrate that the cognitive asset is not related to the achievement deficit, and that the cognitive deficit is related to the achievement deficit, then according to this model a learning disability diagnosis may be appropriate (Hale et al., 2008).

Any discrepancies in diagnoses between the school psychology graduate student and the PI (N = 7) were reviewed by the PI and the PI then made the final decision as to whether or not a learning disability diagnosis was warranted under the specific model assessed. IRB approval for this study was granted on 8/26/2009 (See Appendix A).

Demographic Variables and Statistics

Table 4 presents specific characteristics of the 150 subjects used in this study. As stated previously, all demographic information was obtained through an information packet completed by the referring school district.

Table 4

Demographics

	Frequency	Percent
Gender		
Male	96	64
Female	54	36
Grade		
1	13	8.7
2	23	15.3
3	30	20.0
4	28	18.7

Table 4 -- Continued

	Frequency	Percent
Grade		
5	17	11.3
6	12	8.0
7	11	7.3
8	10	6.7
9	4	2.7
10	2	1.3
Ethnicity		
Caucasian	102	68.0
Hispanic	7	4.7
African American	35	23.3
BiRacial	6	4.0

* The reader is encouraged to view the Membership in Florida's Public Schools, Fall 2009 Data Report at http://www.fldoe.org/eias/eiaspubs/default.asp to compare the ethnic representation of the participants in this study to that of the counties surrounding Tallahassee, Florida.

Table 5

Participants Diagnosed as LD by Gender and Model

	Male (Number and Percentage Diagnosed)	Female(Number and Percentage Diagnosed)
Simple Discrepancy	31 (32%)	14 (26%)
Regression	37 (39%)	11 (20%)
Low-Achievement	68 (71%)	33 (61%)
Aptitude-Achievement Consistency	40 (42%)	14 (26%)
Concordance-Discordance	71 (74%)	33 (61%)

Table 6

Participants Diagnosed as LD by Grade and Model

	1	2	3	4	5	6	7	8	9	10
Simple Discrepancy	6 (46%)	6 (26%)	11 (37%)	4 (14%)	5 (29%)	4 (33%)	4 (36%)	2 (20%)	2 (50%)	1 (50%)
Regression	6 (46%)	8 (35%)	9 (30%)	8 (29%)	5 (29%)	5 (42%)	4 (36%)	2 (20%)	0 (0%)	1 (50%)
Low-Achievement	12 (92%)	15 (65%)	18 (60%)	18 (64%)	8 (47%)	11 (92%)	8 (73%)	9 (90%)	0 (0%)	2 (100%)
Aptitude-Achievement Consistency	6 (46%)	6 (26%)	10 (33%)	12 (43%)	3 (18%)	7 (58%)	4 (26%)	5 (50%)	0 (0%)	1 (50%)
Concordance-Discordance	10 (77%)	17 (74%)	20 (67%)	22 (79%)	12 (71%)	7 (58%)	7 (64%)	6 (60%)	2 (50%)	1 (50%)

Table 7

Participants Diagnosed as LD by Ethnicity and Model

	Caucasian	Hispanic	African American	BiRacial
Simple Discrepancy	28 (27%)	6 (86%)	10 (29%)	1 (17%)
Regression	26 (25%)	6 (86%)	15 (43%)	1 (17%)
Low-Achievement	64 (63%)	6 (86%)	26 (74%)	5 (83%)
Aptitude-Achievement Consistency	42 (41%)	2 (29%)	8 (23%)	2 (33%)
Concordance-Discordance	73 (72%)	5 (71%)	22 (63%)	4 (67%)

Research Question One

Under which model is a student most likely, and least likely, to be diagnosed with a specific learning disability?

The number and percentages of the 150 subjects who met the criteria for a learning disability under each of the five assessed models are presented in Table 8. The results of a frequency analysis reveal that the Concordance-Discordance Model identified the highest number of subjects with a learning disability (N = 104). This was followed by the Low Achievement Model (N = 101), the Aptitude-Achievement Consistency Model (N = 54), the Regression Model (N = 48), and finally by the Simple Discrepancy Model (N = 45).

Table 8

Number and Percentage of Participants Meeting the LD Criteria of the Five Models

Model	N	%
Simple Discrepancy	45	30.0

Table 8 -- Continued

Model	N	%
Regression	48	32.0
Low-Achievement	101	67.3
Aptitude-Achievement		
Con	54	36.0
Concordance-Discordance	104	69.3

Research Question Two

What is the level of agreement among the different diagnostic models regarding a specific learning disability diagnosis?

A McNemar test was used to assess the level of diagnostic agreement for each pair of the five different models for a total of ten pair comparisons. Models 'agree' when both state that either a specific participant qualifies for, or does not qualify for, a learning disability diagnosis. An alpha level of .005 was set to determine statistical significance. The results, which can be seen in Table 9, indicate that there were not significant differences (i.e. the models statistically 'agree' and are therefore likely to either similarly diagnose, or similarly not diagnose, a specific participant with a learning disability) found between the Simple Discrepancy Model and the Regression Model, $\chi 2(5, N = 150) = .43$, $p = .66$; or the Simple Discrepancy Model and the Aptitude-Achievement Consistency Model, $\chi 2\ (5, N = 150) = 1.37$, $p = .29$. However, there was a significant difference (i.e. the models statistically 'do not agree' and are therefore likely to disagree on an LD diagnosis for a particular participant) found between the Simple Discrepancy Model and the Low Achievement Model, $\chi 2\ (5, N = 150) = 41.2$, $p = 0.0001$ and between the Simple Discrepancy Model and the Concordance-Discordance Model, $\chi 2\ (5, N = 150) = 39.11$, $p = 0.0001$. The Regression Model revealed no significant difference with the Aptitude-Achievement Consistency Model, $\chi 2\ (5, N = 150) = .72$, $p = .48$ but significant differences were revealed between the Regression Model and the Low Achievement Model, $\chi 2\ (5, N = 150) = 49.3$, $p = 0.0001$ as well as between the Regression Model and the Concordance-Discordance Model, $\chi 2\ (5, N = 150) = 36.47$, $p = 0.0001$. Furthermore, the Low Achievement Model

revealed no significant difference with the Concordance-Discordance Model, $\chi 2$ (5, N = 150) = .15, p = .80, but there was a significant difference noted between the Low Achievement Model and the Aptitude-Achievement Consistency Model, $\chi 2$ (5, N = 150) = 47, p = 0.0001. And finally, there was also a significant difference between the Aptitude-Achievement Consistency Model and the Concordance-Discordance Model, $\chi 2$ (5, N = 150) = 37.9, p = 0.0001.

Table 9

McNemar Test for Agreement Between Each Pair of Tests

	Regression		Low-Ach		Aptitude A-C		C-DM	
Model	McN	*p*	McN	*p*	McN	*p*	McN	*p*
Simple Discrepancy	0.43	0.66	41.2	0.0001	1.37	0.29	39.11	0.0001
Regression			49.3	0.0001	0.72	0.48	36.47	0.0001
Low-Achievement					47	0.0001	0.15	0.80
Aptitude A-C							37.9	0.0001

Note. Ability A-C = *ability achievement-consistency*; C-DM = *concordance-discordance;* McN = *McNemar*

Research Question Three

What are the relationships among the different models?

As seen in Table 10, Phi Coefficients were determined to analyze the interrelations between the models in terms of strengths of association as well as effect size. The following associations between pairs of models were all significant (i.e. there was a statistically significant categorical correlation in terms of diagnoses made): Simple Discrepancy Model and the Regression Model, Φ = .67, p = .0001, effect size Φ^2 = .45; Regression Model and Low Achievement Model, Φ = .42, p = .0001, effect size Φ^2 = .18; Regression Model and Aptitude-Achievement Consistency Model, Φ = .26, p = .002, effect size Φ^2 = .07; Low Achievement Model and Aptitude-Achievement Consistency Model, Φ = .52, p = .0001, effect size Φ^2 = .27; and the Aptitude-Achievement Consistency Model and the Concordance-Discordance Model, Φ = .26, p = .002, effect size Φ^2 = .07

In contrast, the following associations between pairs of models were not significant: Simple Discrepancy Model and the Low Achievement Model, $\Phi = .15$, $p = .07$, effect size $\Phi^2 = .02$; Simple Discrepancy Model and Aptitude-Achievement Consistency Model, $\Phi = .12$, $p = .16$, effect size $\Phi^2 = .01$; Simple Discrepancy Model and Concordance-Discordance Model, $\Phi = -.04$, $p = .64$, effect size $\Phi^2 = .00$; Regression Model and Concordance-Discordance Model, $\Phi = -.01$, $p = .92$, effect size $\Phi^2 = .00$; Low Achievement Model and Concordance-Discordance Model, $\Phi = .06$, $p = .46$, effect size $\Phi^2 = .00$.

In assessing the associations between the models as based on Phi Coefficients, the models were determined to have little or no association with one another, with the exception of the association between the Simple Discrepancy Model and the Regression Model, the association between the Regression Model and the Low Achievement Model, as well as the association between the Low Achievement Model and the Aptitude-Achievement Consistency Model. Although statistically significant, the relationships between these three pairs of models were weak (http://www.childrens-mercy.org/stats/definitions/phi.htm, 2009). All effect sizes were poor with the exception of the effect size between the Simple Discrepancy Model and the Regression Model and the Low Achievement Model and Aptitude-Achievement Consistency Model which were both moderate (Cohen & Cohen, 1998). According to Professor Gary Peterson (Personal Communication, 2006) effect size is synonymous with 'practical significance'.

Table 10

Phi Coefficients Comparing Level of Association Between Each Pair of Tests

	Regression			Low-Achievement			Aptitude-Achievement Consistency			Concordance-Discordance		
Model	Phi	*p*	Effect Size	Phi	*p*	Effect Size	Phi	*p*	Effect Size	Phi	*p*	Effect Size
Simple Discrepancy	0.67	0.0001	.45	0.15	0.07	.02	0.12	0.16	.01	-0.04	0.64	.00
Regression				0.42	0.0001	.18	0.26	0.002	.07	-0.01	0.92	.00
Low-Achievement							0.52	0.0001	.27	0.06	0.46	.00
Aptitude-Achievement Consistency										0.26	0.002	.07

A contingency table, as seen in Table 11, was used to calculate the level of agreement, in terms of percentages, among the five models. Two models were deemed to have 'agreed' on a learning disability diagnosis if both models concurred on a diagnosis for a particular subject. In other words, 'Yes-Yes' or 'No-No'. From the highest percentage of agreement to the lowest percentage of agreement the results are as follows:

- Simple Discrepancy Model and the Regression Model (86%)
- Low Achievement Model and the Aptitude Achievement Consistency Model (69%)
- Regression Model and the Aptitude Achievement Consistency Model (66%)
- Regression Model and the Low Achievement Model (62%)
- Simple Discrepancy Model and the Aptitude Achievement Consistency Model (60%)
- Low Achievement Model and Concordance-Discordance Model (59%)
- Aptitude Achievement Consistency Model and the Concordance-Discordance Model (56%)
- Simple Discrepancy Model and the Low Achievement Model (49%)
- Regression Model and the Concordance-Discordance Model (43%)
- Simple Discrepancy Model and the Concordance-Discordance Model (41%).

Table 11

Contingency Table Comparing Decisions Made Under Each Pair of LD Diagnostic Models

	Regression				Low-Ach				Consistency				CD-M			
	Yes		No		Yes		No		Yes		No		Yes		No	
Model/Decision	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Simple Discrep																
Yes	36	24	9	6	35	23	10	7	20	13	25	17	30	20	15	10
No	12	8	93	62	66	44	39	26	34	23	71	47	74	49	31	21
Regression																
Yes					46	31	2	1	26	17	22	15	33	22	15	10
No					55	37	47	31	28	19	74	49	71	47	31	21
Low-Ach																
Yes									54	36	47	31	72	48	29	19
No									0	0	49	33	32	21	17	11
Consistency																
Yes													46	31	8	5
No													58	39	38	25

Note. Simple Discrep = *Simple Discrepancy;* Low-Ach = *Low Achievement;* Consistency = *Aptitude-Achievement Consistency;* C-DM = *Concordance-Discordance.*

CHAPTER FIVE: DISCUSSION

The purpose of this study was to examine the frequency of diagnoses, diagnostic agreement, and level of association between five prevalent models currently used for making a Learning Disability determination under the Individuals with Disabilities Education Act (IDEA). Currently, there is a lack of uniformity between school districts with regard to the specific model chosen to identify a student's suspected learning disability (Ahearn, 2008). Furthermore, previous research within the college population has demonstrated that differing models used to diagnose learning disabilities may identify more or fewer subjects (Proctor & Prevatt, 2003; Sparks & Lovett, 2009). Consequently, this study makes a significant contribution to the literature by assessing current models used in a previously unexamined area, the grade 1-10 student population. The models in question include those that have historical roots in many school systems across the United States such as the Aptitude-Achievement Discrepancy Model, the Aptitude-Achievement Regression Model, and the Low Achievement Model (Fletcher et al., 2007). This study also includes more recently formulated models deemed 'Processing Strength and Weaknesses Models', such as the Aptitude-Achievement Consistency Model and the Concordance-Discordance Model.

The remainder of this chapter will discuss the findings of this study as they pertain to the research questions. This chapter will also delineate specific implications for practitioners, state certain limitations, and suggest areas for future research.

Demographic Descriptors

Of the 150 subjects in this study 96 (64%) were males. Furthermore, 111 subjects (74%) were from elementary schools (grades 1-5) and 40 (26.7%) were from middle schools (grades 6-8). The gender and grade differences are not surprising as males, as well as younger children, are more likely than females and older students to be referred for a learning disability assessment (Coutinho & Oswald, 2005). Furthermore, each of the five models diagnosed a higher proportion of males as compared to females. While not all comparisons were statistically significant, this is still somewhat surprising as although males are more likely to be referred for an LD evaluation research has shown that they are no more likely than females to actually possess a learning disability (National Association of Special Education Teachers, 2010). It is possible that this outcome is simply due to a small sample size and with greater power the result

may have been more consistent with previous research. It is also hypothesized that perhaps the referring districts were more likely to send males for an evaluation only when they were clearly struggling academically as opposed to females who may have been referred for less severe difficulties. Consequently, the evaluated males would be more likely to qualify for a learning disability diagnosis.

Analysis of Research Questions

Research Question One

Under which model is a student most likely, and least likely, to be diagnosed with a specific learning disability?

It was noted that the Simple Discrepancy Model (N = 45) and the Regression Model (N = 48) identified similar numbers of subjects. This is not a surprising result, as both models utilize a discrepancy between aptitude and achievement to determine a learning disability. In addition, it was interesting to note that previous studies found that the Simple Discrepancy Model identified more subjects than the comparison models (Proctor & Prevatt, 2003; Sparks & Lovett, 2009). In contrast, the present study found that the Simple Discrepancy Model identified fewer subjects than all of the comparison models examined; however the *percentage* of subjects that qualified for a learning disability under this model fell within the range of participants that qualified under the aforementioned studies. For example, the Proctor and Prevatt (2003) study identified 46.5% of its subjects with an LD using the Simple Discrepancy Model. The Sparks and Lovett (2009) identified 10% of its subjects with this model. In comparison, the present study identified 30% of the subjects with a learning disability with the Simple Discrepancy Model. However, a possible reason for the different diagnostic rates may be due to the contrast in populations. For example, the Proctor and Prevatt (2003) and Sparks and Levitt (2009) studies evaluated college students whereas the current study is comprised of grade 1-10 students.

Furthermore, the present study compared the Simple Discrepancy Model to different models from that of the aforementioned studies with the exception of the Low Achievement Model that was used in the Proctor and Prevatt (2003) study. It was noted that the Proctor and Prevatt (2003) study revealed lower qualification rates for its participants with the Low Achievement Model than the participants in the present study. One possibility for this difference could be due to the fact that the Proctor and Prevatt (2003) study used a college population as

opposed to a grade 1-10 population. It could be argued that even with a learning disability, a college student would need to have mastered a higher level of achievement in order to make it to the college level and this may account for the lower Low Achievement Model qualification rate in the Proctor and Prevatt study.

Another interesting result was that the Low Achievement Model identified over twice as many students as compared to the Simple Discrepancy Model. Previous research has indicated that these two models generally identify similar rates of students (Fletcher et al., 2007). It is possible that the results of the current study are due to the small sample size used in the current study and have therefore produced an aberrant outcome. Consequently, with greater power these results may have differed. It is also hypothesized that perhaps the referring counties, all in the same geographic area, refer students only when they are demonstrating severe, as opposed to moderate, academic difficulties and thus more of their students would qualify under this model.

A further unexpected result is that the Concordance-Discordance Model identified almost twice as many students with a learning disability as the Aptitude-Achievement Consistency Model. This is surprising in that both models adhere to the Processing Strengths and Weaknesses Model. However, when these models are examined more carefully they do have two distinct differences which may account for this variance. For one, the Aptitude-Achievement Consistency Model stipulates that the achievement deficit must have a standard score at or below '85', whereas the Concordance-Discordance Model only requires that an unrelated processing strength be statistically higher than the achievement deficit as specified by the aforementioned Standard Error of Difference (SED) formula. According to Dr. James Hale (Personal Communication, 2009) this gives the Concordance-Discordance Model the advantage of allowing for a diagnosis such as 'Gifted LD' as a standard score achievement deficit below '85' is not a requirement. Furthermore, the Aptitude-Achievement Consistency Model also stipulates that for a student to be diagnosed his/her achievement and related cognitive deficit must occur within an otherwise normal profile (Flanagan, Ortiz & Alfonso, 2007). In contrast, the Concordance-Discordance Model only stipulates that the individual have at least one unrelated processing strength (Hale & Fiorello, 2004). Therefore, when one considers the more restrictive nature of the Aptitude-Achievement Consistency Model, these results may not appear as unexpected. As an example, assume that an assessment revealed a reading achievement standard score of '90' for a particular student. Let's also assume that this student had a related

area of cognitive deficit (e.g. processing speed) and an unrelated cognitive strength (e.g. visual-spatial). Under this scenario the student would qualify under the Concordance-Discordance Model but not under the Aptitude-Achievement Consistency Model as the reading achievement standard score was not '85' or below. These results indicate that if one were to switch between certain models, it is probable that an increase or decrease in overall diagnoses would likely occur.

Research Question Two

What is the level of agreement among the different diagnostic models regarding a specific learning disability diagnosis?

When the five models were examined more closely with regard to 'agreement', it was noted that four of the ten "pairs" had statistical agreement in the sense that they were identifying the same students. On the other hand, six of the ten model pairs identified different students. When the models that identified similar numbers of students, as noted by the frequency analysis, were examined more closely (Simple Discrepancy-Regression, Simple Discrepancy-Ability Consistency Achievement, Regression-Ability Consistency Achievement, Low Achievement-Concordance Discordance) it was noted that they all also demonstrated statistical agreement with regard to the students they identified.

When these aforementioned results are considered, it is not unexpected that the Simple Discrepancy and Regression models were in agreement, as they are both based on similar theoretical orientation. In other words, both of these models are based on a discrepancy between an individual's ability and level of achievement. In contrast, it was unanticipated that the Aptitude-Achievement Consistency and Concordance-Discordance models identified statistically different students in that they are also closely aligned in theory (Hale et al., 2008). However, as previously stated the more restrictive diagnostic nature of the Aptitude-Achievement Consistency Model, as compared to the Concordance-Discordance Model, may explain this discrepancy.

Research Question Three

What are the relationships among the different models? (In other words, what is the interrelationship between models in terms of strength of association and/or effect size.)

When the five models were examined more closely with regard to 'association', it was noted that five of the ten pairs analyzed were found to indicate that there was a statistical association in the sense that there was a categorical correlation in terms of diagnoses made. On the other hand, five of the ten model pairs revealed that the models were not associated. When the models that identified similar numbers of students as noted by the frequency analysis were examined more closely (Simple Discrepancy-Regression, Simple Discrepancy-Ability Consistency Achievement, Regression-Ability Consistency Achievement, Low Achievement-Concordance Discordance) it was noted that only two pairs (Simple Discrepancy-Regression and the Regression-Ability Achievement Consistency) also demonstrated a statistical association. Furthermore, the Simple Discrepancy and Regression pair also had a moderate effect size. (Similarly to the McNemar test analysis, it was anticipated that the Simple Discrepancy and Regression interaction would demonstrate a statistical association as they are based on similar theory.) It should be noted that while the McNemar test and the Phi Coefficient reveal similar information the McNemar test only analyzes the pairs in terms of 'agreement. In other words, similarities of LD diagnoses in terms of 'Yes-Yes' and 'No-No'. On the other hand the Phi Coefficient is evaluating the pair relationship in terms of a categorical correlation.

Several of the interactions that did not identify similar overall numbers of subjects as indicated by the frequency analysis were noteworthy. For example, it was anticipated that the Aptitude-Achievement Consistency and Concordance-Discordance models would be associated, as they, too, are based on similar theory. It was also anticipated that the Regression and Low Achievement models would be associated, as indicated by prior research (Fletcher et al, 2007). However, it was not anticipated that the Simple Discrepancy and Low Achievement models would not show a statistical association (Fletcher, et al, 2007). Once again, as previously hypothesized, one explanation for this surprising result may be due to a small sample size. With greater study power this outcome may too have been statistically significant. Another explanation may be due to the fact that all participants were referred for an assessment from the same geographical area. It is a possibility that students are referred from this area of the country only when their academic difficulties are more severe as compared to other districts across the country which may have skewed the results as well.

Determining Interchangeability Between Models

When determining which of the five models assessed may be interchangeable, it is not recommended to simply use a Phi Coefficient alone if one or more contingency table cells has fewer than five cases (Engineering Statistics Handbook, 2010). Because several cells had fewer than five cases, then a combination of a similarity in frequency of overall numbers diagnosed, significant statistical agreement, and a significant statistical association were the best methods for determining the interchangeability of the five models (J. Kotlerman, Statistical Consulting Group, Personal Communication, 2010). The only two model pairs that meet these criteria were the Simple Discrepancy-Regression relationship and the Regression-Aptitude Achievement Consistency relationship. Furthermore, only the Simple Discrepancy-Regression relationship meet the above criteria while also containing a moderate effect size. In other words, when examining the models' interchangeability, only the Simple Discrepancy-Regression relationship and the Regression-Aptitude Achievement Consistency relationship are empirically supported. Furthermore, due to its moderate effect size ($\Phi^2 = .45$) the Simple Discrepancy-Regression relationship appears to have the most empirical support as being interchangeable.

Yet it should be noted that the author is in no way is advocating for the use of one model over another. It has been previously stated that there is no litmus test for determining a learning disability. Therefore it would be irresponsible to suggest that one model is more or less appropriate in terms of making an accurate LD diagnosis. To the contrary, the author is making a case that each practitioner carefully review all of the pros and cons of each model before making a decision (e.g., empirical support, alignment with research and theory, etc.) However, in general terms, these results indicate that one needs to be cautious when arbitrarily switching between models as it is likely that most models are identifying different subjects, i.e., most of the models are not interchangeable.

Policy and Other Implications for Practicing School Psychologists and School Systems

According to recent research, the Simple Discrepancy Model, the Regression Model, and the Low Achievement Model are still widely used by school systems across the United States (Fletcher et al, 2007). Furthermore, recent research has also indicated that Processing Strengths and Weaknesses models, such as the Aptitude-Achievement Consistency Model and the Concordance-Discordance Models, are also becoming increasingly popular (Flanagan et al.,

2007; Hale et al., 2008; Hale & Fiorello, 2004). Yet, the present research indicates that these models are not identifying the same populations. Furthermore, there is no litmus test for what constitutes a learning disability, and it is this specific knowledge deficit that has plagued the field of special education for decades (Hallahan & Mock, 2003). Consequently, today's school administrators and practitioners need to tread carefully when deciding on a particular model. For example, the author believes that several questions need to be addressed before deciding on a particular model:

1) Is the emphasis on making learning disability diagnoses more generously for fear of making an incorrect non-LD diagnosis and consequently excluding a student who may need services?

While this may be an appropriate rationale this then leads to the possibility of an influx of Type I (false positive) errors. It also leads to risk factors involved with a 'disability stigmatization'. In other words, there is often a negative stigma associated with a learning disability diagnosis (Fletcher et al., 2007.) By possibly diagnosing an individual with an LD in error, the practitioner may create an LD stigma when it is unnecessary.

2) Is the emphasis on assigning learning disability diagnoses more cautiously for fear of diagnosing students with an LD unnecessarily?

This may lead to the possibility of an influx of Type II (false negative) errors which may result in students who don't receive services even though they are in need. That is, using this ideology some students who would otherwise need special education may be excluded.

3) What about the issue of funding?

While many might argue that this should not be a consideration, in practical terms some school systems receive federal funds for each special education student identified; this may incentivize school districts to diagnose more subjects. On the other hand, some school systems encounter a financial loss for each student in special education which may lead to the decision to attempt to qualify fewer students. Furthermore, some models take significantly longer to comprehend and implement. Additionally, it takes significantly longer to train and supervise a school staff with certain models as compared to others. And presumably, all practitioners in a specific school district would be expected to use the same model, which may affect the district financially as well.

4) Is there a need to align the model with current theory?

While there have been many recent arguments to the contrary, some practitioners may still prescribe to the Discrepancy or Low Achievement models (Fletcher et al., 2007). On the other hand, a recent argument, based on CHC theory, is for practitioners to use a model based on the Processing Strengths and Weaknesses theory (Flanagan et al., 2007; Hale et al., 2008; Hale & Fiorello, 2004). Yet even if one prescribes to a certain theory (i.e. the processing strengths and weaknesses model) there is still the question of which model to use. For example, if a practitioner adheres to the statement that an individual must possess a normative processing and achievement deficit, they may tend to use the Aptitude-Achievement Consistency Model. On the other hand, if a practitioner adheres to the concept of Gifted LD, then he/she may want to use the Concordance-Discordance Model. Due to the fact that the Concordance-Discordance Model does not require a normative deficit, but only a relative deficit as demonstrated by the standard error of difference formula, this model contains the ability to diagnosis such a population. As previously mentioned, because there is not a 'litmus test' for LD identification, the diagnosis is based largely on theory. Consequently, while the author concedes that there are other factors that will determine model selection, theory alignment has to be considered a major consideration.

5) Is time a consideration?

Many practitioners do not have the luxury of time within their busy schedules. Due to the methodology involved, the Aptitude-Achievement Consistency Model takes significantly longer than the Discrepancy and Low Achievement models. Furthermore, due to the Standard Error of Difference formula, which needs to be applied to the Concordance-Discordance model, this model takes the longest of all five models to administer. Consequently, even if a practitioner has a natural propensity toward a specific model, practical considerations may prove this unrealistic. It may be apparent that the time it takes to make a diagnosis under each model will vary from practitioner to practitioner. However, this author estimates that the most efficient way to make a learning disability diagnosis is with the Low Achievement Model, followed by the Simple Discrepancy Model, the Regression Model, the Aptitude-Achievement Consistency Model, and finally with the Concordance-Discordance Model taking the longest.

Limitations

The author acknowledges several limitations with the present study. For one, all of the subjects came from the same Northwest region of Florida. Consequently, these results may not

generalize to other settings. For example, many of the participants have a lower than average socio-economic status as compared to the general United States population. The demographic make-up of the participants may not reflect that of other parts of the country (e.g. there were only seven Hispanic participants). Furthermore, it is possible that this area of Florida may refer students for testing only when they have severe, as opposed to moderate, academic difficulties. Secondly, due to the fact that archival data were used, the exact LD referral question was generally unknown. For example, it was unknown if the student was referred for a reading, math, or written language difficulty. Consequently, each subject was given the best chance to qualify for a learning disability even though the student may not have been referred for the specific academic difficulty that resulted in the diagnosis. This may have led to an inflated rate of positive LD diagnoses across models. Next, there is now an emphasis to only test a student after they have been through a Response to Intervention process. Furthermore, the Processing Strengths and Weaknesses models (Aptitude-Achievement Consistency and Concordance-Discordance) both specifically state that they are to be administered only after an in-depth Response to Intervention program has failed to alleviate the academic difficulty (Flanagan et al., 2007; Hale & Fiorello, 2004). Due to the fact that an RTI procedure was not administered many of the students who may have otherwise avoided testing may have not only been referred, but also positively diagnosed. Once again this may have led to an inflated number of positive diagnoses under all models. Furthermore, the Low Achievement Model diagnosed significantly more subjects than the Simple Discrepancy Model. This result differs from previous research (Proctor & Prevatt, 2003; Sparks & Lovett, 2009). This present study result may be due to the fact that the current study was analyzing a grade 1-10 population as opposed to a college population as in the previous studies. However, it is conceivable that this discrepant result stemmed from a low sample size, which is also a limitation of the present study. And lastly, as mentioned in Chapter III, according to the Individuals with Disabilities Education Act (2004) there are currently eight areas that may be used to satisfy the requirement for an achievement deficit. They are as follows:

Oral expression

Listening comprehension

Written expression

Basic reading skill

Reading fluency skills

Reading comprehension

Mathematics calculation

Mathematics problem solving

(Special Education in Texas, 2010)

Yet the Center from which the dataset was obtained for this study does not assess for Oral Expression or Listening Comprehension. This could conceivably lead to a non-diagnosis when in fact one may be warranted. However, in reality the author suspects that in common practice the learning disability diagnostic rate may be significantly lower than that of the current study. Due to reasons such as pressure from administrators, teachers, and parents, funding issues, and other practical concerns the positive LD diagnostic rate would most likely be lower across models. For example, the actual diagnostic rates from the same center where the current participants were gathered between the years of 2004 –2009 were as follows:

* 2004-05 208/43 = 20%
* 2005-06 223/50 = 22%
* 2006-07 188/44 = 23%
* 2007-08 155/45 = 29%
* 2008-09 131/28 = 21%

* These diagnostic rates are generally significantly lower than that of the current study (Please see Table 5).

Suggestions for Future Research

The current study attempted to use learning disability assessment models that are either currently being readily used, and/or are in line with current theory. However, there are many other models that can, and should, be assessed as well (e.g. DSM-IV-TR criteria, Simple Discrepancy Models with varying point differential criteria, Discrepancy-Consistency Model, etc.) Secondly, a logistical regression could be considered to assess which specific features of the subjects correspond to specific diagnoses within certain models. For example, it may be valuable to understand what types of individuals are diagnosed more or less readily by specific models (e.g. IQ, socio-economic status.) Furthermore, as previously stated, a Response to Intervention procedure is becoming ever more prominent. It would therefore be important to

conduct a similar study after incorporating an RTI program to weed out the students who respond appropriately, and therefore only assess the students who do not respond as this would be in greater keeping with best practices (Flanagan et al., 2007; Hale & Fiorello, 2008). The current study found that a larger percentage of males were diagnosed as compared to females under each of the five models assessed. The current research further found that the percentage of diagnoses under each model appear to be higher than that of current practice. If future research replicates these findings, it would be of interest to examine which factors contribute to these results. It was also noted that the Simple Discrepancy and Low Achievement models did not show a statistical association. This result differs from previous research (Fletcher, et al, 2007). It would therefore be interesting to examine if future research replicates this finding. Another area of potential future research would involve assessing the cost of each model in terms of staff training, time considerations, etc. Furthermore, because the models differ in terms of complexity, it may be beneficial to investigate the level of the consumers' comprehension and application efficacy. It may also be beneficial to evaluate diagnostic levels between the models when comparing private to public assessments. And finally, a qualitative study that clearly delineates every step of the evaluation process using each of the five models may be informative. For example, by following one student from the referral stage, through data collection, all evaluation procedures, report write-up, and ending with intervention implementation may shed significant light on the similarities and differences between each of the models.

APPENDIX A
IRB APPROVAL LETTER

Office of the Vice President For Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-8673 · FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 8/26/2009

To: Joshua Shifrin

Address: 123 Smull Avenue - West Caldwell, NJ 07006
Dept.: EDUCATIONAL PSYCHOLOGY AND LEARNING SYSTEMS

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
Assessing The Relationship Among Models For Diagnosing Specific Learning Disabilities

The application that you submitted to this office in regard to the use of human subjects in the research proposal referenced above has been reviewed by the Human Subjects Committee at its meeting on 08/12/2009. Your project was approved by the Committee.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 8/11/2010 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chair of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00000446.

Cc: Briley Proctor, Advisor
HSC No. 2009.2944

APPENDIX B

DISCREPANCY TABLE

CRITERION DISCREPANCY SCORES TABLE

AGE 6 TO 21 YEARS
(GRADES 1 AND ABOVE)

IQ	Criterion Score	IQ	Criterion Score
69	62	97	80
70	62	98	81
71	63	99	82
72	64	100	82
73	65	101	83
74	65	102	84
75	66	103	84
76	67	104	85
77	67	105	86
78	68	106	86
79	69	107	87
80	69	108	88
81	70	109	88
82	71	110	89
83	71	111	89
84	72	112	90
85	73	113	91
86	73	114	91
87	74	115	92
88	75	116	93
89	75	117	93
90	76	118	94
91	76	119	95
92	77	120	95
93	78	121	96
94	78	122	97
95	79	123	97
96	80	124	98
		125	99

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