



University of Tennessee, Knoxville
Trace: Tennessee Research and Creative Exchange

Doctoral Dissertations

Graduate School

8-2007

An Evaluation of the Psychometric Properties of the Test of Dyslexia-Rapid Assessment Profile

Sara Jean McCane

University of Tennessee - Knoxville

Recommended Citation

McCane, Sara Jean, "An Evaluation of the Psychometric Properties of the Test of Dyslexia-Rapid Assessment Profile." PhD diss., University of Tennessee, 2007.
https://trace.tennessee.edu/utk_graddiss/240

This Dissertation is brought to you for free and open access by the Graduate School at Trace: Tennessee Research and Creative Exchange. It has been accepted for inclusion in Doctoral Dissertations by an authorized administrator of Trace: Tennessee Research and Creative Exchange. For more information, please contact trace@utk.edu.

To the Graduate Council:

I am submitting herewith a dissertation written by Sara Jean McCane entitled "An Evaluation of the Psychometric Properties of the Test of Dyslexia-Rapid Assessment Profile." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

R. Steve McCallum, Major Professor

We have read this dissertation and recommend its acceptance:

Sherry Mee Bell, Sherry K. Bain, John W. Lounsbury

Accepted for the Council:

Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

To the Graduate Council:

I am submitting herewith a dissertation written by Sara Jean McCane entitled “An Evaluation of the Psychometric Properties of the Test of Dyslexia-Rapid Assessment Profile.” I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

R. Steve McCallum
Major Professor

We have read this dissertation
and recommend its acceptance:

Sherry Mee Bell

Sherry K. Bain

John W. Lounsbury

Acceptance for the Council:

Carolyn R. Hodges
Vice Provost and
Dean of the Graduate School

(Original signatures are on file with official student records.)

AN EVALUATION OF THE PSYCHOMETRIC PROPERTIES OF THE
TEST OF DYSLEXIA-RAPID ASSESSMENT PROFILE

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Sara Jean McCane
August 2007

DEDICATION

I would like to dedicate this dissertation to my parents, Jim and Mary McCane, and my fiancé, Joseph Bowling, for always providing unconditional love and support, encouraging me to meet my potential, and inspiring me to live life with integrity.

ACKNOWLEDGEMENTS

I would like to extend a word of thanks to all of those who helped me to complete my Doctor of Philosophy Degree in Education. I would like to thank Dr. McCallum for agreeing to serve as my committee chair, assisting me throughout the process, and providing constant encouragement and support. I would also like to thank Dr. Bell for all of her assistance throughout this project and over the course of the past few years. I would also like to thank Dr. Bain, and Dr. Lounsbury for sitting on my committee. Lastly, I would like to thank my research group for their assistance.

ABSTRACT

The Test of Dyslexia-Rapid Assessment Profile (TOD-RAP), designed as a group-administered instrument for the purpose of identifying persons at-risk for reading difficulties, was administered to 357 primary/secondary and collegiate summer school students in a southeastern state, along with the Reading Fluency subtest of the Woodcock-Johnson III Tests of Achievement (WJ-III), the Spelling and Reading portions of the Wide Range Achievement Test 3 (WRAT-3), and Test of Silent Word Reading Fluency (TOSWRF). Internal consistency coefficients of TOD-RAP subtests ranged from .79 to .96 and test-retest coefficients ranged from .70 to .94, indicating adequate reliability. Multivariate analyses of variance (MANOVA) yielded significant differences between non at-risk and at-risk students at the primary/secondary and collegiate level ($F = 2.45, p < .05$; $F = 8.44, p < .001$, respectively). Based on post hoc pairwise comparisons, non at-risk primary/secondary students, as compared to primary/secondary at-risk students, performed significantly better on three of the six TOD-RAP subtests. The non at-risk college group, as compared to at-risk college students, earned significantly higher scores on four of the five TOD-RAP subtests. These results suggest that TOD-RAP subtests may provide a valid means for identifying students at-risk for reading difficulties. Based on multiple regression analyses for the primary/secondary age group, TOD-RAP subtests significantly predicted all four operationalizations of reading achievement (WJ-III Reading Fluency, WRAT-3 Reading, WRAT-3 Spelling, and TOSWRF scores). Of the three TOD-RAP subtests, Spelling appeared as the most consistent predictor, accounting for unique variance for all four operationalizations of the criterion measure. Four of the five TOD-RAP subtests significantly predicted WJ-III

Reading Fluency scores at the college level. These analyses provide evidence for the predictive utility of the TOD-RAP at both the collegiate and primary/secondary level. Although promising, further research must be conducted before this instrument can be used to identify students at-risk for reading difficulties.

TABLE OF CONTENTS

1. INTRODUCTION	1
Purpose and Rationale.....	1
Definition of Dyslexia.....	2
Neurological Etiology of Dyslexia	7
Clinical Description of Dyslexia.....	9
Synthesis of Neurological and Clinical Descriptions	10
Assessment of Dyslexia	11
Rationale for Dyslexia Screener	15
2. STATEMENT OF THE PROBLEM	20
3. RESEARCH QUESTIONS	22
4. METHOD.....	23
Participants.....	23
Instruments.....	23
Test of Dyslexia-Rapid Assessment Profile (TOD-RAP).	23
Woodcock-Johnson III Tests of Achievement (WJ-III) Reading Fluency.	25
Wide Range Achievement Tests III (WRAT-3).	25
Test of Silent Word Reading Fluency (TOSWRF).	26
Procedures	26
5. RESULTS	28
Research Question 1	28
Research Question 2.....	29
Research Question 3.....	30
Primary/ Secondary School Student Group.	30
College Student Group.....	31
Research Question 4.....	31
6. DISCUSSION	35
Reliability: Internal Consistency.....	36
Reliability: Stability	38
Validity: The Relationship between At-Risk and Non At-Risk Students' TOD-RAP Scores	39
Validity: The Relationship between TOD-RAP Subtest Scores and Reading Achievement	42
Summary and Implications	45
Limitations and Future Research	47
REFERENCES	49
APPENDIX	56
VITA	71

LIST OF TABLES

Table 1. A Comparison of Current Dyslexia Definitions Across Three Constructs.....	57
Table 2. Description of the Test of Dyslexia-Rapid Assessment Profile (TOD- RAP) Subtests.....	58
Table 3. Descriptive Statistics of the Test of Dyslexia-Rapid Assessment Profile	59
Table 4. Descriptive Statistics for the Wide Range Achievement Tests (WRAT-3), Woodcock-Johnson (WJ-III) Reading Fluency subtest, and Test of Silent Word Reading Fluency (TOSWRF)	60
Table 5. Internal Consistency and Test-Retest Reliabilities of Test of Dyslexia-Rapid Assessment Profile Subtests	61
Table 6. Descriptive Statistics of the Test of Dyslexia-Rapid Assessment Profile for At-Risk and Non At-Risk Primary and Secondary School Students	62
Table 7. Post Hoc Analysis of Variance for Primary/Secondary School Students ($N = 36$)	63
Table 8. Descriptive Statistics of the Test of Dyslexia-Rapid Assessment Profile for At-Risk and Non At-Risk College Students	64
Table 9. Post Hoc Analysis of Variance College School Students ($N = 187$)	65
Table 10. Zero-Order Correlations Between the Test of Dyslexia-Rapid Assessment Profile (TOD-RAP), Woodcock-Johnson Tests of Achievement (WJ-III), Wide Range Achievement Tests (WRAT-3), and the Test of Silent Word Reading Fluency (TOSWRF)	66
Table 11. Prediction of Wide Range Achievement Test III Spelling from Test of Dyslexia-Rapid Assessment Profile Subtests ($N = 63$)	67
Table 12. Prediction of Test of Silent Word Reading Fluency from Test of Dyslexia- Rapid Assessment Profile Subtests ($N = 60$)	68
Table 13. Prediction of College Students' Woodcock-Johnson III Tests of Achievement Reading Fluency Subtest Scores from Test of Dyslexia-Rapid Assessment Profile Subtests ($N = 280$)	69
Table 14. Test of Dyslexia-Rapid Assessment Profile and Woodcock-Johnson III Reading Fluency Correlations By Age	70

1. INTRODUCTION

Purpose and Rationale

The purpose of this study is to develop items for and evaluate the psychometric properties of a group-administered screening instrument (Test of Dyslexia-Rapid Assessment Profile, or TOD-RAP; McCallum, Bell, & McCane, 2005) designed to identify students exhibiting typical characteristics of dyslexia. The first specific goal is to determine the reliability of each TOD-RAP subtest by calculating Cronbach's alphas. The second goal is to determine test-retest reliability (stability) of all TOD-RAP subtests. The third goal is to determine the discriminant validity of each subtest by assessing score differences between students classified as at-risk for reading disabilities and those classified as normal readers. The last goal is to evaluate the utility of TOD-RAP subtests in predicting students' reading achievement as defined by scores on four published and standardized measures via stepwise multiple regression analyses.

Currently, few published test batteries adequately measure all cognitive and achievement factors that are characteristic of dyslexia; although, there is an experimental test available that assesses each of these areas, the Test of Dyslexia (TOD; Bell, McCallum, & Cox, 2003; McCallum & Bell, 2002). Similarly, there is no published group-administered screening measure that efficiently assesses the majority of these factors, nor is there an experimental measure. The development of a screening test would provide a cost- and time-efficient strategy for identifying students at-risk for dyslexia. In addition, the new method for establishing a learning disability, the Response to Intervention (RTI) model, will require large groups of individuals to be screened for these

difficulties. Such screening is essential in order to comply with early intervention requirements. The proposed screening instrument would be useful in the RTI model of service delivery.

Definition of Dyslexia

As with any other disability, all individuals with dyslexia do not display identical symptoms or characteristics (The National Institute of Child Health and Human Development [NICHD], 1993). The only characteristic shared by all individuals with dyslexia is below average reading levels, as compared normatively to same-aged peers and ipsatively to their own intelligence level. Below grade level reading performance is a necessary, but not sufficient condition for a dyslexia diagnosis (NICHD, 1993). Many non-dyslexic individuals also display similar reading difficulties, making the identification of the disability difficult. In the past, no universal definition of dyslexia existed, leading some professionals to abandon the use of this term (NICHD, 1993).

Throughout history, dyslexia has been defined in many different ways. Neurologist Samuel T. Orton was one of the first scientific researchers to investigate dyslexia (cited in NICHD, 1993). He concluded that individuals with dyslexia exhibit problems in one or more of the following areas:

- (1) difficulty in learning and remembering printed words;
- (2) letter reversals (b for d, p for q) and number reversals (6 for 9) and changed order of letters in words (tar for rat, quite for quiet) or numbers (12 for 21);
- (3) leaving out or inserting words while reading;
- (4) confusing vowel sounds or substituting one consonant for another; persistent spelling errors;
- (5) difficulty in writing. (p. 2)

Orton further noted that individuals with dyslexia exhibit clumsiness when using their hands, often resulting in poor handwriting. These individuals also experience difficulty telling time, distinguishing left from right, and finding the correct word while speaking. Speech is often inadequate or delayed. Furthermore, Orton noted that incidences of dyslexia tend to run in families, appear more often in males, and frequently occur in left-handed individuals.

Later definitions of dyslexia ranged from vague to specific descriptions of clinical symptoms. For instance, the World Federation of Neurology defined dyslexia as “a disorder manifested by difficulty in learning to read despite conventional instruction, adequate intelligence, and sociocultural opportunity” (NICHD, 1993). Definitions such as this led to confusion between the terms “dyslexia”, “reading disability”, and “specified learning disability in reading.” Today, many researchers use the terms “dyslexia” and “reading learning disability” synonymously (Sattler, 1992; Siegel, 1999; Torgesen & Wagner, 1998). Siegel (1999) stated, “There is no difference in the terms dyslexia and reading difficulties” (p.306). However, as previously stated, many students displaying reading difficulties do not exhibit dyslexia (NICHD, 1993). The interchangeable use of these terms continues to contribute to inaccurate diagnoses, and results in untailored interventions and remedial programs.

In an effort to refine the definition of dyslexia, Sattler (1992) characterized students who fail to develop reading ability as having “developmental dyslexia.” He further noted three subtypes of reading disability: (1) auditory-linguistic deficits, (2) visual-spatial deficits, and (3) mixed deficits. Auditory-linguistic deficits comprise the majority of reading learning disabilities, and are characterized by difficulties linking

sounds and symbols, as well learning letter-sound relationships. Individuals exhibiting this deficit typically display higher Performance IQs as compared to Verbal IQs. In contrast, visual-spatial deficits are characterized by difficulties perceiving and reading words as wholes. These individuals often earn higher Verbal IQs as compared to Performance IQs. Lastly, persons with mixed deficits exhibit problems with both language-related and visual-spatial areas of reading.

A comparison of more current definitions is found in Table 1 (all tables are located in the appendix). Sattler's (1992) characterization of dyslexia is mirrored in more current conceptualizations. For example, Wolf (1999) also identified two primary deficits that produce the reading difficulties displayed by persons with dyslexia. These deficits appear in phonological awareness/processing skills and / or rapid automatized naming speed. Naming speed, a fluency-related process, is typically operationalized by the Rapid Automatic Naming (RAN) test. This measure assesses the speed at which an individual names familiar visual stimuli (Krieger, 2000). Deficits in phonological awareness weaken decoding and word attack skills, while deficits in naming speed weaken word identification skills (Wolf, 1999). Wolf, Bowers, and Biddle (2000) identified three subtypes of reading disabilities related to deficits in the two aforementioned areas. Their *double-deficit hypothesis* states that individuals with a reading disability can exhibit deficits in either one or both of these areas, with dual deficits resulting in the most serious disability. This conceptualization corresponds somewhat to Sattler's (1992) three subtypes of reading disability. Phonological awareness deficits included under the *double-deficit hypothesis* correspond with Sattler's (1992) auditory-linguistic deficits,

naming speed deficits somewhat resemble the visual-spatial deficits, and dual deficits correspond to the mixed deficits subtype.

Other definitions also include phonological and fluency related processes. According to Gersons-Wolfensberger and Ruijsenaars (1997), the Committee of Dyslexia of the Health Council of the Netherlands defined dyslexia as the following:

Dyslexia is present when the automatization of word identification (reading) and / or word spelling does not develop or does so very incompletely or with great difficulty. (p. 209)

These authors further defined dyslexia as being accompanied by either slow and / or inaccurate word identification and spelling skills. The reading and spelling difficulties exhibited by these individuals are severe and do not respond to typical intervention methods.

Other researchers offer extremely specific definitions of dyslexia and dyslexia subtypes (Castles & Coltheart, 1993; Manis, Seidenberg, Doi, McBride-Chang, & Petersen, 1996; Seymour & Evans, 1999). Research conducted by Seymour and Evans (1999) supports the existence of three subtypes of dyslexia: (1) literal dyslexia, (2) alphabetic dyslexia, and (3) logographic dyslexia. The authors defined literal dyslexia as difficulty learning the names and sounds of individual letters. This difficulty undermines higher-order reading processes. Alphabetic dyslexia is defined as difficulty in decoding unfamiliar words, even though knowledge of letter sounds has been acquired. This type of dyslexia is reflected by inability to read nonwords, but not in the reading of sight words. Lastly, logographic dyslexia is defined as difficulty recognizing and storing multiletter word segments linked to pronunciations and word meanings. Logographic

dyslexia inhibits sight word acquisition, and is reflected in difficulty identifying familiar words.

Other researchers have found evidence for the existence of two types of developmental dyslexia, referred to as phonological and surface dyslexia (Castles & Coltheart, 1993; Manis et al., 1996). Phonological dyslexia, similar to Seymour and Evan's (1999) conceptualization of logographic dyslexia, results in poor nonword reading as opposed to irregular word recognition. Research conducted by Manis et al. suggests that this dyslexia subtype results from an inability to develop phonological representations impeding the ability to determine phonology from orthography. Surface dyslexia, on the other hand, is characterized by poorer irregular word reading, as compared to nonword reading (Castles & Coltheart, 1993; Manis et al., 1996). This subtype resembles Seymour and Evan's (1999) alphabetic dyslexia. Manis et al. (1996) suggest that surface dyslexia results from either a visual-perceptual deficiency or computational resource limitation. Impairment in each of these abilities produce delays in word reading skills, and hinders reading of irregular words.

Padget, Knight, and Sawyer (1996) examined 25 years worth of literature to develop the following definition of dyslexia:

Dyslexia is a language-based learning disorder that is biological in origin and primarily interferes with the acquisition of print literacy (reading, writing, and spelling). Dyslexia is characterized by poor decoding and spelling abilities as well as deficits in phonological awareness and / or phonological manipulation. These primary characteristics may co-occur with spoken language difficulties and deficits in short-term memory. Secondary characteristics may include poor

reading comprehension (due to the decoding and memory difficulties) and poor written expression, as well as difficulty organizing information for study and retrieval. (p. 55)

Similarly, the International Association of Dyslexia (IDA; 2006) and Lyon, Shaywitz, and Shaywitz (2003) define dyslexia as:

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

These definitions incorporate the many components of earlier conceptualizations, provide the basis of the definition of dyslexia to be used in this study, and include many of the cognitive and academic factors to be included in the proposed screening instrument.

Neurological Etiology of Dyslexia

Rooney (1995) provided a neurological explanation of dyslexia, stating that individuals with dyslexia exhibit unilateral cerebral dominance for language acquisition. She stated, “Deviations from this dominance can result in language acquisition difficulties described as dyslexic” (p. 8). Typically, persons with dyslexia exhibit stronger right brain language acquisition activities as compared to left brain activities. This unilateral cerebral dominance results in strong conceptual reasoning, a right brain

activity, and weak spelling, reading, and writing abilities, left brain activities. This right brain dominance only applies to language acquisition, and is not displayed in other processes.

This neurological etiology of dyslexia is further supported by sex differences in the base rate of dyslexia (Lawrence & Carter, 1999; NICHD, 1993; Rooney, 1995; Shaywitz, 1996). Lawrence and Carter (1999) stated that approximately 10% of the population can be classified as dyslexic, with between 2% and 4% exhibiting severe characteristics and 6% exhibiting mild to moderate characteristics. Consistent with early research, males are overrepresented by a 4:1 ratio. Shaywitz (1996) suggested that women are less likely to exhibit dyslexic characteristics because they have the capacity to engage both the left and right inferior gyrus during phonological processing. Only the left inferior gyrus is engaged in men. Similarly, Rooney (1995) stated that dyslexia results when individuals demonstrate more unilateral cerebral dominance for language acquisition with strengths in right brain functions and weaknesses in left brain functions. Consequently, dyslexic males have no back-up support for language acquisition. Because women have bilateral representations of phonological processing, they are better able to compensate for those weaknesses in left brain functions, whereas men are not. In summary, this sex difference in brain functioning explains why women can more effectively compensate for dyslexia characteristics, and are less often diagnosed with the disability (Shaywitz, 1996). However, despite this research, the IDA (2006) does not agree with all these conclusions. For example, this organization does acknowledge the neurological origin of dyslexia, but states that the disorder affects men and women equally.

Clinical Description of Dyslexia

In their factor analytic research, Bell et al. (2003) characterized the dyslexia skill profile, and claimed that individuals with dyslexia often perform poorly on cognitive auditory processing measures requiring phonemic awareness, phonological skills, sound blending, and decoding of nonsense words. Such individuals also perform poorly on cognitive processing speed and memory measures, including rapid automatized naming, auditory memory, and some types of visual memory. Consequently, individuals with dyslexia exhibit poor performance on academic measures, including spelling, fluency, and letter and word identifications. In contrast, these individuals may perform well on cognitive measures of verbal reasoning, nonverbal reasoning, and visual spatial processing. Also, average performance is often exhibited on reading and listening comprehension measures.

Beyond providing a research-based definition of dyslexia, Padgett et al. (1996) described a specific diagnostic profile of this disability. According to this profile, students diagnosed with dyslexia should possess average or above average general cognitive abilities and listening comprehension skills as evidenced by IQ and listening comprehension standard scores of 90 or better. Second, these individuals should exhibit better listening comprehension as compared to reading comprehension. Third, word recognition scores should be at least one standard deviation below listening comprehension and IQ scores. Furthermore, word recognition scores should be less than or equal to reading comprehension scores. Fourth, spelling skills should be less than or equal to word recognition skills, and at least one standard deviation below listening comprehension and IQ. Fifth, word attack skills should be less than or equal to word

recognition skills. Lastly, phonological awareness skills should be significantly lower than age expectations. These authors suggested using both norm-referenced and criterion-referenced measures to assess the above areas when considering a diagnosis of dyslexia.

Synthesis of Neurological and Clinical Descriptions

The Phonological Model of Dyslexia merges definitions based on observed clinical symptoms and neuroscience regarding brain organization and function (Shaywitz, 1996). This model conceptualizes the language system as a “hierarchical series of modules or components, each devoted to a particular aspect of language” (p. 99). Upper levels of the hierarchy contain components required in developing vocabulary, syntax, and discourse skills. The lowest level consists of the phonological module responsible for processing the sound elements of language. This module is genetically determined, and aids in the recognition, understanding, and storage of words. In order to successfully complete these processes, words must be broken down or parsed into phonetic units. This process is conducted by the phonological module of the brain. This module functions as a translator, assembling spoken phonemes into complete words for the speaker, and then breaking the words back into their phonological components for the listener.

Based on this model, researchers concluded that individuals must efficiently transform visually presented letters into corresponding sounds in order to read (Shaywitz, 1996). This activity represents an unnatural process that must first be learned consciously. Beginning readers must develop a conscious awareness of the phonological structure of spoken words, and then learn how the sequence of lettering on a page represents these sounds. In other words, beginning readers must understand how orthography represents phonology. The central tenet of all dyslexia definitions is that

individuals with dyslexia exhibit difficulties when engaging this process. Due to deficits in the phonological module, these individuals display difficulty segmenting words into phonological components. This explanation of reading difficulties is often termed the “phonological deficit hypothesis.” According to this hypothesis, phonological processing problems create decoding difficulties. Difficulty decoding leads to decreased word recognition. These problems are associated with deficits in lower-order linguistic functioning, but prevent higher-order linguistic functioning and result in poor meaning-making (i.e., comprehension). Readers must be able to recognize words in order to access comprehension processes. Based on these difficulties, Shaywitz (1996) concluded that “phonological deficits are the most significant and consistent marker of dyslexic children” (p. 101).

On the other hand, Wolf (1999) stated that poor phonological awareness/processing is not the only cause of dyslexia. As previously discussed, this author concluded that both phonological processing and rapid naming speed produce the reading difficulties characteristic of dyslexia. He further cautioned professionals that only focusing on the phonological component causes some students with dyslexia to fall through the cracks. Instead, he suggested that both students’ phonological awareness and naming speed be assessed so that students displaying deficits in only one or in both of these areas can be identified by early screening measures.

Assessment of Dyslexia

A review of current literature suggests that Padget et al. (1996) and IDA (2006) provided the most specific, comprehensive, and clinically useful definition for guiding development of assessment procedures. These authors emphasized the importance of

examining listening comprehension, reading comprehension, word recognition, spelling, word analysis, and phonological decoding skills when determining the presence of dyslexia. Several test instruments include measures of these individual components, but few include measures of all. Also, no group-administered instrument assesses each of these components.

Bell et al. (2003) provided an assessment of all of these measures in their experimental test, the TOD. Using TOD operationalizations in a multiple regression, they found auditory processing to be the strongest predictor of reading achievement. This factor was the primary predictor of three of the four achievement measures; Letter Word Calling, Reading Comprehension, and Decoding. Auditory processing accounted for 27% to 43% of the variance across all the achievement areas measured. Visual processing speed and auditory processing were both found to be strong predictors of spelling, each accounting for 27% of the variance, with memory accounting for an additional 19% of the variance. Visual processing speed and memory also served as significant predictors of all other achievement areas. Based on their data, these researchers suggest that measures of auditory processing, visual processing speed, and memory be included in assessment of dyslexia.

Based on the work of Padget et al. (1996), Bell et al. (2003), and IDA (2006) it is possible to generate a comprehensive profile of dyslexia that can be operationalized by use of various published tests. For example, listening comprehension can be assessed using one of three achievement measures, the Kaufman Test of Educational Achievement-II (KTEA-II; Kaufman & Kaufman, 2004), the Weschler Individual Achievement Test-II (WIAT-II; Psychological Corporation, 2001) and the Diagnostic

Achievement Battery III (Newcomer, 2001). These instruments offer listening comprehension subtests. The Woodcock Language Proficiency Battery-Revised (Woodcock, 1991) and the Woodcock-Johnson III Tests of Achievement (WJ-III; Woodcock, McGrew, & Mather, 2001) also provide similar measures (Joshi, 2003).

The second component of the comprehensive profile is reading comprehension. Many standardized achievement tests designed to assess reading include reading comprehension measures, but the specific tasks vary across batteries. For instance, on the WIAT-II (Psychological Corporation, 2001) the examinee reads a passage either silently or aloud and then answers questions asked by the examiner (Padget et al., 1996). On the Peabody Individual Achievement Test-Revised/Normative Update (Markwardt, 1998), the examinee reads a sentence and then selects one of four pictures that best fits the sentence (Joshi, 2003). Joshi (2003) further noted that the Woodcock Reading Mastery Test-Revised/Normative Update (Woodcock, 1998), the Woodcock Diagnostic Battery (Woodcock, 1997), and the Woodcock Language Proficiency Battery-Revised (Woodcock, 1991) all have subtests that use the cloze format to assess reading comprehension. With the cloze procedure, the examinee reads a passage and fills in missing words. The Stanford Diagnostic Reading Test IV (Karlsen & Gardner, 1995) and Gates-MacGinitie Reading Tests IV (MacGinitie, MacGinitie, Maria, & Dreyer, 2002) also provide measures of reading comprehension (Joshi, 2003). Newer instruments, such as the KTEA-II (Kaufman & Kaufman, 2004) and the WJ-III (Woodcock et al., 2001) also provide similar measures. The nature of the skill assessed varies across these different task types, making it difficult to compare reading comprehension scores across differing measures.

The third component of the profile is word recognition, defined as the ability to read independent words. Most achievement tests, including the KTEA-II (Kaufman & Kaufman, 2004), WJ-III (Woodcock et al., 2001), and WIAT-II (Psychological Corporation, 2001) provide measures of this ability. Measures of word recognition are consistent across batteries, requiring the examinee to read a list of words arranged by increasing difficulty. Word recognition skills can also be assessed via criterion-referenced measures. Graded word lists typically are used to determine students' independent, instructional, and frustration reading levels (Padget et al., 1996).

The fourth component of the profile is spelling. The KTEA-II (Kaufman & Kaufman, 2004), WJ-III (Woodcock et al., 2001), and WIAT-II (Psychological Corporation, 2001) all provide measures of this ability. Padget et al. (1996) also recommended using the Developmental Spelling Analysis (Ganske, 1994) when assessing spelling skills. This instrument determines the examinee's instructional spelling level, indicates which skills have been mastered, and suggests which skills need further instruction.

The fifth component of the profile is word analysis, defined as the ability to read and pronounce pseudowords. Students with deficits in this area display difficulties with symbol-sound correspondences. The KTEA-II (Kaufman & Kaufman, 2004), WJ-III (Woodcock et al., 2001), and WIAT-II (Psychological Corporation, 2001) also provide measures of this ability.

The final component of the profile is phonological coding. Several measures are available for measuring this skill, including the KTEA-II (Kaufman & Kaufman, 2004) and the WJ-III (Woodcock et al., 2001). Padget et al. also suggested the use of a

criterion-referenced measure, the Test of Awareness of Language Segments (Sawyer, 1987). Joshi (2003) also suggests using the Lindamood Auditory Conceptualization Test III (Lindamood & Lindamood, 2004), as well as the Test of Phonological Awareness II Plus (Torgesen & Bryant, 2004) and Comprehensive Test of Phonological Processing (Wagner, Torgesen, & Rashotte, 1999), as measures of phonological awareness. He further suggests the use of the Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1998) for the assessment of decoding ability. On this task, the examinee is given 45 seconds to read a list of sight words, and another 45 seconds to decode a list of nonwords. The Auditory Analysis Test is also useful (Shaywitz, 1996). This task measures the examinee's ability to segment and delete phonological units, and is very sensitive.

This compilation of measures available for assessing each component of the comprehensive profile of dyslexia is very cumbersome. The list includes a variety of norm-referenced and criterion-referenced measures. Two published instruments, the KTEA-II (Kaufman & Kaufman, 2004) and the WJ-III (Woodcock et al., 2001) include measures for each component. However, these comprehensive, standardized achievement batteries include several subtests that measure skills unrelated to dyslexia, complicating the assessment process. Furthermore, there is no good group-administered screener that assesses the most relevant of these measures.

Rationale for Dyslexia Screener

The development of a group-administered dyslexia screener would provide a time and cost efficient method for screening individuals for reading difficulties. Individuals scoring above a specified cut-off score would not be referred for more intensive, time-

consuming, and costly individualized evaluation. Furthermore, students would not have to exhibit an extended period of reading failure in order to be considered for special education or remedial services. Rather, all students could be screened allowing for more comprehensive identification of students exhibiting reading difficulty. This screening procedure should help prevent students “falling through the cracks” within our educational system.

Prior to the reauthorization of the Individuals with Disabilities Education Improvement Act (IDEIA; 2004) legislation, public school systems received no federal funding for pre-referral interventions (White, 2005). The new bill now allows school systems to invest as much as 15% of their federal special education funds to early intervention. Schools are no longer required to conduct full standardized cognitive and achievement assessments in order to provide special education services to students. Rather, students can be offered pre-referral interventions designed to improve areas of deficiency. Students who do not respond to research-based interventions may then be offered more intensive services. This new model of service delivery is termed Responsiveness to Intervention (RTI).

The early identification of children at-risk for reading problems is essential for the early intervention process suggested in the RTI model. Early intervention can prevent the development of more serious problems. The NICHD (1993) recommends the early identification of dyslexia:

The earlier dyslexia is diagnosed and treatment started, the greater the chance that the child will acquire adequate language skills. Untreated problems are compounded by the time a child reaches the upper grades, making successful

treatment more difficult. Older students may be less motivated because of repeated failure, adding another obstacle to the course of treatment. (p. 5)

The repeated failure experienced by unidentified students with dyslexia results in drastic emotional impacts. These students often exhibit anger, guilt, and / or depression as a direct result of this failure. Furthermore, unidentified students may exhibit loss of hope and ambition towards their schooling. Counseling may be required to overcome these emotional impacts (NICHD, 1993). Based on this analysis, early identification of and intervention with students displaying characteristics of dyslexia not only prevents or minimizes academic difficulties, but emotional problems as well.

NICHD's (1993) goal is to identify children with dyslexia early in their schooling in order to implement programs to reduce the manifestation of further symptoms of dyslexia and reduce the development of emotional, academic, and intellectual problems. The committee commends any attempt to develop language-based assessments that predict which 5- or 6-year-old students are at risk for reading failure. The committee further notes that the successful development of such instruments will prevent many dyslexia cases. They conclude:

With help a dyslexia child can make gains but the assistance must be timely and thorough, dealing with everything that affects progress. For the child whose dyslexia is identified early, with supportive family and friends, with strong self-image, and with proper remedial program of sufficient length, the prognosis is good. (p. 6)

The Test of Dyslexia-Rapid Assessment Profile (TOD-RAP) should help practitioners fulfill IDEIA and the NICHD's (1993) goals by identifying at-risk students in the early

years of schooling in order to prevent academic failure and the development of emotional problems associated with such failure. Gersons-Woldfensberger and Ruijsenaars (1997) stated early identification of and intervention for reading and spelling difficulties produces the greatest benefit for students. These authors also suggest that the incidences of dyslexia will decrease if educators are able to implement early interventions. Children experiencing reading and / or spelling difficulties should be offered research-based interventions prior to the end of the first year of reading and spelling education (Gersons-Woldfensberger & Ruijsenaars, 1997). In order to comply with these early intervention suggestions, all individuals at risk for dyslexia must be identified early in their educational experience. The TOD-RAP provides an efficient means to screen large groups of young individuals for dyslexia, leading to further assessment of and intervention for students displaying typical characteristics.

Furthermore, 70 to 80 percent of students classified with specified learning disabilities exhibit deficits in reading. Dyslexia appears as the most common cause of these deficits (IDA, 2006). In fact, Shaywitz (2003) notes that dyslexia affects one in five children in the United States. Early identification and intervention would lessen academic frustration for these students and likely decrease the number of students receiving formal diagnoses.

Because the TOD-RAP is designed to identify problematic reading skills regardless of the age of the examinee, it may also be used with adolescents and adults. High school and college students are often required to complete a minimum number of foreign language courses. Research indicates that students with reading disabilities also experience difficulty learning a second language, exhibiting the same phonological

awareness and automaticity deficits seen in their native language (Crombie, 1997; Miller-Guron & Lundberg, 2000; Spolsky, 1989). This cross-language deficit can lead to decreased self-confidence about and negative attitudes toward learning a foreign language (Sparks & Ganschow, 1993). The TOD-RAP can identify high-school and college foreign language students displaying characteristics of dyslexia, allowing for the provision of appropriate accommodations and services for these students. This identification and intervention could lead to more positive attitudes about and success in learning a foreign language. Furthermore, Joshi (2005) noted that 75% of high school drop-outs display reading difficulties. Without remedy, these reading problems persist into adulthood and contribute to the large number of illiterate adults in the United States (4%) (Wagner, 1993). By identifying the disability in adulthood, proper interventions can be developed to assist the individual in reading more efficiently and decrease illiteracy rates.

2. STATEMENT OF THE PROBLEM

In order to provide the most effective interventions, students exhibiting reading difficulties specific to dyslexia need to be identified early. Reliable and valid screening instruments will be needed in this process, and will allow teachers to determine which students may be at-risk for these reading difficulties. Currently, there is no available efficient, group administered screening instrument that extends down to age five and addresses the primary components of dyslexia. The Test of Dyslexia-Rapid Assessment Profile (TOD-RAP) will provide such an assessment. It is based on the work of Padget et al. (1996) and Bell et al. (2003). The TOD-RAP provides a time-efficient, group-administered method for identifying children exhibiting dyslexic characteristics, and provides information regarding specific underlying processes negatively impacting an individual's reading performance.

The TOD-RAP includes six subtests designed to assess the areas identified by Padget et al.'s (1996), Bell et al. (2003), and IDA (2006). These subtests include: (a) Listening Vocabulary, (b) Phonological Decoding, (c) Orthography, (d) Reading Comprehension, (e) Spelling, and (f) Rapid Letter Matching. Because this instrument is to be used for screening, not diagnostic purposes, several related components may be measured within each subtest. For example, Rapid Letter Matching taps orthography, processing speed, and rapid automatized naming (RAN) skills. Scores from these subtests yield a profile that allows educators to determine which students may be at-risk for a diagnosis of dyslexia.

The TOD-RAP is a promising instrument that addresses the major components associated with the dyslexic profile. The instrument is based on a research-based

definition of dyslexia, and provides measures of those factors research indicates as underlying this disability. Administration of the TOD-RAP takes approximately 30 to 45 minutes, and each subtest uses a multiple-choice format. Despite the appeal of this instrument, its psychometric properties must be determined before advocating its use. For this reason, reliability and validity should be established.

3. RESEARCH QUESTIONS

1. Do subtests of the TOD-RAP possess adequate internal consistency reliability (i.e., $= .80$) as determined by Cronbach's alphas?
2. Do subtests of the TOD-RAP possess adequate test-retest reliability (i.e., $= .80$) as determined by significant correlations between pre- and post-test scores?
3. Do subtests of the TOD-RAP exhibit discriminant validity as determined by significant mean score differences between persons designated as at-risk or non at-risk for reading difficulties (as defined by scores on the Woodcock-Johnson-III Reading Fluency subtest)?
4. Do subtests of the TOD-RAP significantly predict students' reading achievement as defined by Woodcock Johnson III (WJ-III) Tests of Achievement Reading Fluency, Wide Range Achievement Test III (WRAT-3) Reading and Spelling, and Test of Silent Word Reading Fluency (TOSWRF) scores?

4. METHOD

Participants

Participants included 357 primary/secondary and collegiate summer school students in a southeastern state. These participants ranged from 4 to 71 years of age, with a mean participant age of 21.55 and a standard deviation of 7.74. Parents for all students under the age of 18 signed permission slips allowing their children to participate, and all participants signed assent forms. Elementary, middle, and high school students attending a summer school program were randomly selected for participation, and ranged from 4 to 15 years of age ($n = 70$). The mean age for this primary/secondary group was 11.99, with a standard deviation of 3.16. Participants were also selected from introductory university foreign language courses. These participants ranged in age from 18 to 71, with a mean age of 23.83 and a 6.69 standard deviation ($n = 278$). Fifty-percent ($n = 178$) of the sample were female, and 50% were male ($n = 179$). Eighty-nine percent of the participants were Caucasian, 8% African American, 2% Asian, and 1% other. The sample included both students who receive and who do not receive special education services. Eighty-seven percent of the sample has not received a special education diagnosis during their schooling. Of the remaining 13%, diagnoses include 6% learning disabilities, 4% Attention Deficit/Hyperactivity Disorder (AD/HD) and Other Health Impairments, 1% perception disabilities, and 2% other (ie. autism, emotional disturbances).

Instruments

Test of Dyslexia-Rapid Assessment Profile (TOD-RAP).

The TOD-RAP is a group-administered battery for persons 5-years-old to adulthood, and is designed to identify students and persons exhibiting primary

characteristics of dyslexia. The test contains six individual subtests, including Listening Vocabulary, Phonological Decoding, Reading Comprehension, Spelling, Orthography, and Processing Rapid Letter Matching. A description of each subtest is provided below and listed in Table 2.

The Listening Vocabulary subtest measures the ability to define words. The examinee marks one of four word choices to match the stimulus definition. Phonological Decoding assesses the examinee's ability to identify nonsense words that correspond to orally presented sounds by matching the sounds to one of four choices. Reading Comprehension measures the examinee's ability to comprehend written passages read silently by answering multiple-choice questions regarding passage content. Spelling assesses the examinee's ability to determine the correct spelling of both phonetically regular and irregular words by selecting the correct spelling of orally presented words from a list of four options. Orthography assesses the ability to accurately discriminate similar stimuli by selecting the only real letter or word from a row of four choices. This subtest includes a timed component; consequently, it also provides a measure of processing speed. Rapid Letter Matching assesses the ability to quickly and accurately identify two identical stimuli from six similar choices by marking both matching stimuli.

This TOD-RAP was group-administered to all participants. Group size ranged from 10 to 30 students. Following administration, the six TOD-RAP subtest raw scores were calculated for each student. Raw scores for subtests equal the total number of items correct. These scores were used to evaluate the TOD-RAP subtests' internal consistency and test-retest reliability. TOD-RAP z -scores were computed for three different age groups by calculating the raw score mean and standard deviation for elementary,

secondary, and college groups separately. These computations were completed for each student for each TOD-RAP subtest. The resulting z -scores were then multiplied by 15 and the products added to 100, yielding standard scores for each student on each subtest. These analyses ensure a sample mean of 100 with a standard deviation of 15, and allow for comparisons between the TOD-RAP and other tests with similar properties. Standard scores were used in multivariate analyses of variance and multiple regression analyses.

Woodcock-Johnson III Tests of Achievement (WJ-III) Reading Fluency.

The WJ-III Reading Fluency subtest was group-administered to all students (Woodcock et al., 2001). Group size ranged from 10 to 30 students. This instrument is normed for persons five years of age and older, and requires students to read simple sentences and decide whether each sentence was true or false by circling “yes” or “no”, respectively, on the testing protocol. Students are given three minutes to complete as many items as possible (Mather & Woodcock, 2001). Administrators followed the scoring procedures outlined in the WJ-III manual and computed raw scores by subtracting the number of items incorrect from the number of items correct. These scores were then converted to standard scores with a mean of 100 and standard deviation of 15 using the tables provided in the WJ-III manual. According to the manual, the WJ-III Reading Fluency subtest has a median reliability of .90 (McGrew & Woodcock, 2001).

Wide Range Achievement Tests III (WRAT-3).

Administrators individually administered the WRAT-3 Reading and Spelling subtests (blue forms) to all primary/secondary students (Wilkinson, 1993a). This instrument is designed for use with persons five years of age and older. The Reading subtest assesses the student’s ability to recognize and name letters, as well as the ability

to pronounce whole words. The WRAT-3 Spelling subtest requires students to write and spell orally presented letters and words, respectively. Median internal consistency reliabilities for the blue form of both subtests are .91. Corrected stability coefficients equal .98 and .93 for the Reading and Spelling subtests, respectively (Wilkinson, 1993b).

Test of Silent Word Reading Fluency (TOSWRF).

The TOSWRF (Form A) was group-administered to all primary and secondary students falling within the norm range, and group size ranged from 10 to 30 students (Mather, Hammill, Allen, & Roberts, 2004a). This instrument can be administered to persons ranging from 6 years, 6 months to 17 years of age, and requires students to identify printed words within presented rows. There are no spaces between the words, and students place a slash mark between identified words. The task is timed, and students must identify as many words as possible within a three-minute time period. This measure assesses students' word identification ability, word comprehension skills, and word reading fluency and is used to identify poor readers and monitor reading development. The average test-retest reliability for this instrument is .92 (Mather, Hammill, Allen, & Roberts, 2004b).

Procedures

The primary investigator administered the TOD-RAP to groups of 10 to 30 students of similar ages. The test was administered to approximately 30 groups during school hours at times deemed appropriate by both summer school and university officials. Administrations required approximately 30 to 40 minutes, and were conducted in classrooms located on either school or university grounds. The primary investigator also group-administered the WJ-III Reading Fluency subtest to all participants and the

TOSWRF to all primary/secondary students falling within the appropriate age range. Furthermore, the WRAT-3 Reading and Spelling subtests were individually administered to all primary/secondary students by their classroom teachers as part of the regular instructional program. TOD-RAP subtests were administered in the same order to all students; however, the starting points within each subtest varied depending on the age and sophistication of the group being tested. The order of administration of each individually administered instrument was counterbalanced.

5. RESULTS

Research questions were designed to assess both the psychometric properties and predictive utility of the TOD-RAP. Descriptive statistics for the TOD-RAP subtests are found in Table 3. WRAT-3 and WJ-III subtest descriptives are listed in Table 4. The means and standard deviations are expressed in raw score units for the TOD-RAP subtests and in standard score units for the WJ-III Reading Fluency, WRAT-3 Reading, WRAT-3 Spelling subtests, and TOSWRF.

Data collected to address the first research question generally support the internal consistency of the TOD-RAP subtests. Further data analyses conducted in response to the second research question provide evidence of test-retest reliability for each TOD-RAP subtest. Four multivariate analyses of variance were conducted to answer the third research question. Results generally indicate that non at-risk students exhibit significantly higher composite means, as compared to at-risk students on TOD-RAP subtests. Five stepwise multiple regressions conducted to address the fourth research question provide further evidence of the predictive utility of the TOD-RAP.

Research Question 1

Internal consistency coefficients for the six TOD-RAP subtests were determined by Cronbach's alphas. Some statisticians suggest that instruments be used only when the measure possesses a reliability coefficient greater than or equal to .70 (Cronbach, 1951). However, more stringent reliability coefficients of .80 and higher are often considered more appropriate for psychoeducational tasks (Sattler, 2001). Results for all subtests are found in Table 5.

Based on the criterion mentioned above, results confirm that four of the six TOD-RAP subtests possess adequate reliability. These subtests include Reading Comprehension (.94), Spelling (.91), Rapid Letter Matching (.96), and Orthography (.92). The internal consistency coefficients for the two remaining subtests, Listening Vocabulary (.79) and Phonological Decoding (.79), fall just below the acceptable value. Interestingly, Listening Vocabulary and Phonological Decoding both contain fewer items than the other four subtests. Typically, longer tests produce higher internal consistency coefficients (Sattler, 2001).

Research Question 2

Test-retest reliability coefficients were computed to determine the stability of each TOD-RAP subtest over time. The Listening Vocabulary, Spelling and Rapid Letter Matching subtests were re-administered to 81 elementary, middle school, and college students one to four weeks following initial testing. The Phonological Decoding and Orthography subtests were re-administered to 82 and 79 students, respectively. Lastly, the Reading Comprehension subtest was re-administered to 43 elementary and middle school students four weeks following initial assessment. As with internal consistencies, test-retest reliability coefficients of .80 and higher were considered acceptable. Results for all subtests are found in Table 5.

Five of the six TOD-RAP subtests exhibit strong test-retest reliability. These measures include Listening Vocabulary (.88), Reading Comprehension (.87), Spelling (.94), Rapid Letter Matching (.94), and Orthography (.94). However, the test-retest reliability coefficient for the Phonological Decoding (.70) subtest does not meet the .80

criterion. Students' initial and follow-up performance on this subtest, as compared to the other subtests, did not remain as stable over the test-retest latency period.

Research Question 3

Two separate multivariate analyses of variance (MANOVA) were conducted to determine whether at-risk and non at-risk students exhibit significant composite mean score differences on TOD-RAP subtests. Analyses for the younger sample included all six TOD-RAP subtests as dependent variables. Analyses for the college sample excluded Reading Comprehension, and included the remaining five TOD-RAP subtests as dependent variables. Because of limited ceiling, Reading Comprehension was not administered to these students.

A MANOVA for each age group compared the performance of students defined as either at-risk or non at-risk for reading difficulties. At-risk students were students performing at or below the 16th percentile (standard score = 85) on the WJ-III Reading Fluency subtest. Non at-risk students were students performing at or above the 50th percentile (standard score = 100) on the same subtest.

Primary/ Secondary School Student Group.

TOD-RAP subtest means and standard deviations for at-risk and non at-risk primary/secondary school groups are listed separately in Table 6. Based on MANOVA results, $F(1, 35) = 2.45, p < .05$, a composite mean difference exists between at-risk and non at-risk groups. Subtest mean score differences between these two groups were determined by post hoc analyses of variance (ANOVAs) using p-values less than .017, based on the Bonferroni correction. These ANOVA results are found in Table 7.

Although all at-risk means are lower than non at-risk means, post hoc F 's show that non

at-risk students' means are significantly higher than at-risk students on three of the six TOD-RAP subtests; Phonological Decoding, Spelling, and Orthography.

College Student Group.

TOD-RAP subtest means and standard deviations are expressed in standard score units for at-risk and non at-risk college groups. Table 8 displays these data by group. MANOVA results indicate a statistically significant, $F(1, 186) = 8.44, p < .001$, composite mean difference between non at-risk and at-risk students. Specific subtest mean score differences were investigated using post hoc ANOVAs; alpha level was set to .02, based on the Bonferroni correction. These ANOVA results are found in Table 9. Again, all at-risk means are lower than non at-risk means, and post hoc Fs show significantly higher scores for non at-risk students on four of the five TOD-RAP subtests. These subtests include Listening Vocabulary, Spelling, Rapid Letter Matching, and Orthography.

Research Question 4

Both correlational coefficients and multiple regression analyses show the relationship between reading achievement, as determined by WJ-III Reading Fluency, WRAT-3 Reading, WRAT-3 Spelling, and TOSWRF scores, and TOD-RAP subtest performance. Correlations are shown in Table 10. All correlation coefficients between the WJ-III Reading Fluency subtest and the TOD-RAP subtests are significant at the .01 level. These correlation coefficients range from .18 to .42, with the highest correlation occurring between WJ-III Reading Fluency and TOD-RAP Reading Comprehension. Correlations between WRAT-3 Reading and TOD-RAP subtests range from .01 to .47, with significant correlations occurring between the WRAT-3 Reading and TOD-RAP

Phonological Decoding, Spelling, and Orthography ($p < .01$). WRAT-3 Reading scores correlate most highly with TOD-RAP Spelling. Correlations between the WRAT-3 Spelling subtest and TOD-RAP subtests range from .08 to .57. Correlations between WRAT-3 Spelling and TOD-RAP Phonological Decoding, Reading Comprehension, Spelling, and Orthography are statistically significant. WRAT-3 Spelling also correlates most highly with TOD-RAP Spelling. Lastly, correlations between TOD-RAP subtests and the TOSWRF range from .12 to .60. TOD-RAP Listening Vocabulary is the only subtest that does not correlate significantly with TOSWRF scores. Phonological Decoding, Spelling, Rapid Letter Matching, and Orthography correlate significantly at the .01 level, while Reading Comprehension correlates significantly at the .05 level. TOSWRF scores have the strongest correlation with TOD-RAP Orthography.

In summary, TOD-RAP Phonological Decoding, Spelling, and Orthography significantly correlate with all four reading achievement operationalizations. TOD-RAP Reading Comprehension correlates with three of the four operationalizations of literacy (WJ-III Reading Fluency, WRAT-3 Spelling, and TOSWRF), while TOD-RAP Rapid Letter Matching correlates with two (WJ-III Reading Fluency and TOSWRF). TOD-RAP Listening Vocabulary only correlates significantly with WJ-III Reading Fluency scores.

The extent to which TOD-RAP cognitive processing measures predict reading achievement was determined by five stepwise multiple regression analyses. WJ-III Reading Fluency, WRAT-3 Spelling, WRAT-3 Reading, and the TOSWRF served as dependent variables. Four of the five regressions included only primary/secondary students. College students did not complete the TOSWRF or WRAT-3 subtests. All four analyses using primary/secondary students included all TOD-RAP subtests as

independent variables. One additional multiple regression used the WJ-III Reading Fluency subtest as the criterion with only college-aged participants. This analysis excluded TOD-RAP Reading Comprehension as an independent variable, but included all other TOD-RAP subtests.

The TOD-RAP Spelling subtest is the most powerful predictor of primary/secondary students' reading achievement. This subtest is the only TOD-RAP measure that predicts these students' performance on the WJ-III Reading Fluency and the WRAT-3 Reading subtests (R^2 adj. = .32; $p < .001$, R^2 adj. = .22; $p < .001$, respectively). TOD-RAP Spelling (R^2 adj. = .32; $p < .001$) also predicts these students' WRAT-3 Spelling subtest scores, accounting for 32% of the variance. TOD-RAP Phonological Decoding accounts for an additional 6% of the variance in WRAT-3 Spelling scores (Table 11). Two measures predict primary/secondary school students' TOSWRF scores (Table 12). TOD-RAP Orthography accounts for 35% of the variance, and TOD-RAP Spelling adds an additional 5%. In summary, three of the six TOD-RAP subtests predict various areas of primary/secondary students' reading achievement. TOD-RAP Spelling predicts performance significantly for all four reading achievement measures ($p < .05$), while TOD-RAP Phonological Decoding and TOD-RAP Orthography predict WRAT-Spelling and TOSWRF scores, respectively, ($p < .05$).

Reading achievement for college students was defined only by WJ-III Reading Fluency scores. Multiple regression analyses indicate that four of the five TOD-RAP subtests predict WJ-III Reading Fluency scores for these students. These results are shown in Table 13. Rapid Letter Matching (R^2 adj. = .17; $p < .001$) accounts for 17 % of the variance, Orthography accounts for an additional 7%, Spelling adds an additional 2%,

and Listening Vocabulary adds an additional 2%. Phonological Decoding is the only TOD-RAP subtest that does not predict WJ-Reading Fluency scores for these college students.

6. DISCUSSION

Based on the work of Padget et al. (1996) and Bell et al. (2003), it is possible to generate a comprehensive profile of dyslexia that can be operationalized by use of various published tests. However, few test batteries, and no group-administered battery, adequately measure all achievement factors characteristic of dyslexia. Current means of screening for reading difficulties, including the Dynamic Indicators of Basic Early Literacy Skills (DIBELS; Good & Kaminski, 2006), are individually administered, decreasing time-efficiency. The purpose of the present study was to develop a more efficient instrument, the Test of Dyslexia-Rapid Assessment Profile (TOD-RAP), and determine the psychometric properties of the individual subtests.

The TOD-RAP is designed to identify students ages 5 to adulthood that display characteristics of dyslexia. The intended purpose of this instrument is not to diagnose persons with dyslexia. Instead, this instrument is designed to identify persons displaying typical characteristics of this disorder and other reading difficulties so additional testing may be conducted and / or early interventions can be implemented to prevent reading failure. This instrument can also be used at the high-school and college levels to identify students displaying characteristics of dyslexia. As previously mentioned, persons with dyslexia often exhibit difficulty learning a foreign language (Crombie, 1997; Miller-Guron & Lundberg, 2000; Spolsky, 1989). Many high-schools and colleges require enrollment in foreign language courses and proper accommodations should be made for persons with dyslexia. The TOD-RAP could be the first step in the provision of such services.

Results provide relatively strong support for the instrument's reliability and validity for use with children, adolescents, and adults. Proper use of this instrument should help fulfill the NICHD's (1993) goal of identifying children with dyslexia early in their schooling, implementing programs to reduce their reading difficulties, and in turn reducing the further development of emotional, academic, and intellectual problems. Early identification and intervention of reading difficulties provides the best benefits for students (Gersons-Woldfensberger & Ruijsenaars, 1997). This instrument could also help ensure that foreign language students exhibiting characteristics of dyslexia be identified, further assessed, and provided with the appropriate accommodations and services. This screening method could help increase affect and success in learning a second language. However, future test revisions and research studies are needed before this instrument is introduced into the field. Limitations and suggestions will be discussed.

Reliability: Internal Consistency

The first psychometric property evaluated was internal consistency. Four of the six TOD-RAP subtests display reliability coefficients greater than .90, confirming that they possess adequate internal consistency: Reading Comprehension, Spelling, Rapid Letter Matching, and Orthography. Interestingly, these four subtests are also the subtests with the greatest number of individual items. The number of items for each of these subtests ranges from 45 to 75. Further, the two subtests with the lowest reliabilities also contain the fewest number of items. These subtests, Listening Vocabulary and Phonological Decoding, contain only 30 items. The internal consistency coefficients for these subtests fall just below the suggested .80 criterion with both subtests yielding .79 reliability coefficients.

Another related explanation for the inadequate reliability yielded by the Phonological Decoding subtest is restriction in range, due to limited ceiling. For this measure, the mean raw score for all participants was 27.26 out of a possible 30, with a standard deviation of 2.93. These data suggest less variance among participants' scores as compared to the other TOD-RAP subtests. Lack of variance is even more pronounced for college age students. This portion of the sample obtained a mean Phonological Decoding score of 28.08 with a standard deviation of 1.59. This decreased variance could simply be a function of the construct itself. Most people typically develop their phonological decoding skills by the end of elementary school, with little improvement occurring during adolescence and adulthood. When only elementary students are examined, the TOD-RAP yields an adequate internal reliability coefficient of .84 ($n = 23$). This result supports the reliability of this instrument and corresponds to the nature of the construct being measured. However, revisions may be necessary if the subtest is to be used with high school and college students.

Furthermore, the reliability of the Listening Vocabulary subtest may have been reduced because of extreme difficulty, increasing the likelihood of guessing ($M = 22.47$, $SD = 3.72$). Participants often complained during this subtest, stating that they were unsure of the meanings of the four choices provided. Increased guessing could have compromised the integrity of the subtest, introduced error into the score, and decreased the reliability coefficient.

Overall, the TOD-RAP displays moderate to strong internal consistency. Two subtests, Listening Vocabulary and Phonological Decoding, fail to yield a minimum reliability coefficient of .80 or higher. As noted, these subtests are also significantly

shorter than the four subtests yielding strong reliability coefficients. It may be necessary to increase the length of these tests (and the ceiling of one) to create acceptable internal consistency. The Phonological Decoding subtest's reliability may not increase due to decreased variance that is inherent in the construct being measured. This decreased reliability should not be seen as a flaw in the instrument, seeing as reliability increases when only elementary aged participants are examined. Future studies using younger samples should be conducted to determine the true reliability of this subtest.

Reliability: Stability

The second research question examined the stability of TOD-RAP subtests over a one to four week test-retest interval. Five of the six TOD-RAP subtests yield stability coefficients greater than .80, suggesting strong test-retest reliability. However, test-retest reliability coefficients tend to decrease with longer pre- to post-test intervals, and TOD-RAP subtest stability coefficients may vary as a function of the test-retest interval. During future pilot testing or standardization of the TOD-RAP, longer test-retest intervals should be utilized to provide further evidence of score stability over time.

One TOD-RAP subtest, Phonological Decoding (.70), exhibits borderline low stability. Interestingly, Phonological Decoding also yields lower internal consistency. The presence of inadequate internal consistency and test-retest reliability suggests psychometric problems. As previously stated, limited variability (poor ceiling) may account for lower reliability coefficients. Eighty-nine percent of all participants earned a Phonological Decoding raw score of 25 (out of a maximum of 30) or higher. When separated by age group, the ceiling effect is even more evident. Fifty-six percent of all primary/secondary students obtained a score of 25 or higher, while 98 % of college

students obtained scores in this range. Interestingly, 43% of college participants obtained a score of 29 or 30. These results suggest that the TOD-RAP Phonological Decoding subtest is too easy for college students and does not produce much variability above primary grades. College students comprised 80% of this sample, and the ceiling effect for this population likely reduced reliability. If the TOD-RAP continues to be used with the college population, the Phonological Decoding subtest will need to be altered in order to obtain a reliable measure of this construct.

Validity: The Relationship between At-Risk and Non At-Risk Students' TOD-RAP Scores

Investigation of the discriminant validity of the TOD-RAP using multivariate analyses of variance reveals that students classified as at-risk for reading difficulties display significantly lower composite means on TOD-RAP subtests when compared to their non at-risk counterparts at both the primary/secondary and collegiate levels. Post hoc analyses of variance show specific pairwise mean differences. Non at-risk primary/secondary students exhibit significantly higher composite means than at-risk primary/secondary students on three of the six TOD-RAP subtests. These subtests include Phonological Decoding, Spelling, and Orthography. TOD-RAP Listening Vocabulary, Rapid Letter Matching, and Reading Comprehension scores do not distinguish as well as the other subtests between poor and average/above average readers at the primary/secondary level. However, at-risk status was defined only on the basis of scores on the WJ-III Reading Fluency subtest for this age group. It is possible that this subtest does not reflect as much content overlap with the TOD-RAP Listening Vocabulary, Rapid Letter Matching, and Reading Comprehension subtests. Furthermore, TOD-RAP

Listening Vocabulary may be less sensitive because of reduced variability. Different operationalizations of at-risk and non at-risk statuses may have yielded different results.

At the college level, non at-risk students exhibit significantly higher composite means than at-risk students on the TOD-RAP Listening Vocabulary, Rapid Letter Matching, Spelling, and Orthography subtests. Phonological Decoding is the only TOD-RAP subtest administered to college students that does not yield a significant difference between at-risk and non at-risk groups. Again, this subtest may be less sensitive due to its poorer psychometric quality.

Overall, at-risk students consistently earn significantly lower scores on two TOD-RAP measures: Spelling and Orthography. TOD-RAP Listening Vocabulary and Rapid Letter Matching were administered to all participants, but significant differences only emerged between at-risk and non at-risk college student scores. TOD-RAP Phonological Decoding was also administered to all participants, but a significant difference between at-risk and non at-risk students was found only at the primary/secondary school level. TOD-RAP Reading Comprehension was administered only to primary/secondary students, and did not yield a significant difference between at-risk and non at-risk groups. As previously stated, non at-risk and at-risk groups may not be adequately defined using WJ-III Reading Fluency subtest scores. Other operationalizations of at-risk status, based on more comprehensive reading assessments, should be investigated.

Based on significant differences found between non at-risk and at-risk students' composite means, the TOD-RAP appears to be effective at distinguishing between these two student groups. This discriminant validity supports the use of this instrument as a screening tool for identifying students potentially at risk for reading difficulties. The low

reliability of the Listening Vocabulary and Phonological Decoding subtests may have limited their capacity to discriminate for specific age groups. Also, Phonological Decoding does not possess an adequate ceiling. This flaw may explain why significant differences were found in the younger sample, but not the college group (ie. items were too easy for all college students). Rapid Letter Matching displays discriminant validity for college students, but not primary/secondary students. This speeded subtest contains an inherent fluency component. Younger students are still working to develop reading fluency, potentially explaining why this type of task may be less effective at distinguishing at-risk and non at-risk students at the primary/secondary level. College students, on the other hand, have had more time to refine these skills, possibly accounting for the larger gap found between these at-risk and non at-risk students. Furthermore, the Reading Comprehension test, although not significant in these multivariate analyses of variance, correlates with three of the four operationalizations of reading achievement and may still be useful for discriminating between at-risk and non at-risk students. Further research using varying definitions of reading achievement need to be investigated before concluding the discriminant capabilities of this subtest.

Interestingly, 74% of those individuals identified as at-risk through these analyses were male, while 63% of non at-risk students were female. These results provide preliminary support for the hypothesized sex difference between the base rates of dyslexia (Lawrence & Carter, 1999; NICHD, 1993; Rooney, 1995; Shaywitz, 1996), and contradict the IDA's (2006) stance that the disorder affects men and women equally. This study, however, only looks at persons at-risk for the disorder. Although our definition of at-risk resembles that of dyslexia, further research investigating sex

differences in persons actually diagnosed with dyslexia are needed. Such research can help resolve the conflict surrounding gender issue and provide further support for the discriminant validity of the TOD-RAP.

Validity: The Relationship between TOD-RAP Subtest Scores and Reading Achievement

To further investigate the relationship between students' TOD-RAP subtest scores and overall reading achievement, defined as performance on four standardized reading measures, multiple regression analyses were conducted. Spelling is the TOD-RAP subtest most predictive of students' reading achievement. However, four other TOD-RAP subtests also display predictive capabilities. These subtests include Listening Vocabulary, Phonological Decoding, Rapid Letter Matching, and Orthography. TOD-RAP Reading Comprehension is the only subtest that does not appear to add any predictive utility.

College students' reading achievement was defined by WJ-III Reading Fluency subtest scores only. Four of the five TOD-RAP subtests analyzed for the college-aged portion of the sample account for unique variance in WJ-III Reading Fluency scores. These subtests include Rapid Letter Matching, Orthography, Spelling, and Listening Vocabulary. The only subtest not accounting for any unique variance in college students' WJ-III scores is TOD-RAP Phonological Decoding. However, as seen in Table 14, scores on this subtest significantly correlate with the WJ-III Reading Fluency subtest ($r = .17, p < .01$). As previously mentioned, low score variability and a potential ceiling effect on this subtest hinder its utility and predictive capabilities with the college population.

At the primary/secondary level, TOD-RAP subtests are not as predictive of reading achievement. For this portion of the sample, multiple regression analyses shows

only Spelling to be predictive of all four operationalizations. Fewer TOD-RAP subtests may enter these predictive equations due to the significantly smaller number of primary/secondary school students as compared to college participants.

Interestingly, significant correlations between primary/secondary students' TOD-RAP and WJ-III Reading Fluency scores exist for five of the six subtests administered, suggesting that other subtests probably possess predictive capability. Similarly, only TOD-RAP Orthography and Spelling and TOD-RAP Spelling and Phonological Decoding predict TOSWRF and WRAT-3 Spelling scores, respectively. However, TOD-RAP Reading Comprehension and Rapid Letter Matching significantly correlate with TOSWRF scores, while Reading Comprehension also correlates significantly with WRAT-Spelling Scores. Despite lacking unique predictive capabilities for the four operationalizations, these subtests are related to overall reading achievement. Listening Vocabulary is the only TOD-RAP subtest that does not appear to be significantly related. This finding may result from this subtest's decreased internal consistency and not the listening vocabulary construct. Future research should investigate the predictive capabilities of TOD-RAP subtests using a larger sample of primary/secondary students. Furthermore, the Listening Vocabulary subtest may need to be revised and reinvestigated in order to truly measure the intended construct.

Overall, the TOD-RAP Reading Comprehension subtest is the only subtest that does not predict any aspect of reading achievement as defined in this study. However, this subtest yields significant correlations with three of the four operationalizations of reading achievement. These operationalizations include only minimal passage comprehension requirements, possibly accounting for this exclusion. For instance,

WRAT-3 Reading requires students to pronounce listed words. This task more closely resembles a word identification, rather than reading comprehension, task. In fact, no comprehension is needed for accurate responding on this subtest.

WRAT-3 Spelling tasks require students to attend to an orally presented word, listen to its use in a sentence, and then write the correct spelling of the specified word. The only comprehension ability required by this task is in the determination of which spelling of the specified word fits the context of the given sentence. The number of words with ambiguous spellings is minimal, and deficits in comprehension likely do not affect WRAT-3 Spelling scores. This task more specifically requires the ability to identify spoken phonemes and translate those units of language into a correctly spelled word. These requirements are consistent with the finding that TOD-RAP Phonological Decoding and Spelling subtests are predictive of WRAT-3 Spelling scores.

The WJ-III Reading Fluency subtest also requires minimal passage comprehension. In this speeded task, students read sentences and determine the accuracy of the given statements by circling “yes” or “no” (to indicate whether the sentence is true). This task does require some level of comprehension. However, the student only has to remember the content of one sentence at a time, not the content of lengthy passages as in TOD-RAP Reading Comprehension. Scores on the WJ-III Reading Fluency scores more likely reflect the speeded aspect of reading and are less sensitive to comprehension deficits. Similarly, passage comprehension is not required by the TOSWRF. This test requires students to quickly place slashes between words presented in a row without spaces. Scores likely are more reflective of the speeded aspects of reading and spelling

ability than reading comprehension. This relation would explain the utility of the TOD-RAP Spelling and Orthography subtests in predicting TOSWRF scores.

Before concluding that TOD-RAP Reading Comprehension does not predict students' reading achievement, operationalizations of reading achievement that include a stronger reading comprehension component must be analyzed. Presumably, this subtest does not appear predictive because the current operationalizations, not due to a flaw in the instrument. TOD-RAP Reading Comprehension does correlate with three of the four reading achievement measures, and is important in understanding the relationship between reading comprehension and achievement.

Summary and Implications

Generally, data analyses support the use of the TOD-RAP as a reliable screening tool for identifying students at-risk for reading difficulties. Four of the six subtests display strong internal consistency, with the remaining two falling just short of the defined criterion. These two subtests are significantly shorter than the other four, and their internal consistencies would likely increase by extending the subtests' lengths. Furthermore, five of the six subtests display stability over time. Phonological Decoding is the only TOD-RAP subtest yielding both inadequate internal consistency and stability. The lack of variance and potential ceiling effect among the students' scores may be responsible for this lower reliability. Test revisions may be needed to refine this specific subtest and increase its consistency.

Similarly, data analyses confirm the validity of this instrument. Significant mean score differences exist between at-risk and non at-risk students on four of the five TOD-RAP subtests administered to the college group and three of the six subtests administered

to primary/secondary school students. No significant score differences exist on the TOD-RAP Listening Vocabulary, Rapid Letter Matching, and Reading Comprehension subtests for primary/secondary school students. In addition, no significant score differences exist on the TOD-RAP Phonological Decoding subtest for college students. The lack of a significant difference for these subtests may result from incomplete definitions of at-risk and non at-risk statuses, subtest limitations, and / or item content. Further research investigating alternative definitions of at-risk and non at-risk statuses will need to be conducted to further determine the discriminant validity of these two subtests.

Furthermore, all TOD-RAP subtests except Reading Comprehension predict at least one operationalization of reading achievement. As previously mentioned, none of these operationalizations measure comprehension, explaining why the this subtest does not predict performance on these measures. Spelling is the most consistent predictor, accounting for unique variance for all operationalizations of reading achievement at both the primary/secondary and college levels. TOD-RAP Phonological Decoding and Orthography also adds to the prediction of various aspects of primary/secondary students' reading achievement. All but one subtest administered to college students account for unique variance in their reading achievement. Phonological Decoding does not predict reading achievement at the college level. Problems inherent in the operationalizations of reading achievement or within the test itself may hinder its predictive capabilities. Further research investigating diverse definitions of reading achievement must be conducted to determine where the problem lies.

Despite its limitations, the TOD-RAP generally possesses the utility to measure the key constructs (listening comprehension, reading comprehension, word analysis, word recognition, phonological decoding, spelling, and processing speed) that current researchers agree define dyslexia (Bell et al., 2003; IDA, 2006; Padget et al., 1996; Wolf, 1999). The instrument's focus on phonological decoding, word recognition, and spelling is most closely aligned with the Padget et al. (1996) and IDA (2006) definitions, while also including measures of processing speed as suggested by Wolf (1999). A reading comprehension measure is used to identify possible secondary effects of deficits in the aforementioned areas (IDA, 2006; Padget et al., 1996). Overall, the TOD-RAP provides a way to conduct comprehensive and group screenings for dyslexia.

Limitations and Future Research

Several of the limitations associated with this research result from the limited sample tested. First, this sample contained four times as many college students as it did primary/secondary school students. Although the test is intended for use with all age groups, it would most likely be used more at the primary/secondary school level. Research using larger samples of primary/secondary school students is needed to confirm the instruments reliability and validity with this age group. Second, all participants were selected from primary/secondary schools and a university located in two counties of East Tennessee. Future research should involve a broader sample in order to ensure generalizability of results.

As previously stated, operationalizations of at-risk status and reading achievement may be too narrow. These imprecise operationalizations may account for the decreased strength of validity analyses. Research should be conducted with persons already

diagnosed with dyslexia to ensure that the TOD-RAP subtests truly identify persons at-risk for the disorder. Also, further research investigating different operationalizations of reading achievement must be conducted to determine whether test content revisions are necessary. Specific test revisions may be needed to increase the reliability of the TOD-RAP Listening Vocabulary and Phonological Decoding subtests. However, future studies must be conducted to determine the exact nature of any revisions.

In conclusion, the TOD-RAP appears to be a promising instrument that could provide early identification of students at-risk for reading difficulties. The new response to intervention model of service delivery emphasizes the need for such screening devices and early intervention for identified problem areas (White, 2005). The TOD-RAP appears to meet the goals of this new model and would be a valuable tool for educators. Data analyses provide limited support for the reliability and validity of certain subtests of the TOD-RAP. Further test revisions, pilot testing, and standardization must be conducted before this instrument can be used in the field.

REFERENCES

References

- Bell, S. M., McCallum, R. S., & Cox, E. A. (2003). Toward a research-based assessment of Dyslexia: Using cognitive measures to identify reading disabilities. *Journal of Learning Disabilities, 36*(6), 505-516.
- Castles, A., & Coltheart, M. (1993). Varieties of developmental dyslexia. *Cognition, 47*, 149-180.
- Crombie, M.A. (1997). The effects of specific learning difficulties (dyslexia) on the learning of a foreign language in school. *Dyslexia, 3*, 27-47.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297-333.
- Ganske, K. (1994). *Developmental Spelling Analysis*. Barboursville, VA: Author.
- Gersons-Wolfensberger, D. C. M., & Ruijsenaars, W. A. J. J. M. (1997). Definition and treatment of dyslexia: A report by the Committee of Dyslexia of the Health Council of the Netherlands. *Journal of Learning Disabilities, 30*(2), 209-213.
- Good, R. H., & Kaminski, R. A. (2006). *Dynamic Indicators of Basic Early Literacy Skills*. Retrieved April 26, 2006 from <http://dibels.uoregon.edu/>
- Individuals with Disabilities Education Improvement Act. (2004).
- International Dyslexia Association. *Dyslexic FAQs*. Retrieved April 2, 2006, from <http://www.interdys.org>
- Joshi, R. M. (2003). Misconceptions about the assessment and diagnosis of reading disability. *Reading Psychology, 24*, 247-266.

- Joshi, R. M. (2005, February). Componential model of reading: Evidence based practices. Paper presented at the biennial meeting of the Fox Professional Development Conference, Murfreesboro, TN.
- Karlsen, B., & Gardner, E. F. (1995). *Stanford Diagnostic Reading Tests* (4th ed.). San Antonio, TX: Harcourt Brace.
- Kaufman, A. N., & Kaufman, S. L. (2004). *Kaufman Test of Educational Achievement* (2nd ed.). Circle Pines, MN: American Guidance Services.
- Krieger, K. (2000). *The relationship of rapid automatized naming (RAN) and word reading in normally developing readers*. Retrieved October 4, 2000, from <http://dldcec.org/Times151/rapidauto.html>
- Lawrence, B., & Carter, J. (1999). The identification and assessment of dyslexia: Class teachers' perceptions of the usefulness of the Dyslexia Screening Test for seven to eight year-old pupils. *British Journal of Special Education*, 26, 107-111.
- Lindamood, C. H., & Lindamood, P. C. (2004). *Lindamood Auditory Conceptualization Test* (3rd ed.). Chicago: Riverside Publishing.
- Lyon, G. R., Shaywitz, S. E., & Shaywitz, B. A. (2003). A definition of dyslexia. *Annals of Dyslexia*, 53, 1-14.
- MacGinitie, W. H., MacGinitie, R. K., Maria, K., & Dreyer, L. (2002) *Gates-MacGinitie Reading Tests* (4th ed.). Itasca, IL: Riverside.
- Manis, F. R., Seidenberg, M. S., Doi, L. M., McBride-Chang, C., & Petersen, A. (1996). On the basis of two subtypes of developmental dyslexia. *Cognition*, 58, 157-195.
- Markwardt, F. C. (1998). *Peabody Individual Achievement Test-Revised/Normative Update*. Circle Pines, MN: American Guidance Services.

- Mather, N., Hammill, D. D., Allen, E. A., & Roberts, R. (2004a). *Test of Silent Word Reading Fluency*. Austin, TX: Pro-ED, Inc.
- Mather, N., Hammill, D. D., Allen, E. A., & Roberts, R. (2004b). Examiner's manual. *Test of Silent Word Reading Fluency*. Austin, TX: Pro-ED, Inc.
- Mather, N., & Woodcock, R. W. (2001). Examiner's manual. *Woodcock-Johnson III Tests of Achievement*. Itasca, IL: Riverside Publishing.
- McCallum, R. S., & Bell, S. M. (2002). *Test of Dyslexia (TOD)*.
- McCallum, R. S., Bell, S. M., & McCane, S. J. (2005). *Test of Dyslexia-Rapid Assessment Profile (TOD-RAP)*.
- McGrew, K. S., & Woodcock, R. W. (2001). Technical manual. *Woodcock-Johnson III*. Itasca, IL: Riverside Publishing.
- Miller-Guron, L., & Lundberg, I. (2000). Dyslexia and second language reading: A second bite at the apple? *Reading and Writing: An Interdisciplinary Journal*, 12, 41-61.
- National Institute of Child Health and Human Development. (1993). Facts about dyslexia (NIH Publication No. 93-3534). Washington, DC: U.S. Government Printing Office.
- Newcomer, P. (2001). *Diagnostic Achievement Battery-3*. Austin, TX: Pro-Ed.
- Padget, S. Y., Knight, D. F., & Sawyer, D. J. (1996). Tennessee meets the challenge of dyslexia. *Annals of Dyslexia*, 46(51-71).
- The Psychological Corporation. (2001). *Weschler Individual Achievement Test*. San Antonio, TX: Harcourt Brace & Co.

- Rooney, K. J. (1995). Dyslexia reinvented: History, educational philosophy, and clinical assessment applications. *Intervention in School and Clinic, 31*(1), 6-15.
- Sattler, J.M. (1992) Assessment of children's intelligence and special abilities, (Third Edition). San Diego: Jerome M. Sattler, Inc.
- Sattler, J. M. (2001). *Assessment of children: Cognitive applications* (4th ed.). San Diego: Jerome M. Sattler, Publisher, Inc.
- Sawyer, D. J. (1987). *Test of Awareness of Language Segments*. Austin, TX: Pro-Ed.
- Seymour, P. H. K., & Evans, H. M. (1999). Foundation-level dyslexia: Assessment and treatment. *Journal of Learning Disabilities, 32*, 394-405.
- Shaywitz, S. E. (1996). Dyslexia. *Scientific American* (November), 98-104.
- Shaywitz, S. (2003). *Overcoming dyslexia: A new and complete science-based program for reading problems at any level*. New York: Alfred A. Knopf.
- Siegel, L. S. (1999). Issues in the definition and diagnosis of learning disabilities: A perspective on Guckenberger v. Boston University. *Journal of Learning Disabilities, 32*, 304-319.
- Sparks, R., & Ganschow, L. (1993). Perceptions of low and high risk students and students with learning disabilities about high school foreign language courses. *Foreign Language Annals, 26*(4), 491-508.
- Spolsky, B. (1989). *Conditions for second language learning*. Oxford: Oxford University Press.
- Torgesen, J. K., & Bryant, B. R. (2002). *Test of Phonological Awareness* (2nd ed. Plus). Austin, TX: Pro-Ed.

- Torgesen, J. K., & Wagner, R. (1998). Alternative diagnostic approach for specific developmental reading disabilities. *Learning Disabilities Research and Practice, 13*, 220-232.
- Torgesen, J. K., Wagner, R., & Rashotte, C. A. (1998). *Test of Word Reading Efficiency*. Austin, TX: Pro-Ed.
- Wagner, D. A. (1993). Myths and misconceptions in adult literacy: A research and developmental perspective. Retrieved from the Web May 23, 2005.
<http://www.nald.ca/fulltext/report3/rep21/rep21-01.htm>
- Wagner, R., Torgesen, J.K., & Rashotte, C. A. (1999). *Comprehensive Test of Phonological Processing*. Austin, TX: Pro-Ed.
- White, C. (2005). A better IDEA: The reauthorized federal law should help educators reach students faster, more effectively, and with less pointless paperwork. *NEA Today*, 34-35.
- Wilkinson, G. S. (1993a). *Wide Range Achievement Tests (3rd ed.)*. Lutz, FL: Psychological Assessment Resources, Inc.
- Wilkinson, G. S. (1993b). Examiner's manual. *Wide Range Achievement Tests (3rd ed.)*. Lutz, FL. Psychological Assessment Resources.
- Wolf, M. (1999). What time may tell: Towards a new conceptualization of developmental dyslexia. *Annals of Dyslexia, 49*, 3-28.
- Wolf, M., Bowers, P., & Biddle, K. (2000). Naming-speed processes, timing, and reading: A conceptual review. *Journal of Learning Disabilities, 33*(4), 387-407.

Woodcock, R. W. (1998). *Woodcock Reading Mastery Test-Revised/Normative Update*.

Circle Pines, MN: American Guidance Services

Woodcock, R. W. (1991). *Woodcock Language Proficiency Battery-Revised*. Chicago:

Riverside Publishing.

Woodcock, R. W. (1997). *Woodcock Diagnostic Battery*. Chicago: Riverside Publishing.

Woodcock, R.W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III Tests of*

Achievement. Itasca, IL: Riverside Publishing.

APPENDIX

Table 1

A Comparison of Current Dyslexia Definitions Across Three Constructs

Researcher	Phonology (Auditory)	Orthography (Visual-Spatial)	Fluency
Sattler, 1992	Poor phonological awareness and processing	Poor naming speed	Poor naming speed
Padget et al. 1996	Poor phonological awareness and manipulation, decoding, and spelling	Poor spelling	
Wolf, 1999	Poor phonological awareness	Poor naming speed	Poor naming speed
IDA, 2006	Poor decoding and word recognition	Poor word recognition accuracy	Poor word recognition fluency

Table 2

Description of the Test of Dyslexia-Rapid Assessment Profile (TOD-RAP) Subtests

Subtest	Description of Task
Listening Vocabulary	This task measures the ability to define words. The examinee marks the word matching the orally presented definition.
Phonological Decoding	This task measures the ability to identify nonsense words. The examinee selects the letter cluster corresponding to an orally presented sound from a list of four choices.
Reading Comprehension	This task measures the ability to comprehend written passages read silently. The examinee answers multiple-choice questions regarding passage content.
Spelling	This task measures the ability to determine the correct spelling of both phonetically regular and irregular words. The examinee selects the correct spelling of orally presented words from a list of four choices.
Rapid Letter Matching	This task measures the ability to quickly and accurately identify two identical stimuli from six similar choices. The examinee marks the matching stimuli. (3 minutes)
Orthography	This task measures the ability to accurately discriminate similar stimuli. The examinee selects the only real letter or word from a row of four choices. (3 minutes)

Table 3

Descriptive Statistics of the Test of Dyslexia-Rapid Assessment Profile

Subtest	<i>N</i>	<i>M</i>	<i>SD</i>
Listening Vocabulary	354	22.47	3.72
Phonological Decoding	355	27.26	2.93
Reading	67	35.28	8.64
Spelling	355	40.21	5.35
Rapid Letter Matching	355	49.45	11.12
Orthography	349	57.58	8.94

Note. These data represent means and standard deviations of the total number of items correct for each subtest.

Table 4

Descriptive Statistics for the Wide Range Achievement Tests (WRAT-3), Woodcock-Johnson (WJ-III) Reading Fluency subtest, and Test of Silent Word Reading Fluency (TOSWRF)

Subtest	<i>N</i>	<i>M</i>	<i>SD</i>
WJ-III Reading Fluency	355	102	13.23
WRAT-3 Reading	68	99	12.19
WRAT-3 Spelling	69	95	13.24
TOSWRF	66	95	12.37

Note. These data represent means and standard deviations of standard scores.

Table 5

Internal Consistency and Test-Retest Reliabilities of Test of Dyslexia-Rapid Assessment

Profile Subtests

Subtest	Internal Consistency	<i>N</i>	Test-Retest	<i>N</i>
Listening Vocabulary	.79	355	.88	81
Phonological Decoding	.79	355	.70	81
Reading Comprehension	.94	355	.87	43
Spelling	.91	355	.94	81
Rapid Letter Matching	.96	355	.94	81
Orthography	.92	355	.94	79

Table 6

Descriptive Statistics of the Test of Dyslexia-Rapid Assessment Profile for At-Risk and Non At-Risk Primary and Secondary School Students

Subtest	At-Risk Status	<i>N</i>	<i>M</i>	<i>SD</i>
Listening Vocabulary	At-Risk	17	100.11	14.82
	Non At-Risk	19	104.31	12.88
Phonological Decoding	At-Risk	17	94.89	14.16
	Non At-Risk	19	106.67	11.28
Reading	At-Risk	17	94.52	21.30
	Non At-Risk	19	106.83	11.25
Spelling	At-Risk	17	90.35	16.36
	Non At-Risk	19	108.80	12.49
Rapid Letter Matching	At-Risk	17	95.80	12.63
	Non At-Risk	19	106.40	13.78
Orthography	At-Risk	17	92.79	13.83
	Non At-Risk	19	105.68	13.53

Note. These data represent means and standard deviations of standard scores; At-Risk = Woodcock Johnson Reading Fluency standard score less than or equal to 85; Non At-Risk = Woodcock Johnson Reading Fluency standard score greater than or equal to 100.

Table 7

Post Hoc Analysis of Variance for Primary/Secondary School Students ($N = 36$)

Subtest	<i>df</i>	<i>F</i>	η^2	<i>p</i>
Listening Vocabulary	1, 35	.83	.02	.370
Phonological Decoding	1, 35	7.70	.19	.009*
Reading Comprehension	1, 35	4.84	.13	.035
Spelling	1, 35	14.65	.30	.001*
Rapid Letter Matching	1, 35	5.74	.14	.022
Orthography	1, 35	7.97	.19	.008*

Note. * = significant difference ($p < .017$).

Table 8

Descriptive Statistics of the Test of Dyslexia-Rapid Assessment Profile for At-Risk and Non At-Risk College Students

Subtest	At-Risk Status	<i>N</i>	<i>M</i>	<i>SD</i>
Listening Vocabulary	At-Risk	22	93.44	16.91
	Non At-Risk	165	101.92	15.04
Phonological Decoding	At-Risk	22	95.38	18.32
	Non At-Risk	165	101.87	12.56
Spelling	At-Risk	22	96.34	15.02
	Non At-Risk	165	103.57	13.28
Rapid Letter Matching	At-Risk	22	85.60	15.34
	Non At-Risk	165	104.41	14.75
Orthography	At-Risk	22	93.47	14.93
	Non At-Risk	165	104.22	12.30

Note. These data represent means and standard deviations of standard scores; At-Risk = Woodcock Johnson Reading Fluency standard score less than or equal to 85; Non At-Risk = Woodcock Johnson Reading Fluency standard score greater than or equal to 100.

Table 9

Post Hoc Analysis of Variance College School Students ($N = 187$)

Subtest	<i>df</i>	<i>F</i>	η^2	<i>p</i>
Listening Vocabulary	1, 186	5.98	.03	.015*
Phonological Decoding	1, 186	4.59	.02	.034
Spelling	1, 186	5.58	.03	.019*
Rapid Letter Matching	1, 186	31.26	.15	.001*
Orthography	1, 186	14.06	.07	.001*

Note. * = significant difference ($p < .020$).

Table 10

Zero-Order Correlations Between the Test of Dyslexia-Rapid Assessment Profile (TOD-RAP), Woodcock-Johnson Tests of Achievement (WJ-III), Wide Range Achievement Tests (WRAT-3), and the Test of Silent Word Reading Fluency (TOSWRF)

		1	2	3	4	5	6	7	8	9	10
1.Listening Vocabulary	Pearson										
2.Phonological Decoding	Pearson	.18**									
3.Reading Comprehension	Pearson	.48**	.42**								
4.Spelling	Pearson	.23**	.38**	.62**							
5.Rapid Letter Matching	Pearson	.08	.35**	.32**	.28**						
6.Orthography	Pearson	.19**	.22**	.49**	.45**	.35**					
7.WJ-III Reading Fluency	Pearson	.19**	.18**	.42**	.35**	.38**	.35**				
8.WRAT-3 Reading	Pearson	.01	.40**	.21	.47**	.13	.39**	.68**			
9.WRAT-3 Spelling	Pearson	.08	.55**	.28*	.57**	.12	.47**	.58**	.74**		
10.TOSWRF	Pearson	.12	.46**	.27*	.57**	.41**	.60**	.69**	.71**	.72**	

Note. These data represent correlations between standard scores. The first six subtests are from the TOD-RAP.;

* = significant correlation ($p < 0.05$, 2-tailed); ** = significant correlation ($p < 0.01$, 2-tailed).

Table 11

Prediction of Wide Range Achievement Test III Spelling from Test of Dyslexia-Rapid Assessment Profile Subtests ($N = 63$)

Factor	R	R^2 adj.	ΔR^2	ΔF	p -value
Spelling	.58	.32	.33	30.83	.001
Phonological Decoding	.63	.38	.07	6.65	.012

Note. adj. = adjusted; * $p < 0.05$, 2-tailed. ** $p < 0.01$, 2-tailed.

Table 12

Prediction of Test of Silent Word Reading Fluency from Test of Dyslexia-Rapid

Assessment Profile Subtests ($N = 60$)

Factor	R	R^2 adj.	$?R^2$	$?F$	p -value
Orthography	.60	.35	.36	33.35	.001
Spelling	.65	.40	.06	5.75	.020

Note. adj. = adjusted

Table 13

Prediction of College Students' Woodcock-Johnson III Tests of Achievement Reading Fluency Subtest Scores from Test of Dyslexia-Rapid Assessment Profile Subtests ($N = 280$)

Factor	R	R^2 adj.	ΔR^2	ΔF	p -value
Rapid Letter Matching	.42	.17	.18	59.77	.001
Orthography	.49	.24	.06	23.48	.001
Spelling	.52	.26	.03	10.42	.001
Listening Vocabulary	.54	.28	.02	6.90	.009

Note. u = unstandardized; s = standardized; adj. = adjusted

Table 14

Test of Dyslexia-Rapid Assessment Profile and Woodcock-Johnson III Reading Fluency

Correlations By Age

		WJ-III Reading Fluency	
		College	Primary/Secondary
Listening Vocabulary	Pearson	.21**	.19
	N	284	68
Phonological Decoding	Pearson	.17**	.32**
	N	285	68
Reading Comprehension	Pearson	-----	.42**
	N	-----	65
Spelling	Pearson	.34**	.57**
	N	285	68
Rapid Letter Matching	Pearson	.43**	.30*
	N	285	68
Orthography	Pearson	.37**	.39**
	N	281	66

Note. * = significant correlation ($p < 0.05$, 2-tailed); ** = significant correlation ($p < 0.01$, 2-tailed).

VITA

Sara Jean McCane was born in Union, KY on September 30, 1980. She graduated from Larry A. Ryle High School in 1998. From there, she attended college at Eastern Kentucky University where she majored in psychology and minored in mathematics and American Sign Language. After earning a Bachelor's of Science degree from Eastern, Sara moved to Knoxville, TN to begin graduate work in school psychology.

Sara is currently pursuing her doctorate in education at the University of Tennessee, Knoxville.