The Lecture Note-Taking Skills of Adolescents with and without Learning Disabilities

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ABSTRACT

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Specific learning disability is by far the most prevalent of the 13 special education categories recognized under the Individuals with Disabilities Educational Act (IDEA), consisting of approximately 2.5 million students and comprising 42% of all children receiving special education services in public schools (Cortiella, 2011). Research suggests that learning disabilities (LDs) are chronic conditions with lifetime implications (Morris, Schraufnagel, Chudhow, & Weinberg, 2009), and by high school, students identified with LDs are reading at an average of 3.4 years below grade level (Cortiella, 2011). Such profound reading deficits result in pervasive academic difficulties, as compared to their non-disabled peers. Thus, students with LDs are at a substantial disadvantage for accessing the curriculum (Cortiella, 2011; Shaywitz, 2003). Not surprisingly, students with LDs are more likely to drop out of high school, less likely to pursue postsecondary education, and twice as likely to be unemployed (Cortiella, 2011).

In light of the drastic impact LDs have upon students and their academic success, schools must make concerted efforts to provide research-based supports for students with LDs in order to minimize these disadvantages. Research suggests that improvements in note-taking may be one way to increase academic achievement, and thus the prominence of lectures, coupled with the established benefits of lecture note-taking, provides unique intervention opportunities to target special education students.

The purpose of this study was to compare the lecture note-taking skills of adolescents with and without LDs by exploring the role of cognitive processes speculated to impact note-taking ability and proficiency. While existing research identifies discrepancies between the quality of notes recorded by students with and without LDs, little is known about the underlying cognitive processes causing these differences. Building upon this previous research, with consideration to the unique characteristics of students with LDs, this study investigates the following cognitive processes theorized to impact the note-taking skills of adolescents with and without LDs: (1) handwriting speed, (2) listening comprehension, (3) sustained attention, and (4) background knowledge.

The researcher hypothesized that 1) NLD students would outperform LD students across all independent and dependent variables, 2) LD status, listening comprehension, handwriting speed, background knowledge, and sustained attention would significantly predict notes, 3) LD status, listening comprehension, handwriting speed, background knowledge, sustained attention, and notes would significantly predict multiple-choice test performance, and 4) the prediction pattern for the LD group would be the same as the prediction pattern for the NLD group.

Participants were recruited from two northeast high schools, located within the same urban school district, and specific selection criteria were identified for the LD and NLD groups. All students selected for the LD group were required to have an IQ score of 70 or above, based on the most recent psychological assessment. Additionally, all potential participants completed a screening session to assess their reading comprehension skills and confirm their appropriateness for the assigned group. The final sample included 70 adolescents with a mean age of 16.1 ($SD=1.23$).

After the screening, all participants completed two sessions in small groups within a ten-day period. During the first session, participants were asked to (a) view a video-recorded lecture while simultaneously taking notes on the lecture content, (b) complete a demographics questionnaire, (c) review their lecture notes, (d) complete a measure of handwriting speed, and (e) complete a multiple-choice test based on the lecture content. In the second experimental session, participants were asked to (a) complete a measure of listening comprehension, (b) complete a measure of background knowledge, and (c) complete a measure of sustained attention.

Consistent with hypothesis, results of the study indicated that NLD students significantly outperformed LD students across all measures. However, contrary to hypotheses, LD status was the only significant predictor of notes' total. Additionally, LD status, handwriting speed, listening comprehension, and background knowledge predicted test performance. When the LD and NLD groups were analyzed separately, none of the independent variables predicted notes' quality. Interestingly, handwriting speed predicted multiple-choice test performance for the LD group, but listening comprehension and background knowledge predicted multiple-choice test performance for the NLD group.

Overall, compared to their NLD peers, LD adolescents struggled significantly across all independent and dependent variables, and given the outcomes, it appears as though LD status mediated the relationship between the cognitive variables and note-taking.

TABLE OF CONTENTS

LIST OF TABLES	iv
LIST OF FIGURES	vi
ACKNOWLEDGEMENTS	vii
CHAPTER	PAGE
I. INTRODUCTION	1
II. REVIEW OF THE LITERATURE	8
Learning Disabilities	8
Historical Overview	8
The LD Movement	13
Definitions of LD	15
Prevalence of LD	17
Prevalence of Reading Disabilities	20
Primary Clinical Presentation of Reading Disabilities	21
Theoretical Models of Reading Disabilities	23
Comorbid Disorders	25
Learning Disabilities in Adolescence and Adulthood	26
Lecture Note-taking	28
Handwriting Speed	31
Listening Comprehension	34
Sustained Attention	37
Background Knowledge	39
Note-Taking and Learning Disabilities	42

CHAPTER	PAGE
Summary, Research Questions, and Hypotheses	46
III. METHOD	49
Participants	49
Selection Criteria	51
Recruitment	52
Comorbidity	53
Materials	53
Reading Comprehension	54
Demographics Questionnaire	55
Lecture	56
Notes	56
Multiple-Choice Test	58
Handwriting Speed	58
Listening Comprehension	59
Sustained Attention	61
Background Knowledge Assessment	63
Design and Procedure	64
IV. RESULTS	66
Intercorrelations	67
Multivariate and Univariate Tests	69
Multiple Regression Analyses	71
Supplementary Analyses	77

CHAPTER	PAGE
V. DISCUSSION	79
Overview	79
Note Quality: Which Variables Predicted Note-taking in Adolescents?	81
Test Performance: Which Variables Predicted Test Performance in Adolescents?	84
How Did NLD Students Compare to LD Students?	88
Educational Implications and Future Research	89
Limitations	93
Conclusions	95
References	96
Appendix A: Supplementary Figures	105
Appendix B: Letter Presented to Potential Participants	107
Appendix C: Materials Sent Home to Parents	109
Appendix D: Screening Session Materials	114
Appendix E: Lecture Materials	122
Appendix F: Session 1 Materials	131
Appendix G: Multiple-Choice Test Scoring Template	145
Appendix H: Session 2 Materials	149
Appendix I: Background Knowledge Scoring Template	158

LIST OF TABLES

Table	Page
1. Demographics Information by School	50
2. Demographics Information by LD Status	51
3. Means, Standard Deviations, Ranges, Skew, and Kurtosis for Predictor and Outcome Variables (N=70)	67
4. Intercorrelations Among the Independent and Dependent Variables for Entire Sample (N= 70)	68
5. Intercorrelations Among the Independent and Dependent Variables for LD Group (n=35)	69
6. Intercorrelations Among the Independent and Dependent Variables for NLD Group (n=35)	69
7. Univariate ANOVAs Comparing LD and NLD Groups Across All Measures (N= 70)	70
8. Means and Standard Deviations by School	71
9. Summary of Regression Analysis Predicting Notes Total	72
10. Summary of Regression Analysis Predicting Multiple-Choice Total	73
11. Summary of Regression Analysis Predicting Multiple-Choice Memory Performance	74
12. Summary of Regression Analysis Predicting Multiple-Choice Inference Performance	74
13. Summary of Regression Analysis Predicting Notes Total for LD Group	75
14. Summary of Regression Analysis Predicting Notes Total for NLD Group	75
15. Summary of Regression Analysis Predicting Notes Total for LD Group	76
16. Summary of Regression Analysis Predicting Notes Total for LD Group	76

Table	Page
17. Summary of Regression Analysis Predicting Notes Total without LD Status	77
18. Summary of Regression Analysis Predicting Multiple-Choice Total without LD Status	78
19. Logistic Regression Classification Table	78
20. Summary of Regression Analysis Predicting LD Status	78
21. Means and Standard Deviations of Native and Non-Native English Speakers	93

LIST OF FIGURES

Figure	Page
1. Frequency Distribution of Nelson Denny Reading Test Percents for Sample (N= 70)	105
2. Frequency Distribution of Full Scale IQ Scores for the LD Group ($n= 35$)	106

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L.M.O.

CHAPTER I

INTRODUCTION

Across academic areas, skill proficiency is generally conceptualized as the simultaneous execution of domain-specific basic skills and higher-level processes, all functioning within the limited capacity of working memory (Peverly & Sumowski, 2012). As such, once basic skills become fluent, increased cognitive resources are available for higher level processing (Peverly, 2006; Peverly & Sumowski, 2012), and individual differences in ability are largely determined by the quality of the higher-level skill (Peverly & Sumowski, 2012). While this theoretical framework is commonly applied to reading (Fletcher, Lyon, Fuchs, & Barnes, 2007; Lyon et al., 2001; Perfetti, 1977;), writing (Berninger, 1999; Berninger et al., 2006; Peverly, 2006), and mathematics (Geary, 1994), research investigating the underlying cognitive processes related to study skills suggests that note-taking adheres to a similar conceptual model by relying on a variety of basic and higher-level processes (Gleason, 2012; Peverly, Garner, & Vekaria, 2014; Peverly et al., 2007; Peverly and Sumowski, 2012; Vekaria, 2011).

Multiple studies demonstrate that the quality of text and lecture notes is a significant predictor of test performance, and as such, note-taking is an essential academic skill for secondary and postsecondary education students (Armbruster, 2009; Kobayashi, 2006; Peverly et al., 2007; Peverly & Sumowski, 2012). Theorists speculate that notes serve two major functions related to learning, including (1) encoding and (2) external storage (DiVesta & Gray, 1972). First, the encoding function – the act of transcribing notes – engages learners by promoting a deeper, more meaningful processing of information than achieved by reading or listening without taking notes (DiVesta & Gray, 1972; Kiewra, 1985; Piolat, Olive, & Kellogg, 2005). The second function, external storage, is also associated with positive educational outcomes, as research

suggests that reviewing notes significantly enhances learning (Kobayashi, 2006; Kiewra, 1985) facilitates the reconstruction of content (Rickards & Friedman, 1978). While, standing alone, encoding and external storage functions separately promote positive educational outcomes, it is not surprising that note-taking is most effective when the two processes are utilized together (Armbruster, 2009; Kobayashi, 2006).

At the secondary-education level, lectures are the primary instructional technique teachers utilize, and several investigations stress the prominence of lectures in high school settings. For example, in surveying secondary-education teachers, Vogler (2006) found that 79% of the participants reported to “regularly” or “mostly” use lectures when teaching. Another study, which surveyed a longitudinal sample of over 500 high school students, reported that “listening to lectures” and “independent work” were the two activities in which students engaged in the most (Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003). Additionally, Putnam, Deshler, and Schumaker (1993) found that lecture material was a major source of information used by teachers when developing test questions, further emphasizing the relevance of lecture note-taking. However, despite the universal acceptance of lecture as effective instructional approach, note-taking is a cognitively demanding task which may prove challenging for some students. In a lecture setting, individuals must retain the verbally presented information, identify the most important components, and then quickly transcribe the information without diverting attention from the ongoing presentation (Peverly et al., 2007; Piolat et al., 2005). Considering the multitude of complex cognitive processes necessary, a breakdown at any of these points could negatively impact note-taking proficiency and learning potential.

One group of students who may be experiencing difficulties with lecture note-taking includes individuals with learning disabilities (LDs). Some research posits that students without

LDs are better note-takers than students with LDs, and thus profit more from instruction (Boyle, 2010; Hughes & Suritsky, 1994). Further, survey data investigating learning-disabled students' perceptions of note-taking indicates that students with LDs find note-taking to be a struggle. For instance, Cowen (1988) reported that 72% of the learning-disabled college students surveyed expressed difficulty with taking adequate notes, and Suritsky (1992) indicated that learning disabled undergraduate students acknowledged difficulties with writing quickly enough, paying attention, and identifying important lecture points.

At least two studies document differences in the quality of notes taken by students with LDs as compared to the quality of notes recorded by students without LDs. First, in a study of university students with and without LDs, Hughes and Suritsky (1994) found that students with LDs transcribed significantly fewer lecture points than students without LDs. The largest discrepancy observed was with the number of cued lecture points, or information units explicitly identified by the speaker as important. As these results suggest, students with LDs demonstrate increased difficulties recognizing the major lecture objectives even when given assistance by the instructor (Boyle, 2010; Hughes & Suritsky, 1994). Additionally, Boyle (2010) yielded similar results when studying the note-taking skills of middle school students with and without LDs. This study's findings indicated that when compared to students without LDs, students with LDs recorded fewer total lecture points, fewer cued lecture points, and performed worse when tested on the lecture material (Boyle, 2010).

Although a multitude of research identifies discrepancies between the quality of notes recorded by students with and without LDs, very little is understood about the underlying cognitive processes causing these differences. Yet, when considering the significant academic challenges facing students with LDs, developing a comprehensive understanding of these

cognitive variables is essential for implementing successful interventions and thus, ensuring universal access to the curriculum. Building upon previous note-taking research with special consideration to the unique characteristics of students with LDs, several cognitive processes related to lecture note-taking are worth exploring, including: (1) handwriting speed, (2) listening comprehension (3) sustained attention, and (4) background knowledge.

Handwriting speed is an important component of lecture note-taking, and a growing body of research indicates that writing speed is a significant predictor the quality and completeness of notes (Peverly, 2006; Peverly et al., 2007; Peverly & Sumowski, 2012; Peverly et al., 2014). However, indirect evidence suggests that handwriting speed is an area of difficulty for students with LDs, as Suritsky (1992) indicated that 45% of the learning disabled undergraduates surveyed acknowledged difficulties with spelling and writing quickly enough to keep up with the lecturer's pace. Interestingly, one study compared the handwriting speed of students with and without learning disabilities at the secondary-education level, but failed to find any significant differences between the two groups (Boyle, 2010). Despite these findings, the consistent data relating handwriting speed to quality note-taking and test performance indicates that this variable needs further investigation (Gleason, 2012; Peverly, 2006; Peverly et al., 2007; Peverly & Sumowski, 2012).

Listening comprehension is another cognitive construct relevant to note-taking, and evidence suggests that students with language-based LDs likely struggle with this skill. Multiple studies identify a significant correlation between listening comprehension and reading abilities (Curtis, 1980; Diakidoy, Stylianour, Karefillidou, & Papageorgiou, 2005; Sticht, Beck, Hauke, Kleinman & James, 1974). Thus researchers speculate that poor readers also struggle with listening comprehension tasks (Curtis, 1980; Sticht et al., 1974; Ward-Lonergan, Liles, &

Anderson, 1998), like lecture note-taking. For instance, Curtis (1980) found that “skilled readers” outperformed “less skilled” readers on measures of decoding and listening comprehension, and Ward-Lonergan and colleagues (1998) found that individuals with language-based LDs demonstrated more difficulties recalling verbal information than their non-disabled peers. While no published articles specifically focus on the relationship between listening comprehension and the note-taking skills of individuals with LDs, studies of students with Attention Deficit-Hyperactive Disorder (ADHD) suggest that listening comprehension predicts the completeness and overall quality of notes among disabled populations (Gleason, 2012; Vekaria, 2011). As such, when investigating the note-taking skills of students with LDs, listening comprehension appears to be an influential cognitive process ripe for further analysis.

Sustained attention is third relevant variable in educational settings, and some theorists even speculate that attention is the most important component of note-taking (Williams and Eggbert, 2002). In a lecture setting, unless students are focused on the ongoing presentation, they will not be able to meaningfully process the information or accurately identify the main ideas expressed by the speaker (Williams & Eggbert, 2002). While survey data suggests that students with LDs consistently struggle to pay attention during classes (Suritsky, 1992), empirical investigations of students with ADHD further emphasize the significance of sustained attention with regards to lecture note-taking proficiency. Specifically, when Gleason (2012) compared the note-taking skills of high school students with and without ADHD, results indicated that ADHD status and sustained attention significantly predicted the quality and completeness of notes. Additionally, in a similar study of undergraduate and graduate students with and without ADHD, Vekaria (2011) also found attention to be a significant predictor of note-taking proficiency. Moreover, research documenting high comorbidity rates of LDs and

attention deficits (Morris, Schraufnagel, Chudhow, & Weinberg, 2009) further suggests that students with reading disabilities experience substantial difficulties sustaining attention in lecture settings.

Finally, background knowledge – the prior knowledge about a topic that students bring to the learning process (Jonassen & Gabrowski, 1993) – facilitates comprehension across a variety of contexts (Adams, Bell, & Perfetti, 1995; Schneider, Carr, & Thomas, 1996; Walker, 1987), and most likely impacts the note-taking skills of students with LDs. Kintsch (1998) posits that readers with high background knowledge construct richer macrostructures of text than readers with low background knowledge, and empirical studies further suggest that background knowledge compensates for low aptitude (Schneider et al., 1996; Walker, 1987) and poor reading skills (Adams et al., 1995; Carr & Thomas, 1996; Schneider et al., 1989). While the relationship between background knowledge and LDs requires further investigation, Carr and Thomas (1996) found that students with LDs significantly benefited from the activation of domain knowledge prior to reading a passage. Specific to note-taking, the few studies examining the impact of background knowledge on note-taking proficiency yielded somewhat mixed results. For instance, in an investigation of text note-taking, Peverly (2003) failed to find a relationship between background knowledge and the number of information units recorded by undergraduates; however, background knowledge predicted test performance. Further, although Peverly and Sumowski (2012) also found background knowledge not to significantly predict note-taking proficiency, it predicted test performance and inference responses. Considering these results along with the significant impact of background knowledge on comprehension, it appears likely that background knowledge may compensate for the processing deficits of LDs and, thereby, influence note-taking skills and lecture recall abilities.

From the limited research conducted to date, it is apparent that students with learning disabilities do not have the same access to the curriculum as their non-learning disabled peers. As Suritsky & Hughes (1991) indicated, "...information on note-taking characteristics is essential for improving current note-taking interventions for designing cost-effective alternative interventions for students with [learning disabilities]." Moreover, as some investigations suggest that students with LDs benefit from note-taking remediation (Boyle & Weishaar, 2001), identifying the meaningful cognitive variables to target with interventions may significantly improve the educational experience of individuals with LDs.

Research Questions

This study utilized a quasi-experimental design to investigate four primary research questions regarding the lecture note-taking and study skills of adolescents with and without LDs:

- 1) Are there significant differences between adolescents with and without learning disabilities in the areas of handwriting speed, listening comprehension, sustained attention, background knowledge, quality of notes and/or test performance?
- 2) Does LD status, handwriting speed, sustained attention, listening comprehension, and/or background knowledge contribute to differences in the quality of notes?
- 3) Does LD status, handwriting speed, sustained attention, listening comprehension, background knowledge, and/or quality of notes contribute to differences on test performance?
- 4) Are the note-taking or test performance predictors different for students with LDs than for students without LDs?

CHAPTER II:

REVIEW OF THE LITERATURE

LEARNING DISABILITIES

Specific learning disability is the most prevalent of the 13 special education classifications identified by the Individuals with Disabilities Education Improvement Act (IDEIA) (Cortiella, 2011). First designated as a “handicapping condition” by the federal government in 1969 (U.S. Department of Education, 1999), learning disabilities (LDs) account for the majority of students receiving special education services in public schools today (Cortiella, 2011). The following section reviews the scientific literature on learning disabilities, concentrating on reading disorders and the cognitive processes related to study skills and note-taking.

Historical Overview. The LD field emerged in response to several scientific, social and political objectives (Fletcher, Lyon, Fuchs, & Barnes, 2007; Lyon et al., 2003; Torgesen, 2004). First, the need to understand individual differences in learning, especially with regards to unexpected patterns of cognitive strengths and deficits, is evident throughout history (Fletcher et al., 2007; Lyon et al., 2003), tracing back to early Greek civilizations (Torgesen, 2004). However, Franz Joseph Gall, an early nineteenth century German physician and anatomist, is credited with authoring the first scientific works relevant to contemporary conceptualizations of LDs (Fletcher et al., 2007; Lyon et al., 2003; Torgesen, 2004). While studying patients suffering from brain damage, Gall observed that targeted areas of cognitive functioning could be impaired while other abilities remained intact and, thereby, established the roots for “specific” rather than “generalized” deficits (Fletcher et al., 2007; Lyon et al., 2003; Torgesen, 2004; Zola-Morgan,

1995). Beyond this contribution, Gall also developed frameworks for the current LD exclusionary criteria applied today, as he advocated for ruling out pervasive conditions like mental retardation and deafness when diagnosing specific disabilities (Lyon et al., 2003).

Building upon Gall's research, several medical professionals throughout the 1800s and early 1900s documented patients who demonstrated intra-individual strengths with patterns of deficits in specific areas like linguistics, reading, or cognitive abilities (Fletcher et al., 2007). For instance, Carl Wernicke and Paul Broca independently reported on specific language deficits evident in the absence of other significant cognitive or linguistic dysfunctions (Fletcher et al., 2007; Lyon et al., 2003, Torgesen, 2004). Additionally, John Baptiste Bouillaud, Hughlings Jackson, and Henry Head studied the adulthood loss of various speech and language abilities as the result of damage to isolated regions of the brain (Torgesen, 2004). By the beginning of the twentieth century, consistent findings among independent researchers offered robust support for the existence of specific disabilities and also began shaping a set of common characteristics defining unique types of learners (Fletcher et al., 2007; Lyon et al., 2003).

Specific to reading disorders, developmental dyslexia in children was first reported by W. Pringle Morgan in 1896, while several early researchers described adult patients presenting with an inability to read despite average to above average intelligence and appropriate educational opportunities (Shaywitz & Shaywitz, 2005). In 1917, James Hinshelwood, a Scottish ophthalmologist, documented the first clinical investigations of specific reading disabilities by investigating multiple cases of adults who suddenly lost the ability to read (Fletcher et al., 2007; Torgesen, 2004). Hinshelwood speculated that damage to localized regions of the brain contributed to this rapid atrophy of skills and attempted to support his hypotheses by citing evidence from the patients' lives and through postmortem examinations (Torgesen, 2004).

Additionally, Hinshelwood studied children struggling to acquire basic reading skills, which he described as “congenital word blindness” (Lyon et al., 2003; Torgesen, 2004). Hinshelwood postulated that these observed reading deficits resulted from damage to areas of the brain responsible for visual memory (Torgesen, 2004). Although recent assessments of Hinshelwood’s studies suggest that his research overlooked significant environmental factors, Hinshelwood is credited as one of the first researchers to provide scientific documentation of specific reading disabilities without global cognitive impairment (Torgesen, 2004).

Throughout the twentieth century, learning disorders were studied from various neurological, psychological, and educational perspectives. In the 1920s, Samuel Orton, an American neurologist, extended LD research through clinical studies of children with reading disabilities or dyslexia (Torgesen, 2004). Unlike previous theorists who commonly believed that specific deficits resulted from localized brain damage, Orton hypothesized that the observed reading difficulties were actually due to a delay in or failure of the left cerebral hemisphere to establish language dominance (Fletcher et al., 2007; Torgesen, 2004). As evidence for this theory, Orton cited the presence of “strephosymbolia,” a term he used to describe the frequent difficulties reading disabled children demonstrated when reading reversible letters and words (e.g., “b-d” and “was-saw”) (Fletcher et al., 2007; Torgesen, 2004). Orton believed that this condition was symptomatic of the neurological confusion that occurred when visual stimuli were processed in the absence of a language dominant brain hemisphere (Torgesen, 2004). Although subsequent empirical research offers limited support for Orton’s neurological theories of dyslexia, he is credited as a pioneer in the field for identifying the link between reading skills and language abilities. Also among his professional accomplishments, Orton applied data from his

research to develop an effective systematic reading remediation program that is still widely applied today (Fletcher et al., 2007; Torgesen, 2004).

During the 1930s and 1940s, the clinical and empirical works of Heinz Werner, a developmental psychologist, Alfred Strauss, a neuro-psychiatrist, and their colleagues directly contributed to the emergence of LD as a recognized professional field (Fletcher et al., 2007; Torgesen, 2004). While researching at Wayne County Training School in Northfield, Michigan, Werner and Strauss attempted to demonstrate that specific disabilities resulted from deficient learning processes and such cognitive deficits were identifiable through behavioral observations (Fletcher et al., 2007; Torgesen, 2004). In these clinical studies, Werner and Strauss compared the behavior of children with presumably organic mental retardation to the behaviors of children with suspected brain injuries. As cited in Fletcher et al. (2007), the results indicated that both groups demonstrated “difficulties on tasks assessing figure-ground perception, attention, and concept formation in addition to hyperactivity.” Such clinical observations were significant at the time, as they suggested that brain dysfunction was detectable by observing individuals’ behaviors, especially their approaches to learning tasks (Lyon et al., 2003). Beyond intellectual disabilities, subsequent studies of children of average intelligence who demonstrated learning and behavioral difficulties led Strauss and Werner to conclude that academic remediation should focus on minimizing the impact of the deficient cognitive processes, a concept embedded within contemporary approaches of LD instruction (Fletcher et al., 2007; Torgesen, 2004).

It is important to note that the empirical works of Werner and Strauss have been criticized over the years, as researchers question their experimental designs and, consequently, the validity of the results obtained (Torgesen, 2004). However, despite these concerns regarding

research methods, the writings of Werner and Strauss ignited the LD movement by profoundly impacting the way professionals conceptualized and approached academic disorders.

Influenced by Werner and Strauss, several other behavioral scientists contributed to early LD research and clinical developments (Fletcher et al., 2007; Lyon et al., 2003; Shaywitz & Shaywitz, 2005). Among the most notable of these scientists were William Cruickshank, Helmer Myklebust, Doris Johnson, and Samuel Kirk, all of whom focused on understanding individual learning profiles and developing interventions to target deficit areas (Fletcher et al., 2007; Lyon et al., 2003). For example, Cruickshank, Bice and Wallen (1957) proposed reducing distracting stimuli in the classrooms of children exhibiting learning and attention difficulties, while Johnson and Myklebust (1967) were among the first scientists to design intervention procedures for remediating academic skills (Fletcher et al., 2007). In 1963, Kirk coined the term “learning disabilities” at the Conference on Exploration into Problems of the Perceptually Handicapped, sponsored by the Fund for Perceptually Handicapped Children, Inc. (Torgesen, 2004). At this event, Kirk (1963) proposed the first formal definition of LD by stating:

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 the blind. I also exclude from this group children who have generalized mental retardation (p. 2).

Kirk’s presentation served as a catalyst for the LD movement (Torgesen, 2004), as his definition implied that these unique learning characteristics were neurologically, rather than environmentally, based (Fletcher et al., 2007; Lyon et al., 2003). Further, Kirk unequivocally declared that LD was diagnostically different from mental retardation and other pervasive disorders, and thus such “unexpected” patterns of learning deficits require specialized remediation (Fletcher et al., 2007; Lyon et al., 2003). Although limited systematic research

investigating LDs was conducted before the 1970s, Kirk's theoretical conceptualization of LDs nevertheless motivated parents, educators, and advocates to fervently lobby for legislation to service LD students in public schools (Fletcher et al., 2007; Lyon et al., 2003).

The LD Movement. As previously discussed, social and cultural factors contributed to the intensity of the LD movement during the 1960s. Although evidence suggests that reading deficits have existed for hundreds of years (Fletcher et al., 2007; Lyon et al., 2003; Shaywitz & Shaywitz, 2005; Torgesen, 2004), reading difficulties prior to the twentieth century were considerably less problematic, as the majority of daily information was exchanged verbally and routine written records remained relatively simple (Sleeter, 1986). However, with major societal changes like industrial expansion and increased global competition, stronger literacy skills and more advanced professional training became increasingly important for many occupations (Sleeter, 1986). As the 1900s progressed, schools responded to these cultural shifts by implementing methods geared towards raising academic standards and increasing literacy levels (Sleeter, 1986). For instance, in the early 1960s, several common achievement tests like the Metropolitan Achievement Tests and the Iowa Tests of Basic Skills were renormed to reflect escalated standards of reading, while the readability level of many widely-used elementary school textbooks was raised (Sleeter, 1986).

Despite increased academic demands, limited assistance was available for struggling students before the mid-1960s (Lyon et al., 2003). While some disabilities like mental retardation were formally recognized in education, students demonstrating specific academic deficits with average to above-average intelligence were disenfranchised from special education services, as their educational characteristics did not neatly fit within any recognized disability category (Lyon et al., 2003). This disenfranchisement escalated the LD movement, as parents,

teachers, and advocates were motivated to protect children from being underserved in the educational system (Lyon, 2003).

The field of learning disabilities was formally established as a social, political, and educational movement with the formation of the Association for Children with Learning Disabilities (ACLD) in 1963 (Sleeter, 1986; Torgesen, 2004). While the professional advisory board of the ACLD was comprised of the leading educational experts of the time, the organization was primarily for parents who intended to “mobilize social and political concern for the plight of children with learning disabilities and to create public sector services for them” (Torgesen, 2004, p. 15). With similar objectives, other advocacy groups quickly joined the efforts and the new field rapidly moved towards formal legislation.

Lobbying efforts first met success in 1969 when Congress enacted the Children with Specific Learning Disabilities Act as part of the Education of the Handicapped Act (P.L. 91-230). This law was the first to recognize LD as a formal category and also authorized targeted research and training programs to support children with LDs (Lyon, 2003; Sleeter, 1986). Soon after, in 1975, the Education for All Handicapped Children Act (P.L. 94-142) was enacted, which was the precursor to the Individuals with Disabilities Education Act (IDEA), the current special education legislation. This law mandated free appropriate public education for all students, including those identified with LDs. Beyond federal legislation, “specific developmental disorders” first appeared in the third edition of the *Diagnostic Statistical Manual of Mental Disorders* (DSM-III) in 1980 (American Psychiatric Association, 1980). Previous editions of the *DSM* described learning and behavioral deficits under one category known as “minimal brain dysfunction (MBD).” However, the *DSM-III* dichotomized learning disorders

and attention disorders into individual categories (American Psychiatric Association, 1980), allowing for more accurate classification and efficient remediation (Lyon, 2003).

Definitions of LD. As the politically-charged LD movement preceded the majority of systematic studies regarding LD diagnosis, initial definitions relied heavily on clinical theories and anecdotal evidence (Fletcher et al., 2007; Hammill, 1990; Lyon, 2003). Despite advances in recent decades, establishing diagnostic criteria for LDs continues to be a difficult, controversial task, complicating research efforts and resulting in multiple theoretical and operational conceptualizations of the disorder (Fletcher et al., 2007; Graham & Bellert, 2004; Hammill, 1990; Lyon, 2003). As Fletcher et al. (2007) described, “No single problem has plagued the study of LDs more than the problem of definition” (p. 25). In spite of competing perspectives, some researchers posit that more agreement than disagreement exists among the most widely used definitions, suggesting that a consensus may be closer than previously assumed (Hammill, 1990).

To date, federal special education law provides the most commonly used definition of LD. The IDEA identifies a specific learning disability as “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 the imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations” (Pub. L. No. 108-445, sec. 602(3)). Notwithstanding its prevalent application, this definition has been widely criticized as vague, incomplete, and in some instances inaccurate. As such, the National Joint Committee on Learning Disabilities (NJCLD), a national committee composed of representatives from eight professional organizations, recommends improving the definition by (1) reinforcing the idea that learning disabilities exist at all ages, (2) omitting the controversial phrase “basic psychological processes,” (3) distinguishing

between learning disabilities and learning problems, and (4) clearly indicating that the exclusionary clause does not rule out the possible coexistence of other handicapping conditions (Hammill, 1990). With this position, the NJCLD offers the following LD definition:

Learning disabilities 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 skills. These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction and may occur across the life span. Problems in self-regulatory behaviors, social perception, and social interaction may exist with learning disabilities, but do not, by themselves, constitute a learning disability. Although learning disabilities may occur concomitantly with other disabilities (e.g., 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” (NJCLD, 1988, p. 1).

While the NJCLD definition addresses issues related to heterogeneity, persistence, intrinsic etiology, and comorbidity, it is still considered vague and ambiguous, and does little to resolve identification problems (Lyon et al., 2003).

From a medical perspective, both the *Diagnostic Statistical Manual of Mental Disorders – Fourth Edition* (DSM-IV; American Psychiatric Association, 1994) and the *International Classification of Diseases – Tenth Edition* (ICD-10; World Health Organization, 1992) currently include criteria for learning disorders by separating academic skills into specific deficit domains (Fletcher et al., 2007). For instance, the *DSM-IV* identifies criteria for “reading disorder” (315.00), “mathematical disorder” (315.1), and “disorder of written expression” (315.2) (American Psychiatric Association, 1994), while the *ICD-10* identifies criteria for “specific reading disorder” (F81.1), “specific disorder of arithmetic skills” (F81.2) and “specific spelling disorder” (F81.1) (World Health Organization, 1992). Specific to reading, the *DSM-IV* describes a reading disorder as, “reading achievement, as measured by individually administered standardized tests of reading accuracy or comprehension, is substantially below that expected given the person’s chronological age, measured intelligence, and age-appropriate education”

(American Psychiatric Association, 1994). Further, “the disturbance in Criterion A significantly interferes with academic achievement or activities of daily living that require reading skills,” and “if a sensory deficit is present, the reading difficulties are in excess to those usually associated with it” (American Psychiatric Association, 1994).

Beyond these primary definitions, many other theorists have attempted to capture the essence of LDs. Specifically, Hammill (1990) analyzed the components of eleven LD definitions across nine key elements, including the IDEA and NJCLD definitions cited above. Contrary to popular opinion, analyses suggest that considerable agreement exists among definitions, as a significant relationship is identified among all definitions developed since 1977 with the highest percentage of agreement observed between the IDEA and the NJCLD definitions (Hammill, 1990). Overall, despite linguistic nuances, most definitions recognize LD as a specific academic deficit that is neurologically based and not caused by behavioral, environmental, or instructional influences.

Prevalence of LDs. Due to several factors, including the aforementioned controversial struggle with definition and identification, reliable estimates of the prevalence of learning disorders are scarce (Cortiella, 2011). While public schools track the number students classified with LDs, estimates outside of school-aged populations are obtained exclusively from parent and self-report surveys, with the most recent data provided by the 2005 United States Survey of Income and Program Participation (SIPP) (Cortiella, 2011). The SIPP estimates that the overall prevalence rate of LDs in the United States is about 1.8%, equating to approximately 4.67 million Americans (Cortiella, 2011). Specifically, the SIPP reported that about 3% of all school-aged children have LDs, which is slightly less than the approximate 5% reported by the United States Department of Education in 2009 (Cortiella, 2011). Among adults, a lower prevalence

rate of LDs is observed, and the rate of reported LDs steadily decreases with age, ranging from a rate of 2.7% in adults aged 18 to 24 to a rate of 0.4% in adults aged 85 and older (Cortiella, 2011). Considering the totality of available data, the overall true prevalence rate of LDs in the United States is most likely between 4-6% among both children and adults (Cortiella, 2011).

Specific learning disability is by far the largest disability category recognized under the IDEA, consisting of approximately 2.5 million students and comprising 42% of all children receiving special education services in public schools (Cortiella, 2011). This percentage is more than double that of the second most prominent category, Speech/Language Impairments, which accounts for only 19% of all special education students (Cortiella, 2011). The number of students identified with LDs grew nearly 300% between 1976 and 2000 after the enactment of the Education for All Handicapped Children Act (P.L. 94-142) in 1975 (Cortiella, 2011; Lyon et al., 2001). Specifically, during the 1976–1977 academic year LDs represented approximately 22% of all special education students. By the 1997–1998 academic year LDs represented about 52% of all special education students (Lyon et al., 2001). Many factors contributed to this drastic, initial growth of LD identification. First, as discussed in previous sections, the LD category fulfilled a substantial educational need, as a vast number of students demonstrating specific academic deficits with adequate intelligence were previously disenfranchised from special education services (Fletcher et al., 2007; Lyon et al., 2001; Lyon et al., 2003). Additionally, compared to other special education categories like mental retardation and serious emotional disturbance, the term “specific learning disability” is non-stigmatizing and thus more willingly accepted by parents, educators, and students (Cortiella, 2011; Fletcher et al., 2007; Lyon et al., 2001; Lyon et al., 2003). Finally, the ambiguity of the federal definition, coupled with the lack of an empirically-supported diagnostic model, resulted in imprecise assessment

methods, eligibility inconsistencies, and perhaps an over-identification of “disabled” students (Cortiella, 2011; Lyon et al., 2001; Lyon et al., 2003).

The initial rapid increase in LD classifications yielded criticism from both researchers and policy makers (Cortiella, 2011). As such, many widespread educational practices and procedures underwent substantial changes with the turn of the twenty-first century (Cortiella, 2011) to combat these accelerating identification rates. For instance, LD identification methods shifted away from the ability-achievement discrepancy model and moved towards the Response-to-Intervention (RTI) approach (Cortiella, 2011). In theory, the RTI model allows for struggling students to access educational interventions within the general education curriculum, reducing the need for special education classification (Cortiella, 2011). Additionally, reading instruction improved nationwide, which decreased the overall prevalence of reading difficulties among students (Cortiella, 2011). Also contributing to the decline of LD classification was the 1999 introduction of Attention Deficit Hyperactive Disorder (ADHD) and Attention Deficit Disorder (ADD) as disabling conditions under the IDEA’s Other Health Impairment (OHI) category (Cortiella, 2011). This amendment to special education laws allowed for more efficient classification, as students struggling with attention difficulties may previously have been assigned to the LD classification (Cortiella, 2011). In sum, while the percentage of special education students identified with LDs continues to grow slightly, due to several policy changes, the overall rate of LD identification has drastically subsided throughout the past decade (Cortiella, 2011).

Currently, several subgroups are disproportionately represented within the LD category. Among school-aged children, males are twice as likely as females to be classified with LDs, as the prevalence rate for boys is 3.9%, while the prevalence rate for girls is 2.0% (Cortiella, 2011).

This discrepancy is consistent with overall special education classification rates, as boys are about twice as likely as girls to be identified as special education students under the IDEA (Cortiella, 2011). Additionally, families living below the poverty line reported that approximately 4.1% of their children were identified with LDs, while families living above the poverty line reported that only 2.7% of their children were identified with LDs (Cortiella, 2011). Regarding racial and ethnic groups, LDs appear to impact Caucasians, African Americans and Latinos equally; however, the prevalence rate of LD is significantly higher among Native Americans and substantially lower among Asian Americans (Cortiella, 2011). The disproportionate distribution among gender, socio-economic, and ethnic groups suggests that learning disorders are not exclusively neurologically based; instructional, environmental, behavioral, and cultural factors most likely play a role in the development of learning difficulties and the formal identification of LDs.

Prevalence of Reading Disabilities. Dyslexia, or the disorder characterized by difficulties with single word decoding, is estimated to account for at least 80% of all LDs (Cortiella, 2011; Fletcher et al., 2007; Lyon et al., 2001, Shaywitz, 2003; Shaywitz & Shaywitz, 2005). This percentage indicates that at least 2 million individuals in the U.S., or 3.5% of all school-aged children, receive special education services for reading disabilities (Cortiella, 2011; Lyon et al., 2001, Shaywitz, 2003; Shaywitz & Shaywitz, 2005). However, while some researchers and policymakers criticize the accelerating classification rates of LDs in previous years, other researchers speculate that the true number of children impacted by reading disabilities may be much higher than current estimates suggest (Shaywitz, 2003; Shaywitz & Shaywitz, 2005). For instance, in reviewing data provided by the 1998 National Assessment of Educational Progress (NAEP), Shaywitz (2003) reported that of the thousands of children

assessed, 69% of fourth grade students and 67% of eighth grade students scored below reading proficiency levels. Further, the National Center for Educational Statistics reported that more than 35% of fourth grade students performed below proficiency levels in 2003 (Fletcher et al., 2007). Similarly, in an ongoing longitudinal study of over 400 children conducted by Shaywitz (2003), about 20% of the participants were reading below grade level as measured by standardized achievement tests; yet, less than one third of those students were classified as LD under the IDEA. Considering the dimensional nature of reading disabilities, prevalence rates substantially depend upon where the “cut-off” points are established (Fletcher et al., 2007; Lyon et al., 2003; Ramus et al., 2003; Shaywitz, 2003; Shaywitz & Shaywitz, 2005).

Primary Clinical Presentation of Reading Disabilities. Vellutino, Fletcher, Snowling, and Scanlon (2004) define reading as “the process of extracting and constructing meaning from written text for some purpose.” Considering this description, reading depends on a multitude of cognitive processes like phonological awareness, visual coding, working memory, rapid automatic naming, language ability, and access to background knowledge, all of which must be executed simultaneously for text to be comprehended (Fletcher et al., 2007, Vellutino et al., 2004). A breakdown at any point of these processes will result in reading difficulties (Fletcher et al., 2007, Lyon et al., 2003; Vellutino et al., 2004). Although the IDEA recognizes reading disabilities in terms of basic skill deficits or reading comprehension deficits, researchers commonly group reading disorders into three major disability categories, including word recognition, reading fluency, and text comprehension (Fletcher et al., 2007; Lyon et al., 2003). While a disorder in any one of these three domains significantly impacts the ability to understand text, students demonstrating deficits in more than one of these areas are at an increased risk of academic failure (Fletcher et al., 2007).

Individuals suffering from dyslexia, or word-level reading disability, comprise the majority of all LDs (Fletcher et al., 2007; Hoskyn, 2004; Lyon et al., 2003; Shaywitz & Shaywitz, 2005; Vellutino et al., 2004). This disorder is characterized by significant difficulties in acquiring phonological awareness, the metacognitive understanding that words are developed from internal structures based on sounds (Fletcher et al., 2007; Hoskyn, 2004; Lyon et al., 2003; Shaywitz & Shaywitz, 2005). As such, dyslexic students have trouble segmenting words into phonemes and internalizing the visual-auditory association between letters and sounds (Fletcher et al., 2007; Hoskyn, 2004; Shaywitz & Shaywitz, 2005). Specifically, Hoskyn (2004) reported “literally hundreds of studies” demonstrate that poor readers experience significant difficulties memorizing the phonological representations of words. Coupled with decoding deficits, struggles establishing sight words automaticity are also observed, which further contribute to difficulties accurately reading and encoding words (Fletcher et al., 2007; Lyon et al., 2003). Dyslexia significantly interferes with reading comprehension in two ways. First, difficulties with decoding often lead to inaccurate decisions about words, which result in misunderstandings of the texts’ meaning (Fletcher et al., 2007; Lyon et al., 2003). Additionally, when an individual’s limited capacity working memory becomes consumed with deciphering print, fewer resources are available for higher-level processing and interpretation, thereby hindering comprehension in a second way (Fletcher et al., 2007; Hoskyn, 2004; Lyon et al., 2003; Perfetti, 1977).

Individuals demonstrating fluency deficits comprise a second group of struggling readers (Fletcher et al., 2007; Lyon et al., 2003). Despite intact phonological awareness, these individuals demonstrate difficulties with automatic word retrieval (Fletcher et al., 2007; Lyon et al., 2003). Although they may present with age-appropriate word accuracy, these individuals read words, sentences, and paragraphs at a rate significantly slower than their peers (Fletcher et

al., 2007; Lyon et al., 2003). Similar to difficulties encountered by individuals with dyslexia, this reading dysfluency quickly overloads working memory, resulting in limited cognitive effort being available for comprehension (Fletcher et al., 2007; Hoskyn, 2004; Lyon et al., 2003; Perfetti, 1977). Researchers speculate that two main cognitive processes are related to isolated reading fluency concerns, including rapid naming, which is the ability to retrieve information quickly, and orthographic processing, which is the ability to process increasingly large units of words (Fletcher et al., 2007; Lyon et al., 2003).

Comprehension deficits comprise the third subtype of reading disabilities, as strong evidence suggests that such deficits can present in the absence of word recognition or fluency disorders (Fletcher et al., 2007; Lyon et al., 2003). Specifically, reading comprehension disabilities are characterized by significant difficulties abstracting meaning from print, despite adequate decoding skills (Fletcher et al., 2007; Hoskyn, 2004; Lyon et al., 2003). Frequently, these individuals are able to successfully derive surface meaning from texts through accurate word recognition, but struggle with advanced interpretation of passages, like drawing inferences or understanding text structure (Fletcher et al., 2007; Lyon et al., 2003). As such, theorists speculate that comprehension difficulties are related to deficits in one or more of the processes related to language abilities, like listening comprehension or verbal abilities (Fletcher et al., 2007; Hoskyn, 2004; Lyon et al., 2003).

Theoretical Models of Reading Disabilities. Learning disabilities are well established as neurological disorders that impact the brain's ability to retain, process, or communicate information (Cortiella, 2011; Hoskyn, 2004; Ramus et al., 2003; Shaywitz & Shaywitz, 2005). While the true causes of LDs remain unclear, genetics factors appear to be strongly linked to learning difficulties, as LDs present with greater frequency among family members (Cortiella,

2011; Shaywitz & Shaywitz, 2005). Specific to reading, researchers suggest that reading disorders are best understood within a dimensional model, with reading ability on one side of the continuum and reading disability on the opposite end of the spectrum (Lyon et al., 2003; Ramus et al., 2003; Shaywitz & Shaywitz, 2005). Individuals demonstrate granulated degrees of reading proficiency along this continuum, “with reading disability representing the lower tail of a normal distribution of reading ability” (Shaywitz & Shaywitz, 2005). Evidence indicates that there is no obvious breaking point in proficiency levels when comparing “reading disabled” and “non-reading disabled” populations (Lyon et al., 2003; Ramus et al., 2003; Shaywitz & Shaywitz, 2005). As such, individuals approaching - but not meeting - the disability criteria typically demonstrate many of the same difficulties as individuals identified with reading disabilities (Lyon et al., 2003; Ramus et al., 2003; Shaywitz & Shaywitz, 2005).

For a variety of reasons, including difficulties dissociating targeted cognitive constructs and challenges designing valid assessment methods, obtaining empirical evidence to refine proposed theories of reading disabilities is difficult. The most common, well-established theory of dyslexia is the phonological processing theory, which attributes word recognition difficulties to a “specific impairment in the representation, storage and/or retrieval of speech sounds” (Ramus et al., 2003, p. 842). However, although the importance of phonological awareness is rarely disputed, theorists grapple about the essence of this cognitive process (Ramus et al., 2003; Shaywitz & Shaywitz, 2005). Some researchers speculate that phonological awareness is an independent cognitive construct, while other theorists regard phonological deficits as symptomatic of more pervasive sensory, motor, or learning problems (Ramus et al., 2003). For instance, the rapid auditory processing theory attributes phonological difficulties to an underlying deficit in the discrimination of sounds (Ramus et al., 2003). From this perspective,

reading decoding difficulties are caused by an inability to fluently process auditory information (Ramus et al., 2003). Similarly, other researchers speculate that rapid automatic naming, or the ability to retrieve information quickly (e.g. letter-sound knowledge), is dissociable from phonological processing and is the primary cause of dyslexia (Ramus et al., 2003). Additionally, the visual processing theory emphasizes the role of the visual components of reading by attributing word recognition difficulties to deficits processing letters or words in print (Ramus et al., 2003). These visual-association deficits are speculated to result in struggles with phonics and phonological awareness (Ramus et al., 2003).

As described in previous sections, evidence suggests that comprehension difficulties may present despite adequate phonological awareness and word-recognition skills (Hoskyn, 2004). However, compared to decoding disorders, comprehension-based reading disabilities have historically received less scholarly attention by psychologists and educators, as speech and language pathologists have conducted most research regarding language comprehension (Bishop & Snowling, 2004). In recent years, however, this sharp divide between dyslexia and comprehension deficits has narrowed, and many theorists speculate that these two disorders are points on a continuum rather than discreet conditions (Bishop & Snowling, 2004). Currently, the most prevalent theoretical models suggest that comprehension deficits impacting literacy acquisition are attributed to difficulties with underlying language processes like semantics, syntax, and discourse (Bishop & Snowling, 2004; Fletcher et al., 2007; Lyon et al., 2003).

Comorbid Disorders. Data indicates that LDs have a high comorbidity rate with several other disorders (Morris et al., 2009). Specifically, a higher than average concurrence rate is identified between LDs and ADD/ADHD; however, the literature reports inconsistent prevalence estimates, ranging from 4-23% to 15-90% (Morris et al., 2009). Similarly, a high comorbidity

rate is also observed between LDs and mood disorders (Morris et al., 2009). Specifically, the estimated prevalence rate of depression among students identified with LDs ranges from 26-40%, while the estimated prevalence rate among students not identified with LDs is significantly lower at approximately 1.8% (Morris et al., 2009). Further, the available data suggests that adults with LDs demonstrate a higher than average incidence rate of psychological difficulties (Morris et al., 2009; Raskind, Goldberg, Higgins, & Herman, 1999). For instance, in a twenty-year longitudinal study of individuals with LDs, Raskind et al. (1999) found that 42% of the participants reported being diagnosed with DSM-IV disorder, including depression, alcohol dependency, and anxiety disorders.

Learning Disabilities in Adolescence and Adulthood. Learning disabilities are chronic conditions with lifetime implications (Morris et al., 2009), and evidence suggests that rather than a “developmental lag,” reading disabilities persist over time (Morris et al., 2009; Shaywitz, 2003; Shaywitz & Shaywitz, 2005). Several longitudinal studies report that children demonstrating poor reading proficiency in early school years tend to remain poor readers throughout their lifetimes (Morris et al., 2009; Shaywitz, 2003; Shaywitz and Shaywitz, 2005). By high school, students identified with LDs are typically significantly below grade level, and research posits that in the area of reading, at least 20% of high school students with LDs are five or more years behind their enrolled grade level, averaging 3.4 years below grade level (Cortiella, 2011). Such profound reading deficits result in pervasive difficulties across all academic areas; compared to their non-disabled peers, students with reading disabilities are at a substantial disadvantage for accessing the curriculum, thus fulfilling the so-called Matthew Effect (Cortiella, 2011; Shaywitz, 2003). Not surprisingly, the high school dropout rate for students identified with LDs is significantly higher than for students who are not identified with LDs; yet, some improvement

was observed in the recent decade (Cortiella, 2011). Specifically, in 2000, 40% of students identified with LDs dropped out high school, while in 2009 the dropout rate decreased to 22% (Cortiella, 2011). This decline is attributed to several factors, including an increase in alternative certificates offered by public schools instead of standard high school diplomas (Cortiella, 2011). For instance, in 2008, while fewer learning-disabled students dropped out, only 64% of students with LDs graduated with a traditional high school diploma (Cortiella, 2011).

Data indicates that students with LDs demonstrate postsecondary aspirations similar to that of their non-disabled peers (Cortiella, 2011). As summarized by Cortiella (2011), the National Longitudinal Transition Study-2 reported that approximately 54% of learning disabled high school students hope to attend a two- or four-year college, about 43% intend to receive vocational training, and roughly 57% aspire for competitive employment (Cortiella, 2011). However, despite similar goals, data suggests that individuals with LDs are significantly less like to receive any form of postsecondary education compared to their non-disabled peers (Cortiella, 2011; Murray, Goldstein, Nourse, & Edgar, 2000), which perhaps limits overall employment options and overall earning potential. Additionally, of the individuals with LDs who attend postsecondary schools, few seek academic supports or ultimately earn undergraduate or advanced degrees. (Cortiella, 2011). Regarding employment, data indicates that adults with LDs (ages 18-64) face increased difficulties obtaining and maintaining jobs (Cortiella, 2011). Specifically, in 2005 while 76% of individuals without learning disabilities were employed, only 55% of individuals with learning disabilities were employed (Cortiella, 2011).

LECTURE NOTE-TAKING

Multiple studies demonstrate that lectures are commonly used instructional methods throughout middle school and high school settings (Armbruster, 2009; Putnam et al., 1993; Shernoff et al., 2003; Vogler, 2006). For instance, Vogler (2006) found that 79% of the secondary education teachers surveyed reported to “regularly” or “mostly” utilize lectures during instruction. Similarly, in another survey of middle school teachers and high school teachers, participants at both educational levels reported devoting an average of 49% of each class period to lecturing (Putnam et al., 1993). Lecture-format instruction is a prominent among mathematics and science classes, as Fulp reported that 66% of the secondary-education science teachers surveyed required their students to listen to lectures and take notes (as cited in Boyle, 2010, p. 530), and Hudson, McMahon, and Overstreet reported that 80% of the math classes investigated utilized lectures (as cited in Boyle, 2010, p. 530). Surveys targeting students’ perspectives also emphasize the prevalence of lectures in secondary education settings. In a longitudinal study of over 500 high school students, “listening to lectures” and “independent work” were reported as the two academic most engaged in by participants (Shernoff et al., 2003).

Notes are defined as “short condensations of source material” that are transcribed “while simultaneously listening, studying or observing” (Oyzon & Olmos, 2009, p. 7), and considering the widespread acceptance of lectures, note-taking may be one of the most important prerequisite skills for most classes beyond elementary school. Moreover, lecture material is reportedly a major source of information used by teachers when developing tests (Putnam et al., 1993), and with some exceptions, research generally demonstrates that the quality of notes is a significant predictor of test performance (Armbruster, 2009; Boyle, 2010; Gleason, 2012; Kobayashi, 2006; Peverly et al., 2007; Peverly & Sumowski, 2012; Vekaria, 2011). By requiring learners to

actively participate in the lecture process, note-taking serves two major functions theorized to facilitate comprehension, including encoding and external storage (Armbruster, 2009; DiVesta & Gray, 1972).

The encoding process – or the act of writing notes – provides note-takers with increased opportunities to generate connections among individual lecture points and to relate the lecture content to their personal background knowledge and experiences (Armbruster, 2009; DiVesta & Gray, 1972). Research indicates that transcribing lecture material results in a deeper, more meaningful processing of content than achieved by listening alone (DiVesta & Gray, 1972; Kiewra, 1985; Piolat et al., 2005); thus, the very act of taking notes enhances learning, even when the notes are not later reviewed (Rickards & Friedman, 1978). Specifically, in reviewing the findings of 56 studies investigating the encoding function, Kiewra (1985) found that the majority of studies, or 59%, favored note-taking, 38% found no significant differences between note-taking and listening, and only 4% found note-taking to hinder performance.

Beyond increased depth of processing, the external storage function of note-taking is also associated with positive learning outcomes, as it allows for lecture information to be reviewed at a later time (Armbruster, 2009; DiVesta & Gray, 1972; Kiewra, 1985; Kobayashi, 2006). The external storage hypothesis suggests that when coupled with review, notes facilitate the reconstruction of lecture content to solidify details and promote mastery (DiVesta & Gray, 1972; Rickards & Friedman, 1978). Additionally, by studying notes, the learner is able to avoid the forgetting of lecture material, relearn forgotten information, and develop new cognitive connections associated with the lecture (Armbruster, 2009; DiVesta & Gray, 1972; Kiewra, 1985; Kobayashi, 2006). In reviewing twenty-two studies investigating the review process of note-taking, Kiewra (1985) found that the overwhelming majority, or 78%, favored review, 23%

found no significant benefit of review, and none of the studies found review to hinder performance. With consideration to the individual effects observed for the encoding and external storage processes alone, it is not surprising that research suggests note-taking to be most beneficial when the encoding and external storage functions are utilized together (Armbruster, 2009; Kobayashi, 2006).

While lectures are widely accepted instructional tools and scientific evidence suggests that note-taking promotes learning, lecture note-taking demands substantial cognitive effort and may prove challenging for some students (Peverly et al., 2007; Piolat et al., 2005). To be successful note-takers in the lecture setting, individuals must retain the verbally presented information, decide which components are most important, and then rapidly transcribe the content while continuing to focus on the ongoing lecture (Peverly et al., 2007; Piolat et al., 2005). The time urgency of this process imposes significant demands on limited capacity working memory and also requires multiple processes to be executed simultaneously and with accuracy (Peverly et al., 2007; Piolat et al., 2005). When considering the processing deficits theorized to be related to reading disabilities (e.g., phonological awareness, rapid auditory naming, and language comprehension), note-taking is most likely a difficult task for individuals with reading disabilities. Prior research suggests that several cognitive processes are related to note-taking proficiency and academic performance, including handwriting speed (Peverly, 2006; Peverly et al., 2007; Peverly & Sumowski, 2011; Peverly et al., 2014) listening comprehension (Gleason, 2012; Vekaria, 2011), sustained attention (Gleason, 2012; Peverly et al., 2014; Vekaria, 2011), and background knowledge (Peverly & Sumowski, 2011). The following sections summarize the relationship between these four variables and lecture note-taking, with special consideration to the unique implications for students with reading disabilities.

Handwriting Speed. Handwriting speed refers to the rate at which words or letters are written (Armbruster, 2009). In experimental settings, this is typically measured by summing the number of words or letters written in an abbreviated time period (e.g., 60 seconds) (Berninger et al., 1997; Boyle, 2010; Gleason, 2012; Peverly et al., 2007; Peverly & Sumowski, 2012).

Various empirical investigations suggest that handwriting speed is related to writing skills. For instance, studies with elementary and middle school students found handwriting speed to be correlated with the quality of written compositions (Graham, Berninger, Abbott, Abbott, & Whitaker, 1997; Jones & Christensen, 1999), and other research suggests that targeted handwriting instruction is associated with improvements in the quantity and/or quality of students' written work (Berninger et al., 1997; Graham, Harris, & Fink, 2000; Jones & Christensen, 1999). While some researchers speculate that the relevance of handwriting skill decreases with age (Berninger, 1999; Connelly & Hurst, 2001), other data suggests that handwriting speed continues to impact academic performance throughout postsecondary education, especially with regard to timed writing assignments (Connelly, Dockrell, & Barnett, 2005) and note-taking skills (Peverly et al., 2007; Peverly & Sumowski, 2012).

Researchers hypothesize that individual differences in working memory contribute to variations in handwriting speed and ultimately impact writing outcomes (McCutchen, 1996; Peverly, 2006). When handwriting is fluent, cognitive resources are available for more complex information processing (McCutchen, 1996; Peverly, 2006). However, if an individual's limited capacity working memory becomes consumed with the mechanics of forming letters, less cognitive effort can be devoted to higher level cognitive processes (McCutchen, 1996; Peverly, 2006), such as sustaining attention to the ongoing lecture, selecting the important information to be recorded, or accessing background knowledge. A growing body of research identifies a

relationship between handwriting speed and the quality of notes (Gleason, 2012; Peverly, 2006; Peverly et al., 2007; Peverly et al., 2014; Peverly & Sumowski, 2012). For instance, Peverly and colleagues (2007) examined several cognitive variables related to lecture noting-taking, including handwriting speed, verbal working memory capacity, and main idea identification skills. Their findings indicated that handwriting speed was the best predictor of the quality and quantity of the participants' notes. Interestingly, similar results were obtained in another study which investigated text note-taking skills of undergraduates, as again handwriting fluency was found to be the best predictor of the quality of the participants' notes (Peverly & Sumowski, 2012). Additionally, in both of these studies, individuals' notes were significant predictors of test performance (Peverly et al., 2007; Peverly & Sumowski, 2012).

Indirect evidence suggests that individuals with reading disabilities and other language-based difficulties are more likely to struggle with handwriting fluency than their non-disabled peers. Like listening, speaking, and reading, written production is another component of language, which draws on some unique, but many overlapping, cognitive processes (Berninger et al., 2006). Specifically, the act of spelling – or creating orthographic representations of words – is achieved by “mapping” words into their spoken counter parts and then applying phonics skills to retrieve the appropriate symbols (Berninger et al., 2006). In general, writing fluency increases when the associations between the phonological and orthographic representations of words become fluent and working memory resources are available for higher level writing processes (e.g., composition organization or text monitoring) (Berninger et al., 2006). Considering this, individuals demonstrating processing deficits while reading most likely struggle with the same cognitive processes when “mapping” words into their orthographic representations; hence, dysfluent reading most likely impacts writing fluency. Unsurprisingly, written language

difficulties are symptomatic among a large percentage of individuals with learning disabilities (Gregg, Coleman, Davis, & Chalk, 2007), and Gregg, Coleman, and Hartwig reported, “difficulties with handwriting, spelling, syntax, organization, and writing fluency are often characteristics of dyslexia” (as cited in Gregg et al., 2007, p. 307).

The limited studies investigating the educational impact of handwriting fluency with regards to individuals with reading disabilities yield mixed results. For instance, Gregg et al. (2007) compared the performance of adolescents with ($n= 65$) and without ($n= 65$) dyslexia on a timed, impromptu essay task, which is similar to the writing assessments utilized in high school state testing situations. Results of this study found that individuals with dyslexia wrote fewer total words and also demonstrated increased difficulties finishing within the 30-minute time constraint. Specifically, while 91% of the individuals without dyslexia finished the essay, only 71% of the students with dyslexia completed the assignment (Gregg et al., 2007). Moreover, verbosity, as measured by the number of total words, was found to be highly predictive of performance scores, and individuals with dyslexia wrote significantly fewer total words than individuals without dyslexia (Gregg et al., 2007). However, in another study investigating the writing skills of school-aged children with dyslexia ($N= 122$), Berninger et al. (2008) found a non-significant relationship between handwriting fluency and composition quality. The same investigation found significant relationships between word spelling and composition quality, and also between rapid automatic naming and rapid automatic writing, thereby suggesting that spelling speed may have a “proximal influence” on writing skills (Berninger et al., 2008).

Empirical studies investigating the impact of handwriting speed on the note-taking skills of individuals with LDs are sparse; yet, survey data suggested that handwriting speed is a challenge for such individuals (Suritsky, 1992). In a survey of college students with LDs ($N=31$),

45% of the participants reported experiencing difficulties writing while taking lecture notes, including struggles with spelling and writing fast enough to keep up with the lecture's pace (Suritsky, 1992). However, when Boyle (2010) investigated the lecture note-taking skills of middle school students with ($n = 45$) and without ($n = 45$) LDs, he failed to find a significant difference between the two groups with regards to handwriting speed. Of note, it is possible that Boyle's (2010) measurement techniques account for some of the obtained results. Specifically, rather than an alphabet-writing task commonly used by other researchers (Gleason, 2012; Peverly et al., 2007; Peverly & Sumowski, 2012; Vekaria, 2011), the participants were required to write their first names repeatedly. Further, the fluency measure lasted 180 seconds in duration, which is substantially longer than the 60-second time span used in other studies (Peverly et al., 2007; Peverly & Sumowski, 2012). As such, muscle-memory, boredom, or fatigue may have impacted the study's results. Despite Boyle's findings, the totality of data suggests that handwriting speed is an influential variable and requires further investigation with regards to note-taking and LDs.

Listening Comprehension. When considering the widespread prevalence of lectures in secondary education settings, proficient listening comprehension is an obvious skill necessary for achievement; however, listening is also a dynamic task composed of several independent, yet related, processes. As described by Richards (1983), listening involves three interactive levels of processing discourse, including (1) the identification of propositions, or recognizing words, (2) the interpretation of illocutionary force, or understanding the speaker's intent, and (3) the activation of background knowledge. In order for the literal and inferential meanings of spoken language to be understood (Byrnes, 1984), all three of these micro-skills must be executed in concordance (Richards, 1983). In sum, rather than the passive experience of receiving a code,

listening is a “highly complex problem-solving activity” (Byrnes, 1984, p.318), which requires individuals to continuously make judgments about the subtle nuances of spoken language. As such, the learners’ ability to identify and utilize verbal cues, such as key phrases and changes in prosody, facilitates note-taking (Piolat et al. 2005). Considering this, adolescents with language-based disorders appear to be at a substantial disadvantage for comprehending spoken information and thus, for accessing lecture information (Ward-Lonergan et al., 1998).

The relationship between listening comprehension and reading comprehension is well documented (Curtis, 1980; Diakidoy, Stylianour, Karefillidou, & Papageorgiou, 2005; Sinatra, 1990; Sticht, Beck, Hauke, Kleinman & James, 1974; Sticht & James, 1984), and many theorists speculate that the two skills rely on the same general language processes (Diakidoy et al., 2005). Developmentally, listening skills precede all language production (Byrnes, 1984), and children generally enter kindergarten with stronger listening abilities than reading comprehension skills. However, this discrepancy seems to diminish over time and with increased print exposure (Curtis, 1980; Diakidoy et al., 2005; Sticht & James, 1984). A meta-analysis conducted by Sticht and colleagues (1974) supports this trend. After analyzing 33 studies, they concluded that listening exceeds reading throughout elementary school, but around eighth grade, the two skills are highly correlated, with a correlation coefficient of 0.6 (Sticht et al., 1974). While Sticht and colleagues (1974) speculated that this correlation is observed only after decoding skills are mastered and is most likely a low estimate due to variability among the studies, the totality of data suggests that reading disorders profoundly impact and/or are profoundly impacted by listening comprehension abilities.

At least two studies focusing on the relationship between listening comprehension and reading skills suggested that individuals with reading difficulties struggle more with listening

comprehension than skilled readers. For instance, Curtis (1980) examined the impact of decoding and listening comprehension abilities on the overall reading achievement of “skilled” ($n = 60$) and “less skilled” ($n=40$) elementary school students. This study indicated that “skilled” readers outperformed “less skilled” readers on measures of both reading comprehension and listening comprehension (Curtis, 1980). Interestingly, while the “less skilled” readers struggled with decoding, their comprehension difficulties persisted on listening comprehension tasks, which theoretically removed the demands placed on working memory by problems with decoding (Curtis, 1980). Considering this finding, Curtis (1980) speculated that reading comprehension and decoding difficulties both might stem from inadequate listening comprehension skills.

Consistent results were obtained in another study which investigated the listening comprehension and recall abilities of adolescents with ($n = 20$) and without ($n = 29$) language-learning disabilities (Ward-Lonergan et al., 1998). Specifically, participants were required to view two brief (approximately five minutes) social studies lectures and respond to verbally-presented literal and inferential comprehension questions (Ward-Lonergan et al., 1998). Results indicated that adolescents with language-learning disabilities performed significantly worse than adolescents without language-learning disabilities, as they struggled when responding to both inferential and literal comprehension questions (Ward-Lonergan et al., 1998).

Specific to note-taking research, studies assessing the role of listening comprehension are surprisingly sparse and still fewer studies investigated this variable in relation to the note-taking skills of individuals with disabilities. However, indirect evidence suggests that strong language skills facilitate note-taking proficiency. For instance, Piolat et al. (2008) examined the note-taking skills of undergraduates who were non-native (yet proficient) English speakers ($N=21$).

The obtained results indicated that participants exerted more cognitive effort when taking notes in English than in their native language of French, and overall, these individuals wrote slower when taking notes in English (Piolat et al., 2008). Similarly, when surveying international ($n=110$) and American ($n=54$) postsecondary-education students about their perspectives on note-taking, Dunkel and Davey (1989) found significant differences between the two groups. Specifically, a larger percentage of the international group expressed a desire for better note-taking skills and described feeling pressured by the time constraints of lecture note-taking in English.

Finally, two studies investigating the note-taking skills of individuals with and without ADHD found listening comprehension to be a significant predictor of the quality of notes. Specifically, when investigating the note-taking skills of high school students, Gleason (2012) found that students with ADHD performed significantly worse on measures of listening comprehension than students without ADHD, and listening comprehension skills predicted the completeness of notes. In a similar investigation of undergraduates with and without self-reported ADHD, Vekaria (2011) also found listening comprehension to be a significant predictor of the notes' quality.

Sustained Attention. In lecture note-taking, focusing on the ongoing presentation is an essential process. As Mirsky, Pascualvaca, Duncan, and French (1999) described, sustained attention “entails being able to stay on task in a vigilant manner for an appreciable interval: not missing designated targets, responding briskly to them, and inhibiting responses to nontargets” (p. 171). Some researchers speculate that sustained attention is the most important component of lecture note-taking; as Williams and Eggert (2002) posit, unless students' attention is focused on the speaker, they will not be able to meaningfully process the information or take notes.

Furthermore, when considering the cognitive profiles of individuals with learning disabilities and the frequency of comorbid attention difficulties, understanding the role of sustained attention in note-taking is necessary for providing effective instruction for special education students.

In reviewing the available literature regarding students' attention during lecture note-taking, Wilson and Horn (2007) found that an overwhelming majority of the published articles claim that attention levels deteriorate approximately ten to fifteen minutes into the lecture; however, Wilson and Horn (2007) further reported that empirical support for this accepted global assumption was weak. These researchers argued that while students' attention levels most likely vary when listening to lectures, the majority of the studies they reviewed failed to consider the impact of individual differences in sustained attention, thus the relationship between attention and note-taking is difficult to discern (Wilson & Horn, 2007). Further, in an informal analysis of the listening patterns of undergraduates, Williams and Eggbert (2002) reported that at any given point of a lecture, as few as 10% or as many as 98% of the students could recite what the speaker just said. Such findings suggest that while sustained attention varies between individuals, students' personal focusing levels also fluctuate within short time periods.

Researchers have only recently begun examining the relationship between individual differences in sustained attention and the quality of lecture notes; however, the few empirical studies conducted to date suggest that difficulties focusing negatively impact note-taking skills. For instance, Spinella and Miley (2003) investigated the relationship between undergraduates' exam scores and their self-ratings of impulsivity levels (N= 27). Results of this study showed that individuals with higher reported levels of impulsivity achieved lower exam scores. In another study with undergraduate students (N= 72), which investigated note-taking expertise,

Peverly et al. (2014) found a significant relationship between sustained attention and the predicted quality of students' notes.

As described herein, students with LDs frequently present with comorbid attention deficits (Morris et al., 2009), suggesting that many learning disabled students likely encounter similar difficulties with note-taking as individuals with ADHD. Moreover, studies comparing the note-taking skills of students with and without ADHD suggested that sustained attention significantly impacts academic performance. When Gleason (2012) investigated the lecture note-taking skills of high school students with ($n = 40$) and without ($n=40$) ADHD, results yielded significant differences between the two groups. Specifically, individuals with diagnosed ADHD produced less complete notes (ADHD= 13.5% of the lecture vs. non-ADHD= 26.3% of the lecture) and performed worse on listening comprehension tasks. Additionally, ADHD status and performance on an attention measure were significant predictors of the quality of notes and test performance. In a similar study, Vekaria investigated the note-taking skills of undergraduate students with ($n = 22$) and without ($n = 50$) self-reported ADHD. Although ADHD status was not found to predict the quality of notes, students' performance on measures of sustained attention and listening comprehension were found to be significant.

Background Knowledge. Empirical evidence suggests that background knowledge – or the “knowledge, skills, or ability that students bring to the learning process” (Jonassen & Gabrowski, 1993, p. 417) – is associated with positive learning outcomes (Chiesi, Spilich, & Voss, 1979; Dochy, Segers, & Buehl, 1999; Walker, 1987). Specifically, researchers suggest that domain knowledge enhances overall comprehension (Adams et al., 1995; Schneider et al., 1996; Korkel, & Weinert, 1989; Walker, 1987) and can compensate for low-aptitude (Schneider et al., 1989; Walker, 1987) and poor reading skills (Adams et al., 1995; Carr & Thomas, 1996;

Schneider et al., 1989). In a model of text processing, Kintsch (1998) posits that readers with high background knowledge construct richer macrostructures of the text than readers with low background knowledge. As such, individuals with extensive domain knowledge easily make connections between the text and information stored in long-term memory, readily integrating new information into existing networks (Kintsch, 1998). While this model for reading comprehension seems logical, the relationship between domain knowledge and lecture note-taking is less clear. The robust evidence documenting the correlation between listening comprehension and reading comprehension suggests that domain knowledge would facilitate comprehension of lecture material; however, few studies have investigated this relationship and none explicitly examined the impact of domain knowledge on the note-taking skills of students with LDs.

Walker (1987) investigated the impact of background knowledge on verbal comprehension with two similar experiments (N=16 and N=60), which included participants from enlisted Army personnel. For both experiments the subjects were divided into low-aptitude and high-aptitude groups. The low-aptitude groups were comprised of individuals participating in the Army's Basic Skills Education Program (BSEP) due to low aptitude test scores or a commander referral, and the high-aptitude groups were comprised of individuals who were not required to participate in the BSEP. All of the participants completed a baseball knowledge test, and from their scores, researchers determined if they had high knowledge or low knowledge of baseball. A narrative text describing a fictitious half-inning of baseball was presented both in print and through an audio recording, and then the participants were tested on the information. Results of this study indicated that low-aptitude/high-knowledge participants performed significantly better than the high-aptitude/low-knowledge participants and performed similarly to

the high-aptitude/high-knowledge group. Such findings suggest that domain knowledge may compensate for pervasive processing difficulties, such as language deficits.

In a similar study, Schneider et al. (1989) found comparable results when focusing on the impact of domain knowledge on children's reading comprehension abilities. This study also included two experiments (N= 576 and N= 185), however, the participants were third, fifth, and seventh grade students. Based on the students' performance on a verbal cognitive assessment, they were separated into high and low aptitude groups. After completing a soccer knowledge test, the participants were coded as either "expert" or "novice" based on their score. In both experiments, the students were required to read a passage focusing on the domain of soccer and were later tested on the material. In both experiments the high-knowledge (expert) groups outperformed the low-knowledge (novice) groups, and aptitude did not have a significant main effect on performance. The authors concluded that "children's prior knowledge about text contents is a much more powerful predictor of their text comprehension and recall than their general intellectual ability" (Schneider et al., 1989, p.311). Similar results were reported by Adams, Bell, and Perfetti (1995) when studying fourth through seventh grade students. Like the previous studies, the participants were divided into high and low reading groups and then further divided into high and low knowledge groups. As an interaction effect was observed for domain knowledge and reading comprehension, the authors concluded that high-domain knowledge can compensate for low reading skills and high reading skills can compensate for low-domain knowledge.

With consideration to students with LDs, Carr and Thomas (1996) investigated the impact of teachers' facilitation of students' background knowledge prior to reading a passage. Results of this study demonstrated that students with LDs and students without LDs both

demonstrated reading comprehension improvements after domain knowledge was activated (Carr & Thomas, 1996). However, a larger effect was observed in students with LDs and when reading topics were unfamiliar to the participants (Carr & Thomas, 1996).

The relationship between domain knowledge and note-taking is somewhat unclear, as the limited number of empirical studies conducted to date yield somewhat conflicting results. For instance, Peverly et al. (2003) failed to find a relationship between background knowledge and the quantity of macro-propositions recorded by undergraduates when taking text notes. Similarly, when investigating prior knowledge and the quality of lecture notes, Oyzon and Olmos (2009) also did not find a main effect for domain knowledge. However, in an ethnographic study of undergraduates (N=252) conducted by van Meter, Yokoi, and Pressley (1994) interview data suggested that when students possess domain knowledge, they find taking notes easier, but are also more selective when transcribing information and thus, record less. Finally, Peverly and Sumowski (2012) also investigated the relationship between domain knowledge, notes, and test performance. While they did not find a significant relationship between domain knowledge and the quality of notes, domain knowledge was found to be a significant predictor of test performance, especially with regards to inferential questions.

NOTE-TAKING AND LEARNING DISABILITIES

As described in previous sections, students with LDs are at an increased risk for academic failure, as they are more likely to drop out of high school, less likely to pursue postsecondary education, and twice as likely to be unemployed (Cortiella, 2011). Considering such stark statistics, schools must make a concerted effort to provide learning disabled students with research-based supports to promote learning and success. The prominence of lectures,

coupled with the established benefits of lecture note-taking, provides unique intervention opportunities to target special education students, since research suggests that improvements in note-taking most likely facilitate improvements in achievement. Only a few studies have investigated the note-taking skills of students with LDs compared to the skills of students without LDs, and none explicitly have examined the psychological variables that may be uniquely impacting the note-taking proficiency of learning disabled students. However, the research conducted to date suggests that students with LDs struggle more with note-taking than their non-disabled peers, as they typically record fewer total notes, or macropropositions (Boyle, 2012; Hughes & Suritsky, 1994), include less cued lecture points (Boyle, 2012; Hughes & Suritsky, 1994), and perform worse on tests based on lecture material (Boyle, 2012).

Interestingly, some research posits that students with LDs significantly benefit from targeted interventions in note-taking (Boyle & Rivera, 2012; Boyle & Weishaar, 2001; Maydosz & Raver, 2010), which suggests that honing in on the relevant cognitive variables is worthwhile.

Hughes and Suritsky (1994) were some of the first researchers to investigate the note-taking behaviors of individuals with LDs by utilizing a sample of undergraduates with ($n = 30$) and without ($n = 30$) LDs. The participants were required to take notes while watching a 20-minute videotaped lecture, and the quality of their notes was assessed. Results indicated that compared to students without LDs, students with LDs transcribed significantly fewer information units. Specifically, while individuals with LDs recorded only 36% of the total macropropositions presented, students without LDs recorded 56% of the macropropositions presented. Moreover, a significant discrepancy was observed with the total number of cued lecture points recorded by the two groups. While students with LDs recorded only about 46% of the cued units, individuals without LDs recorded about 77% of the cued units. These results

suggest that beyond producing incomplete notes, learning-disabled students demonstrate more difficulties identifying the important lecture concepts than their non-disabled peers and profit less from intervention. Further, the authors speculated that slow writing speed and infrequent abbreviations usage contributed to the significantly incomplete notes, which is consistent with the note-taking research surrounding handwriting speed (Peverly et al., 2007).

One limitation of this study is the inclusionary criteria applied by the researchers when selecting the participants with LDs. Although all of the students in the LD group were formally diagnosed with a learning disability on the basis of the severe discrepancy model, the standardized achievement and cognitive scores described were all within the average range. Specifically, the mean scores reported were: “Wechsler Adult Intelligence Scale–Revised (Wechsler, 1981) Full Scale IQ = 107,” “Woodcock-Johnson Psycho-Educational Battery: Tests of Achievement (Woodcock, 1978) Reading = 96.2,” and “Written Language = 92” (Hughes and Suritsky, 1994, p. 21). Although limited information can be inferred from reviewing means alone, the scores raise several questions about the severity of the LDs and suggest that many of the participants perhaps would not meet more stringent criteria.

Boyle (2010) extended the note-taking and LDs research with a middle school sample and obtained similar results. This study also utilized participants with ($n=45$) and without ($n=45$) LDs, and the students were required to complete a handwriting speed task, watch a 19-minute videotaped lecture, record notes, and then immediately take a quiz on the lecture material. The students’ notes were analyzed in terms of total words, total lecture points, cued lecture points, non-cued lecture points, and test performance. In general, the obtained results were consistent with data reported by other note-taking studies (Gleason, 2012; Peverly & Sumowski, 2012), as notes were found to be a significant predictor of test performance. Further,

students with LDs performed more poorly across most variables, as they recorded significantly fewer total lecture points (with LDs= 13%, without LDs= 24%), cued lecture points (with LDs= 18%, without LDs= 42%), and non-cued lecture points (with LDs= 11%, without LDs= 21%), and also performed worse on the test (average score: with LDs= 47%, without LDs= 67%) (Boyle, 2010). Regarding handwriting speed, Boyle (2010) failed to find a difference in the writing speeds between students with and without LDs; however, as described previously, these results may be related to measurement techniques.

Results obtained by Boyle (2010) in this LD note-taking study seem to be limited by the same factors as Hughes and Suritsky (1994). Boyle (2010) selected students for the LD group based on their special education eligibility status, which was determined by school districts utilizing the severe discrepancy model. While the mean full scale cognitive score was reported to be in the average range (SS= 99.7), the mean standard reading (SS= 93.5) and writing (SS= 97.9) scores were also in the average range. Similar to the Hughes and Suritsky (1994) study, limited conclusions can be drawn using mean scores alone; however, as all of the reported scores were reported to be average, the severity of the ability-achievement discrepancy, as well as the final classification decisions, are called into question. As such, future studies comparing students with LDs to students without LDs may yield more powerful results if the two groups are more discrete. Despite such concerns, the available data clearly demonstrates that students with LDs are worse note-takers, struggle more with recognizing important information, and perform worse on relevant assessments than students without LDs.

Encouragingly, in spite of the described concerns, multiple studies suggest that students with LDs benefit from targeted interventions and note-taking instruction (Boyle & Rivera, 2012; Boyle & Weishaar, 2001; Maydosz & Raver, 2010; Suritsky, & Hughes, 1991). In a meta-

analysis, Boyle and Rivera (2012) reviewed the research regarding note-taking remediation for students in grades three through twelve (nine total studies), and found that several approaches appeared to be effective. Specifically, Boyle and Rivera (2012) suggested that students with LDs and other disabilities performed significantly better on tests and quizzes when provided with guided note-taking or strategic note-taking interventions. Guided notes are teacher-prepared outlines of the lecture that include spaces for recording more detailed information, while strategic note-taking involves direct instruction in recognizing the verbal cues identifying important lecture information. Beyond assessment performance, such remediation increased the notes' accuracy, the number for total words recorded, the degree of detail transcribed, and the number of cued lecture points noted (Boyle & Rivera, 2012).

The effectiveness of these interventions is consistent with the cognitive variables hypothesized to impact the note-taking skills of students with LDs. Guided note-taking and strategic note-taking reduce the demands of handwriting speed, listening comprehension, sustained attention, and background knowledge, as the speaker facilitates the note-taking process and provides explicit guidance on note-taking procedures. Considering the success of these strategies, identifying the cognitive variables most influencing the note-taking skills of students with LDs should significantly enhance these intervention approaches and improve educational outcomes for students.

SUMMARY, RESEARCH QUESTIONS, AND HYPOTHESES

As lectures are the primary mode of instruction utilized across secondary and postsecondary educational settings, note-taking is a necessary prerequisite skill for most classes beyond elementary school. While research suggests that students with LDs struggle more with

note-taking than students without LDs, little is known about the underlying cognitive variables causing these differences. The current investigation aims to extend note-taking research by investigating the lecture note-taking skills of adolescents with LDs as compared to the lecture note-taking skills of adolescents without LDs. Specifically, the role of LD status (with LD versus without LD), handwriting speed, listening comprehension, sustained attention and background knowledge will be examined with regard to the quality of notes produced and test performance. The proposed study intends to investigate the following four research questions regarding the lecture note-taking and study skills of adolescents with and without LDs:

Question 1: Are there significant differences between adolescents with (LD) and without (NLD) learning disabilities in the areas of handwriting speed, listening comprehension, sustained attention, background knowledge, quality of notes and/or test performance?

Hypothesis: Significant differences will be found between LD and NLD adolescents in these areas; such that, NLD adolescents will perform significantly better than LD adolescents on measures of handwriting speed, listening comprehension, sustained attention, background knowledge, quality of notes, and test performance.

Question 2: Does LD status, handwriting speed, sustained attention, listening comprehension, and/or background knowledge contribute to differences in the quality of notes?

Hypothesis: LD status, handwriting speed, sustained attention, listening comprehension, and background knowledge will be significantly related to differences in the quality of notes. NLD adolescents with faster handwriting speed, better sustained attention, better listening comprehension, and more background knowledge will produce more complete notes

Question 3: Does LD status, handwriting speed, sustained attention, listening comprehension, background knowledge, and/or quality of notes contribute to differences on test performance?

Hypothesis: LD status, handwriting speed, sustained attention, listening comprehension, background knowledge, and quality of notes will be significantly related to differences in test performance. NLD adolescents with faster handwriting speed, better sustained attention, better listening comprehension, more background knowledge, and more complete notes will perform better on the test.

Question 4: Are the note-taking or test performance predictors different for students with LDs than for students without LDs?

Hypothesis: The note-taking and test performance predictors will not significantly differ for LD and NLD students.

CHAPTER III

METHOD

Participants

This experiment investigated cognitive variables contributing to the note-taking skills and test performance of adolescents with (LD) and without (NLD) learning disabilities. Participants were high school students ($N= 70$) from two Connecticut high schools, located within the same urban school district. Regarding the two schools, School #1 ($n= 57$) is a relatively large, comprehensive high school with a total enrollment of about 1200 students. Within this school, 14.6% are identified as special education students and 62.3% qualify for free/reduced lunch services. In terms of the racial/ethnic breakdown of the school population, 49% of the students identify as Hispanic, 33.7% of the students identify as African American, 13.4% of the students identify as Caucasian, 2.0% of the students identify as Asian, <1% of the students identify as American Indian, and <1% of the students identify as Pacific Islander.

School #2 ($n= 13$) is an inter-district, college preparatory magnet school, with a total population of approximately 685 students. Of these students, 4.82% are identified as special education students, and 60.6% qualify for free/reduced lunch services. Additionally, 45.5% of the students identify as African American, 30.5% identify as Hispanic, 16.5% identify as Caucasian, 1.3% identify as Asian, <1% identify as American Indian, and <1% identify as Pacific Islander.

Participants' ages ranged from 14.2 to 19.2, with a mean age of 16.1 years old ($SD= 1.23$). Forty-five of the participants (64.3%) were in the ninth grade, nine (12.9%) were in the tenth grade, ten (14.3%) were in the eleventh grade, and six (8.6%) were in the twelfth grade. Further, 41 of the participants (59%) were female, and data collected from the demographics

survey indicated that 46% were Latino/a, 33% were African American, 11% were Caucasian, 7% were “Mixed,” 1% were Asian, and 1% were Native American. Further, 24% of the participants reported that English was not their first language; of note, one individual did not respond to this question. Table 1 displays demographics information organized by school.

The study consisted of up to three total sessions: one screening session and two study sessions. In addition to the 70 participants included in the final analyses, 30 other individuals participated in the screening session but did not complete one or more of the investigation sessions for several reasons. First, 22 students did not meet the reading comprehension screening criteria implemented by this study and therefore, were omitted from the study sessions. Specific details regarding the reading comprehension criteria for each group are provided in the next section. Additionally, six students withdrew before completing both of the study sessions, and two other students were unable to complete the study due to school suspension. As the demographics information was not collected during the screening session, limited information about the individuals excluded from the study is available.

Table 1:
Demographics Information by School

	<i>School #1</i>	<i>School #2</i>
	<i>Comprehensive School (n= 57)</i>	<i>Magnet School (n= 13)</i>
Mean Age (<i>SD</i>)	16.09 (1.36)	15.89 (0.63)
Female	56%	69%
Non-Native English Speaker	25%	23%
ADD/ADHD	9%	0%
Ethnicity		
African American	26%	62%
Latino/a	47%	38%
Caucasian	14%	0%
Asian	2%	0%
Native American	2%	0%
Mixed	9%	0%

Selection Criteria. During the screening session, all potential participants were administered the Nelson-Denny Reading Test (NDRT) Comprehension Subtest in small groups, and their performance was used to determine their appropriateness for the two study sessions of the study. See figure 1 in Appendix A for a frequency distribution chart of the percentile ranks for all individuals included in the final sample (N= 70).

Learning Disability (LD) Group. The current study utilized the *DSM-IV* definition of a reading disorder to identify participants for the LD group. This means that once individuals were identified by the school district as meeting IDEA criteria for Specific Learning Disabilities, they were also required to demonstrate “reading achievement... substantially below that expected given the person’s chronological age, measured intelligence, and age-appropriate education” (American Psychiatric Association, 1994). Additionally, the majority of the LD students recruited for this study participated in general education classes with resource room academic support.

Specifically, half of the total participants ($n= 35$) were identified as students with Learning Disabilities, and these individuals were recruited through the district’s department of special education. Three main criteria were established for the LD group for the purpose of this study. First, all LD adolescents had active Individualized Education Plans (IEPs), with their primary disability identified as “Specific Learning Disabilities” under the IDEA. Second, none of the LD students selected for the study met the criteria for Intellectually Disabled; this means that on their most recent psycho-educational evaluation (within the past three years), all students in the LD group achieved a full-scale cognitive score of 70 or above. The standard IQ score of 70 was used as the cutoff because learning deficits demonstrated by individuals with lower cognitive scores are typically attributed to Mental Retardation, rather than a learning disability

(American Psychiatric Association, 1994). Specific to this sample, the average overall cognitive score was 81.6 ($SD= 8.4$, $range= 71-107$); see Appendix A, Figure 2 for the frequency distribution of these scores. Finally, LD students had to be “below average” readers as confirmed by the NDRT administered during the screening session. LD individuals who scored at or above the 16th percentile on the NDRT were excluded from the study. Of note, the 16th percentile was identified as the cutoff because it is one standard deviation below the mean; as such, the mean percentile rank on the NDRT for the LD group was 3.51 ($SD= 3.59$).

Non-Learning Disability (NLD) Group. The NLD group ($n= 35$) was comprised of general education students identified by school personnel. Since general education students have not completed the same standardized psycho-educational evaluations as their learning disabled peers, different selection criteria was applied to identify potential NLD participants. First, adolescents considered for the NLD did not have an active IEP. Second, all students identified for the NLD group scored at the “proficient,” “goal,” or “advanced” level on recent (within the past two years) statewide and/or district-wide reading assessments, including the Connecticut Academic Performance Test (CAPT) or Connecticut Mastery Test (CMT). Finally, all participants included in the NLD group were at least “average” readers, as confirmed by the NDRT administered during the screening session. All identified NLD students who scored below the 16th percentile on this measure were omitted from the study, regardless of the other criteria. Once again, the 16th percentile was identified as the cutoff because it is one standard deviation below the mean; as such, the mean percentile rank for the NLD group on the NDRT was 51.78 ($SD= 26.15$).

Recruitment. School personnel identified students who met the first and second criteria for the LD and NLD groups. The researcher and/or a teacher met with these potential

participants to explain the study, and interested students were provided with a parent letter and parental consent form.

Comorbidity. As a higher than average concurrence rate is identified between LDs and ADD/ADHD (Morris et al., 2009), participants were asked to report if they have ever been diagnosed with ADD or ADHD. Overall, only 7% of all participants ($n= 5$) reported to suffer from ADD/ADHD; however, all of those students were in the LD group.

Table 2:
Demographics Information by LD Status

	<i>LD</i> <i>(n= 35)</i>	<i>NLD</i> <i>(n= 35)</i>
Mean Age (<i>SD</i>)	16.63 (1.32)	15.55 (0.89)
Female	49%	69%
Non-Native English Speaker	29%	20%
ADD/ADHD	14%	0%
Ethnicity		
African American	29%	37%
Latino/a	60%	31%
Caucasian	3%	20%
Asian	0%	3%
Other	3%	3%
Mixed	4%	6%

Materials

The study utilized the following materials: (1) a measure of reading comprehension (the Comprehension subtest from the Nelson-Denny Reading Test – Form G; Brown, Fishco, & Hanna, 1993), (2) a video-recorded lecture on an American mercantile ship, “The General Harrison” (adapted from a book entitled *Adventures of a Sea Hunter: In Search of Famous Shipwrecks*; Delgado, 2004), (3) a demographics questionnaire (experimenter developed), (4) a measure of handwriting speed (alphabet task), (5) a multiple-choice test on the lecture content

(experimenter developed), (6) a measure of listening comprehension (the Listening Comprehension subtest from the Kaufman Test of Educational Achievement – Second Edition; Kaufman & Kaufman, 2004), (7) a background knowledge assessment on American history (experimenter developed), and (8) a measure of sustained attention (the Lottery subtest from the Test of Everyday Attention; Robertson, Ward, Ridgeway & Nimmo-Smith, 1994). Participants were provided with individual protocols containing most of the required material (e.g. note-taking sheets and response forms); see Appendices B through H. All measures were administered in small groups, consisting of 4 to 12 participants. A laptop with a speaker dock was used to present the two auditory-based measures (listening comprehension and sustained attention), and the video-recorded lecture was projected on a screen.

Inter-rater scoring agreement was established for all measures by selecting 20% of participants' protocols to be scored by two independent raters, who were graduate students from a psychology program.

All students were rewarded for their participation with a \$10.00 gift card to a local movie theater. Additionally, participants who completed the expected number of sessions ($N = 100$) were eligible to win one of two iPad Minis. The odds of winning the raffle was approximately 2 in 100, or 2.0%. All incentives were purchased with funding awarded to the researcher by the Educational Policy Dissertation Fellowship Award.

Reading Comprehension. Participants' reading skills were assessed with the Comprehension subtest from the Nelson-Denny Reading Test (NDRT) – Form G (Brown, Fishco, & Hanna, 1993). This measure served as a screening tool to discriminate adolescents selected for the LD group from adolescents selected for the NLD group. As previously stated, in order to continue in the study, individuals selected for the LD group had to demonstrate below

average reading comprehension skills (i.e., scoring below the 16th percentile), while individuals selected for the NLD group had to demonstrate at least average reading comprehension skills on this measure (i.e., scoring at or above the 16th percentile).

The complete NDRT, designed for ages 9 and up, is comprised of two subtests: Vocabulary and Comprehension, with an embedded measure of reading rate. Only Comprehension was used during this study, specifically Comprehension- Form G, which is specific for grades 9 through adulthood. This twenty-minute standardized subtest requires individuals to read seven passages and respond to 38 multiple-choice questions, each including five answer choices. In general, the NDRT is intended for individual or group administration. Reliability scores for the subtest are reported in the manual based on KR-20 estimates, which yielded correlations ranging from 0.87 to 0.88 for high school students. Additionally, alternate form reliabilities yielded a correlation of 0.81 between the parallel forms of the of the Comprehension component.

Regarding scoring, the typical scoring guidelines were applied, where individuals were awarded one point for each correct response and zero points for incorrect or blank responses. The correct responses were totaled, yielding the raw score, which was then converted to a weighted score. The weighted score was used to derive the percentile rank, utilizing grade-level norms. Analysis of internal consistency for all participants who participated in the screening session ($N= 102$) yielded a Cronbach's alpha coefficient of 0.92, while the analysis with only participants included in the final sample ($N= 70$) was essentially the same.

Demographics Questionnaire. Demographic data were obtained with a self-report survey. Participants were asked to provide information regarding their gender, age, primary language, and ethnicity. Additionally, participants were asked to report if they have ever been

identified with a reading disability, writing disability, mathematics disability, and/or attention deficit-hyperactive disorder. Finally, participants were asked to provide information regarding their note-taking frequency and academic achievement. When responding to the item “I take notes during class,” 20% of the participants reported “almost always,” 35.7% reported “often,” 41.4% reported “sometimes” and 2.3% reported “never.” Similarly, when presented with the item “I take notes when I read,” 12.9% of the participants reported “almost always,” 28.6% reported “often,” 47.1% reported “sometimes,” and 11.4% reported “never.” In sum, 97.1% of the participants endorsed taking notes at least some of the time in class, while 88.6% of the participants endorsed taking notes at least some of the time while reading.

Lecture. A video-recorded lecture on the history of the General Harrison, a 19th century American mercantile ship, was presented, and participants were asked to take notes while viewing the presentation. The lecture content was adapted from a book entitled *Adventures of a Sea Hunter: In Search of Famous Shipwrecks* (Delgado, 2004), which was used in a similar lecture note-taking study conducted with high school students with and without ADHD (Gleason, 2012). However, the contents of the lecture were condensed and presented at a slower pace in order to make the material more accessible. The lecture was approximately twelve minutes long and delivered at a pace of approximately 104 words per minute. The Flesch Reading Ease of the lecture transcript is 55.1 and the Flesch-Kincaid Grade Level is 10.4. A secondary education teacher, with performance arts experience, delivered the lecture for the video recording; this teacher also provided recommendations to the researcher about appropriate pace and length of the lecture for the student population.

Notes. Within the protocols, each participant received four sheets of lined, letter-sized (8 ½ by 11-inch) paper for taking notes during the lecture. The notes were scored for quality, such

that points were awarded for overall completeness of the notes, as well as main ideas and details. Similar to the scoring criteria utilized by Gleason (2012), notes' completeness was defined as the number of overall lecture points recorded. This scoring system varied somewhat from the scoring utilized during the pilot study in which notes' quality was measured by totaling only the number of information units recorded. However, an analysis of the pilot data suggested that this approach was not sensitive to participants' varying abilities to infer main ideas and make connections among details; as such, the scoring criteria utilized by Gleason (2012) was applied.

The main ideas, details, and total lecture points were identified from a transcript of the lecture by a team of doctoral students who also developed the scoring rubric. First, the primary investigator met with two psychology graduate students to discuss the goals for the scoring rubric: identifying individual information units from within the lecture transcript and keeping rubric as sensitive as possible. Then, the primary researcher and the graduate students independently coded the lecture. The individual rubrics were emailed to the primary investigator, who reviewed them for differences and commonalities. All follow-up discussion took place through email, and disagreements were settled through consensus. Once the lecture was divided into individual lecture points, each team member independently identified the units as "main idea" or "detail." Once again, the scoring rubrics were emailed to the primary investigator, and all follow up discussion took place through email. Again, disagreements were settled through consensus. Overall, 224 information units were identified, including 90 main ideas and 134 details. Inter-rater agreement regarding identifying the lecture units was 0.96, and the inter-rater agreement regarding classifications (main idea vs. detail) was 0.94; disagreements were settled through discussion and consensus.

The primary investigator scored all of the notes based on the scoring rubric developed by the researcher team. Once scored, twenty percent of the notes were randomly selected for two independent raters to double-score. The independent raters were also psychology graduate students, however, they were not involved in developing the scoring rubric. The inter-rater agreement of total notes was 0.94.

Multiple-Choice Test. Participants' mastery of the lecture material was assessed with a 20-question multiple-choice test, with each question consisting of four answer choices. Similar to assessments used in other note-taking experiments (Brown, 2005; Gleason, 2011; Sumowski, 2007), the questions were based on Kintsch's (1998) model of text comprehension. Specifically, ten of the questions assessed *memory*, or the ability to recall information explicitly presented during the lecture, and the other ten questions assessed *inference*, or the ability to derive information implicitly presented. Inter-rater agreement regarding the question classification (memory vs. inference) was 1.0.

In terms of analysis, each item was scored one point if correct, and the total was summed with the total possible points ranging from 0 to 20. This scoring method was identical to that applied during the pilot study; however, for the actual study, the count of correctly answered memory items (0-10) and correctly answered inference items (0-10) was analyzed separately. Analysis of internal consistency for the total measure yielded a Cronbach's alpha coefficient of 0.79. While internal consistency for the memory items yielded a Cronbach's alpha of 0.72, and internal consistency for the inference items yielded a Cronbach's alpha of 0.57.

Handwriting Speed. The alphabet task, based on the measure used by Berninger and Alsdorf (1989) and Berninger, Mizokawa, and Bragg (1991), was used to assess participants' handwriting speed. This handwriting speed measure has been consistently used to assess writing

speed in many similar note-taking experiments (e.g., Gleason, 2012; Vekaria, 2011). Participants were provided with lined paper and asked to write the alphabet as quickly as possible in either uppercase or lowercase letters, whichever they prefer. They were instructed that once finished with an alphabet sequence, they should begin the alphabet again until the 45-second time limit expired. With regards to scoring, one point was awarded for every recognizable letter. While participants were not penalized for omitting letters in the alphabet, letters incorrectly inserted or repeated within the sequence were not counted as correct. This scoring method is identical to the procedure applied in analyzing the pilot study data. The inter-rater agreement on this measure was 1.0.

Listening Comprehension. Participants' listening comprehension skills, or the ability to understand spoken language, was assessed with a modified version of the Listening Comprehension subtest from the Kaufman Test of Educational Achievement – Second Edition (KTEA-II), Form A (Kaufman & Kaufman, 2004). The KTEA-II Listening Comprehension items are designed to assess both literal and inferential comprehension skills through varied questioning. While this subtest is typically administered individually by presenting level-appropriate auditory passages and requiring the examinee to verbally respond to several verbally presented questions, this measure was adapted in several ways for group administration purposes.

First, all participants responded to the most advanced item set (Set G), which included six passages. Additionally, participants wrote their answers to the standardized multiple-choice or short-answer questions on the provided response sheets. After each auditory passage was presented from the laptop, the researcher read the standardized questions while simultaneously displaying the questions on a PowerPoint slide. Once a question was presented, participants

were allotted 45 seconds to record a response before the researcher proceeded to the next question. This format allowed for written information to be collected without participants accessing questions prematurely or returning to earlier questions. The 45-second time allotment was modified from the pilot study data, as students in the LD group of the pilot study often required more time to finish than the previously allotted 30 seconds. Overall, the Listening Comprehension subtest lasted approximately 18 minutes.

Participants' responses were assessed with the scoring criteria provided by the KTEA-II manual. Each accurate response was awarded one point and each inaccurate response was awarded zero points. Of the nineteen total questions within this set (between two and four questions per passage), three of the questions include two parts (e.g. "what are two ways..."), and in these instances, responses were scored as zero, one, or two points. As such, participants were able to earn a total of 22 points on this measure, and raw scores, rather than standard scores, were used in analyzing the data. This scoring procedure is identical to the method applied during the pilot study. The inter-rater agreement for this measure was 0.99, and an analysis of internal consistency yielded a Cronbach's alpha coefficient of 0.83.

According to the test manual, the KTEA-II was standardized and normed between September 2001 and May 2003 using data obtained from the March 2001 Current Population Survey. The age norm sample included 3000 participants (age 4 years, 6 months to age 25 years, 11 months), while the grade norm sample included 2400 participants (grades kindergarten through twelve); the age norm and grade norm samples overlapped. The norming data was collected from 39 states and Washington D.C., and groups were matched to the U.S. population in terms of gender, mother's education level, ethnicity, and parental education with each group. Additionally, the samples including adult participants (ages 18 to 25) were further controlled by

educational status of the participant. Throughout the standardization process, the administrative procedures and assessment items were adjusted based on analysis (Kaufman & Kaufman, 2004).

Regarding the Listening Comprehension subset, the test manual indicated that auditory items yielded higher reliability when they were presented via compact disc rather than verbally stated by the examiner. The internal consistency estimates for this measure were high across the 14-25 year old age groups, ranging from 0.83 to 0.88, with Standard Errors of Measurement ranging from 5.27 to 6.21. Further, the inter-rater agreement coefficient for the measure was also high at 0.97. Validity was determined based on the measure's correlation with other assessments of listening comprehension and reading comprehension. The KTEA-II Listening Comprehension subtest correlated strongly with the WIAT-II Listening Comprehension (0.72 for grades 6-11) and the WJ-III Achievement Oral Language Composite (0.71 for grades 6-11). Moderate correlations were also reported between the KTEA-II Listening Comprehension measure and reading comprehension measures from the KTEA-II and WIAT-II (0.61-0.73). In sum, the statistical evidence presented by the KTEA-II test manual indicates that the Listening Comprehension subtest is reliable, valid, and appropriate for use with high school students.

Sustained Attention. Participants' sustained attention, or the ability to maintain focus on relatively unchanging stimuli for an appreciable interval (Mirsky et al., 1999), was assessed with the Lottery subtest from the Test of Everyday Attention (TEA) (Robertson et al., 1994). To avoid ceiling effects found in previous research and maximize individual differences, the TEA, which was standardized on individuals ages 18 through 80, was used instead of the Test of Everyday Attention for Children (TEA-Ch).

For the Lottery subtest, participants were asked to imagine that they have found a lottery ticket ending in the number "55" (Version A), where all ticket numbers include two letters

followed by three numbers, e.g. “AB123,” or “CD155.” In order to check their ticket against the winning tickets, they were required to listen to a 10-minute series of winning numbers presented via MP3 player. While listening, participants were directed to identify the first two letters of a sequence every time they heard a ticket ending in “55.”

Like the KTEA-II, this subtest is intended for individual administration and was adapted in several ways for group administration. First, rather than verbally identifying the letters, participants were asked to write their responses on the provided response sheets. Regarding scoring, the TEA manual directs the examiner to score each of the ten items as one or zero points. Specifically, one point should be scored if the examinee identifies both letters accurately and zero points should be scored if the examinee does not identify both letters accurately. However, to maximize variability, items were scored zero points if none of the letters were identified, one point if one letter was identified, and two points if both letters were identified. With this scoring schema, a participant could obtain a total of twenty points on this measure, and raw scores were used for all statistical analysis. Finally, commission errors were noted but not analyzed. The inter-rater agreement on this measure was 1.0, and analysis of internal consistency yielded a Cronbach’s alpha coefficient of 0.86.

The TEA was normed with 154 participants from England, ages 18 through 80. The norming sample was stratified by four age bands, and 39 individuals were within the 18 through 34 age bracket. With regards to the reliability of the TEA, internal reliability data is not provided in the manual; however, one-week test-retest reliability for the Lottery subtest was adequate at 0.77. Overall, the Lottery subtest seems to have strong construct validity, as it is often used in research on attention (Gleason, 2012; Strauss et al., 2006; Vekaria, 2011), found to be related to note-taking (Peverly et al., 2014), and based on established theory (Strauss et al.,

2006). The principle component analysis completed by the authors found the Lottery subtest to load high on the sustained attention factor (0.70) and low on the other three factors, including visual selective attention/speed (-0.10), attentional switching (0.18), and auditory-verbal working memory (0.25). Additionally, validity studies indicated that the Lottery subtest was not highly correlated with estimates of verbal intelligence or hearing impairments, which suggests strong discriminant validity. Finally, according to the manual, the Lottery subtest significantly discriminates between clinical and control groups (Roberston et al., 1994; Strauss et al., 2006). In sum, the evidence presented by the TEA test manual suggests that the Lottery subtest is an acceptable assessment of sustained attention and appropriate for use in research.

Background Knowledge Assessment. Participants were asked to complete an experimenter-developed assessment of background knowledge on general American history. The measure consisted of twenty multiple-choice questions each consisting of four answer choices, and participants were allotted fifteen minutes to complete the test. The textbook, *A Survey of American History – Twelfth Edition* (Brinkley, 2007), was used as a general guide for developing these questions. Although this text is typically utilized in advanced placement or college level courses, only very basic material was selected for this history assessment and each item was written in simple language. Additionally, a secondary-education teacher reviewed the questions for level appropriateness and the measure was piloted with fifteen high school students to ensure sufficient variability among individuals. Inter-rater scoring agreement for this measure was 1.0. Regarding internal consistency, analysis of the sample yielded a Cronbach's alpha coefficient of 0.76.

Design and Procedure

Students were recruited with the assistance of the district's special education department. School personnel identified students who met the LD and NLD criteria utilized by this study. The researcher or a teacher met with all potential participants in small groups to explain the study and provide them with a parent letter and parental consent form. Students were required to return the consent form in order to participate; they were also required to complete the student assent form during the screening session.

Participants completed the entire study in up to three total sessions, one screening session or one screening session and two study sessions, and all sessions occurred within a ten-day period. The screening session lasted approximately 25 minutes, while the study sessions each lasted approximately 45 minutes. All measures were administered in small groups consisting of 4 to 12 participants.

At the start of each session, participants completed the student assent form and then were provided with protocols including all of the materials required for that session (i.e., answer sheet for Nelson Denny Reading Comprehension Test, sheets for note-taking, demographics questionnaire, handwriting speed response sheet, TEA response sheet, background knowledge test, and/or the KTEA-II response sheet). The protocols were distributed at the start of each session and collected at the end. To prevent participants from prematurely accessing the assessment questions, the multiple-choice test was not included within the packets, but instead distributed separately.

During the screening session, participants were asked to complete the NDRT – Form G, Comprehension subset (20 minutes). If they met the reading comprehension criteria for their designated group (i.e., LD/NLD), they were invited to participate in the study sessions. During

the first study session, participants were asked to (a) view a video-recorded lecture while simultaneously taking notes on the lecture content (12 minutes), (b) complete a demographics questionnaire (5 minutes), (c) review their lecture notes (10 minutes), (d) complete a measure of handwriting speed (1 minute), and (e) complete a multiple-choice test based on the lecture content (15 minutes). Immediately preceding the lecture presentation, participants were informed that they would be completing a multiple-choice test based on the lecture content at the end of the session. They were also told that the notes they took would be their only study material in preparing for the test.

In the second study session, participants were asked to (a) complete a measure of listening comprehension, the KTEA-II Listening Comprehension Subtest (18 minutes), (b) complete a background knowledge assessment (15 minutes), and (c) complete a measure of sustained attention, the TEA Lottery subtest (10 minutes). After completing the final task of the experiment, all participants were thanked for their participation in the study with a \$10.00 gift card to a local movie theater and raffle ticket to win one of two iPad Minis.

Chapter IV

RESULTS

This study utilized a quasi-experimental design to investigate four hypotheses regarding the lecture note-taking skills of adolescents with and without reading disabilities. First, the researcher hypothesized that adolescents without learning disabilities (NLD) would perform significantly better than adolescents with learning disabilities (LD) on measures of handwriting speed, listening comprehension, sustained attention, background knowledge, quality of notes, and test performance. Further, it was predicted that LD status, handwriting speed, listening comprehension, background knowledge, and sustained attention would significantly contribute to differences in the quality of notes. Additionally, the researcher hypothesized that LD status, handwriting speed, listening comprehension, background knowledge, sustained attention, and notes quality would contribute to significant differences in test performance. Finally, it was hypothesized that the predictors of quality of notes and test performance for the LD group would not differ significantly from the predictors of quality of notes and test performance for the NLD group.

The primary dependent variables were note quality and multiple-choice test performance. Note quality was comprised of three scores: notes total, main ideas, and details. Test performance was also separated into three scores: multiple-choice total, multiple-choice memory, and multiple-choice inference. Learning disability status (i.e., LD or NLD) was the between-subjects variable. The other independent variables included handwriting speed, listening comprehension, background knowledge, and sustained attention. Notes total was also included as a predictor for multiple-choice test performance.

The means, standard deviations, and range of the scores in the total sample, as well as information about the distribution for each of these variables, are displayed below in Table 3.

The variables of handwriting speed, background knowledge, notes total, notes main ideas, notes details, multiple-choice total, multiple-choice memory, and multiple-choice inference met all assumptions of normality. The variable of listening comprehension was slightly positively skewed and the variable of sustained attention was slightly negatively skewed. However, since these variables were only slightly skewed, no transformations were performed.

Table 3

Means, Standard Deviations, Ranges, Skew, and Kurtosis for Predictor and Outcome Variables (N=70)

	<i>Mean</i>	<i>SD</i>	<i>Range</i>	<i>Skew</i>	<i>Kurtosis</i>
Handwriting Speed	68.17	29.10	10.0-145.0	0.26 (0.29)	0.14 (0.57)
Listening Comprehension	6.83	4.46	0.0-19.0	0.68 (0.29)	-0.08 (0.57)
Sustained Attention	11.90	4.60	0.0-20.0	-0.57 (0.29)	-0.08 (0.57)
Background Knowledge	10.80	3.93	4.0-20.0	0.29 (0.29)	-0.30 (0.57)
Notes Total	39.04	26.46	2.0-100.0	0.30 (0.29)	-0.82 (0.57)
Notes Main Ideas	17.60	11.42	0.0-43.0	0.17 (0.29)	-0.93 (0.57)
Notes Details	21.44	15.72	0.0-58.0	0.48 (0.29)	-0.58 (0.57)
Multiple-Choice Test	10.76	4.20	1.0-19.0	-0.03 (0.29)	-0.78 (0.57)
Multiple-Choice Memory	6.19	2.50	0.0-10.0	-0.30 (0.29)	-0.66 (0.57)
Multiple-Choice Inference	4.57	2.12	0.0-9.0	0.18 (0.29)	-0.57 (0.57)

Intercorrelations

In order to avoid Type I errors, all intercorrelations were tested using an adjusted alpha of .05 and 0.001. Intercorrelations among the independent and dependent variables for the total sample are contained in Table 4. Intercorrelations among several demographic variables (gender, age, ethnicity, native English speaker status, ADHD status) and the independent and dependent variables of the entire sample were also explored. However, since none of these correlations were significant a table is not provided. Total note quality was significantly correlated with LD status, handwriting speed, listening comprehension, background knowledge,

multiple-choice total, and reading comprehension. Multiple-choice total was significantly correlated with LD status, listening comprehension, background knowledge, sustained attention, notes total, and reading comprehension.

Intercorrelations among the independent and dependent variables for the LD and NLD groups were calculated separately; see Tables 5 and 6, respectively. Additionally, since IQ scores were available for the LD group, intercorrelations among IQ scores and all variables were included for this subset. For the LD group, neither notes total nor multiple-choice total were significantly correlated with any of the independent variables. Regarding the NLD group, notes total was not significantly correlated with any of the independent variables, however, multiple-choice total was significantly correlated with listening comprehension and background knowledge.

Table 4

Intercorrelations Among the Independent and Dependent Variables for Entire Sample (N= 70)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. LD Status	--											
2. Handwriting Speed	-.38*	--										
3. Listening Comprehension	-.65**	.24*	--									
4. Sustained Attention	-.39**	.40**	.39**	--								
5. Background Knowledge	-.76**	.32*	.66**	.25*	--							
6. Notes Total	-.79**	.42**	.51**	.37*	.69**	--						
7. Notes Main Ideas	-.78**	.44**	.50**	.34*	.71**	.97**	--					
8. Notes Details	-.76**	.39*	.51**	.38*	.64**	.98**	.90**	--				
9. Multiple-Choice Test	-.76**	.18	.72**	.36*	.76**	.67**	.68**	.64**	--			
10. Multiple-Choice Memory	-.73**	.16	.64**	.38*	.74**	.67**	.67**	.65**	.92**	--		
11. Multiple-Choice Inference	-.65**	.17	.66**	.26*	.64**	.54**	.56**	.50**	.89**	.66**	--	
12. Reading Comprehension	-.80**	.39**	.73**	.31*	.78**	.68**	.70**	.64**	.78**	.68**	.74**	--

* $p \leq 0.05$

** $p \leq 0.001$

Table 5
Intercorrelations Among the Independent and Dependent Variables for LD Group (n=35)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Handwriting Speed	--											
2. Listening Comprehension	-.05	--										
3. Sustained Attention	.32	.22	--									
4. Background Knowledge	.07	.19	.09	--								
5. Notes Total	.33	-.01	.34	.09	--							
6. Notes Main Ideas	.39*	.01	.33	.14	.93*	--						
7. Notes Details	.26	-.03	.32	.04	.96*	.80*	--					
8. Multiple-Choice Test	-.27	.30	.20	.22	.23	.18	.24	--				
9. Multiple-Choice Memory	-.17	.23	.26	.30	.28	.20	.32	.85*	--			
10. Multiple-Choice Inference	-.28	.24	.02	-.02	.04	.07	.01	.70*	.22	--		
11. IQ Score	.06	.14	.20	.10	.19	.05	.28	-.01	.15	-.22	--	
12. Reading Comprehension	-.35*	.29	.19	.23	.03	.11	-.03	.22	.23	.09	.05	--

* $p \leq 0.05$

** $p \leq 0.001$

Table 6
Intercorrelations Among the Independent and Dependent Variables for NLD Group (n=35)

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Handwriting Speed	--										
2. Listening Comprehension	.01	--									
3. Sustained Attention	.24	.17	--								
4. Background Knowledge	.03	.42*	-.26	--							
5. Notes Total	.07	.01	-.12	.31*	--						
6. Notes Main Ideas	.07	-.05	-.23	.36*	.90**	--					
7. Notes Details	.06	.05	-.03	.24	.96**	.73**	--				
8. Multiple-Choice Test	-.08	.54**	-.02	.60**	.15	.23	.08	--			
9. Multiple-Choice Memory	-.21	.40*	-.03	.51*	.19	.27	.12	.82**	--		
10. Multiple-Choice Inference	.05	.51*	<.01	.50*	.08	.13	.03	.88**	.44*	--	
11. Reading Comprehension	.35*	.54**	-.02	.57**	.20	.28	.13	.56**	.34*	.60**	--

* $p \leq 0.05$

** $p \leq 0.001$

Multivariate and Univariate Tests

A one-way MANOVA was conducted to simultaneously compare the means between the LD and NLD groups across measures of handwriting speed, listening comprehension, background knowledge, sustained attention, total note quality, and multiple-choice total. It was

hypothesized that there would be a main effect for LD status, with students in the NLD group performing significantly better than students in the LD group.

The assumption of equal covariance matrices was met (Box's $M=23.69$, $F(21, 17007)=1.02$, $p=0.43$), as well as all assumptions of equal variances. The multivariate test was significant (Wilks' $\lambda=0.03$, $F(6, 63)=32.80$, $p<.01$, partial $\eta^2=0.76$, observed power= 1.000). Follow-up ANOVAs with a Bonferroni correction ($p\leq 0.008$) revealed that NLD students significantly outperformed LD students on measures of handwriting speed ($F(1, 68)=11.60$, $p=0.001$, partial $\eta^2=0.15$), listening comprehension ($F(1, 68)=50.11$, $p<0.001$, partial $\eta^2=0.424$), background knowledge ($F(1, 68)=94.00$, $p<0.001$, partial $\eta^2=0.580$), sustained attention, ($F(1, 68)=12.250$, $p=0.001$, partial $\eta^2=0.155$), notes total ($F(1, 68)=109.87$, $p<0.001$, partial $\eta^2=0.618$), and multiple-choice total ($F(1, 68)=95.39$, $p<0.001$, partial $\eta^2=0.584$). Consistent with the hypothesis, NLD students performed significantly better across all independent and dependent variables. Results of univariate ANOVAs are displayed in Table 7.

Table 7
Univariate ANOVAs Comparing LD and NLD Groups Across All Measures (N= 70)

<i>Source</i>	<i>LD Group (n= 35)</i>		<i>NLD Group (n= 35)</i>		<i>Significance</i>
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	
Handwriting Speed	57.14	31.35	79.20	22.03	0.001*
Listening Comprehension	3.94	2.83	9.71	3.91	<0.001*
Background Knowledge	7.83	2.35	13.77	2.77	<0.001*
Sustained Attention	10.11	4.78	13.69	3.68	0.001*
Notes Total	18.40	14.97	59.69	17.86	<0.001*
Multiple-Choice Test	7.57	2.52	13.94	2.92	<0.001*

* $p\leq 0.008$

School. In order to obtain a sufficient sample size, high school students were recruited from two different schools within the same Connecticut school district. A one-way MANOVA

was conducted to simultaneously compare the means of the students from School #1 ($n = 57$) and School #2 ($n = 13$) on the variables of handwriting speed, listening comprehension, background knowledge, sustained attention, notes total, and multiple-choice total. Table 8 contains the means and standard deviations of the variables separated by school. The assumption of equal covariance matrices was met (Box's $M = 18.80$, $F(21, 1717) = 0.72$, $p = 0.82$), as well as all assumptions of equal variances. The multivariate test was not significant (Wilks' $\lambda = 0.92$, $F(6, 63) = 0.91$, $p = 0.50$, partial $\eta^2 = 0.08$, observed power = 0.33), indicating that the sample was homogeneous.

Table 8

Means and Standard Deviations by School

Variables	<i>School #1 ($n = 57$)</i>		<i>School #2 ($n = 13$)</i>	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Handwriting Speed	69.09	30.30	64.15	23.73
Listening Comprehension	6.75	4.74	7.15	3.08
Background Knowledge	10.77	4.13	10.92	3.01
Sustained Attention	11.61	4.59	13.15	4.65
Notes Total	37.04	26.70	47.85	24.41
Multiple-Choice Test	10.54	4.40	11.69	3.17

* $p < 0.05$

Multiple Regression Analyses

Regression analyses using the enter method were used to evaluate which variables contributed significantly to notes' quality and test performance. It was hypothesized that handwriting speed, listening comprehension, background knowledge, and sustained attention would predict total notes, while handwriting speed, listening comprehension, background knowledge, sustained attention, and total notes would predict test performance.

Notes. In the first regression analysis, notes total was regressed on LD status, handwriting speed, listening comprehension, background knowledge, and sustained attention. It

was hypothesized that all five variables would predict notes' quality. The regression model was significant (tolerance and variance inflation factor values were within acceptable limits; $R = .81$, $R^2 = .66$, $R^2_{\text{adjusted}} = .63$; $F(5,64) = 24.37$, $p < 0.001$). The model accounted for 66% of the variance in the data. The effect size, with Cohen's f -squared used as an effect size, was large ($f^2 = 1.94$). Contrary to hypothesis, LD status was the only significant predictor of notes total ($\beta = -0.59$, $p < 0.001$); see Table 9. Since the correlations among notes main ideas, notes details, and notes total were so high, separate regression analyses were not conducted with notes' main ideas and details as dependent variables.

Table 9
Summary of Regression Analysis Predicting Notes Total

<i>Variable</i>	<i>B</i>	<i>SE B</i>	β	<i>Tolerance</i>	<i>VIF</i>
LD Status	-30.80	6.53	-0.59*	0.35	2.87
Writing Speed	0.10	.08	.17	0.77	1.30
Listening Comprehension	-0.47	0.63	-0.08	0.48	2.08
Background Knowledge	1.61	0.82	0.24	0.36	2.77
Sustained Attention	0.41	0.50	0.07	0.72	1.39

* $p < 0.05$

Multiple-Choice Test. Multiple-choice total was regressed on LD status, handwriting speed, listening comprehension, background knowledge, sustained attention, and notes quality. It was hypothesized that all six variables would predict test performance. The regression model was significant (tolerance and variance inflation factor values were within acceptable limits; $R = 0.86$, $R^2 = .74$, $R^2_{\text{adjusted}} = .71$; $F(6,63) = 29.09$, $p < 0.001$). The model accounted for 74% of the variance and the effect size was large ($f^2 = 2.84$). Several variables were significant predictors of multiple-choice total, including LD status ($\beta = -0.26$, $p = 0.045$), handwriting speed ($\beta = -0.18$, $p = 0.021$), listening comprehension ($\beta = -0.27$, $p = 0.006$), and background knowledge

($\beta = 0.32$, $p = 0.006$). Contrary to the hypothesis, sustained attention and notes total did not significantly predict overall performance on the multiple-choice test; see Table 10.

Table 10
Summary of Regression Analysis Predicting Multiple-Choice Total

<i>Variable</i>	<i>B</i>	<i>SE B</i>	β	<i>Tolerance</i>	<i>VIF</i>
LD Status	-2.17	1.06	-0.26*	0.26	3.87
Handwriting Speed	-0.03	0.01	-0.18*	0.75	1.33
Listening Comprehension	0.25	0.09	0.27*	0.48	2.10
Background Knowledge	0.34	0.12	0.32*	0.34	2.93
Sustained Attention	0.07	0.07	0.08	0.71	1.40
Notes Total	0.03	0.02	0.16	0.34	2.90

* $p < 0.05$

Separate regression analyses were run with multiple-choice memory items and multiple-choice inference items as the dependent variables. First, multiple-choice memory was regressed on LD status, handwriting speed, listening comprehension, background knowledge, sustained attention, and notes total. The regression model was significant (tolerance and variance inflation factor values were within acceptable limits; $R = 0.83$, $R^2 = .068$, $R^2_{\text{adjusted}} = .065$; $F(6,63) = 22.32$, $p < 0.001$). The model accounted for 68% of the variance in the data, with a large effect size ($f^2 = 2.13$). However, handwriting speed ($\beta = -0.22$, $p = 0.01$) and background knowledge ($\beta = -0.36$, $p = 0.005$) were the only significant predictors of performance on the memory items. LD status, listening comprehension, sustained attention, and notes total did not predict performance; see Table 11.

Table 11

Summary of Regression Analysis Predicting Multiple-Choice Memory Performance

<i>Variable</i>	<i>B</i>	<i>SE B</i>	β	<i>Tolerance</i>	<i>VIF</i>
LD Status	-1.10	0.70	-0.22	0.26	3.87
Handwriting Speed	-0.02	0.01	-0.22*	0.75	1.33
Listening Comprehension	0.08	0.06	0.14	0.48	2.10
Background Knowledge	0.23	0.08	0.36*	0.34	2.93
Sustained Attention	0.08	0.05	0.15	0.71	1.40
Notes Total	0.02	0.01	0.22	0.34	2.90

* $p < 0.05$

Next, multiple-choice inference was regressed on LD status, handwriting speed, listening comprehension, background knowledge, sustained attention, and notes total. The regression model was significant (tolerance and variance inflation factor values were within acceptable limits; $R = 0.74$, $R^2 = .0.55$, $R^2_{\text{adjusted}} = .0.51$; $F(6,63) = 12.78$, $p < 0.001$). The model accounted for 55% of the variance in the data, and the effect size was large ($f^2 = 1.22$). Interestingly, listening comprehension was the only significant predictor of the inference items ($\beta = 0.36$, $p = 0.005$); see Table 12.

Table 12

Summary of Regression Analysis Predicting Multiple-Choice Inference Performance

<i>Variable</i>	<i>B</i>	<i>SE B</i>	β	<i>Tolerance</i>	<i>VIF</i>
LD Status	-1.076	0.70	-0.26	0.26	3.87
Handwriting Speed	-0.01	0.01	-0.09	0.75	1.33
Listening Comprehension	0.17	0.06	0.36*	0.48	2.10
Background Knowledge	0.11	0.08	0.21	0.34	2.93
Sustained Attention	-0.01	0.05	-0.02	0.71	1.40
Notes Total	0.01	0.01	0.06	0.34	2.90

* $p < 0.05$

Comparing LD and NLD Predictors. Additional regression analyses were run to assess if LD and NLD exhibited different prediction patterns for note-taking or multiple-choice test performance; it was hypothesized that the significant predictors would be the same for the two

groups. For each group notes total was regressed on handwriting speed, listening comprehension, sustained attention, and background knowledge. The regression model for the LD group was not significant (tolerance and variance inflation factor values were within acceptable limits; $R = 0.42$, $R^2 = .018$, $R^2_{\text{adjusted}} = .007$; $F(4,30) = 1.62$, $p = 0.20$); see Table 13. The regression model for the NLD group also was not significant (tolerance and variance inflation factor values were within acceptable limits; $R = 0.34$, $R^2 = .012$, $R^2_{\text{adjusted}} < 0.00$; $F(4,30) = 1.00$, $p = 0.42$); see Table 14.

Table 13

Summary of Regression Analysis Predicting Notes Total for LD Group

<i>Variable</i>	<i>B</i>	<i>SE B</i>	β	<i>Tolerance</i>	<i>VIF</i>
Handwriting Speed	0.12	.08	.23	.88	1.14
Listening Comprehension	-0.37	.92	-.07	.90	1.11
Background Knowledge	0.39	1.08	.06	.96	1.05
Sustained Attention	0.87	.57	.28	.84	1.19

$p < 0.05$

Table 14

Summary of Regression Analysis Predicting Notes Total for NLD Group

<i>Variable</i>	<i>B</i>	<i>SE B</i>	β	<i>Tolerance</i>	<i>VIF</i>
Handwriting Speed	.06	.14	.07	.93	1.08
Listening Comprehension	-.62	.91	-.14	.74	1.35
Background Knowledge	2.32	1.32	.36	.71	1.42
Sustained Attention	-.11	.94	-.02	.78	1.28

$p < 0.05$

Separate analyses were run for the LD and NLD groups with multiple-choice total as the dependent variable. For each group multiple-choice total was regressed on handwriting speed, listening comprehension, sustained attention, background knowledge, and notes total. The regression model was significant for the LD group (tolerance and variance inflation factor values were within acceptable limits; $R = 0.56$, $R^2 = .031$, $R^2_{\text{adjusted}} = .019$; $F(5,29) = 2.64$, $p = 0.044$),

and the model accounted for 31% of the variance in the data, and the effect size was medium ($f^2 = 0.45$). Contrary to hypothesis, only handwriting speed ($\beta = -0.42$, $p = 0.018$) was a significant predictor of multiple-choice total when the LD group alone was analyzed; see Table 15.

For the NLD group the regression model was significant (tolerance and variance inflation factor values were within acceptable limits; $R = 0.69$, $R^2 = .047$, $R^2_{\text{adjusted}} = .038$; $F(5,29) = 5.21$, $p = 0.002$). The model accounted for 47% of the variance in the data, and the effect size was large ($f^2 = 0.89$). Interestingly, listening comprehension ($\beta = 0.33$, $p = 0.045$) and background knowledge ($\beta = 0.48$, $p = 0.008$) were the only significant predictors of multiple-choice total; see Table 16.

Table 15
Summary of Regression Analysis Predicting Notes Total for LD Group

<i>Variable</i>	<i>B</i>	<i>SE B</i>	β	<i>Tolerance</i>	<i>VIF</i>
Handwriting Speed	-0.03	0.01	-0.42*	0.83	1.20
Listening Comprehension	0.19	0.15	0.21	0.90	1.12
Background Knowledge	0.18	0.17	0.16	0.95	1.05
Sustained Attention	0.09	0.09	0.17	0.78	1.28
Notes Total	0.05	0.03	0.30	0.82	1.22

* $p < 0.05$

Table 16
Summary of Regression Analysis Predicting Notes Total for LD Group

<i>Variable</i>	<i>B</i>	<i>SE B</i>	β	<i>Tolerance</i>	<i>VIF</i>
Handwriting Speed	-0.02	0.02	-0.12	0.92	1.08
Listening Comprehension	0.25	0.12	0.33*	0.73	1.37
Background Knowledge	0.50	0.18	0.48*	0.64	1.56
Sustained Attention	0.06	0.12	0.08	0.78	1.28
Notes Total	<0.01	0.02	0.02	0.88	1.13

* $p < 0.05$

Supplementary Analyses

Regression Analysis without LD Status. Since LD status was highly correlated with the independent and dependent variables, supplementary regression analyses were used to evaluate which variables contributed significantly to notes' quality and test performance when LD status was not included in the model. First, notes total was regressed on handwriting speed, listening comprehension, background knowledge, and sustained attention. The regression model was significant (tolerance and variance inflation factor values were within acceptable limits; $R = .73$, $R^2 = .55$, $R^2_{\text{adjusted}} = .51$, $F(4,65) = 18.76$, $p < 0.001$). The model accounted for 55% of the variance in the data, and the effect size was large ($f^2 = 1.22$). Background knowledge was the only significant predictor of notes total ($\beta = 0.57$, $p < 0.001$); see Table 17.

Table 17

Summary of Regression Analysis Predicting Notes Total without LD Status

<i>Variable</i>	<i>B</i>	<i>SE B</i>	β	<i>Tolerance</i>	<i>VIF</i>
Writing Speed	0.15	0.09	0.17	0.79	1.27
Listening Comprehension	0.27	0.70	0.05	0.51	1.95
Background Knowledge	3.81	0.78	0.57*	0.53	1.87
Sustained Attention	0.84	0.56	0.15	0.75	1.34

* $p < 0.05$

Next, multiple-choice total was regressed on handwriting speed, listening comprehension, background knowledge, sustained attention, and notes total. The regression model was significant (tolerance and variance inflation factor values were within acceptable limits; $R = .85$, $R^2 = .72$, $R^2_{\text{adjusted}} = .70$, $F(5, 64) = 32.46$, $p < 0.001$). The model accounted for 72% of the variance in the data, and the effect size was large ($f^2 = 2.57$). Handwriting speed ($\beta = -0.17$, $p = 0.03$), listening comprehension ($\beta = 0.32$, $p = 0.001$), background knowledge ($\beta = 0.40$, $p < 0.001$), and notes total ($\beta = 0.27$, $p = 0.007$) were significant predictors of multiple-choice total; see Table 18.

Table 18

Summary of Regression Analysis Predicting Multiple-Choice Total without LD Status

<i>Variable</i>	<i>B</i>	<i>SE B</i>	β	<i>Tolerance</i>	<i>VIF</i>
Writing Speed	-.03	.01	-.17*	.75	1.33
Listening Comprehension	.30	.09	.32*	.51	1.96
Background Knowledge	.43	.11	.40*	.39	2.56
Sustained Attention	.09	.07	.10	.72	1.39
Notes Total	.04	.02	.27*	.46	2.15

*p<0.05

Logistic Regression Analysis. In order to evaluate which of the cognitive variables significantly predicted LD status, logistic regression, using the enter model, was applied. In this model, LD status was the dependent variable and handwriting speed, listening comprehension, background knowledge, and sustained attention were the independent variables. The model was significant, $\chi^2(4, N=70) = 72.2, p<0.001$, accounting for 64.3% of the variance when the Cox and Snell R^2 was used as a measure of effect size. Background knowledge was the only variable that significant predicted LD status; see Tables 19 and 20.

Table 19

Logistic Regression Classification Table

	<i>NLD</i>	<i>LD</i>	<i>Percentage Correct</i>
<i>NLD</i>	33	2	94.3
<i>LD</i>	3	32	91.4
<i>Overall Percentage</i>			92.9

Table 20

Summary of Regression Analysis Predicting LD Status

<i>Variable</i>	<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>Exp (B)</i>	<i>95% C.I. for Exp (B)</i>	
Writing Speed	-0.03	0.02	1.85	0.98	0.94	1.01
Listening Comprehension	-0.36	0.20	3.25	0.70	0.47	1.03
Background Knowledge	-0.98	0.31	10.22*	0.37	0.21	0.68
Sustained Attention	-0.12	0.17	0.48	0.89	0.64	1.23

*p<0.05

CHAPTER V

DISCUSSION

In the high school setting, lecture is the primary instructional tool utilized by teachers to disseminate information (Vogler, 2006; Shernoff et. al, 2003; Putnam, Deshler, & Schumaker, 1993). Yet, lecture note-taking is a cognitively demanding task, which is challenging for many individuals (Peverly et al., 2007; Piolat et al., 2005). When required to take notes, students must simultaneously execute several cognitive processes, including listening comprehension, sustained attention, accessing background knowledge, and handwriting skills, which all operate within a limited capacity working memory (Peverly et al., 2007; Piolat et al., 2005). Thus, a breakdown at any point in the execution of these processes will likely interfere with note-taking proficiency and learning of the lecture material. Not surprisingly, at least two studies posit that students with Learning Disabilities (LDs) struggle more with lecture note-taking than their non-learning disabled (NLD) peers (Hughes & Suritsky, 1994; Boyle, 2010). However, to date, research has not investigated the underlying cognitive processes contributing to this disparity.

Building upon previous studies, this dissertation sought to examine the lecture note-taking skills and test performance of adolescents with and without LDs by investigating the cognitive variables impacting these skills. It was hypothesized that NLD adolescents would perform significantly better than LD adolescents on measures of handwriting speed, listening comprehension, sustained attention, background knowledge, quality of notes, and test performance. It was further hypothesized that LD status and all four cognitive variables would contribute to significant differences in notes' completeness and test performance; it was also hypothesized that notes' completeness would significantly predict test performance. Finally, the

researcher hypothesized that the note-taking and test performance prediction patterns for the LD group would not significantly differ from the prediction patterns for the NLD group.

To test these hypotheses, participants were recruited from two Northeast high schools, located within the same urban school district. Specific selection criteria were applied to identify students for the LD and NLD groups, and the study took place over two sessions. During the first session, participants were asked to view a video-recorded lecture while taking notes, complete a demographics questionnaire, review their notes, complete a measure of handwriting speed, and complete a multiple-choice test based on the lecture content. In the second session, participants were asked to complete measures of listening comprehension, background knowledge, and sustained attention. The dependent variables were note quality (notes' total, main ideas, and details) and multiple-choice test performance (total items, memory items, and inferential items). The independent variables included LD status, handwriting speed, listening comprehension, background knowledge, and sustained attention; notes' total was also included as a predictor for the multiple-choice test.

As predicted, the study's results indicated that NLD students significantly outperformed LD students across all measures. However, contrary to the other hypotheses, LD status was the only significant predictor of notes' quality, while LD status, handwriting speed, listening comprehension, and background knowledge predicted test performance. When the LD and NLD groups were analyzed separately, none of the independent variables predicted notes' quality; yet, handwriting speed predicted test performance for the LD group, and listening comprehension and background knowledge predicted test performance for the NLD group.

Note Quality: Which variables predicted note-taking in adolescents?

LD status. LD status emerged as the only significant predictor of notes' total, accounting for 66% of the variance in the model. On average, students in the LD group recorded significantly fewer total lecture points than students in the NLD group, a finding consistent with the available, albeit scarce, LD and note-taking literature. First, in a study of undergraduates, Hughes and Suritsky (1994) found that, on average, LD individuals recorded 36% of the macropropositions from a lecture, while NLD individuals recorded 56% of the macropropositions from the same lecture. Additionally, in a study with middle school participants, Boyle (2010) reported that LD students recorded 13% of the lecture points, while NLD students recorded 24% of the lecture points. Results from the current investigation are consistent with these patterns. LD students, on average, documented 8.2% of the total lecture points, while NLD students documented 26.6% of the lecture points. Specific to high school students, the percentage recorded by the NLD students is consistent with other note-taking data obtained from groups of typically developing high school students, as Carrier and Titus (1981) found that adolescents recorded 27% of the lecture information, and Gleason (2012) found that they recorded 26.3% of the lecture content.

Background knowledge. Background knowledge did not significantly predict notes' completeness in the full model; however, once LD status was omitted from the model in the supplementary analyses, background knowledge emerged as the only significant predictor of note-taking, accounting for 55% of the variance. When considering this finding, two points are noteworthy: (1) the LD students performed significantly worse on the background knowledge assessment than their non-disabled peers, and (2) background knowledge was highly correlated with LD status (-0.76). As such, LD status seemed to mediate the relationship between

background knowledge and notes; thus, once LD status was removed from the model, background knowledge emerged as the best predictor of an individual's ability to extract meaning from the lecture and take notes. This is consistent with results obtained from the logistic regression analysis, where background knowledge emerged as the only cognitive variable predicting LD status.

Not only are there very few studies on the relationship between background knowledge and note-taking skills, the results have been inconsistent. Specifically, Peverly et al. (2003), Oyzon and Olmos (2009), and Peverly and Sumowski (2012) all failed to find relationships between background knowledge and notes. Yet, other research suggests that background knowledge can compensate for low-aptitude and poor reading comprehension (Adams et al., 1995; Carr & Thomas, 1996; Schneider et al., 1989; Walker, 1987). Specifically, in a study with elementary and secondary education students, Schneider et al. (1989) found that background knowledge was a more powerful predictor of comprehension than intelligence, and Adams, Bell, and Perfetti (1995) concluded that high background knowledge can compensate for low reading skills when the text matches students' background knowledge. As such, it seems likely that the individuals in this study with more background knowledge were better able to quickly interpret and document information from the lecture.

Handwriting speed. While a growing body of research consistently finds handwriting speed to significantly predict notes' completeness (Gleason, 2012; Peverly, 2006; Peverly et al., 2007; Peverly et al., 2013; Peverly et al., 2014; Peverly & Sumowski, 2012), the current study failed to find such a relationship. This finding is unexpected given evidence suggesting that individuals with disabilities are more likely to struggle with handwriting speed (Berninger et al., 2006; Gregg et al., 2007) and note-taking skills (Boyle, 2010; Hughes & Suritsky, 1994) than

their non-disabled peers, which is consistent with results obtained in the current study. Specifically, analyses indicated that, on average, NLD students wrote significantly faster (79 letters vs. 57 letters) and took better notes (26.6% of the lecture vs. 8.2% lecture) than LD students, however, this disparity did not equate to a predictive relationship even though the correlation between handwriting speed and notes' total was significant (0.42). As such, it is likely that LD status mediated the relationship between handwriting speed and notes, but future research with a larger sample size is necessary to verify this interpretation.

Listening comprehension. Listening comprehension did not predict note-taking performance, an unexpected finding both in the context of the literature and when considering the seemingly essential role of listening comprehension in lecture note-taking. Specifically, Gleason (2012) and Vekaria (2011) both found listening comprehension to predict note-taking skills in studies that included ADHD and non-ADHD students, and Peverly et al. (2013) also found a relationship between listening comprehension and note-taking skills. Further, given the well-documented relationship between listening comprehension and reading comprehension (Curtis, 1980; Diakido et al., 2005; Sticht & James, 1984; Ward-Loneragan et al., 1998), it is surprising that the relationship between listening comprehension and note-taking was not significant in an investigation with LD students. While analyses indicated that LD students struggled significantly more with listening comprehension and note-taking than NLD students, once again this discrepancy did not equate to a predictive relationship, even though the correlation between listening comprehension and notes' total was significant (0.51). Consistent with speculations regarding the lack of significance of the handwriting speed variable, it is possible that LD status mediated the relationship between listening comprehension and notes.

This seems especially likely when considering the significant correlation between listening comprehension and LD status (-0.65).

Sustained attention. Finally, the current study failed to find a relationship between sustained attention and note-taking, a result contrary to both the researcher's hypothesis and trends in the literature. For instance, Gleason (2012), Peverly et al. (2014), and Vekaria (2011) all found significant relationships between sustained attention and quality of lecture notes, and some researchers even posit that sustained attention is the most important lecture note-taking variable (Williams & Eggert, 2002). In the current study, NLD students performed significantly better on the sustained attention measure than LD students, providing on average 13.69 correct responses compared to 10.11 correct responses. Thus, as with the other independent variables discussed previously, it seems likely LD status mediated the relationship between sustained attention and notes, especially as the correlation between sustained attention and LD status was significant (-0.39).

Test Performance: Which variables predicted test performance in adolescents?

LD status. LD status was a significant predictor of test performance. On average, the NLD students correctly answered 14 of the 20 test questions, while LD students correctly answered only 7 of the 20 test questions. This result is consistent with modern conceptualizations of learning disabilities, as current definitions identify academic deficits, i.e. poor performance on assessment measures, as key criteria of the disorder (American Psychiatric Association, 1994; Pub. L. No 108-445, sec. 602(3)). Also, the literature suggests that the significant learning difficulties demonstrated by LD students within the context of this study are consistent with the overall pattern of performance in other settings. Specifically, students

identified with LDs are typically significantly below grade level by high school (Cortiella, 2011), at a substantial disadvantage for accessing the curriculum (Cortiella, 2011; Shaywitz, 2003), more likely to drop out of high school (Cortiella, 2011), and less likely to pursue post-secondary education (Cortiella, 2011).

Background knowledge. Consistent with hypotheses, background knowledge was significantly related to multiple-choice test performance. In general, this fits with research that has found strong background knowledge to enhance overall comprehension (Adams et al., 1995; Schneider et al., 1996; Korkel & Weinert, 1989; McNamara, Kintsch, Songer & Kintsch, 1996; Walker, 1987), and to especially benefit students with LDs (Carr & Thomas, 1996). Furthermore, when the question types (memory vs. inferential) were analyzed separately, the background knowledge variable was a significant predictor for the memory items only. This finding diverges from results obtained by Peverly and Sumowski (2012), as researchers identified a predictive relationship between background knowledge and both memory items and inference items. Nonetheless, results seem to further suggest that individuals with greater background knowledge more easily comprehended the lecture material, which increased working memory capacity, thereby allowing more resources to be devoted to learning lecture material.

Handwriting speed. Although handwriting speed did not predict notes' completeness, it significantly predicted test performance; however, this finding is confusing and difficult to explain for several reasons. First, the multiple-choice test utilized in this study included limited writing demands, so the impact of handwriting speed on this assessment is somewhat unexpected. Additionally, handwriting speed was not significantly correlated with test performance (0.18) or LD status (-0.38), yet individuals in the LD group wrote significantly slower and performed significantly worse on the multiple-choice test. As such, it is possible that

in addition to measuring fine motor skills, the handwriting speed task also accounted for verbal fluency. This possibility is consistent with recent note-taking research, as Peverly et al. (2014) found that two variables- fine motor fluency and verbal fluency- significantly predicted handwriting speed, a finding that has been replicated in other studies (Peverly & Vekaria, in preparation). Thus, if verbal fluency, rather than fine motor skills, accounted for the relationship between handwriting speed and multiple-choice test performance, LD students who likely demonstrate slower verbal fluency than NLD students, were at a disadvantage for both tasks.

Another possibility for the relationship between handwriting speed and multiple-choice test performance is the constraints of working memory. In general, researchers hypothesize that fluent handwriting lessens the burdens on working memory; thus, with fast handwriting, working memory resources are more available for complex information processing (McCutchen, 1996; Peverly & Sumowski, 2012), like comprehending lecture material. When considering this conceptualization in relation to this study's findings, it's possible that the faster (i.e. more fluent) participants wrote, the more cognitive resources were available to attend to the lecture and comprehend the material, which ultimately led to better test performance. This finding appears especially relevant for adolescents with disabilities, as some evidence suggests that individuals with LDs tend to write few words on timed writing assignments (Gregg et al., 2007) and take less complete notes (Boyle, 2010; Hughes & Suritsky, 1994), which may be related to increased cognitive resources consumed by the writing process. As such, future research with a larger sample size is needed to better understand this finding, including the possible impact of verbal fluency and working memory limitations.

Listening comprehension. Listening comprehension was a significant predictor of overall test performance, a finding congruent with the literature. Further, when the types of

questions were analyzed individually, listening comprehension predicted only inferential questions. Consistently, theorists speculate that, rather than a passive process of simply receiving a code, listening comprehension is actually a dynamic task requiring individuals to continuously make judgments about the subtle nuances of spoken language (Byrnes, 1984; Richards, 1983). As such, it seems reasonable that individuals with stronger listening comprehension abilities would be more skilled with both comprehending the lecture and responding to inferential multiple-choice questions. Additionally, other note-taking studies found similar outcomes, as Gleason (2012) and Vekaria (2011) both found listening comprehension to be significantly related to test performance. Not surprisingly, on average, LD students performed significantly worse on the listening comprehension task than the NLD students. This finding is also consistent with the robust body of literature identifying the correlation between listening comprehension and reading comprehension (Curtis, 1980; Diakido et al., 2005; Sinatra, 1990; Sticht et al., 1974; Sticht & James, 1984), as the students with LDs included in this sample demonstrated below average reading comprehension skills on the screening measure.

Sustained attention. Sustained attention did not predict test performance, and in the context of this study, sustained attention appeared to be the least influential of the independent variables. This is consistent with results obtained by Gleason (2012) and Vekaria (2011), who both failed to find relationships between sustained attention and test performance in studies with secondary and post-secondary students, respectively. Overall, data regarding the relationship between sustained attention and test performance in the context of note-taking is relatively scarce; however, based on the available information, it seems likely that note-taking mediates the relationship between sustained attention and test performance.

Notes. While the literature consistently demonstrates that the quality of notes is related to test performance (Armbruster, 2009; Boyle, 2010; Gleason, 2012; Kobayashi, 2006; Peverly et al., 2007; Peverly & Sumowski, 2011; Vekaria, 2011), notes' completeness did not emerge as a significant predictor in the full model. However, once LD status was removed from the model, notes' total emerged as a significant predictor of test performance. One possible explanation for this outcome is the high correlations between notes' quality and the other variables. Specifically, notes' total was significantly correlated with LD status (-0.79), handwriting speed (0.42), listening comprehension (0.51), and background knowledge (0.69), all variables that significantly predicted multiple-choice test performance in the full model. Notes' quality was also significantly correlated with multiple-choice test performance (0.67). As such, it seems likely that LD status mediated the relationship between notes' total and test performance, and the variance accounted for by notes' total was also embedded within the other cognitive variables.

How did NLD students compare to LD students?

As described herein, the NLD students significantly outperformed the LD students across all independent and dependent variables. Specifically, NLD students wrote faster, demonstrated better listening comprehension, demonstrated better sustained attention, possessed greater background knowledge, recorded more complete notes, and performed better on the test. Interestingly, when the LD and NLD groups were analyzed separately, none of the cognitive variables predicted notes' completeness. With regard to test performance, handwriting speed was a significant predictor for the LD group, while listening comprehension and background knowledge were significant predictors for the NLD group. Such findings are difficult to interpret

due to the relatively small size of the two groups ($n=35$). However, the available data suggest that the test performance prediction patterns for the LD and NLD groups may be different.

Educational Implications and Future Research

To date, this is the first study investigating the lecture note-taking skills of adolescents with and without learning disabilities. Thus, if replicated, these findings have significant educational and research implications, several of which are discussed in the following sections.

LD students in high school. The results of this investigation clearly demonstrate that, compared to typically developing adolescents, individuals with LDs significantly struggle with note-taking and learning lecture material. This raises some interesting questions when considering the common practice of inclusion (Allison, 2012) and the prominence of lectures in high school settings (Shernoff et. al, 2003; Vogler, 2006). Specifically, in an investigation of inclusive classrooms, Allison (2012) stated, “in 1997, the reauthorization of IDEA obligated schools to include disabled students in the general education setting with inclusion as the preferred model...” (p. 37). Thus, by 2000, 96% of disabled children were included in general education settings 80% of the school day (Allison, 2012). When considering the results of this study, it seems as though at-risk students are frequently placed at a significant academic disadvantage when mainstreamed in traditional classrooms that rely heavily on lectures (Shernoff et. al, 2003; Vogler, 2006).

Further, while the relationship between learning struggles and LDs is undisputed, it seems less likely that educators are aware of the challenges that students with LD face when taking lecture notes. For instance, Allison (2012) found that general education and special education teachers alike believe that general education teachers need more training about the

inclusion model and educating students with special learning needs. Future research should investigate educators' perceptions of the effectiveness of lectures for students with LDs, and thereby identify areas of instructor professional development that would ultimately benefit struggling students.

Need for comprehensive interventions. The findings indicate that LD students suffer from severe and pervasive cognitive difficulties on at least four variables associated with positive learning outcomes; they also significantly struggled with note-taking and learning lecture material when compared to typically developing peers. Interestingly, in contrast to the majority of note-taking studies, (Armbruster, 2009; Boyle, 2010; Gleason, 2012; Kobayashi, 2006; Peverly et al., 2007; Peverly & Sumowski, 2012; Vekaria, 2011), this study failed to find a predictive relationship between notes' completeness and test performance, which may be related to the significant difficulties that LD students encountered. Specifically, it appears as though the skills of the LD students were so impaired that they were unable to utilize note-taking as a learning tool. In contrast, the NLD students, who demonstrated more fluency across all skill areas, also exhibited superior note-taking and test performance, as such a predictive relationship between notes and test performance could not emerge. Considering this finding, it seems reasonable to assume that note-taking and overall learning could be improved simply by increasing the fluency of basic skills, yet more growth would likely be observed by integrating explicit instruction of note-taking skills into the interventions efforts.

Impact of IQ. The impact of IQ is an interesting, perhaps confounding, variable when considering the participants in this study. Specifically, the mean IQ score for individuals in the LD group was 81.6 ($SD= 8.4$, $range= 71-107$), which is considerably below average when compared to same-aged peers. However, this pattern also fits with the literature, as research

demonstrates that “dynamic interrelations between reading and IQ” account “for differences in reading development” (Ferrer et al., 2010, p. 99). Ferrer et al., (2010) suggests that for typical readers, reading and IQ show “bidirectional influences,” but for disabled readers these influences are “smaller (from IQ to reading) or imperceptible (from reading to IQ)” (p. 99). Over time, barriers to reading significantly limit one’s ability to acquire knowledge and develop vocabulary, thus it seems reasonable that the students selected for the LD group would present with below average IQ scores (Cortiella, 2011; Ferrer et al., 2010; Shaywitz, 2003).

Interestingly, selecting participants with at least average cognitive abilities ($IQ \geq 85$) is the general trend in LD research (Boyle, 2010; Hughes & Suritsky, 1994), however, this researcher was motivated to increase the ecological validity of the findings by focusing on students who represent the special education population in urban schools. Yet, since IQ scores were only available for the LD group, understanding the impact of cognitive functioning on the main effects was difficult. As part of a post hoc analysis, the researcher separately regressed reading comprehension, notes’ total, and multiple-choice test on IQ score for the LD group; however, IQ did not significantly predict any of these outcome variables. Next, the researcher attempted to account for the IQ variable for the entire sample with the KTEA Listening Comprehension scores obtained in the study, as Stanovich (1991) suggests that listening comprehension can be used as a proxy for verbal intelligence. However, given the group administration format, which omitted reversal rules, many of the students did not reach basal on this measure (LD= 27, NLD= 17), and an estimate of IQ could not be derived for over half of the sample.

In sum, while the significant differences between the two groups suggest that students in the NLD group have higher IQ scores on average than students in the LD group, no specific data supports this assumption. Thus, the impact of IQ remains an unknown, but seemingly influential variable, and future research should include cognitive ability as an independent variable.

English as a second language. The number of participants in this study who reported that English was not his/her first language is noteworthy, especially since more of these students were in LD group ($n = 10$) than in the NLD group ($n = 7$). Research suggests that individuals may be more challenged when taking notes in their second language than in their native language (Dunkel & Davey, 1989; Piolat et al., 2008;). For instance, when Piolat et al. (2008) examined the note-taking skills of undergraduates who were non-native (yet proficient) English speakers, results indicated that participants exerted more cognitive effort and wrote slower when taking notes in English than in their native language. Similarly, when surveying international ($n = 110$) and American ($n = 54$) postsecondary-education students about their perspectives on note-taking, Dunkel and Davey (1989) found that a larger percentage of the international group expressed a desire for better note-taking skills and described feeling pressured by the time constraints of lecture note-taking in English.

Considering this literature, post hoc one-way MANOVA was conducted to simultaneously compare the means of the native English speakers ($n = 53$) and the non-native English speakers ($n = 17$) on the variables of handwriting speed, listening comprehension, background knowledge, sustained attention, notes total, multiple-choice total, and reading comprehension. Table 21 contains the means and standard deviations of these variables separated by native English speakers and non-native English speakers. The multivariate test was not significant (Wilks' $\lambda = 0.40$, $F(7, 62) = 1.06$), indicating that the sample was homogeneous.

As such, learning English as a second language did not appear to impact the results of the current study, however, research including a larger sample size of non-native English speakers may yield different results.

Table 21
Means and Standard Deviations of Native and Non-Native English Speakers

<i>Source</i>	<i>Native English Speakers (n= 53)</i>		<i>Non-Native English Speakers (n= 17)</i>		<i>Significance</i>
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	
Handwriting Speed	67.7	28.5	69.8	31.8	0.797
Listening Comprehension	7.25	4.7	5.5	3.3	0.169
Background Knowledge	10.9	4.2	10.7	2.8	0.855
Sustained Attention	11.8	4.7	12.2	4.5	0.798
Notes Total	38.9	27.3	39.4	24.3	0.956
Multiple-Choice Test	11.2	4.3	9.4	3.8	0.130
NDRT	29.8	7.3	21.0	24.2	0.306

Limitations.

Research with disordered populations has many inherent limitations, and this study is no exception. First, since the field of learning disabilities was established, theorists, legislators, and researchers have struggled to reliably identify individuals who suffer from LDs (Fletcher et al., 2007, Graham & Bellert, 2004; Hammill, 1990, Lyon, 2003). This study was presented with the same challenge. The researcher attempted to refine the groups beyond the IDEA identification criteria by including performance on the Nelson Denny Reading Test (NDRT) as a selection criterion in addition to one's LD status as defined by the school district. However, in essence, the reading comprehension criterion captures the criticisms of the special education identification process, highlighting the major limitation of this type of research.

Specifically, of the 102 adolescents who were initially recruited for the study, 10 of the 49 LD students were omitted for scoring too high on NDRT, and 11 of the 53 NLD students

were omitted for scoring too low on the NDRT. While it should be noted that the NDRT has been criticized for reliability and item difficulty (van Meter & Herrmann, 1986), the finding suggests that approximately 20% of the students recruited for this study are labeled (LD vs. NLD) in a way that is inconsistent with their reading comprehension skills. Further, as the 16th percentile was used as the cutoff point, with no gap between the LD and the NLD groups, it is possible some overlap in reading skills was evident between the two groups occurred. As such, conclusions drawn from research with LD populations in general must be cautiously interpreted, as significant variability is evident within the identification systems, and this study is no exception.

Other researchers have encountered similar inclusionary challenges when investigating LD students. Boyle (2010) and Hughes and Suritisky (1994) both reported that the mean scores on standardized reading assessments for LD groups in their studies were in the average range, which is significantly higher than predicted based on definitions of LDs. As such, while including the NDRT measure does not rectify the pervasive problems with LD classification, this study attempted to further standardize the LD/NLD selection criteria.

The size of the sample is another limitation of the study. Once the 21 students were omitted and six others dropped out, the final sample became drastically smaller, including only 35 students in each group. While there were sufficient participants to test overall group effects, differences among subgroups, e.g., gender, language, race/ethnicity, socio-economic status, could not be sufficiently analyzed. Additionally, all of the data were gathered from one relatively large, urban school district, potentially calling into question whether the results can be generalized to other adolescent groups. Finally, as mentioned in the previous section, the impact

of IQ and motivation was beyond the scope of this current study, yet it is possible that these variables impacted outcomes.

Conclusions.

In summary, lecture note-taking is an imperative academic skill in secondary education settings, as lectures are the prominent instructional approach utilized by high school teachers. The current study is the first to investigate the lecture note-taking skills of adolescents with and without LDs, and results indicated that LD status was the only predictor of notes' completeness, while LD status, handwriting speed, listening comprehension, and background knowledge predicted test performance. Additionally, LD students demonstrated significant deficits in cognitive variables found to contribute to note-taking and learning, including handwriting speed, accessing background knowledge, listening comprehension, and sustained attention. These findings suggest that LD students are significantly struggling in high school settings and require comprehensive interventions in order to access the curriculum. When considering the limitations of working memory, interventions targeting both basic and higher level skills would likely be most effective, but more research is needed to investigate if this assertion is accurate. Future research should also examine the impact of cognitive functioning and motivation on the note-taking skills and test performance of adolescents with and without LDs.

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Appendix A Supplementary Figures

Figure 1
*Histogram of Nelson Denny Reading Test
Percentile ranks of final sample (N= 70)*

Figure 2

Histogram of Full Scale IQ Scores for the LD Group (n= 35)

Appendix B Letter Presented to Potential Participants

THANK YOU FOR YOUR INTEREST IN THIS RESEARCH STUDY!

Please read the following while I read it aloud:

I am a graduate student at Teachers College, Columbia University, and I am conducting a research study here at your school. For this study, I am interested in investigating the note-taking skills of adolescents with and without learning difficulties. The purpose of this short meeting is to tell you about the study and to find out if you are interested in participating.

Study Procedure: The study includes two sessions that will each last about 45 minutes. *During the first session*, you will be asked to (a) watch a video-recorded lecture while simultaneously taking notes on the lecture, (b) fill out a demographics questionnaire, (c) review your notes, (d) complete a measure of handwriting speed, and (e) complete a multiple-choice test based on the lecture. *During the second session*, you will be asked to (a) complete a measure of listening comprehension, (b) complete an American history quiz, and (c) complete a measure of attention.

***Since the experiment will take up to 90 minutes, you will miss two class periods in order to take part in the study.

Additionally, some of your standardized assessment scores will be reviewed, including your CAPT or CMT scores and, if psycho-educational data are available, standardized scores on reading assessments will be reviewed.

Risk and Benefits: Your participation in this study is expected to pose the same amount of risk that students encounter during usual classroom activities. This study represents common learning situations using classroom type materials and measures that are identical to what other researchers have used in their studies. There are no direct benefits in participating; however, the data gathered in this study may help researchers better understand students' note-taking skills and provide useful recommendations for future instruction.

Voluntary Participation: Participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time with no negative or positive consequences in terms of grades, class standing, or other entitlement. If you choose not to participate in the study, you will take part in your regular school schedule instead of the research session.

Statement of Confidentiality: Your participation in this research is confidential. Only the persons listed above will have access to the data. All forms used to collect data will use ID numbers so that your data cannot be linked to your name. All forms will be stored in a locked cabinet at Teachers College, Columbia University to ensure confidentiality.

Right to Ask Questions: You have the right to ask questions about this research. Contact Lisa Marie Oefinger or Dr. Stephen Peverly if you have complaints, concerns, or questions about this research or your rights as a research participant.

Payment for Participation: All participants will a \$10.00 gift card to *Rave Cinemas* at the end of Session 2.

**Do you have any questions about the study or what would be expected of you??

If you are interested in participating in this study, please take home the **Informed Parental Consent** and **Participant's Rights** forms. Have your parent fill out forms and then return them to _____.

Thank you for your time and interest in this important study!

Sincerely,

Lisa Marie Oefinger, Ed.M.
Ph.D. Candidate, School Psychology
Teachers College, Columbia University

APPENDIX C
Materials Sent Home to Parents

Teachers College, Columbia University
525 West 120th Street
New York NY 10027
212 678 3000
www.tc.edu

March 28, 2013

Dear Parent,

My name is Lisa Marie Oefinger, and I am currently a School Psychology Doctoral student at Teachers College, Columbia University. I am interested in investigating ways to improve the academic performance of students with learning difficulties. The quality of students' notes is an excellent predictor of test performance. For my dissertation research, I am examining note-taking skills of adolescents with and without learning disabilities. I hope that data gathered through my research can be used to design academic interventions to help students with learning difficulties in the future.

[School] and [School] have graciously allowed me to conduct a pilot study at their school. Attached, please find the **Informed Parental Consent** and the **Participant's Rights** forms, which provide more information about the details of the study and provide you with the opportunity to grant permission for your child to participate. The research session will take place your son/daughter's school, and if you allow your child to participate, your child will miss two class periods. Student participants will be thanked for their time and participation with a \$10.00 gift card to *Rave Cinemas*.

I hope you will consider allowing your child to take part in this important and informative study, and I thank you very much for your and your child's time. Please contact me with any questions or concerns regarding this study.

Sincerely,

Lisa Marie Oefinger, Ed.M.
Ph.D. Candidate – School Psychology
Teachers College, Columbia University
Lmo2108@columbia.edu; (203) 376-0641

Teachers College, Columbia University
 525 West 120th Street
 New York NY 10027
 212 678 3000
www.tc.edu

INFORMED PARENTAL CONSENT

TITLE OF PROJECT: The Lecture Note-Taking Skills of Adolescents with and without Learning Disabilities

PRINCIPAL INVESTIGATOR: Lisa Marie Oefinger, Ed.M
Lmo2108@columbia.edu

FACULTY SPONSOR: Stephen Peverly, Ph.D.
 Box 120 – Teachers College
 Columbia University
 525 West 120th Street
 New York, NY 10027
 (212) 678 – 3084, stp4@tc.columbia.edu

DESCRIPTION OF THE RESEARCH: Your child is invited to participate in a study of lecture note-taking skills. The quality of notes is an excellent predictor of test performance, and the purpose of this study is to explore the note-taking skills of adolescents with and without learning disabilities. Information gathered through this investigation will be used for my doctoral dissertation and results will be shared with [District]. This study consists of two sessions, each lasting about 45 minutes in length. Both of these sessions will take place at your son or daughter's school, during school hours. *During the first session*, your child will be asked to (a) watch a video-recorded lecture while simultaneously taking notes on the lecture, (b) fill out a demographics questionnaire, (c) review his/her notes, (d) complete a measure of handwriting speed, and (e) complete a multiple-choice test based on the lecture. *During the second session*, your child will be asked to (a) complete a measure of listening comprehension, (b) complete an American history quiz, and (c) complete a measure of attention. All of the activities/measures for the session will be administered in a small group, and each of the two sessions will last for one class period. Additionally, your child's most recent standardized assessment scores will be reviewed, including his/her performance on the CAPT or CMT, and if psycho-educational data are available, his/her most recent achievement scores in the area of reading will be reviewed.

TIME INVOLVEMENT: Participation in this study consists of two sessions, each lasting approximately 45 minutes. Students will miss two class periods for participation in this study.

RISKS AND BENEFITS: Student participation in this study is expected to pose the same amount of risks that students encounter during usual classroom activities. The study represents common learning situations using classroom type materials and measures of cognitive functions that are identical to what other researchers have used in their studies. There are no direct benefits to participation; however, the data gathered may help researchers better understand students' note-taking skills and thereby provide useful recommendations for future instruction. Participation is voluntary and individuals may refuse to participate or withdraw from the study at any time with no negative or positive consequences in terms of student grades, class standing, or other entitlement. Students who choose not to participate in the study will take part in their regular school schedule.

PAYMENTS: Students will receive a gift card to *Rave Cinemas* (\$10.00) at the end of Session 2.

STATEMENT CONFIDENTIALITY: Participation in this research is confidential. Only the persons listed above will have access to the data. Session data and previous assessment data (CAPT scores, CMT scores, and if applicable, standardized reading scores from the most recent psycho-educational assessment) will utilize ID numbers so that your and your child's data cannot be linked to names. All forms will be stored in a locked cabinet at Teachers College, Columbia University to ensure confidentiality.

RIGHT TO ASK QUESTIONS: You and/or your child have the right to ask questions about this research. Contact Lisa Marie Oefinger or Dr. Stephen Peverly if you have complaints, concerns, or questions about this research or your child's rights as a research participant.

HOW WILL RESULTS BE USED: The results of this study will be used for my doctoral dissertation and results of the study will be shared with [District].

If you agree to allow your child to take part in this study, please fill out the following:

I, _____ (your name), give my child, _____ (child's name), permission to participate in the research study outlined above.

Parent's Signature

Date

Please sign this copy and have your child return it to _____.

****Thank you for your participation in this study!!!****

Lisa Marie Oefinger, Ed.M.
Ph.D. Candidate – School Psychology
Teachers College, Columbia University

Stephen Peverly, Ph.D.
Faculty Sponsor
Professor of Psychology & Education
Teachers College, Columbia University

Teachers College, Columbia University
 525 West 120th Street
 New York NY 10027
 212 678 3000
www.tc.edu

INFORMED PARENTAL CONSENT

TITLE OF PROJECT: The Lecture Note-Taking Skills of Adolescents with and without Learning Disabilities

PRINCIPAL INVESTIGATOR: Lisa Marie Oefinger, Ed.M
Lmo2108@columbia.edu

FACULTY SPONSOR: Stephen Peverly, Ph.D.
 Box 120 – Teachers College
 Columbia University
 525 West 120th Street
 New York, NY 10027
 (212) 678 – 3084, stp4@tc.columbia.edu

DESCRIPTION OF THE RESEARCH: Your child is invited to participate in a study of lecture note-taking skills. The quality of notes is an excellent predictor of test performance, and the purpose of this study is to explore the note-taking skills of adolescents with and without learning disabilities. Information gathered through this investigation will be used for my doctoral dissertation and results will be shared with [District]. This study consists of two sessions, each lasting about 45 minutes in length. Both of these sessions will take place at your son or daughter's school, during school hours. *During the first session*, your child will be asked to (a) watch a video-recorded lecture while simultaneously taking notes on the lecture, (b) fill out a demographics questionnaire, (c) review his/her notes, (d) complete a measure of handwriting speed, and (e) complete a multiple-choice test based on the lecture. *During the second session*, your child will be asked to (a) complete a measure of listening comprehension, (b) complete an American history quiz, and (c) complete a measure of attention. All of the activities/measures for the session will be administered in a small group, and each of the two sessions will last for one class period. Additionally, your child's most recent standardized assessment scores will be reviewed, including his/her performance on the CAPT or CMT, and if psycho-educational data are available, his/her most recent achievement scores in the area of reading will be reviewed.

TIME INVOLVEMENT: Participation in this study consists of two sessions, each lasting approximately 45 minutes. Students will miss two class periods for participation in this study.

RISKS AND BENEFITS: Student participation in this study is expected to pose the same amount of risks that students encounter during usual classroom activities. The study represents common learning situations using classroom type materials and measures of cognitive functions that are identical to what other researchers have used in their studies. There are no direct benefits to participation; however, the data gathered may help researchers better understand students' note-taking skills and thereby provide useful recommendations for future instruction. Participation is voluntary and individuals may refuse to participate or withdraw from the study at any time with no

negative or positive consequences in terms of student grades, class standing, or other entitlement. Students who choose not to participate in the study will take part in their regular school schedule.

PAYMENTS: Students will receive a gift card to *Rave Cinemas* (\$10.00) at the end of Session 2.

STATEMENT CONFIDENTIALITY: Participation in this research is confidential. Only the persons listed above will have access to the data. Session data and previous assessment data (CAPT scores, CMT scores, and if applicable, standardized reading scores from the most recent psycho-educational assessment) will utilize ID numbers so that your and your child's data cannot be linked to names. All forms will be stored in a locked cabinet at Teachers College, Columbia University to ensure confidentiality.

RIGHT TO ASK QUESTIONS: You and/or your child have the right to ask questions about this research. Contact Lisa Marie Oefinger or Dr. Stephen Peverly if you have complaints, concerns, or questions about this research or your child's rights as a research participant.

HOW WILL RESULTS BE USED: The results of this study will be used for my doctoral dissertation and results of the study will be shared with [District].

If you agree to allow your child to take part in this study, please fill out the following:

I, _____ (your name), give my child, _____ (child's name), permission to participate in the research study outlined above.

Parent's Signature

Date

Please retain this copy for your records. Please sign the other copy and have your child return it to _____ so that we can retain a copy for our records.

****Thank you for your participation in this study!!!****

Lisa Marie Oefinger, Ed.M.
Ph.D. Candidate – School Psychology
Teachers College, Columbia University

Stephen Peverly, Ph.D.
Faculty Sponsor
Professor of Psychology & Education
Teachers College, Columbia University

APPENDIX D
Screening Session Materials

SCREENING SESSION: Participant Booklet

Thank you for your interest and participation in this study! Please read the following silently as I read it aloud:

First, I'd like to remind you about the purpose and procedures of this study. I am interested in investigating note-taking skills of adolescents with and without learning difficulties.

Study Procedure: This study includes **up to three** sessions. Session 1 will last about 25 minutes in length, and depending on your reading skills, you may be asked to participate in two additional sessions, which will each last about 45 minutes.

During today's session, you will be asked complete a measure of reading comprehension. If you are invited to participate in *Session 2*, you will be asked to (a) watch a video-recorded lecture on a computer screen while simultaneously taking handwritten notes on the lecture, (b) fill out a demographics questionnaire, (c) review your notes, (d) complete a measure of handwriting speed, and (e) complete a multiple-choice test based on the lecture. *During Session 3*, you will be asked to (a) complete a measure of listening comprehension, (b) complete an American history quiz, and (c) complete a measure of attention. Since the experiment will take up to 90 minutes, you will miss two class periods in order to take part in the study.

Risk and Benefits: Your participation in this study is expected to pose the same amount of risk that students encounter during usual classroom activities. This study represents common learning situations using classroom type materials and measures that are identical to what other researchers have used in their studies. There are no direct benefits in participating; however, the data gathered in this study may help researchers better understand students' note-taking skills and provide useful recommendations for future instruction.

Voluntary Participation: Participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time with no negative or positive consequences in terms of grades, class standing, or other entitlement. If you choose not to participate in the study, you will take part in your regular class schedule instead of the research session.

Payment for Participation: All participants will a \$10.00 gift card to *Rave Cinemas* within one week of completing their final session. Additionally, once after you complete all of the expected sessions (from one to three), you will be entered to win one of two **iPad Minis**. The odds of winning this prize are about 1 in 35, or 2.9%.

****Do you have any questions??**

Please turn to the next page, where you will find a statement of your rights as a participant in this research. Please read through these rights. Below these rights, please sign your name to indicate that you agree to participate in the study.

Teachers College, Columbia University
 525 West 120th Street
 New York NY 10027
 212 678 3000
www.tc.edu

PARTICIPANT'S RIGHTS

Principal Investigator: Lisa Marie Oefinger, Ed.M.
 School Psychology Doctoral Student

Research Title: The Lecture Note-Taking Skills of Adolescents with and without Learning Disabilities

- I have read and discussed the Research Description with the researcher. I have had the opportunity to ask questions about the purposes and procedures regarding this study.
- My participation in research is voluntary. I may refuse to participate or withdraw from participation at any time without jeopardy to future medical care, employment, student status or other entitlements.
- The researcher may withdraw me from the research at his/her professional discretion.
- If, during the course of the study, significant new information that has been developed becomes available which may relate to my willingness to continue to participate, the investigator will provide this information to me.
- Any information derived from the research project that personally identifies me will not be voluntarily released or disclosed without my separate consent, except as specifically required by law.
- If at any time I have any questions regarding the research or my participation, I can contact the investigator, who will answer my questions.
- If at any time I have comments, or concerns regarding the conduct of the research or questions about my rights as a research subject, I should contact the Teachers College, Columbia University Institutional Review Board /IRB. The phone number for the IRB is (212) 678-4105. Or, I can write to the IRB at Teachers College, Columbia University, 525 W. 120th Street, New York, NY, 10027, Box 151.
- I should receive a copy of the Research Description and this Participant's Rights document.

Assent to Participate:

I _____ (name) agree to participate in the study entitled: The Lecture Note-Taking Skills of Adolescents with and without Learning Disabilities. The purpose and nature of the study has been fully explained to me by Lisa Marie Oefinger. I understand what is being asked of me, and should I have any questions, I know that I can contact Lisa Marie Oefinger at any time. I also understand that I can quit the study any time I want to.

Name of Participant: _____

Signature of Participant: _____ Date: _____

*****When you complete this form, please tear off the first 2 pages of this booklet and return them to the researcher**

 --

Investigator's Verification of Explanation:

I certify that I have carefully explained the purpose and nature of this research to _____ (participant's name) in age-appropriate language. He/She has had the opportunity to discuss it with me in detail. I have answered all his/her questions and he/she provided the affirmative agreement (i.e. assent) to participate in this research.

Investigator's Signature: _____ Date: _____

Teachers College, Columbia University
 525 West 120th Street
 New York NY 10027
 212 678 3000
www.tc.edu

PARTICIPANT'S RIGHTS

Principal Investigator: Lisa Marie Oefinger, Ed.M.
 School Psychology Doctoral Student

Research Title: The Lecture Note-Taking Skills of Adolescents with and without Learning Disabilities

- I have read and discussed the Research Description with the researcher. I have had the opportunity to ask questions about the purposes and procedures regarding this study.
- My participation in research is voluntary. I may refuse to participate or withdraw from participation at any time without jeopardy to future medical care, employment, student status or other entitlements.
- The researcher may withdraw me from the research at his/her professional discretion.
- If, during the course of the study, significant new information that has been developed becomes available which may relate to my willingness to continue to participate, the investigator will provide this information to me.
- Any information derived from the research project that personally identifies me will not be voluntarily released or disclosed without my separate consent, except as specifically required by law.
- If at any time I have any questions regarding the research or my participation, I can contact the investigator, who will answer my questions.
- If at any time I have comments, or concerns regarding the conduct of the research or questions about my rights as a research subject, I should contact the Teachers College, Columbia University Institutional Review Board /IRB. The phone number for the IRB is (212) 678-4105. Or, I can write to the IRB at Teachers College, Columbia University, 525 W. 120th Street, New York, NY, 10027, Box 151.
- I should receive a copy of the Research Description and this Participant's Rights document.

Assent to Participate:

I _____ (name) agree to participate in the study entitled: The Lecture Note-Taking Skills of Adolescents with and without Learning Disabilities. The purpose and nature of the study has been fully explained to me by Lisa Marie Oefinger. I understand what is being asked of me, and should I have any questions, I know that I can contact Lisa Marie Oefinger at any time. I also understand that I can quit the study any time I want to.

Name of Participant: _____

Signature of Participant: _____

Date: _____

****Please retain this copy for your records.*

Student ID Number: _____

Experimental Session 1

Thank you for your participation in this study! Please read the following silently as I read it aloud:

During today's session, you will be asked to:

1. Complete a test of reading comprehension.

Do you have any questions?

Please turn to the next page and wait for further instructions.

Please read the following silently as I read it aloud. This is a reading comprehension test, which is in this packet following these instructions. After carefully listening to the directions, you will have TWENTY MINUTES to complete the test. Please note that the booklet has two parts: Part I Vocabulary and Part II Comprehension. You are only going to complete **Part II**. Please mark your answers by circling the letter of your response on the answer form below. Also, if you change an answer, please be sure to clearly indicate your change of answer by crossing out the unintended response. Please do not make any marks on the passages themselves. The experimenter will tell you when you have 10 minutes, 5 minutes and 1 minute remaining. Please complete as many of the items as you can within the time limit.

Are there any questions? Please remove the booklet from your packet and read along silently as I read parts A, B, and D of the directions.

ANSWER FORM

Passage One

1.	A	B	C	D	E
2.	F	G	H	I	J
3.	A	B	C	D	E
4.	F	G	H	I	J
5.	A	B	C	D	E
6.	F	G	H	I	J
7.	A	B	C	D	E
8.	F	G	H	I	J

Passage Two

9.	A	B	C	D	E
10.	F	G	H	I	J
11.	A	B	C	D	E
12.	F	G	H	I	J
13.	A	B	C	D	E

Passage Three

14.	F	G	H	I	J
15.	A	B	C	D	E
16.	F	G	H	I	J
17.	A	B	C	D	E
18.	F	G	H	I	J

Passage Four

19.	A	B	C	D	E
20.	F	G	H	I	J
21.	A	B	C	D	E
22.	F	G	H	I	J
23.	A	B	C	D	E

GO ON TO THE NEXT PAGE

Passage Five

24.	F	G	H	I	J
25.	A	B	C	D	E
26.	F	G	H	I	J
27.	A	B	C	D	E
28.	F	G	H	I	J

Passage Six

29.	A	B	C	D	E
30.	F	G	H	I	J
31.	A	B	C	D	E
32.	F	G	H	I	J
33.	A	B	C	D	E

Passage Seven

34.	F	G	H	I	J
35.	A	B	C	D	E
36.	F	G	H	I	J
37.	A	B	C	D	E
38.	F	G	H	I	J

STOP**Please wait before turning to the next page.**

THANK YOU AGAIN FOR YOUR PARTICIPATION IN THIS STUDY!! As you are aware, you may be asked to participate in two additional research sessions. If so, the experimenter will work with you to schedule the next appointments, and you will receive your \$10.00 gift card to *Rave Cinemas* and a raffle ticket at the end of Session 3.

If you are not required to participate in the next sessions, you will be provided with your gift card and raffle ticket within one week of completing this session.

Thank you again! 😊

APPENDIX E

Lecture Materials

Lecture Transcript: LECTURE TRANSCRIPT

During today's lecture we'll be talking about an old ship called the General Harrison. We will discuss its early history, its connection to the California Gold Rush, and its rediscovery almost 150 years later.

The General Harrison has an early history that is like many other mercantile ships of its time. It was built in 1840 in Newburyport Massachusetts for a group of local merchants. It measured 126 feet in length and had a mass of 409 tons. They used her to transport passengers and cargo between Boston, New York, and New Orleans. After six years, the ship's owners sold her to a group of residents from Charlestown MA who had connections with shipping ports all over the Pacific Ocean. The new owners sent the General Harrison on a trip around the world for trade. When it returned to America, the General Harrison was sold to a new owner, his name was Thomas H. Perkins, Jr, and he was the eldest son of the wealthiest man in America at the time. Thomas Perkins Jr. was in possession of the General Harrison in 1849, this was the year when gold was discovered in California.

The General Harrison has close historical ties to the Gold Rush of 1849. The news of gold sparked the interest of thousands of Americans, and people from all walks of life were drawn to California. Many gold seekers chose to rush there by ship, the fastest mode of transportation at that time. In fact, between 1848 and 1849 over 750 ships set sail for California from various American ports. The General Harrison's current owner, Thomas Perkins Jr., hoped to take advantage of the opportunity so he made plans to transport passengers and cargo to San Francisco on the General Harrison

The General Harrison set sail on its journey from Boston to California on August 3, 1849. It rounded the tip of South America, and made a stop at the Chilean port of Valparaiso. While in Chile, the General Harrison's local agents E. Mickle and Company, loaded her up with all sorts of merchandise to sell once they arrived in California. The ship's agents, E. Mickle and Company, were an important part of her shipping industry. They are hired to provide onsite

knowledge of the local port procedures and vendors. They coordinate all of the ships needs while in port. E. Mickle and Company had established a brand new office in San Francisco in 1849, and they were ready to take care of the ship and her cargo once she landed in California in 1849.

The General Harrison arrived in San Francisco a bit late in early 1850, on February 3rd. The passengers rushed off to the gold mines and all of the cargo was immediately sold. It would have been ready for another voyage. However, the promise of gold overpowered the wills of General Harrison's crew and they deserted the ship, along with hundreds of other ships on the docks of San Francisco. Just 20 days later, E. Mickle and Company was instructed to post the General Harrison for sale and E. Mickle and Co purchased the ship for themselves on March 7, 1850.

Why did E Mickle and Company want the ship for themselves? Well due to the number of ships arriving on the docks of San Francisco, the traffic of ships was constantly growing. The city was crowded beyond its capacity, and its entrepreneurs began to build up the shallow cove to gain more space. They pounded thousands of pilings into the ships and built long wharves. Buildings were built on top of the pilings and many ships were hauled up onto the mud. There, they were converted to residences, stores, and even restaurants. Mr. Mickle had his workers remove the General Harrison's masts and hauled her up onto the mud for just such a conversion. They housed in her over the ship's hull, built a structure on the deck and cut doors into the lower deck. On the inside of the ship, the holds were cleaned out and made ready to store cargo. In short, they had converted the General Harrison into a warehouse that now permanently sat at the corner of Clay and Battery Streets in San Francisco. They advertised the ship's new purpose in a San Francisco daily newspaper at the end of May, saying that it was ready to receive merchandise of any kind.

The General Harrison had many business uses as a warehouse. E Mickle and Co. handled cargo that arrived from around the world, stored them in the holds of the ship, and arranged for their sale at auction. They also collected rent for storing the merchandise and earned a 10 percent commission on the sale of merchandise that they stored. They also rented the converted basement of the General Harrison to leasers looking for office space or a place to start a store.

Based on figures reported about a similar ship of the time, the General Harrison was probably earning E. Mickle and Company about \$80,000 dollars per month in today's economy.

The General Harrison kept up a thriving business for about a year, while the city continued to expand. New construction had pushed well past the General Harrison and she was completely surrounded and closed in. Along with other converted ships, she was perched next to two and three story buildings, completely out of her intended element – the ocean.

The General Harrison was destroyed by a devastating fire on May 4, 1851. During the gold rush, San Francisco had many fires, probably due to its cramped conditions. This fire was the worst yet, and it began just after 11 pm on May 3rd. It quickly spread throughout the city. The fire continued through the night and into the morning. It was impossible to see the damage until the thick smoke cleared. When it finally died, the fire had claimed several lives, nearly two thousand buildings, and millions of dollars in destroyed property and merchandise including the ship, the General Harrison.

After the fire, it was clear that the area would need to be rebuilt in a different manner. The newspaper reported that the piles that provided the foundations for the whole area had been so badly damaged in the fire that they would no longer be able to provide stable foundations for the district. Therefore, it was necessary to fill the whole area with new earth so that future foundations could be supported. Over the coming years, sand from the surrounding dunes was used to fill in and bury the old waterfront beneath 16 feet of new ground and people slowly forgot about the great ship, the General Harrison.

The first time the General Harrison was seen again was in the years following a huge earthquake that occurred in 1906. The workers cleared the ruins and dug deep into the sand in order to pour new foundations for new buildings. During this process they hit the buried ship, the General Harrison, but no one remembered the ship's name and it was mistaken for another ship from Spain. The workers actually tried to clear away the remains of the ship by chopping it up, but the old hull was too strong to break that easily. Therefore, the workers gave up and decided to

simply hammer a few pilings through the ship to support the new building's foundation. Then the General Harrison was reburied and forgotten about once again.

The General Harrison was not thought about again until the late 1990s, when an archeologist discovered the remains, excavated a portion of the ship's wreckage, but ultimately decided to allow the General Harrison to remain buried in San Francisco.

Word Count: 1278

Lecture Time: 12 minutes, 16 seconds

Lecture Pace: 104.3 words per minute

Flesch Reading Ease: 55.1

Flesch-Kincaid Grade Level: 10.4

Lecture Scoring Template

		Main Ideas	Details
1	During today's lecture we'll be talking about an old ship □	✓	
2	called the General Harrison □	✓	
3	We will discuss its early history □	✓	
4	its connection to the California Gold Rush □	✓	
5	and its rediscovery almost 150 years later. □	✓	
6	The General Harrison has an early history □	✓	
7	that is like many other mercantile ships of its time. □	✓	
8	It was built in 1840 □		✓
9	in Newburyport, Massachusetts □		✓
10	for a group of local merchants. □		✓
11	It measured 126 feet in length □		✓
12	and had a mass of 409 tons. □		✓
13	They used her to transport passengers □	✓	
14	and cargo □	✓	
15	between Boston, □		✓
16	New York, and □		✓
17	New Orleans. □		✓
18	After six years, □		✓
19	the ship's owners sold her □	✓	
20	to a group of residents □	✓	
21	from Charlestown, Massachusetts □		✓
22	who had connections with shipping ports □		✓
23	all over the Pacific Ocean. □		✓
24	The new owners sent the General Harrison on a trip □	✓	
25	around the world □	✓	
26	for trade. □		✓
27	When it returned to America, □		✓
28	the General Harrison was sold to a new owner, □	✓	
29	his name was Thomas H. Perkins, Jr, □	✓	
30	and he was the eldest son □		✓
31	of the wealthiest man □		✓
32	in America at the time. □		✓
33	Thomas Perkins Jr. was in possession of the General Harrison □	✓	
34	in 1849, □	✓	
35	this was the year when gold was discovered □	✓	
36	in California. □	✓	
37	The General Harrison has close historical ties □	✓	
38	to the Gold Rush □	✓	
39	of 1849. □		✓
40	The news of gold sparked the interest □		✓
41	of thousands of Americans, □		✓
42	and people from all walks of life □		✓
43	were drawn to California. □		✓
44	Many gold seekers chose to rush there by ship, □	✓	
45	the fastest mode of transportation at that time. □		✓
46	In fact, between 1848 and 1849 □		✓
47	over 750 ships □		✓
48	set sail for California □		✓
49	from various American ports. □		✓

50	The General Harrison's current owner, Thomas Perkins, Jr. ☐	✓	
51	hoped to take advantage of the opportunity ☐	✓	
52	so he made plans to transport passengers ☐		✓
53	and cargo ☐		✓
54	to San Francisco ☐		✓
55	on the General Harrison. ☐		✓
56	The General Harrison set sail on its journey ☐	✓	
57	from Boston to ☐		✓
58	California on ☐		✓
59	August 3, 1849. ☐		✓
60	It rounded the tip of South America, ☐	✓	
61	and made a stop at the Chilean port ☐	✓	
62	of Valparaiso. ☐		✓
63	While in Chile, ☐		✓
64	the General Harrison's local agents ☐	✓	
65	E. Mickle and Company, ☐		✓
66	loaded her up with all sorts of merchandise ☐	✓	
67	to sell ☐	✓	
68	once they arrived in California. ☐		✓
69	The ship's agents, E. Mickle and Company, ☐	✓	
70	were an important part of her shipping industry. ☐	✓	
71	They are hired to provide onsite knowledge ☐	✓	
72	of the local port procedures ☐		✓
73	and vendors. ☐		✓
74	They coordinate all of the ships needs ☐	✓	
75	while in port. ☐		✓
76	E. Mickle and Company had established a brand new office ☐	✓	
77	in San Francisco in 1849, ☐	✓	
78	and they were ready to take care of the ship ☐	✓	
79	and her cargo ☐		✓
80	once she landed in California ☐		✓
81	in 1849. ☐		✓
82	The General Harrison arrived in San Francisco ☐	✓	
83	a bit late ☐	✓	
84	in early 1850, ☐		✓
85	on February 3rd. ☐		✓
86	The passengers rushed off ☐	✓	
87	to the gold mines ☐	✓	
88	and all of the cargo was immediately sold. ☐	✓	
89	It would have been ready for another voyage. ☐		✓
90	However, the promise of gold ☐	✓	
91	overpowered the wills of General Harrison's crew ☐	✓	
92	and they deserted the ship, ☐	✓	
93	along with hundreds of other ships ☐		✓
94	on the docks of San Francisco. ☐		✓
95	Just 20 days later, ☐		✓
96	E. Mickle and Company was instructed ☐		✓
97	to post the General Harrison for sale ☐		✓
98	and E. Mickle and Co purchased the ship for themselves ☐	✓	

100	Why did E Mickle and Company want the ship for themselves? ☐		✓
101	Well due to the number of ships ☐		✓
102	arriving on the docks of San Francisco, ☐	✓	
103	the traffic of ships was constantly growing. ☐		✓
104	The city was crowded beyond its capacity, ☐	✓	
105	and its entrepreneurs began to build up the shallow cove ☐	✓	
106	to gain more space. ☐		✓
107	They pounded thousands of pilings ☐		✓
108	into the ships ☐		✓
109	and built long wharves. ☐	✓	
110	Buildings were built on top of the pilings ☐	✓	
111	and many ships were hauled up onto the mud. ☐		✓
112	There, they were converted to residences, ☐		✓
113	stores, ☐		✓
114	and even restaurants. ☐		✓
115	Mr. Mickle had his workers ☐		✓
116	remove the General Harrison's masts ☐		✓
117	and hauled her up onto the mud ☐		✓
118	for just such a conversion. ☐		✓
119	They housed in her over the ship's hull, ☐		✓
120	built a structure on the deck ☐		✓
121	and cut doors into the lower deck. ☐		✓
122	On the inside of the ship, ☐		✓
123	the holds were cleaned out ☐		✓
124	and made ready to store cargo. ☐		✓
125	In short, they had converted the General Harrison ☐	✓	
126	into a warehouse ☐	✓	
127	that now permanently sat ☐		✓
128	at the corner of Clay and Battery Streets ☐		✓
129	in San Francisco. ☐		✓
130	They advertised the ship's new purpose ☐	✓	
131	in a San Francisco daily newspaper ☐		✓
132	at the end of May, ☐		✓
133	saying that it was ready to receive merchandise of any kind. ☐		✓
134	The General Harrison had many business uses as a warehouse. ☐	✓	
135	E Mickle and Co. handled cargo ☐	✓	
136	that arrived from around the world, ☐		✓
137	stored them in the holds of the ship, ☐	✓	
138	and arranged for their sale ☐	✓	
139	at auction. ☐		✓
140	They also collected rent ☐	✓	
141	for storing the merchandise ☐		✓
142	and earned a 10 percent commission ☐		✓
143	on the sale of merchandise that they stored. ☐		✓
144	They also rented the converted basement of the General Harrison	✓	
145	to leasers looking for office space ☐		✓
146	or a place to start a store. ☐		✓

147	Based on figures reported about a similar ship of the time, □		✓
148	the General Harrison was probably earning E. Mickle and Company □		✓
149	about \$80,000 dollars per month □		✓
150	in today's economy. □		✓
151	The General Harrison kept up a thriving business □	✓	
152	for about a year, □		✓
153	while the city continued to expand. □		✓
154	New construction had pushed well past the General Harrison □		✓
155	and she was completely surrounded and closed in. □	✓	
156	Along with other converted ships, □		✓
157	she was perched next to two and three story buildings, □		✓
158	completely out of her intended element □	✓	
159	– the ocean. □		✓
160	The General Harrison was destroyed □	✓	
161	by a devastating fire □	✓	
162	on May 4, 1851. □		✓
163	During the gold rush, □	✓	
164	San Francisco had many fires, □	✓	
165	probably due to its cramped conditions. □		✓
166	This fire was the worst yet, □	✓	
167	and it began just after 11 pm □		✓
168	on May 3 rd . □		✓
169	It quickly spread throughout the city. □	✓	
170	The fire continued through the night □		✓
171	and into the morning. □		✓
172	It was impossible to see the damage □		✓
173	until the thick smoke cleared. □		✓
174	When it finally died, □		✓
175	the fire had claimed several lives, □		✓
176	nearly two thousand buildings, □		✓
177	and millions of dollars □		✓
178	in destroyed property □		✓
179	and merchandise □		✓
180	including the ship, the General Harrison. □		✓
181	After the fire, □		✓
182	it was clear that the area would need to be rebuilt □	✓	
183	in a different manner. □		✓
184	The newspaper reported □		✓
185	that the piles that provided the foundations for the whole area □		✓
186	had been so badly damaged □		✓
187	in the fire □		✓
188	that they would no longer be able to provide stable foundations □	✓	
189	for the district. □		✓
190	Therefore, it was necessary to fill the whole area with new earth □	✓	
191	so that future foundations could be supported. □		✓

192	Over the coming years, ☐		✓
193	sand from the surrounding dunes ☐	✓	
194	was used to fill in and bury ☐	✓	
195	the old waterfront ☐	✓	
196	beneath 16 feet of new ground ☐		✓
197	and people slowly forgot about the great ship, the General Harrison. ☐	✓	
198	The first time the General Harrison was seen again ☐	✓	
199	was in the years following a huge earthquake ☐	✓	
200	that occurred in 1906. ☐		✓
201	The workers cleared the ruins ☐	✓	
202	and dug deep into the sand ☐		✓
203	in order to pour new foundations ☐		✓
204	for new buildings. ☐		✓
205	During this process they hit the buried ship, the General Harrison, ☐	✓	
206	but no one remembered the ship's name ☐	✓	
207	and it was mistaken for another ship ☐		✓
208	from Spain. ☐		✓
209	The workers actually tried to clear away the remains of the ship ☐	✓	
210	by chopping it up, ☐		✓
211	but the old hull was too strong to break that easily. ☐	✓	
212	Therefore, the workers gave up ☐	✓	
213	and decided to simply hammer a few pilings ☐		✓
214	through the ship ☐		✓
215	to support the new building's foundation. ☐		✓
216	Then the General Harrison was reburied ☐	✓	
217	and forgotten about once again. ☐	✓	
218	The General Harrison was not thought about again ☐		✓
219	until the late 1990s, ☐		✓
220	when an archeologist ☐	✓	
221	discovered the remains, ☐	✓	
222	excavated a portion of the ship's wreckage, ☐		✓
223	but ultimately decided to allow the General Harrison to remain buried ☐	✓	
224	in San Francisco. ☐		✓
TOTAL PAGE 5			
PAGE 4			
PAGE 3			
PAGE 2			
PAGE 1			
TOTAL			
GRAND TOTAL			

APPENDIX F
Session 1 Materials

Session 1

Thank you for your participation in this study! Please read the following silently as I read it aloud:

During today's session, you will complete several tasks in the following order:

1. Watch a video-recorded lecture while simultaneously taking notes on the lecture.
2. Fill out a short demographics questionnaire.
3. Review your notes.
4. Complete a measure of writing speed.
5. Take a multiple-choice test based on the lecture.

Do you have any questions?

Please turn to the next page and wait for further instructions.

You are now going watch a short history lecture on the American mercantile ship, the General Harrison. Please use this page and the following blank sheets (as needed) to take notes on the lecture. Remember, the notes you take will be your only study guide for the multiple choice test at the end of this session. During the review period, you WILL be able to review your notes, you WILL NOT be able to view any part of the lecture again. ***If you have any questions, please ask them now.***

[illegible]

Student ID Number: _____

Notes...

[illegible]

Student ID Number: _____

Notes...

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Student ID Number: _____

Notes...

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins or other markings on the paper.

Once the lecture is over, take a moment to complete your notes and then turn to the next page to wait for instructions.

Student ID Number: _____

Demographics Questionnaire

Please answer the following questions:

1. Gender: ☐ Female ☐ Male

2. Date of Birth: ☐ Month ☐ Day ☐ Year

3. Grade Level: ☐ 9th ☐ 10th ☐ 11th ☐ 12th

4. Is English your first language? ☐ Yes ☐ No

5. I take notes during class:

☐ Almost Always ☐ Often ☐ Sometimes ☐ Never

6. I take notes when I read for class:

☐ Almost Always ☐ Often ☐ Sometimes ☐ Never

7. My grades in school are typically:

☐ A's ☐ B's ☐ C's ☐ D's ☐ F's ☐ Prefer not to say/Don't know

8. I belong to the following group:

☐ Black/African American	☐ Asian-American/Pacific Islander
☐ Latina/Latino	☐ Native American
☐ White American	☐ Other (specify: _____)

9. Have you ever been identified with a reading disability?

☐ Yes ☐ No ☐ Don't know

10. Have you ever been identified with a writing disability?

☐ Yes ☐ No ☐ Don't know

11. Have you ever been identified with a math disability?

☐ Yes ☐ No ☐ Don't know

12. Have you ever been identified with attention deficit/hyperactive disorder (ADHD)?

☐ Yes ☐ No ☐ Don't know

Thank you. Please turn to the next page only when you are finished.

Student ID Number: _____

Review

Now you will have 10 minutes to study the notes you took. Please refer back to pages 2 – 5 of your packet where you took the lecture notes. Remember, a multiple-choice test will follow at the end of the session.

Student ID Number: _____

Writing Speed

Please read the following instructions to yourself as I read them aloud:

Please use the following lines to write all the letters of the alphabet *as quickly as you can* from A to Z. Once you get to Z, please start again at A. You can write upper or lower case letters. You will have 45 seconds. Please keep writing all the letters as quickly as you can until I tell you to stop. Do you have any questions?

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Please wait as I hand out the multiple-choice test. This test based on the lecture you viewed earlier in the session. You will have 15 minutes to complete this test. Once you have finished, please place this booklet and your test inside the envelope and hand it to the examiner. **Remember, at the end of Session 3, you will be given a \$10.00 gift card to Rave Cinemas and entered to win one of two iPad Minis!!**

Thank you again for your participation!!! ☺

Please read the following instructions to yourself as I read them aloud:

You will have 15 minutes to complete this multiple-choice test based on the lecture. You will be notified when you have 5 minutes and 1 minute left. Once you have finished, please place this test with your packet inside the envelope, and wait for the researcher to collect it. After today, there is one more experimental session, and then you will be eligible to win an iPad Mini and you will be given a \$10 gift card to Rave Cinemas. The researcher will contact you to arrange this final meeting. Do you have any questions?

Turn the page and begin.

MULTIPLE-CHOICE TEST**1. Where was the General Harrison built?**

- a. Charlestown, Massachusetts
- b. Newburyport, Massachusetts
- c. San Francisco, California
- d. New York, New York

2. Before the General Harrison set sail for California, the ship was used to ____.

- a. transport passengers and cargo between Boston, New York, and New Orleans.
- b. transport slaves from Africa to the South.
- c. transport wealthy passengers from Southampton, United Kingdom to New York City, United States.
- d. transport gold from Valparaiso, Chile to Newburyport Massachusetts.

3. How many times was the General Harrison forgotten?

- a. once
- b. twice
- c. three times
- d. four times

4. Once in San Francisco, why did E. Mickle and Company put an advertisement into the newspaper?

- a. to hire waiters and waitresses because the General Harrison had been converted into a restaurant.
- b. to attract passengers on the General Harrison's return trip to Boston
- c. to find carpenters to repair the General Harrison.
- d. so people would be aware of the newly available storage space in the crowded city

5. How old was the General Harrison when it was destroyed by a fire?

- a. 111 years old
- b. 11 years old
- c. 50 years old
- d. 200 years old

6. Before its destruction, about how much money per month (in today's economy) was the General Harrison making E. Mickle and Company?

- a. \$8.1 million
- b. \$100
- c. \$80,000
- d. \$5,000

- 7. Why did Thomas Perkins Jr. sell the General Harrison?**
- a. because it was worth more to sell than to keep it for maritime trading
 - b. because he owed money to E. Mickle and Co.
 - c. because he wanted to search for gold.
 - d. because he had no crew to bring it back to the East coast.
- 8. Which of the following would be the best title for this lecture?**
- a. The History of an American Mercantile Ship
 - b. The Voyages of a Famous Ship from Chile
 - c. A Civil War Treasure
 - d. Influential People of the California Gold Rush
- 9. When did the huge earthquake occur?**
- a. 1906
 - b. 1887
 - c. 1912
 - d. 1851
- 10. Why did Thomas Perkins Jr. send the General Harrison to California in 1849?**
- a. to search for gold
 - b. to find the fastest route from the East coast to the West coast by sea
 - c. to charge passengers for transport to San Francisco and to bring goods to trade in San Francisco.
 - d. to sell the ship when it got to San Francisco
- 11. Why are shipping agents an important part of the shipping industry?**
- a. it is difficult for the ship's owners or captains to know the local port procedures which might differ from port to port
 - b. because they help the captain to find the best restaurant in town
 - c. because they calculate the amount of fuel needed for the ship
 - d. because they help the ship book entertainment for the crew
- 12. How was the General Harrison initially destroyed?**
- a. The ship sank during its return voyage to Newburyport, Massachusetts.
 - b. The ship was destroyed by a tsunami, which devastated San Francisco Bay.
 - c. The ship was destroyed by a huge earthquake.
 - d. The ship was destroyed by a devastating fire.
- 13. Why did people pay rent to E. Mickle and Company to store their merchandise in the General Harrison's holds?**
- a. because it was easier and less expensive than maintaining their own property space in the overcrowded San Francisco
 - b. because E. Mickle and Co. had the connections to arrange for the sale of merchandise they were holding at auction.
 - c. both a and b
 - d. none of the above

14. Why were the docks of San Francisco over-crowded in 1849?

- a. The ships that came to San Francisco had gotten stuck in the mud of the shallow cove, so it became crowded.
- b. The population had grown over the years because people had been drawn to the nice weather.
- c. Gold had been discovered and thousands of people came there by ship to search for the gold.
- d. There was a ship construction company in San Francisco that resulted in crowded docks.

15. When was the General Harrison first rediscovered after it was destroyed and covered over with landfill?

- a. after a huge earthquake
- b. after a large flood
- c. after a firm wanted to build a hotel over the area
- d. after new laws required them to dig up the ship

16. Where is the General Harrison today?

- a. in a museum
- b. buried in San Francisco
- c. its location is unknown
- d. rebuilt and serving as a cruise ship

17. Why was the General Harrison reburied after being rediscovered for the first time?

- a. because they decided the ship was not important enough to remove
- b. to protect the remains for future historians
- c. because the workers thought it would be bad luck to remove it from where it was
- d. because the workers were unable to chop through the ship's strong hull

18. Why did Tomas Perkins Jr. think it was a good opportunity to send the General Harrison to San Francisco in 1849?

- a. because there were many people searching for gold in California, and he expected he would be able to sell the ship for a high price once they got there
- b. because it as a good time to find the fastest route from the East coast to the West coast by sea
- c. because there were so many people searching for gold in California that it would be a profitable place to trade
- d. because he wanted to search for gold

19. When the General Harrison was used to store goods for renters, how much commission would E. Mickle & Company have earned on a \$10 sale?

- a. \$9.00
- b. \$4.00
- c. \$0.25
- d. \$1.00

20. Why did they cover the ruined ships and buildings in the bay of San Francisco with new land?

- a. because they wanted to make San Francisco bigger
- b. because the rotting wood from the ships was giving off dangerous fumes
- c. because they needed to create stable land for constructing new building foundations
- d. because they were hoping to prevent flooding.

APPENDIX G
Multiple-Choice Test Scoring Template

MULTIPLE-CHOICE TEST

MEMORY ITEMS:

- 1. Where was the General Harrison built?**
 - a. Charlestown, Massachusetts
 - b. *Newburyport, Massachusetts*
 - c. San Francisco, California
 - d. New York, New York

- 2. Before the General Harrison set sail for California, the ship was used to ____.**
 - a. *transport passengers and cargo between Boston, New York, and New Orleans.*
 - b. transport slaves from Africa to the South.
 - c. transport wealthy passengers from Southampton, United Kingdom to New York City, United States.
 - d. transport gold from Valparaiso, Chile to Newburyport Massachusetts.

- 6. Before its destruction, about how much per month was the General Harrison making E. Mickle and Company?**
 - a. \$8.1 million
 - b. \$100
 - c. *\$80,000*
 - d. \$5,000

- 9. When did the huge earthquake occur?**
 - a. *1906*
 - b. 1887
 - c. 1912
 - d. 1851

- 10. Why did Thomas Perkins Jr. send the General Harrison to California in 1849?**
 - a. to search for gold
 - b. to find the fastest route from the East coast to the West coast by sea
 - c. *to charge passengers for transport to San Francisco and to bring goods to trade in San Francisco.*
 - d. to sell the ship when it got to San Francisco

- 12. How was the General Harrison initially destroyed?**
 - a. The ship sank during its return voyage to Newburyport, Massachusetts.
 - b. The ship was destroyed by a tsunami, which devastated San Francisco Bay.
 - c. The ship was destroyed by a huge earthquake.
 - d. *The ship was destroyed by a devastating fire.*

15. When was the General Harrison first rediscovered after it was destroyed and covered over with landfill?

- a. *after a huge earthquake*
- b. *after a large flood*
- c. *when a firm wanted to build a hotel over the area*
- d. *when new laws required them to dig up the ship*

16. Where is the General Harrison today?

- a. *in a museum*
- b. *buried in San Francisco*
- c. *its location is unknown*
- d. *rebuilt and serving as a cruise ship*

17. Why was the General Harrison reburied after being rediscovered for the first time?

- a. *because they decided the ship was not important enough to remove*
- b. *to protect the remains for future historians*
- c. *because the workers thought it would be bad luck to remove it from where it was*
- d. *because the workers were unable to chop through the ship's strong hull*

20. Why did they cover the ruined ships and buildings in the bay of San Francisco with new land?

- a. *because they wanted to make San Francisco bigger*
- b. *because the rotting wood from the ships was giving off dangerous fumes*
- c. *because they needed to create stable land for constructing new building foundations*
- d. *because they were hoping to prevent flooding.*

INFERENTIAL ITEMS:

3. How many times was the General Harrison forgotten?

- a. *once*
- b. *twice*
- c. *three times*
- d. *four times*

4. Once in San Francisco, why did E. Mickle and Company put an advertisement into the newspaper?

- a. *to hire waiters and waitresses because the General Harrison had been converted into a restaurant.*
- b. *to attract passengers on the General Harrison's return trip to Boston*
- c. *to find carpenters to repair the General Harrison.*
- d. *so people would be aware of the newly available storage space in the crowded city*

- 5. How old was the General Harrison when it was destroyed by a fire?**
- a. 111 years old
 - b. *11 years old*
 - c. 50 years old
 - d. 200 years old
- 7. Why did Thomas Perkins Jr. sell the General Harrison?**
- a. because it was worth more to sell than to keep it for maritime trading
 - b. because he owed money to E. Mickle and Co.
 - c. because he wanted to search for gold.
 - d. *because he had no crew to bring it back to the East coast.*
- 8. Which of the following would be the best title for this lecture?**
- a. *The History of an American Mercantile Ship*
 - b. The Voyages of a Famous Ship from Chile
 - c. A Civil War Treasure
 - d. Influential People of the California Gold Rush
- 11. Why are shipping agents an important part of the shipping industry?**
- a. *it is difficult for the ship's owners or captains to know the local port procedures which might differ from port to port*
 - b. because they help the captain to find the best restaurant in town.
 - c. because they calculate the amount of fuel needed for the ship.
 - d. because they help the ship book entertainment for the crew.
- 13. Why did people pay rent to E. Mickle and company to store their merchandise in the General Harrison's holds?**
- a. because it was easier and less expensive than maintaining their own property space in the overcrowded San Francisco
 - b. *because E. Mickle and Co. had the connections to arrange for the sale of merchandise they were holding at auction.*
 - c. both a and b
 - d. none of the above.
- 14. Why were the docks of San Francisco over-crowded in 1849?**
- a. The ships that came to San Francisco had gotten stuck in the mud of the shallow cove, so it became crowded.
 - b. The population had grown over the years because people had been drawn to the nice weather.
 - c. *Gold had been discovered and thousands of people came there by ship to search for the gold.*
 - d. There was a ship construction company in San Francisco that resulted in crowded docks.

18. Why did Tomas Perkins Jr. think it was a good opportunity to send the General Harrison to San Francisco in 1849?

- a. because there were many people searching for gold in California, and he expected he would be able to sell the ship for a high price once they got there
- b. because it as a good time to find the fastest route from the East coast to the West coast by sea
- c. *because there were so many people searching for gold in California that it would be a profitable place to trade*
- d. because he wanted to search for gold

19. When the General Harrison was used to store goods for renters, how much commission would E. Mickle & Company have earned on a \$10 sale?

- a. \$9.00
- b. \$4.00
- c. \$0.25
- d. \$1.00

APPENDIX H
Session 2 Materials

Student ID Number: _____

Session 2

Thank you again for your participation in this study! Please read the following silently as I read it aloud:

You will complete several tasks during today's session in the following order:

1. Complete a measure of listening comprehension.
2. Complete a background knowledge quiz on American History.
3. Complete a measure of attention.

Do you have any questions?

Please turn to the next page and wait for further instructions.

Student ID Number: _____

Listening Comprehension**Please read the following instructions to yourself as I read them aloud:**

You are going to hear several short stories. Listen carefully to each story, because when the story is finished, you will be asked some questions about it. The questions will be displayed on this screen.

Please write your answers on the lines provided:

Story 1:

1. _____
2. _____
3. _____
4. _____

Story 2:

1. Please circle one choice:
(A) (B) (C) (D) (E)
2. _____
3. Reason One: _____
Reason Two: _____

Story 3:

1. _____
2. _____
3. Please circle one choice:
(A) (B) (C) (D)

Story 4:

1. Please circle one choice:

(A)

(B)

(C)

(D)

2. _____

3. Way One: _____

Way Two: _____

Story 5:

1. Please circle one choice:

(A)

(B)

(C)

(D)

(E)

2. _____

3. _____

4. _____

Story 6:

1. Action One: _____

Action Two: _____

2. _____

Please read the following directions to yourself as I read them aloud:

Using either pen or pencil, please answer each multiple-choice question by circling the lettered item, which BEST answers the question. Be sure not to skip any. You will have 15 minutes to complete this task. Any questions?

AMERICAN HISTORY QUIZ**1. How long is a single term in office for the U.S. President?**

- a) 3 years
- b) 4 years
- c) 5 years
- d) 6 years

2. Which of these battles was the first military conflict of the American Revolution?

- a) Battle of Saratoga
- b) Battle of Gettysburg
- c) Battle of Lexington
- d) Battle of Yorktown

3. Which country paid for Christopher Columbus's voyage to the Americas?

- a) France
- b) Spain
- c) Portugal
- d) England

4. What are the three branches of the U.S. government?

- a) Judicial, Executive, and Legislative
- b) Executive, Legislative, and Military
- c) Judicial, Military, and Executive
- d) Military, Legislative, and Judicial

5. Who was president during the U.S. Civil War?

- a) Andrew Jackson
- b) Ulysses Grant
- c) Theodore Roosevelt
- d) Abraham Lincoln

6. Who is the current Vice President of the United States?

- a) John Boehner
- b) Joe Biden
- c) Hillary Clinton
- d) Paul Ryan

7. In 1803, President Jefferson bought a large amount of land from the French. What was this event called?

- a) Louisiana Purchase
- b) New Deal
- c) Oregon Territory
- d) Adams-Onis Treaty

8. What country attacked Pearl Harbor in 1941?

- a) Germany
- b) Japan
- c) Russia
- d) Korea

9. Which of the following was NOT one of the original thirteen colonies?

- a) Delaware
- b) Connecticut
- c) Georgia
- d) Maine

10. What Supreme Court decision ended racial segregation in schools?

- a) Brown vs. Board of Education
- b) Plessy vs. Ferguson
- c) Parks vs. Board of Education
- d) King vs. Board of Education

11. The Statue of Liberty was a gift from whom?

- a) England
- b) Spain
- c) France
- d) Italy

12. What single event is most commonly associated with the "Great Depression"?

- a) The beginning of World War I
- b) The Great Plague
- c) The Wall Street Crash of 1929
- d) The Great Chicago Fire

13. Who delivered the famous "I Have a Dream" speech?

- a) Malcolm X
- b) Jesse Jackson
- c) Abraham Lincoln
- d) Martin Luther King Jr.

14. Who wrote the Declaration of Independence?

- a) Thomas Jefferson
- b) Benjamin Franklin
- c) George Washington
- d) Alexander Hamilton

15. What is the Underground Railroad?

- a) the New York City subway system, which is the most extensive public transportation system in the world
- b) a network of secret routes and safe houses used by slaves attempting to escape to the North
- c) the extensive railway system, also known as the Granite Railway, which was designed to transport slaves to the South
- d) the official weekly newspaper of the American Anti-Slavery Society, which published essays, speeches, and debates related to the question of slavery

16. Who was the first African-American player to join Major League Baseball?

- a) Jackie Robinson
- b) Larry Doby
- c) Roberto Clemente
- d) Willie Mays

17. Of the following individuals, who NEVER served as president of the United States?

- a) James Buchanan
- b) Andrew Jackson
- c) John Adams
- d) Benjamin Franklin

18. Which of these wars occurred FIRST?

- a) World War I
- b) Vietnam War
- c) War of 1812
- d) Mexican American War

19. During the American Revolution, what name was given to those who supported the British?

- a) Loyalists
- b) Federalists
- c) Abolitionists
- d) Republicans

20. Who invented the cotton gin?

- a) Benjamin Franklin
- b) Alexander Graham Bell
- c) Eli Whitney
- d) Thomas Edison

Please read the following silently as I read it aloud:

55

Remember: Write down the first two letters of each lottery number you hear ending in 55.

[illegible]

Thank you for your participation in the study!!! The experiment is now complete. Please hand your materials to the researcher. Once you have turned in everything, the researcher will provide you with a \$10.00 gift card to *Rave Cinemas*. You are now entered to win one of the two iPad Minis!

THANK YOU!!! 😊

APPENDIX I
Background Knowledge Scoring Template

AMERICAN HISTORY QUIZ

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