

COMPARISON OF THE DYNAMIC INDICATORS OF BASIC EARLY LITERACY
SKILLS TO THE COMPREHENSIVE TEST OF PHONOLOGICAL PROCESSING
AND IMPLICATIONS FOR CONSTRUCT VALIDITY

by

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Under the Direction of Noel Gregg

ABSTRACT

There is a great need for educators to focus on the development of early literacy skills as national assessment data indicate that less than half the children who enter into the fourth grade read proficiently (Center for Education Statistics, 2005). As a result of these statistics, federal mandates aim to close the achievement gap. In order to achieve this goal, educators need valid instruments to assess early literacy skills. The current research examined two sources of validity for the *Dynamic Indicators of Basic Early Literacy Skills* (Good & Kaminski, 1996) assessment. Concurrent evidence of validity was examined for the *Dynamic Indicators of Basic Early Literacy Skills* (Good & Kaminski, 1996) with the *Comprehensive Test of Phonological Processing* (Wagner, Torgesen, & Rashotte, 1999). The validity evidence included concurrent and factor analytic measures. The convergent and divergent relationship between the two literacy measures investigated supports the hypothesis that they are measuring similar latent constructs. A confirmatory factor analysis was conducted to investigate the dimensionality of the latent constructs (i.e. phonemic and orthographic awareness). The results indicated a strong relationship between measures of phonemic and orthographic awareness, and a weak relationship between phonemic and orthographic awareness with rapid naming tasks.

INDEX WORDS: Validity, Reliability, Construct validity, Concurrent validity, Phonemic awareness, Orthographic awareness, Reading assessments, Early Literacy, Kindergarten, Dynamic Indicators of Basic Early Literacy Skills (DIBELS), Comprehensive Test of Phonological Processing (CTOPP)

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B.S., Santa Clara University, 2000

M.Ed., Gonzaga University, 2002

A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial
Fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

2007

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ACKNOWLEDGEMENTS

Thank you to my family, Mom, Dad, Karen & Sergio, Brian & Lindy, Mikey, Henry, Mindy and Uncle Don for all of your unconditional love and support during my doctoral program. I also want to thank my best friend, Theresa, for her encouragement throughout my academic career.

I would like to thank my advisor, Dr. Noel Gregg. Not only did she make me a better student, a better writer, and a better professional, but she also made me a better person through her confidence in my abilities.

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CHAPTER I

INTRODUCTION

This study investigates markers of phonemic and orthographic awareness in the development of early reading skills in kindergarten students. Furthermore, the research provides information about the construct validity of the *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS, Good & Kaminski, 1996) and the *Comprehensive Test of Phonological Processing* (CTOPP, Wagner, Torgesen, & Rashotte, 1999). As federal policy mandates the use of effective assessment tools to determine those students in need of identification and intervention for reading difficulties, the current research focuses on relating early literacy needs to the measures associated with the variables that have shown to be predictive of successful reading skill development.

Focus on Early Literacy

A high percentage of children fail to meet standards of early reading. National reading assessment data indicate that less than half the children who enter the fourth grade read proficiently (Center for Education Statistics, 2005). As a result of these outcomes, federal policy calls for educators to look at the cause of early literacy problems more intensely as the *No Child Left Behind Act* aims to close the achievement gap by ensuring that all children read proficiently by the third grade (NCLB, U.S. Department of Education, 2002). In addition to the policies that require educators to identify individuals who have reading difficulties and to effectively intervene with these students, educators also need reliable and valid instruments to direct identification and intervention efforts

particularly with pre-readers (Hintze, Ryan, & Stoner, 2003; Speece, Mills, Ritchey, & Hillman, 2003). To this end, valid measures of early reading processes must have social value by providing outcomes that are meaningful and useful to address recommendations outlined in federal mandates (Messick, 1989). Furthermore, in addition to test scores, observable variables (e.g, exposure to literacy) that contribute to the development of reading must also be addressed.

The amount of exposure to literacy that an individual receives contributes to future reading success as some children come from literacy-rich environments where they are exposed to reading experiences many hours a day (Hart & Risley, 1995, Adams, 1990; Juel, 1988). Other children may have limited exposure to literacy-related activities, or they may have no experience with reading altogether. Evidence shows that children who come from families of a low socio-economic status, parents who lack an education, and the absence of motivating experiences related to reading are all part of the explanation of low literacy rates (Hart et al., 1995; Bradley & Browyn, 2002). Furthermore, a child who comes from a home that lacks a literacy-rich environment will most likely continue throughout the elementary school years without opportunities to increase the number of words spoken, read and written as well as the number of novel vocabulary words heard in his or her environment. Consequently, these children will likely fall behind their peers and, in turn, fail academic areas that require the use of literacy skills (Hart et al., 1995; Stanovich, 1986). Researchers suggest that word reading differs across individuals depending on the degree to which phonologic and orthographic features represent and define a word (Verhoeven & Carlisle, 2006); therefore, exposure to language and print can affect the development of the fundamental processes to read

proficiently. As a large amount of knowledge is acquired through reading-related activities, it is important for children to receive the appropriate instruction to learn how to read in order to become proficient readers as early as possible (Torgesen, 2000).

The interest in predicting early literacy reading skills is a response to the need for determining effective instructional methods to teach beginning readers with strategies that prevent reading difficulties (Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004). By identifying children who are in need of specific instruction, which may differ significantly from their peers, teachers can invest in preventative measures to specifically address the individual needs of each student in his or her classroom (Torgesen, 1998; Snow, Burns, & Griffin, 1998; Adams, 1990). Currently, preventative models use tiers of intervention with a primary focus on general education classrooms and a secondary focus on special education (Denton & Mathes, 2003; Fuchs, Fuchs, & Compton, 2005; Denton, Fletcher, Anthony, & Francis, 2006). Since the most effective methods to teach reading are essential at an early age, there is a critical need for assessments that can show the processes that must develop in order to achieve higher-order skills, such as reading parts of words and reading whole words (Chard & Dickson, 1999). With use of valid assessments and effective teaching strategies, a child can be taught basic early literacy skills, as learning how to read is a key component of a child's academic experience (Lyon, 1999; National Reading Panel, 2000; Denton et al., 2003; Lyon, Fletcher, Fuchs, & Chhabra, 2006). Although a large body of research supports effective instructional methods to help teach individuals to become proficient readers, the number of children failing to read proficiently by the fourth grade continues to be a serious concern (Denton et al., 2006).

In striving to ensure that students become proficient readers, the federal mandates suggest the use of response-to-intervention (RTI) in order to distinguish students who have reading problems (*Individuals with Disabilities Education Act*, 2004; Fuchs & Fuchs, 1998). Currently, RTI practices are used to determine if student performance below the proficient level is due to a disability rather than ineffective instruction (Fuchs, Mocks, Morgan, & Young, 2003). In addition to the cognitive deficits individuals may have, another primary cause of long-term reading disabilities for most students is lack of effective instruction (Vellutino et al., 1996; Vellutino, Scanlon, Small, & Fanuele, 2006). Although it is not distinguished in the research as an evidenced-based practice, educators employ RTI to determine effective methods to identify reading problems. Furthermore, if RTI will regularly be used as a method to determine learning disabilities, there will continue to be a need for evidence-based intervention, accurate measurement of the interventions and the use of evidence to guide instructional efforts (Gresham, 2002). Moreover, the treatment validity of the assessment procedures will need to be established to determine the extent to which the assessment produces the most beneficial results (Gresham, 2002). These outcomes contribute to effective planning for intervention.

As part of an effective intervention plan, there is a need for educators to use valid assessment tools that help determine the extent to which a child can show his or her knowledge of basic early literacy skills in order to reduce the number of individuals who have difficulties with reading (Lyon et al., 2001). These assessments provide data that are used to evaluate whether interventions are effective and also determine the efficacy on an individual level. The *Dynamic Indicators of Early Literacy Skills* (DIBELS, Good & Kaminski, 1996) are short, fluency-based measures modeled after curriculum-based

measurement (CBM, Deno, 1985) to provide markers of performance of early reading processes in the areas of phonological awareness, alphabetic understanding, and early reading fluency (Adams, 1990; Ehri, Nunes, Stahl, & Willows, 2001; Speece, Ritchey, Cooper, Roth, & Schatschneider, 2004; Torgesen, Wagner, & Rashotte, 1997). This assessment is prevention-oriented and school-based to indicate the development of individuals throughout critical periods during the early school years (Good, Gruba, & Kaminski, 2002).

The *Comprehensive Test of Phonological Processing* (CTOPP, Wagner et al., 1999) is also a prevention-oriented assessment that monitors the development of phonological processing. It contends to measure early reading skills, specifically three types of phonological processing: phonological awareness, phonological memory, and rapid naming. The authors of the CTOPP, Wagner, Torgesen and Rashotte, refer to these processing abilities as existing on a “phonological” level defined as, speech sounds that are combined into families called phonemes which “represent differences in speech sounds that signal differences in meaning” (CTOPP manual, Wagner, et al., 1999, 3). Although the CTOPP authors coin the term “phonological awareness” to represent the construct, the present research terms this idea as “phonemic awareness” which is defined in chapter two.

The authors of the CTOPP describe four uses for the test including: the identification of individuals who show actual achievement below expected, or typical achievement in measures of early reading skills, to identify strengths and weaknesses in types of phonological processing, to record benchmark progress of individuals receiving special education interventions in reading, and to be used as a measurement tool for

research on phonological processing (CTOPP manual, Wagner, et al., 1999). In order for these assessments to be useful, they must tap into the essential early literacy skills required for a successful reader.

Purpose of this Study

The first purpose of this study was to investigate the *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS) and the *Comprehensive Test of Phonological Processing* (CTOPP) for evidence of concurrent validity. The second purpose was to investigate the dimensionality of the latent constructs (i.e., phonemic awareness, orthographic awareness, and rapid naming) represented by the tasks across these two measures. Implications of these findings for literacy assessment and instruction are discussed in Chapter Five.

CHAPTER II

LITERATURE REVIEW

The purpose of this review is to describe the constructs of phonemic awareness and orthographic awareness as they relate to early reading skills and the need for further research. First, a description of the fundamental processes utilized in the development of early literacy skills is provided. Second, descriptions for the *Dynamic Indicators of Early Literacy Skills* (DIBELS, Good et al., 1998) and the *Comprehensive Test of Phonological Processing* (CTOPP, Wagner et al., 1999) tasks, and a rationale for using these measures as markers that are predictive of early literacy skills (i.e. phonemic awareness and orthographic awareness) are discussed. Finally, this review provides the theoretical foundation of the need for further research.

Early Literacy Abilities

Since the early 1970s, much research has focused on the types of processes that are essential to learn how to read (Adams, 1990). The evidence suggests that different processes are required to identify and understand sounds of spoken and printed words (Rosner & Simon, 1971; Ehri & Wilce, 1979; Goswami, 1993; Ehri, 1998, 2005). Two common latent constructs predictive of early reading performance are phonemic awareness and orthographic awareness (Scanlon & Vellutino, 1996; Adlof, Catts, & Little, 2006; Verhoeven & Carlisle, 2006; Torgesen, Wagner, & Rashotte, 1994; Speece et al., 2004; Kuo & Anderson, 2006; Speece et al., 2003; Fuchs & Fuchs, 1999; Byrne, Fielding-Barnsley, & Ashley, 2000; Fletcher & Satz, 1984; Scarborough, 1998b;

Vellutino et al., 1996; Torgesen, Alexander, Wagner, Rashotte, Voelher & Conway, 2001; Smith, Simmons, & Kame'enui, 1995). These latent constructs influence the accuracy and automaticity with reading performance. Reading fluency is often impacted indicating that these latent constructs are all critically connected to early reading acquisition. Although much of the literature is convergent about the types of skills necessary to learn how to read, the theories that debate the processes responsible for the development of early reading skills remain discrepant.

Phonemic Awareness

Phonemic awareness refers to the ability to manipulate and hear sounds or phonemes in words (National Reading Panel, 2000). It includes hearing and recognizing individual phonemes in words or phonemes in isolation. Research has provided evidence to support specific tasks that contend to measure phonemic awareness (Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993; Wagner et al., 1994; Goswami, 2001). Individuals with phonemic awareness can recognize and produce rhymes (e.g., 'sit' rhymes with 'fit') (Bradley, 1988; Lane, Pullen, Eisele, & Jordan, 2002), match sounds to words (e.g., 'dog' begins with '/d/') (Adams, 1990; Treiman, 1985, 1991, 1992; Goswami & Mead, 1992), blend phonemes (e.g., the word '/f/ /o/ /x/' is 'fox') (Adams, 1990; Lenchner, Gerber, & Routh, 1990), and delete phonemes from words (e.g., 'cat' without '/k/' is 'at') (Rosner, 1974; Yopp, 1988; Stahl & Murray, 1994). Someone who has phonemic awareness also has the ability to segment individual phonemes in words (e.g., the sounds in the word 'sit' are '/s/ /i/ /t/') (Liberman, Shankweiler, & Liberman, 1989; Lundberg, 1988). Phonemic awareness is evaluated in the absence of symbols

corresponding to the words or sounds presented. All of these tasks evaluating phonemic awareness fall under different levels of difficulty.

Different levels of phonemic awareness are represented by the tasks as they vary in levels of difficulty (Adams, 1990; Stahl & Murray, 1994; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004). Adams (1990) describes a five level hierarchy of phonemic awareness tasks. The first level represents the ability to hear sounds in words which is demonstrated by rhyming skills. The next level includes the ability to focus on sounds in order to identify rhyme and differences in sounds, groups of sounds, and vowel sounds that may differ in the number of syllables. The third level describes the ability to divide syllables into phonemes by blending. The fourth level of difficulty indicates the ability to segment whole words into phonemes. The final and most difficult level of phonemic awareness is the ability to manipulate phonemes by adding, deleting and moving phonemes to make a new word or a nonsense word. As seen throughout the growing body of literature, if an individual shows that he or she has phonemic awareness, there is an increased future probability that the individual will be able to successfully develop reading decoding skills (Adams).

The theory that supports phonemic awareness as a latent construct that functions as the primary predictor of reading achievement suggests that phonemic awareness is a unitary construct (Stanovich, Cunningham, & Feeman, 1984; Wagner & Torgesen, 1987; Schatschneider et al., 2004). A large, mounting body of correlational and experimental evidence has found strong predictive links between phonemic awareness and reading decoding with young children and phonemic awareness is identified as a unidimensional construct (Clay, 1967; Bradley & Bryant, 1978, 1983; Stanovich, Feeman, &

Cunningham, 1983; Maclean, Bryant, & Bradley, 1987; Juel, 1988; Stanovich, 1992; Torgesen, Wagner, & Rashotte, 1994; Smith, Simmons, & Kame'enui, 1998; Branum-Martin, Mehta, Fletcher, Carlson, Ortiz, Carlo et al., 2006; Gray & McCutchen, 2006). These studies indicate that training in phonemic awareness promotes early reading acquisition. However, although this does not imply that phonemic awareness is the only causal factor in reading development, it is a foundational skill that is necessary to learn how to read. This model of reading asserts that patterns of letter-sound correspondence will seem illogical without phonemic awareness and therefore, phonemic awareness instruction is critical in order to most effectively develop reading skills (Wagner & Torgesen, 1987; Torgesen et al., 1994; Branum-Martin et al., 2006). This perspective also argues that children who are learning to read must initially understand that speech sounds are the same as letters paired with sounds before students can acquire alphabetic understanding (Kame'enui, Carnine, Dixon, Simmons, & Coyne, 2002).

The results from numerous studies provide evidence that phonemic awareness is an accurate predictor of reading decoding development. Strong correlations between phonemic awareness skills and successful reading development indicate predictive and concurrent relationships (Wagner & Torgesen, 1987; Stahl & Murray, 1994; Wood, Hill, Meyer, & Flowers, 2005). Research has indicated that as markers of phonemic awareness are identified as early literacy skills develop, the absence of these markers may be the cause of failure to develop early literacy skills. Juel's (1988) findings indicated that first-grade students who had difficulty with phonemic awareness tasks including blending sounds to make words, segmenting words into individual phonemes, and identifying initial and final sounds in words continued to have reading difficulties four

years later. The students' reading problems kept them in the bottom 25 percent of their reading class when follow-up data were collected while the students were in the fifth grade. Additional studies suggest that phonemic awareness is specifically predictive of early reading outcomes (Badain, 1995; Wood et al., 2005). As research has shown that phonemic awareness is a key component in learning how to read, instruction in early reading focuses on explicit and extensive practice of phonemic skills (Wadlington, 2000; Yopp, 1992; Cunningham, 1990; Lane, 1994).

Researchers have found that instruction in phonemic awareness is effective not only for students who show difficulties in early literacy skills, but for any student learning to read (Ehri, 2004). In addition, it appears that phonemic awareness is essential to learning to read across many orthographies. These findings indicate the utility of a universal phonemic awareness instructional method for parents and teachers who may find it useful for children learning a new language (Ehri). Castiglioni-Spalten and Ehri (2003) found that phonemic awareness training combined with articulation training produced equally effective outcomes compared to articulation training alone. Students' abilities in phoneme segmentation were improved by phonemic awareness and articulation training. In another study, the National Reading Panel conducted a meta-analysis to evaluate the effects of phonemic awareness instruction on reading and spelling. Their research indicated that phonemic awareness instruction not only helped children acquire phonemic awareness, but word reading and reading comprehension benefits were also observed (Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh, & Shanahan, 2001). Since phonemic awareness is related to the acquisition of early literacy skills, systematic phonics instruction may be found helpful for beginning readers and

students who have difficulties in reading (Kame'enui, Carnine, Dixon, Simmons, & Coyne, 2002).

Orthographic Awareness

Another critical latent construct influencing the development of early literacy skills is orthographic awareness. Orthographic awareness is the ability to recognize that phonemes, the sounds in spoken words, have a systematic relationship with their symbolic representations, or graphemes (Adams, 1990; Goswami & Bryant 1990; Snow et al., 1998). With grapheme-phoneme correspondence, learners demonstrate emerging print knowledge by recognizing that phonemes are represented by relational units, including single letters and letter groups (Venezky, 2001; Landry, Swank, Smith, Assel, & Gunnewig, 2006). Mather and Goldstein (2002) expand the definition of orthographic awareness to include an individual's ability to have fluent access to graphemes. They define orthographic awareness as "the ability to establish detailed visual or mental representations of letter strings and words and to have rapid, fluent access to these representations" (Mather & Goldstein, 2002, 165; N. Mather, personal communication, February 8, 2007).

Common tasks used to evaluate an individual's orthographic awareness include naming letters by name and by sound (i.e. *DIBELS Letter Naming Fluency, LNF*, Kaminski et al., 1996), identifying printed letters that form blends (i.e. *DIBELS Nonsense Word Fluency, NWF*, Kaminski et al.), and decoding a string of phonemes to make a whole word (i.e. *DIBELS Oral Reading Fluency, ORF*, Kaminski et al.; *Test of Word Read Efficiency, TOWRE*, Torgesen, Wagner, & Rashotte, 1997). There is a large and growing body of literature indicating that orthographic awareness is necessary for the

development of early reading (O'Connor & Jenkins, 1999; Scarborough 1998b; Van der Leij, & Morfidi, 2006).

Researchers have also identified a core deficit in naming-speed processes for some individuals who demonstrate difficulty on orthographic awareness tasks. A common measure of naming-speed is the *Rapid Automated Naming (RAN)* test developed by Denckla (Denckla, 1972; Denckla & Rudel, 1974, 1976). On the RAN test a student is required to rapidly name 50 visual stimuli from different categories such as colors (Wolf & Bowers, 1999). Rapid naming involves many different cognitive and language processes (e.g., phonemic awareness, orthographic awareness, semantic memory) depending on the specific requirements of the task (Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997; Havey, Story, & Buker, 2002). Bowers and Wolf (1993) explain that children who have both phonemic and naming-speed deficits will have more difficulties in acquiring reading skills as compared to children who do not have any or just one of the deficits. These difficulties are referred to as the 'double-deficit hypothesis' (Wolf et al., 1986; Wolf et al., 1994; Badain, 1997; Wolf et al., 1999; Wolf et al., 2002). Outcomes of naming-speed and fluency tasks provide valid indicators of early reading skills as supported by evidence (Blachman, 1984; Wolf et al, 2002; Speece, Mills, Ritchey, & Hillman, 2003). In learning how to read, phonemic awareness, orthographic awareness, and rapid automatized naming all appear to be essential for the identification and spelling of words.

Fluency

The term 'fluency' refers to a level of accuracy and automaticity. In the early stages of literacy development, it is assumed that a child's focus is on accuracy. Once

children become more automatic with the decoding and encoding of words, more attention can be directed on the meaning of words and text (LaBerge & Samuels, 1974; Ruddell, Ruddell, & Singer, 1994) Reading fluency refers to the identification and expression of grapheme-phoneme correspondences.

Evidence suggests that children must first develop specific processes in word phonemic awareness and orthographic awareness proficiency in order to reach proficiency with reading decoding and spelling (O'Shea, Sindelar, & O'Shea, 1985; Schwanenflugel, Hamilton, Kuhn, Wisenbaker, & Stahl, 2004; Kuhn, 2005). Researchers have demonstrated that students with reading disabilities demonstrate difficulty with phonemic awareness which consequently hinder the development of reading fluency (Bradley & Bryant, 1983; Torgesen et al., 1994; Foorman, Francis, Shaywitz, Shaywitz, & Fletcher, 1997; Wolf, O'Rourke, Gidney, Lovett, Cirino, & Morris, 2002). This indicates a close relationship between deficits in reading decoding accuracy and fluency.

Letter naming skills have also proven to be consistent predictors of early reading proficiency (Speece et al., 2003; Speece & Case, 2001; Badian, 1995; Scarborough, 1998a; Good et al., 1996). However, it is important to keep in mind that no single cognitive or language process is solely responsible for the development of reading decoding or comprehension (Snow et al., 1998; Wood et al., 2005). Although research supports letter naming knowledge as the strongest predictor of future reading ability, having accuracy of letter-naming may be only one component in facilitating reading (Speece et al., 2003; Scarborough, 1998). Another crucial skill to facilitate reading is knowledge of letter sounds (Speece et al., 2003; Ehri & Wilce, 1985; Treiman, Tincoff, Rodriguez, Mouzaki, & Francis, 1998) although letter-naming skills are fundamental in

learning letter sounds (Ehri, 1983). The relationship between letter name and letter sound knowledge and phonemic awareness skills has been widely researched to suggest that phonemic awareness and orthographic awareness have causal effects on one another (Ehri & Wilce, 1979; Wolf, 1984; Ehri, 2005).

The theory that supports phonemic awareness and orthographic awareness as latent constructs that both function as primary predictors of reading performance explains that phonemic and orthographic processes are bi-directionally integrated with one another (Ehri & Wilce, 1979, 1986; Perfetti, Beck, Bell, & Hughes, 1987; Stanovich, 1991; Goswami, 1993; Wolf, Pfeil, Lotz & Piddle, 1994; Burgess & Lonigan, 1998; Ehri, 2005). This model of reading describes reciprocal, causal effects between phonemic awareness and reading outcomes. Evidence for this model supports the idea that phonemic awareness is not sufficient by itself for children to learn how to read. In addition to phonemic awareness, grapheme-phoneme correspondence is necessary for reading acquisition (Foorman, Francis, Fletcher, Schatschneider, & Metha, 1998; Adams, 1990; Ball & Blachman, 1991; Ehri, 1998; Ehri, 2005; Molfese, Modglin, Beswick, Neamon, Berg, Berg, et al., 2006). Grapheme-phoneme correspondence allows a child to learn to read by visual cues along with remembering sounds (Ehri & Wilce, 1985). For example, letter-sound training taught along with phonemic awareness will help the child read nonsense words with orthographic awareness and it will also help the child remember how to read the word with phonemic awareness (Ehri, 1989; Adams, 1990; Shinn & Shinn, 2002; Molfese et al., 2006). As phonemic awareness and orthographic awareness influence one another, an interactive relationship is formed (Stanovich, 1991) and as a result early literacy skills develop given correct exposure and teaching.

The integration of orthographic and phonological awareness is also important in learning sight words (Ehri, 2005). Segmentation of words is the most important skill in the process of sight word reading. Once the relationship between phonemes and graphemes is established, the spellings are remembered (Ehri & Wilce, 1979; Ehri, 1986; Ehri, 2005). Phonological awareness is triggered when a word is presented while phonological awareness also facilitates word recognition when the recognition is slow (Stanovich, 1991; Wolf et al., 1994). Within both of these models of reading, the idea that causal roles exist may indicate specific problems in phonological and orthographic processes before they arise.

Reliability and Validity Evidence of Early Reading Measures

In order to investigate the development of phonemic awareness and orthographic awareness, researchers need reliable and valid assessments to measure development in early literacy skills. In this study, two measurement tools that purport to monitor the growth of early literacy development in kindergarten students were investigated for evidence of validity. The *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS, Good et al., 1996) are designed to measure phonemic awareness through accuracy and fluency levels in Initial Sound Fluency and Phoneme Segmentation Fluency and the DIBELS are also designed to measure phonemic awareness and orthographic awareness, through accuracy and fluency levels in Letter Naming Fluency and Nonsense Word Fluency.

The DIBELS Initial Sound Fluency subtest is designed to measure aspects of phonemic awareness (Good et al., 1996). The assessor conducts this measure by presenting the child with four pictures containing different initial sounds and asking him

to identify the picture with a specific initial sound. For example, the examiner presents one picture card with all four pictures on it and says the name of the picture while pointing to each one as the assessor orally labels, “cup,” “apple,” “sink,” and “lamp.” The child is asked to point to and/or say the word that starts with the sound “/a/” (Good et al., 1996). With the Initial Sound Fluency measure, the examiner calculates the amount of time it takes the child to identify or produce initial sounds after he is asked. At the end of the measure, the assessor takes the total number of seconds converting the value into correct initial sounds in a minute.

Reliability evidence of the *DIBELS Initial Sound Fluency* subtest includes alternate (equivalent) forms of the measure administered at two separate occasions. Good et al. (1996) and Good, Simmons, and Kame-enui (2001) reported reliability coefficients of .91 and .72 respectively, using equivalent forms of *Initial Sound Fluency* with one month in between administrations. These moderate to high correlations show that the *DIBELS Initial Sound Fluency* subtest is a reliable measure of early literacy skills at the beginning of kindergarten.

The *Phoneme Segmentation Fluency (PSF)* subtest of the DIBELS is designed to measure aspects of phonological awareness and morphological awareness. This test requires the child to segment a word presented to him orally. For example, the assessor asks the child to say all the sounds in the word “cat” and the child correctly responds with “/k/ /a/ /t/” (Good et al., 1996). The reliability estimates for equivalent forms of *Phoneme Segmentation Fluency* were .88 across studies showing a moderate correlation indicating a fairly reliable measure of phoneme segmentation skills (Good & Kaminski, 1996;

Kame'enui & Simmons, 2001; Kaminski et al., 1996; Olson, Wise, Johnson, & Ring, 1997).

A measure of phonemic awareness and orthographic awareness by assessing grapheme-phoneme correspondence is the *DIBELS Letter Naming Fluency* subtest. *Letter Naming Fluency* is an example of a fluency task that measures subword skills (Kame'enui et al., 2001; Kaminski et al., 1996; Olson, Wise, Johnson, & Ring, 1997). Reliability of this measure was examined by coefficients of stability and equivalence (Elliot, Lee, & Tollefson, 2001; Good et al., 1996; Good et al., 2001; Good, Kaminski, Laimon, & Johnson, 2000; Kaminski et al., 1996). The values for the coefficients of equivalence ranged from .79 to .93 showing moderate to high correlations for reliability with the *Letter Naming Fluency* subtest of the DIBELS. Additionally, the coefficient of stability value was $r=.90$ which provided evidence that the *DIBELS Letter Naming Fluency* subtest is a reliable measure of the letter-naming sub skill for reading.

The *Comprehensive Test of Phonological Processing* (CTOPP, Wagner et al., 1999) is designed to measure phonological awareness through tasks of *Elision*, *Blending Words*, *Sound Matching*, *Memory for Digits*, *non-word repetition*, *Rapid Color Naming* and *Rapid Object Naming*. The *Elision* subtest requires the child to repeat a word the examiner orally presents such as the word 'cup.' Then the child is asked to repeat the word a second time only without the phoneme identified by the examiner (i.e., Say 'cup' without saying '/k/') (Wagner et al., 1999). *Blending Words* involves listening to sounds produced on an audiocassette followed by the child stringing the phonemes together to make a word (i.e., the segmented phonemes '/m/ /oo/ /d/' make up the word 'mood') (Wagner et al.) .

The *Sound Matching* subtest uses initial and final sounds, in words represented in a picture book, to have the child indicate other words with the similar initial or final sounds (i.e., Which word starts with the same sound as in ‘mat?’ hat, meet, or bet?) (Wagner et al.). *Non-word Repetition* requires the child to reproduce nonsense words after hearing each word on the audiocassette and the *Memory for Digits* subtest involves repeating numbers heard on an audiocassette in the same order the digits were presented. *Memory for Digits* assesses phonological awareness for long-term memory phonologic codes (Wagner et al.), as well as short-term memory recall (Wagner et al.; Plake, Impara, & Spies, 2003).

Phonological memory and naming speed skills can also be predictive of reading performance (Stanovich, 1981). The *CTOPP Rapid Color Naming* and *Rapid Object Naming* subtests measure phonological awareness and rapid naming. They are conducted similarly as the student is instructed to name as quickly as possible a series of colors and objects presented to him or her within a specified amount of time (Wagner et al., 1999; Plake et al., 2003). The rapid naming tasks are separated into their own ‘factor’ or construct although the skill taps into more than just a rapid naming skill, as indicated in *RAN* tasks (Torgesen et al., 1997; Havey et al., 2002)

The developers of the CTOPP, Wagner et al. (1999), estimated reliability with measures of internal consistency and test-retest reliability. For both test forms (ages 5 and 6 and ages 7 to 24), coefficient alpha values for internal consistency had a mean of .87 with a range of .70 to .96 (Wagner et al.). A total of 91 individuals, with 32 children between the ages of 5 and 7 years were assessed to evaluate test-retest reliability. The correlation coefficients had a mean of .82 with a range of .68 to .97 for the 5 to 7 year-old

children (Wagner et al.). Although these values are adequate for reliability, further test-retest reliability estimates may add to the literature to support the belief that little to no development in phonological processing would occur between the administrations of the measures (Plake et al., 2003).

Throughout the past decade, a growing body of research has focused on demonstrating the validity of reading assessments to address the issue of low reading achievement in children (see Appendix A). In order to establish research of valid indicators of early literacy, Kaminski et al. (1996) evaluated the predictive and concurrent evidence of validity of *Phoneme Segmentation Fluency* and *Letter Naming Fluency* DIBELS measures in kindergarten to three criterion measures including the *McCarthy Scales of Children's Abilities* (McCarthy, 1972), the *Metropolitan Readiness Test* (Nurss & McGauvran, 1986), and the *Stanford Diagnostic Reading Test* (Karlsen & Gardner, 1985). Correlational data indicated moderate correlations between *Phoneme Segmentation Fluency* and the *McCarthy Scales of Children's Abilities* ($r=.57$), *Phoneme Segmentation Fluency* and the *Metropolitan Readiness Test* ($r=.68$), and a strong correlation between *Phoneme Segmentation Fluency* and the *Stanford Diagnostic Reading Test* ($r=.73$). All three criterion-related measures showed strong correlations with *Letter Naming Fluency* indicating that the DIBELS measure of *Letter Naming Fluency* is evidently predictive of reading skills.

Hintze, Ryan, and Stoner (2003) looked at the concurrent evidence of validity and diagnostic accuracy of the DIBELS and CTOPP. The researchers used correlation patterns to examine whether both assessments measured the same construct. They also developed a series of Receiver Operating Characteristic (ROC) curves to indicate the

diagnostic accuracy over cut scores for *DIBELS Initial Sound Fluency*, *Phoneme Segmentation Fluency*, and *Letter Naming Fluency* measures. Strong correlations between the DIBELS ISF and PSF subtests and the CTOPP phonological awareness subtests indicated that both assessment tools measure the relationship between phonological awareness skills and reading performance. The ROC curves showed that the *Letter Naming Fluency* and *Initial Sound Fluency* measures of the DIBELS indicated verifiable diagnostic accuracy in predicting the Phonological Awareness Composite score of the CTOPP. These results suggested that the DIBELS and CTOPP measure a construct relating to same process.

Another study investigated the reliability and validity of the *Dynamic Indicators of Basic Early Literacy Skills-Modified* (DIBELS-M, Elliott et al., 2001). The predictor measures included DIBELS-Modified *Letter Naming Fluency*, *Sound Naming Fluency*, *Initial Phoneme Ability*, and *Phoneme Segmentation Ability*. The *Woodcock-Johnson Psychoeducational Achievement Battery—Revised* (WJ-R; Woodcock, McGrew, Mather, & Schrank, 1990), *Broad Reading* and *Skills* clusters, the *Test of Phonological Awareness* for kindergarten (TOPA; Torgesen et al., 1994), the *Kaufman Brief Intelligence Test* (K-BIT; Kaufman & Kaufman, 1990), and the *Developing Skills Checklist* (DSC; CTB Macmillan/McGraw-Hill, 1990) were the criterion measures in this study. Reliability was evaluated through repeated test administrations and interrater reliability estimates. The researchers computed correlations between the average scores (referred to as “level” estimates over repeated test administrations for test-retest reliability) from each of the predictive measures and the average scores from each criterion measure. The results of the concurrent evidence of validity of DIBELS-M

indicated the strongest correlations of the level estimates for the DIBELS-M with the Skills Cluster scores of the WJ-R and the *Developing Skills Checklist*. The fluency composite score of the DIBELS-M (*Letter Naming Fluency* and *Sound Naming Fluency*) and the criterion achievement measures showed the strongest correlation although the Total Score and the Skills Cluster on the WJ-R showed the single strongest correlation ($r=.81$). The data also indicated that only 16% of the variance was explained by the DIBELS-M measures. The researchers conducted four hierarchical regression analyses that were all significant. The results of these analyses supported the use of the DIBELS-M to monitor student progress and identify kindergarten students who are at-risk for future reading difficulties.

The developers of the CTOPP assessed evidence of construct validity by conducting a confirmatory factor analysis along with age differentiation and group differentiation (Wagner et al., 1999). The researchers hypothesized that the latent constructs (or factors) the CTOPP subtests tapped into were phonological awareness, phonological memory and rapid naming. Factor loadings over .52 suggested that the hypothesized latent constructs were assessed by the CTOPP providing evidence of construct validity (Wagner et al., Plake et al., 2003).

Another subtest that evaluates phonemic awareness and orthographic awareness is *DIBELS Nonsense Word Fluency*. This subtest evaluates an individual's accuracy of identifying a string of phonemes using his or her grapheme-phoneme correspondence. The examiner presents a list of nonsense words and instructs the child to either segment the words (by phonemes) or read whole words (Wagner et al., 1999). Good et al. (1996) reported a reliability coefficient of .83 using equivalent forms of the *Nonsense Word*

Fluency measure with one month in between administrations. This moderate correlation establishes that the *DIBELS Nonsense Word Fluency* subtest is a reliable measure of early literacy skills in the middle of kindergarten.

Validity research with measures of phonemic awareness and orthographic awareness have added to the literacy literature (Havey et al., 2002). Hagan-Burke, Burke and Crowder (2006) conducted a study to examine the convergent validity of DIBELS with the *Test of Word Reading Efficiency* (TOWRE) (Torgesen, Wagner, & Rashotte, 1997). The researchers found low to moderate correlations between scores on the DIBELS subtests of *Letter Naming Fluency*, *Phoneme Segmentation Fluency*, *Nonsense Word Fluency*, and *Word Use Fluency* with the TOWRE subtests of *Phoneme Decoding Efficiency* and *Sight Words* subtests. The lowest correlation with the phonemic awareness subtests was between the *DIBELS Phoneme Segmentation Fluency* and the *TOWRE Sight Words* subtest ($r=0.32$) and the *DIBELS Phoneme Segmentation Fluency* and the *TOWRE Phoneme Decoding Efficiency* subtests ($r=.29$) showing some divergent relations. The results showed the strongest correlations between the *DIBELS Nonsense Word Fluency* measure and the TOWRE subtests, *Sight Words* ($r=0.73$) and *Phoneme Decoding Efficiency* ($r=0.74$). These researchers also examined convergent validity of DIBELS with phonological decoding skills and sight word reading fluency standardized measures.

Past research has examined the construct validity of early literacy assessments and implications of the reading skills necessary to become a skillful reader by examining concurrent and predictive evidence of validity. Concurrent and predictive validity studies with the DIBELS measures and other criterion measures are presented in Appendix B.

CHAPTER III

METHOD

As the *No Child Left Behind Act* mandates students to read proficiently by the end of third grade, understanding markers of literacy development is critical (U.S. Department of Education, 2004). Valid instruments are integral to the evaluation of student progress through literacy intervention. Cognizant of this directive, the purpose of this research was to investigate two sources of validity for the *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS, Good et al., 1996) as it is a commonly used measure to assess early literacy. First, evidence of concurrent validity for the DIBELS and the *Comprehensive Test of Phonological Processing* (CTOPP, Wagner et al., 1999) was investigated. Second, the dimensionality of the phonemic, orthographic, and rapid automatized learning subtests represented in these two early literacy assessments was investigated. Implications of the current research will contribute to effective intervention planning for individuals who are at risk for future reading difficulties.

Research Questions

The research questions addressed throughout the study were:

1. What is the concurrent evidence of validity of the *Dynamic Indicators of Basic Early Literacy Skills* (Good et al., 1996) with the *Comprehensive Test of Phonological Processing* (Wagner et al., 1999)?

Construct validity is met when structurally valid measures support expected convergent and divergent relations with measures of constructs external to the focal

measures (Benson, 1998; Benson & Hagtvet, 1996). The type of external validity investigated in this question is the concurrent evidence of validity of the DIBELS with another literacy test, the CTOPP, that include measures of similar constructs (i.e., phonemic and orthographic awareness). Summary statistics (i.e., means, standard deviations) and correlations were conducted to address this question.

2. Are phonemic and orthographic awareness as measured on the CTOPP and DIBELS distinguishable latent constructs or are these abilities so interrelated as to be indistinguishable?

A confirmatory factor analysis (CFA) was conducted using a single group analysis with the software program LISREL 8.8 (Jöreskog & Sörbom, 2006). The factor models were specified based on the theoretical model of reading that orthographic and phonemic processes are integrated (Stevens, 2002; Tabachnick & Fidell, 2001; Pearson & Moomaw, 2006; Thompson, 2004). All three models had a fixed variance of the factors with a value of one to scale the latent variables. Figures 1, 2 and 3 represent three, one-factor and two-factor CFA models used to investigate the factor structures of the DIBELS and CTOPP subtests.

The first model serves as a baseline, and it was used to investigate a two-factor model in which phonemic and orthographic awareness as two distinct latent constructs. Phonemic and orthographic awareness in this model are correlated with one another in this model. The subtests hypothesized to measure phonemic awareness were the DIBELS' *Initial Sound Fluency* and *Phoneme Segmentation Fluency* and the CTOPP's *Elision*, *Blending Words*, *Sound Matching*, *Memory for Digits* and *Nonword Repetition*. As the definition of phonemic awareness indicates that tasks requiring the manipulation

and hearing of sounds, the tasks listed require the students to listen and attend to the sounds produced by the assessors and respond with a different form of the sounds to show they can manipulate phonemes. The definition of phonemic awareness assumes that there is no visual component with these tasks, which underlies the theory of this hypothesis (National Reading Panel, 2000; Wagner et al., 1993; Wagner et al., 1994; Goswami, 2001).

The subtests hypothesized to measure orthographic awareness were the *DIBELS' Letter Naming Fluency* and *Nonsense Word Fluency* and the *CTOPP's Rapid Color Naming* and *Rapid Object Naming*. These tasks have visual components, which indicate that although they may be tasks that require phonemic awareness, they are also tasks that require knowledge that something visual represents the sounds the student produces in her or her response. The DIBELS tasks require the student to demonstrate knowledge that the symbols presented the target sounds produced, which indicates an ability of orthographic awareness according to the definition presented in chapter two. The CTOPP rapid naming tasks have a visual component as well; however, the colors and pictures of objects presented are not the symbols referred to in the definition of orthographic awareness. The theoretical justification for including the rapid naming subtests as tasks that have a relationship with orthographic awareness is supported by evidence that individuals who have difficulties in rapid naming have also shown to have deficits in orthographic tasks (Wolf et al., 1986; Bowers et al., 1993; Wolf et al., 1994; Badain, 1997; Wolf et al., 1999, Wolf et al., 2002).

CFA Model Specification 1 - Baseline

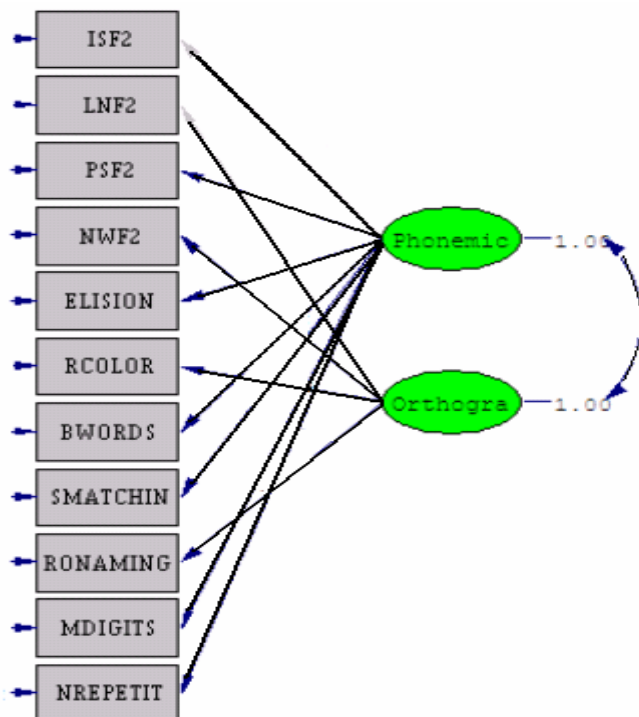


Figure 1. Model for the relationship between the DIBELS subtests: ISF2 = *Initial Sound Fluency*; LNF2 = *Letter Naming Fluency*; PSF2 = *Phoneme Segmentation Fluency*; NWF2 = *Nonsense Word Fluency*, the CTOPP subtests: ELISION = *Elision*; RCOLOR = *Rapid Color Naming*; BWORDS = *Blending Words*; SMATCHIN = *Sound Matching*; RONAMING = *Rapid Object Naming*; MDIGITS = *Memory for Digits*; NREPETIT = *Nonword Repetition*, with phonemic awareness and orthographic awareness as latent constructs that are correlated.

The second model was used to investigate the theory that phonemic awareness and orthographic awareness are not independent of one another whereas there are not two distinct dimensions but one. Consistent with previous research, phonemic awareness has a strong correlation with tasks that are related to early literacy skills (Perfetti et al., 1987; Wagner et al., 1993, 1994; Goswami, 2001; Nagy et al, 2006). Furthermore, experimental evidence has found that phonemic awareness has a causal role with the development of early reading skills; therefore, the research supports the theoretical

perspective that there is a predictive relationship between phonemic awareness and early literacy skills (Clay, 1967; Bradley et al., 1978, 1983; Stanovich et al., 1983; Maclean et al., 1987; Juel, 1988; Stanovich, 1992; Torgesen et al., 1994; Smith et al., 1998; Branum-Martin et al., 2006; Gray et al., 2006). Supportive of this evidence, model two demonstrates the relationship between phonemic awareness and tasks that contend to measure early reading skills developed by the time a child reaches the winter benchmark of kindergarten. Furthermore, model one becomes model two when the correlation between the two factors, phonemic and orthographic awareness, equals one which indicates that models one and two are nested models.

CFA Model Specification 2

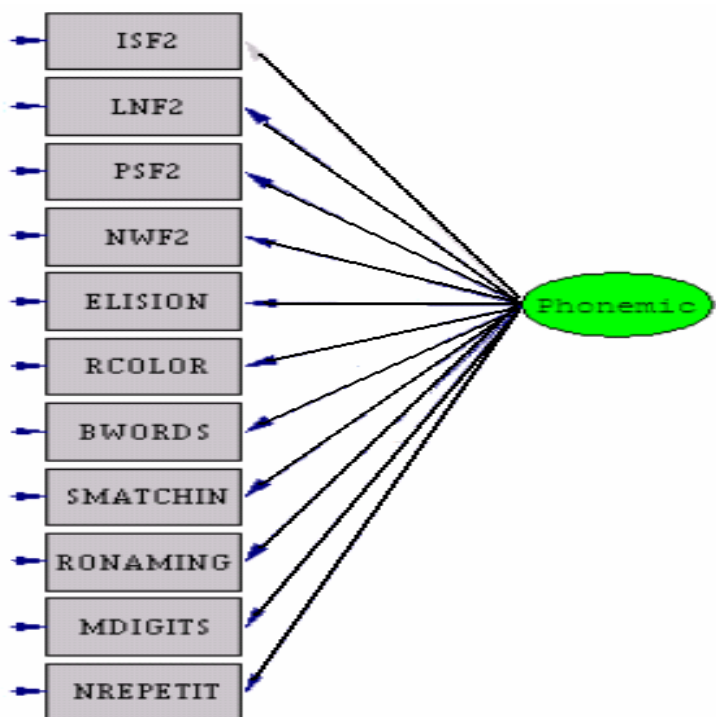


Figure 2. Model for the relationship between the DIBELS subtests: ISF2 = Initial Sound Fluency; LNF2 = Letter Naming Fluency; PSF2 = Phoneme Segmentation Fluency; NWF2 = Nonsense Word Fluency, the CTOPP subtests: ELISION = Elision; RCOLOR = Rapid Color Naming; BWORDS = Blending Words; SMATCHIN = Sound Matching;

RONAMING = *Rapid Object Naming*; MDIGITS = *Memory for Digits*; NREPETIT = with phonemic awareness as a single, latent construct.

Finally, the third model presents the two factors of phonemic and orthographic awareness such as with first model, but the factors function independently of each other. This model has the same theoretical justification as the first model for the relationships between the hypothesized subtests and phonemic and orthographic awareness. In this model, the latent constructs are not correlated with one another to test the relationship of the hypothesized subtests with phonemic and orthographic awareness as constructs independent of each other.

CFA Model Specification 3

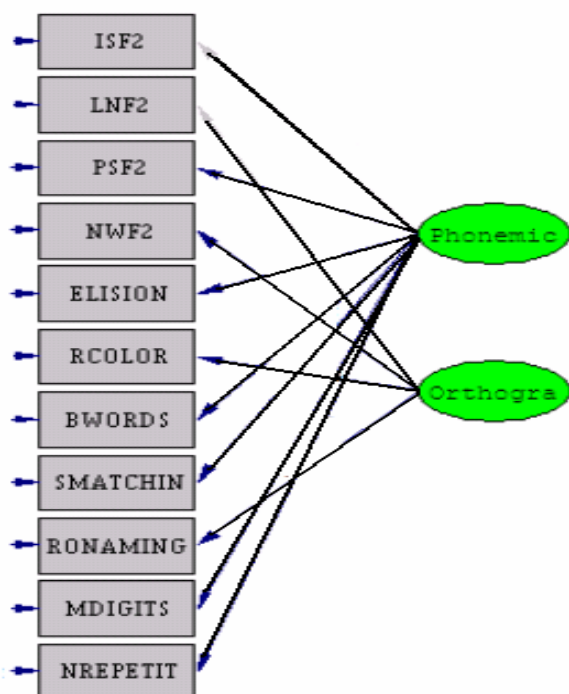


Figure 3. Model for the relationship between the DIBELS subtests: ISF2 = *Initial Sound Fluency*; LNF2 = *Letter Naming Fluency*; PSF2 = *Phoneme Segmentation Fluency*; NWF2 = *Nonsense Word Fluency*, the CTOPP subtests: ELISION = *Elision*; RCOLOR = *Rapid Color Naming*; BWORDS = *Blending Words*; SMATCHIN = *Sound Matching*;

RONAMING = *Rapid Object Naming*; MDIGITS = *Memory for Digits*; NREPETIT = *Nonword Repetition*, with phonemic awareness and orthographic awareness as latent constructs that are not correlated.

Participants

The data for this study were taken from an extant database of assessment scores on early literacy measures. These data were collected as part of an outreach grant that focused on comprehensive behavioral and instructional support with Mack D. Burke and Shanna Hagan-Burke as the principal investigators (U.S. Department of Education, Office of Special Education Programs, 2002). The assessments were used to monitor the progress of students, identify students in need of academic support, and provide recommendations for instruction. The school obtained consent from the students' parents to conduct the assessments at the school.

The participants in this study were 133 students in kindergarten at a primary school. The school included pre-kindergarten, kindergarten, first, and second grades and was located in a rural area in Northeast Georgia. Table 3.1 presents the demographic data for the participants in this study.

A small number of students received special education or early intervention services. These services included pull-out resource for particular subject areas such as reading and math and self-contained classes for students with mild to moderate mental retardation. In addition to students served with Individualized Education Plans, the school implemented a school-wide positive behavior support program to promote instructional and behavioral support for all students within the school. The school also adapted a technology program where technology is integrated as part of the curriculum from pre-kindergarten through second grade.

Table 3.1

Demographic Data for Participants (N=133)

Demographic Variable	Frequency	Percent
Gender		
Female	62	46.3
Male	71	53.7
Ethnicity		
Asian	1	1.0
African-American	34	25.5
Hispanic (non-white)	4	3.2
Multi-racial	6	4.1
White (European)	88	66.2
Socio-Economic Status (as indicated by school meal payment)		
Free (no payment)	44	33.2
Reduced payment	6	4.5
Full-pay (no assistance)	83	62.4

The 133 participants comprised of 70 (53%) male and 63 (47%) female students.

The following describes the ethnic composition of the participants: 88 (66.2%) Caucasian, 34 (25.5%) African-American, 4 (3.2%) Hispanic, 1 (1%) Asian, and 6 (4.1%) multiracial. Socio-economic status was defined by rates of free or reduced-payment school lunch. 83 (62.4%) of the kindergarten students did not receive financial assistance for school meals.

The assessors administered the subtests to the 133 participants in kindergarten during the winter benchmark of the school year, beginning in late November and ending in mid-December in 2004. The tests were administered in empty classrooms provided on the school campus or in the school library. Each individually administered session

ranged from 10 to 30 minutes. University students organized appropriate times with all teachers to pull students only from instruction rather than during preferred or earned activities such as recess.

Measures

Descriptions of all subtests' stimuli, target responses and materials are provided in

Table 3.2

Table 3.2

DIBELS and CTOPP Tasks

Subtest	Materials	Stimulus	Target Response
<i>DIBELS Initial Sound Fluency</i>	-pages containing 4 pictures on each page	“Point to the picture that begins with /c/.” “Tell me the sound that ‘mop’ begins with.”	The student points to the cat on the page. “/m/”
<i>DIBELS Phoneme Segmentation Fluency</i>	-list of words on a page	“Tell me the sounds you hear in the word ‘mop’.”	“/m/ /o/ /p/”
<i>DIBELS Letter Naming Fluency</i>	-a page containing capital and lowercase letters	“Tell me as many names of the letter you see as fast as you can.”	The student says the name of each letter on the page.
<i>DIBELS Nonsense Word Fluency</i>	-a page containing nonsense words	“Sound out the word or read the whole word.”	“sim” or “/s/ /i/ /m/”

<i>CTOPP Elision</i>	-CTOPP test booklet	“Say the word ‘backyard.’ “Now say the word ‘backyard’ without saying ‘yard’.”	“backyard” “back”
<i>CTOPP Blending Words</i>	-CTOPP test booklet -audiocassette and tape player	“Listen carefully and put the words together. ‘/m/ /oo/ /d/”	“mood”
<i>CTOPP Sound Matching</i>	-CTOPP test booklet -CTOPP picture booklet	“Which word starts with the same sound as in ‘mat?’ ‘hat,’ ‘meet,’ or ‘bet’?”	“meet”
<i>CTOPP Rapid Color Naming</i>	-CTOPP test booklet -CTOPP picture booklet	“Tell me the names of each color you see as fast as you can.”	The student says the names of the colors on the page.
<i>CTOPP Rapid Object Naming</i>	-CTOPP test booklet -CTOPP picture booklet	“Tell me the names of each object you see as fast as you can.”	The student says the names of the objects on the page.
<i>CTOPP Memory for Digits</i>	-CTOPP test booklet -audiocassette and tape player	“Say the numbers in the same order you hear them.”	The student repeats the numbers in the same order presented on the audiocassette.
<i>CTOPP Nonword Repetition</i>	-CTOPP test booklet -audiocassette and tape player	“Say each nonsense word after you hear it.” “mif”	“mif”

The *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS, Good et al., 1996) subtests include *Initial Sound Fluency* (ISF), *Letter Naming Fluency* (LNF), *Phoneme Segmentation Fluency* (PSF) and *Nonsense Word Fluency* (NWF). These four subtests of the DIBELS were administered to the kindergarten students during the winter benchmark as previous research using analysis of variance to assess the relationship between grade level and the subtests scores (Fuchs, Fuchs, Hamlett, Walz, & Germann, G., 1993). The results with a representative sample indicated the specific early literacy skills that are expected to develop by winter of the kindergarten year. To this end, the evidence demonstrates that this use of curriculum-based measurement to formatively evaluate progress reflects those reading skills that typically develop based on the standard curriculum for kindergarten (Fuchs et al., 1993).

Initial Sound Fluency (ISF). ISF is a phonemic awareness measure of fluency used to test the ability to individually identify sounds, specifically beginning sounds, within words (Good et al., 1996). The assessor presented a sheet of four pictures to the participant, said the name of each while pointing to the respective picture, and asked the participant to point to the picture that starts with the sound the assessor emitted. This was measured for three of the pictures. For a fourth picture on the page, the assessor asked the participant to produce the sound with which one of the words began, identified by one of the pictures. For example, the assessor presented a sheet with the four pictures and said the name of each picture, “car, flag, light, hat” and told the participant to “point to the picture that begins with “/c/” and the participant pointed to ‘car’ (Good et al.). The assessor repeated this with two more of the pictures and then instructed the participant to “tell me the sound that ‘light’ begins with.” The participant responded with the sound

“/l/” (Good et al.) After the assessor presented each question, he or she started the timer and stopped the timer as soon as the participant responded. This calculated the number of seconds taken to identify and produce correct sounds. Only the correct pictures the participant pointed to and the correct sounds emitted were scored as correct responses. The number of correct responses multiplied by 60 was divided by the number of seconds recorded for onset of responses for the entire measure. This calculation identified the number of correct onsets emitted per minute.

Good et al. (1996) and Good et al. (2001) provided reliability evidence of the ISF measure with alternate (equivalent) forms of reliability coefficients of .91 and .72. The researchers administered the different forms of the ISF subtest one month from each other. The correlations showed moderate to high coefficients indicating that the *Initial Sound Fluency* subtest is a reliable measure of early literacy skills. Evidence of concurrent validity of the ISF measure was established with experimental outcome measures of basic skills at the kindergarten level with a coefficient of .72 (VanDerHeyden, Witt, Naquin, & Noell, 2001). Appendix E presents an example of the ISF measure.

Phoneme Segmentation Fluency (PSF). PSF is a phonemic awareness measure of fluency used to test the ability to individually identify sounds and specifically isolate phonemes within words (Good & Kaminski, 1996a). The assessor presented a two to three phoneme word orally and asked the student to produce each sound. For example, if the assessor said, “Tell me the sounds you hear in mop,” the student said “/m/ /o/ /p/” to receive three points for the word, one point for every phoneme the student emitted. If the student isolated part of the phonemes such as “/mo/ /p/” the student received two points.

The measure was administered for one minute and the assessor counted the number of correct phonemes emitted. Reliability evidence of the PSF subtest includes equivalent forms with estimates of .88 indicating that it is a reliable measure of phoneme segmentation (Good et al., 1996; Kame'enui et al., 2001; Kaminski et al., 1996; Olson et al. 1997). Evidence of concurrent validity with the *Metropolitan Readiness Test* (Psychological Corporation, 1990) was established with a coefficient of .68 (Good et al., 2000; Kaminski et al., 1996). Predictive evidence of validity of the PSF measure with the *Stanford Diagnostic Reading Test* (Psychological Corporation, 1984) showed a moderate relationship with a coefficient of .73 (Kaminski et al., 1996; Good et al., 2000). Refer to Appendix F for an example of the PSF measure.

Letter Naming Fluency (LNF). LNF is a general measure for students in Kindergarten to the beginning of first grade that serves as an indicator of risk for reading problems that could potentially occur in the future (Kaminski & Good, 1996). The administration consisted of the assessor presenting a participant with a list of upper and lower-case letters listed in rows on a single page. The assessor asked the participant to identify the names of the letters and timed the measure for one-minute. The number of correct letters named per minute was the score recorded for this measure. Coefficients of stability and equivalence showed moderate to high correlations for reliability of LNF with values ranging from .79 to .93 (Elliot et al., 2001; Good et al., 1996; Good et al., 2001; Good et al., 2000; Kaminski et al., 1996). Validity evidence of the LNF measure has been evaluated by predictive and concurrent evidence of validity, yielding a range of coefficients. A moderate correlation was seen with LNF and the *Metropolitan Readiness Test* with a coefficient of .86 (Good et al., 2000; Kaminski et al., 1996) although adequate

concurrent evidence of validity was not established with the *Test of Phonological Awareness* (Torgesen & Bryant, 1994) yielding a coefficient of .50 (Elliot et al., 2001). Predictive evidence of validity was established as LNF accounted for a majority of variance in the *Test of Word Reading Efficiency* (TOWRE, Torgesen et al., 1999; Hagan-Burke, et al., 2005). The LNF measure is presented in Appendix G.

Nonsense Word Fluency (NWF). NWF is a measure of sound-symbol correspondence as letters are represented within nonsense words. The assessor presented the student with a sheet of randomly ordered nonsense words (e.g., sig, rav, ov) and asked the student to orally produce the individual letter sounds, or read the whole nonsense word. The total number of correct sounds the student emitted was counted. If the student read the whole word correctly, all sounds in the word were counted as correct. For example if the student read the nonsense word “mig,” the assessor award the student three points for the three sounds emitted correctly. If the participant emitted responses that did not use the word correctly, the words were not counted toward the participant’s score. Reliability of NWF was evaluated by equivalent forms with a one-month interim and the coefficient was .83. This indicates that the *Nonsense Word Fluency* subtest is a reliable measure of early literacy. Concurrent and predictive validity was established with the *Test of Word Reading Efficiency* (TOWRE, Torgesen et al., 1999) as the NWF measure had reported coefficients of .73 and .74 for evidence of concurrent validity of both TOWRE subtests. In addition, the NWF subtest accounted for most of the variance in the TOWRE subtests (Hagan-Burke et al., 2005). The NWF measure is presented in Appendix H.

The Comprehensive Test of Phonological Processing

The version of the *Comprehensive Test of Phonological Processing* (CTOPP, Wagner, Torgesen, & Rashotte, 1999) specifically designed for children 5 and 6 years old includes the following subtests: *Elision*, *Blending Words*, *Sound Matching*, *Non-word Repetition*, *Rapid Color Naming*, *Rapid Object Naming*, and *Memory for Digits*. The CTOPP was administered at the 2004 winter benchmark of Kindergarten. Refer to Table 3.3 for age group population alpha values of the CTOPP subtests.

Elision. The *Elision* subtest requires the child to repeat a compound word or a word with two syllables such as ‘backyard.’ Then the examiner asks the child to say the word without saying ‘yard’ (Wagner et al., 1999). This measure also requires the child to repeat a word the examiner orally presents such as the word ‘cup.’ Then the child is asked to repeat the word a second time only without the phoneme identified by the examiner (e.g., Say ‘cup’ without saying ‘/k/’) (Wagner et al.). The examiner stopped administering the test after a child missed three in a row.

Reliability was evaluated by measures of internal consistency, coefficient alpha at age intervals (Wagner et al., 1999). The values for alpha at the five and six year old intervals were .90 and .92 respectively. Additionally, test-retest reliability for ages five to seven years old has an estimate of .88. Concurrent evidence of validity was established with the *Lindamood Auditory Conceptualization* tasks with a correlation of .75 and predictive validity was evaluated and established between the *Elision* subtest of the CTOPP and the *Woodcock Reading Mastery Tests Revised* (Wagner et al., 1999). The *Elision* subtest is presented in Appendix I.

Table 3.3

Alpha Values for Age Group Population on the CTOPP (CTOPP manual, Wagner et al., 1999)

Subtest	Coefficient Alpha	
	Age 5	Age 6
<i>Elision</i>	.90	.92
<i>Blending Words</i>	.88	.89
<i>Sound Matching</i>	.93	.93
<i>Memory for Digits</i>	.78	.79
<i>Nonword Repetition</i>	.80	.80
<i>Rapid Color Naming</i>	.74	.80
<i>Rapid Object Naming</i>	.82	.81

Rapid Object Naming. *Rapid Object Naming* is one of the subtests from the CTOPP that measures phonological awareness and rapid naming (Wagner et al., 1999). The assessor presented a sheet consisting of pictures of objects and instructed the student to name as quickly as possible a series of objects presented on the page. If the student hesitated for more than two seconds on a single object, the assessor directed her to the

next item prompting a response with a phrase such as, “what’s the name of this one?”

The amount of time and errors were recorded on the data sheet. Reliability of the *Rapid Object Naming* measure of the CTOPP was moderate with a value of .82 and .81 for five and six-year-old students. The test-retest reliability correlation value was .77 (Wagner et al.). Appendix J presents an example of the *Rapid Object Naming* subtest.

Blending Words. *Blending Words* involves listening to sounds produced on an audiocassette followed by the child stringing the phonemes together to make a word (e.g., the segmented phonemes ‘/m/ /oo/ /d/’ make up the word ‘mood’) (Wagner et al., 1999). The students are instructed to “listen carefully to put the words together” (Wagner et al.). The assessor stopped administration if the child missed three items in a row. The reliability of the *Blending Words* subtest has been established with a coefficient alpha value of .88 and .89 for five and six-year-old students respectively. The test-retest correlation value was .88. However, the *Blending Words* measure yielded the lowest correlation coefficients for predictive and concurrent evidence of validity across all CTOPP subtests. The highest value for concurrent evidence of validity was a correlation value of .58 for *Blending Words* and the *Lindamood Auditory Conceptualization Tests*. The other values for concurrent evidence of validity ranged from .48 to .02. Predictive evidence of validity values were higher ranging from .27 to .48 with the *Woodcock Reading Mastery Tests Revised* and the *Gray Oral Reading Test-3* (Wagner, et al.) indicating the need for further investigation of correlations between the CTOPP Blending Words subtest and other measures of early reading. The *Blending Words* subtest of the CTOPP is presented in Appendix K.

Sound Matching. The *Sound Matching* subtest uses initial and final sounds, in words represented in a picture book, to have the child indicate other words with the similar initial or final sounds (e.g., Which word starts with the same sound as in ‘mat?’ hat, meet, or bet?) (Wagner et al.). The assessor gave at least seven test items and if the child missed four items, administration was stopped. The *Sound Matching* measure has been established as a reliable measure with coefficient alpha values of .93 for both five and six year old intervals. The test-retest reliability value was .83 (Wagner, et al.) The *Sound Matching* subtest is presented in Appendix L.

Rapid Color Naming. *Rapid Color Naming* is conducted in the same way as the *Rapid Object Naming* subtest as the student is instructed to name as quickly as possible the series of colors presented on the page (Wagner et al., 1999). The time it took for the student to complete the measure as well as the number of errors were recorded. The *Rapid Color Naming* subtest showed to be moderately reliable with a test-retest correlation value of .78 (Wagner, et al.) Appendix M presents an example of the *Rapid Color Naming* subtest.

Memory for Digits. *Memory for Digits* assesses phonological awareness for long-term memory phonologic codes (Wagner et al., 1999) as well as short-term memory recall (Plake et al., 2003). The *Memory for Digits* subtest involves repeating numbers heard on an audiocassette in the same order the digits were presented. The assessor plays the audiocassette and instructs the student to “say the numbers in the same order as they are heard” (Wagner et al., 1999). If the child missed three items in a row, the administration was stopped. Reliability for the *Memory for Digits* measure yielded a value of .74 for test-retest and the values for coefficient alpha were .78 and .79

respectively for the five and six-year-old intervals. A comparison of the *Memory for Digits* measure and the *Word Attack* subtest of the *Woodcock Reading Mastery Test Revised* yielded a low to moderate coefficient value of .36. The values for the concurrent evidence of validity studies with the *Memory for Digits* subtest presented the range of values from .32 to .49. In addition, the values for predictive evidence of validity were variable ranging from .21 to .37 (Wagner et al.). The *Memory for Digits* subtest is presented in Appendix N.

Non-Word Repetition. *Non-word Repetition* requires the child to reproduce nonsense words after hearing each word on the audiocassette. On the audiocassette, a non-word is presented such as ‘mif’ (Wagner et al, 1999). The assessor instructs the child to repeat the word the same way it is heard. Administration of this subtest was stopped after a child gave three incorrect responses. This measure obtained the lowest test-retest reliability coefficient ($r=.68$) out of all the subtests of the CTOPP. The non-word repetition subtest has variable values for predictive and concurrent validity evidence such as with the *Memory for Digits* subtest (Wagner et al.). Appendix O presents an example of the *Non-word Repetition* subtest of the CTOPP.

Procedures

Data Collection

The DIBELS (Good et al., 1996) and the CTOPP (Wagner et al., 1999) subtests were administered in the winter of 2004. The measures included the following subtests of the DIBELS: *Initial Sound Fluency* (ISF), *Letter Naming Fluency* (LNF), *Phoneme Segmentation Fluency* (PSF), and *Nonsense Word Fluency* (NWF). The CTOPP measures that were administered in winter of kindergarten were: *Elision*, *Rapid Color*

Naming, Blending Words, Sound Matching, Rapid Object Naming, Memory for Digits, and Non-word Repetition.

Seven undergraduate and graduate students from the University of Georgia administered the subtests of the DIBELS (Good et al., 1996) and the CTOPP (Wagner et al., 1999). Two doctoral students conducted a training for the administration of the assessments. All assessors practiced administering the tests, scoring the measures, and obtaining inter-rater reliability with at least 90% agreement with the experienced assessors. Appendix C shows an outline of the training and the assessors obtained and Appendix D presents general assessment guidelines.

A group of four to six kindergarten students were pulled from their classes by a graduate assistant or faculty member from the University of Georgia. The students walked to the library or a vacant classroom and the assessments were administered to every student in kindergarten as they were placed at individual tables with one assessor. All students were assessed including those students receiving special support services, such as special education. If a student did not want to finish the assessment for any reason, he or she was taken back to the classroom with no consequences. The DIBELS assessments ranged from five to 10 minutes and the CTOPP assessments ranged from 10 to 30 minutes. At the end of the assessment, the students chose a sticker as a reward for participating.

Reliability evidence was obtained by coefficient alpha and inter-rater agreement methods. Inter-rater reliability for all the DIBELS measures was conducted by two doctoral students who were fluent in the data collection procedures and the DIBELS measures. Throughout the DIBELS assessments only, the doctoral students sat with each

data collector and independently recorded the responses of the same student. Percent agreement was calculated by the number of agreements divided by the number of agreements plus disagreements and multiplied by 100.

CHAPTER IV

RESULTS

In response to the need for educators to focus on the development of early literacy skills, the use of instruments to assess early literacy is increasing (Center for Education Statistics, 2005). In addition to the need for use of early literacy assessments to determine areas of reading skill development, the validity of these assessments demands further investigation. The current research responds to the need for valid instruments to assess early literacy skills by investigating the reliability and concurrent evidence of validity of an early literacy assessment.

The purpose of the present study was to examine two sources of construct validity through summary statistics, coefficients for concurrent evidence of validity, and a confirmatory factor analysis (CFA) to indicate the degree to which the measures of the *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS) and the *Comprehensive Test of Phonological Processing* (CTOPP) provide operational definitions of the early literacy latent constructs, phonemic and orthographic awareness. The measures for reliability and the summary statistics will first be discussed in order to describe the distribution of the scores created by the assessments. The values for reliability indicate the extent to which the assessments were administered reliably with interrater agreement and the consistency of responses with alpha. The mean and standard deviations report the variability in the data and the differences between subtest scores. Next, a correlation matrix of the DIBELS and CTOPP subtests is provided as a source of concurrent evidence of validity.

Lastly, the relationships between the participants' scores on the DIBELS and CTOPP subtests and the latent constructs, phonemic and orthographic awareness, were examined with a Confirmatory Factor Analysis.

Reliability Estimates

Reliability estimates were obtained by two methods for different groups of tasks across the DIBELS and CTOPP subtests as indicated in Table 4.1.

Table 4.1

Reliability Estimates for DIBELS and Non-speeded CTOPP Subtests (with interrater values multiplied by 100)

Measure	Interrater Reliability <i>N</i> =35	Cronbach's Alpha
Initial Sound Fluency	87	
Letter-Naming Fluency	95	
Phoneme Segmentation Fluency	91	
Nonsense Word Fluency	95	
CTOPP subtests: Elision, Blending Words, Sound Matching, Memory for Digits, and Non-word Repetition		.77

Interrater reliability values with the DIBELS indicate that the four DIBELS measures used for this study were administered consistently across assessors with the values ranging from .87 to .95. Although internal consistency coefficients are affected by

the dimensionality of the fluency tasks, the consistency of correct and incorrect responses is really just an artifact of the tasks' rapidity. However, a measure of internal consistency using Cronbach's alpha was used to report the reliability for the CTOPP subtests that were not fluency based. These CTOPP measures do not include the Rapid Object Naming and Rapid Color Naming measures. The value for alpha was .77 indicating good reliability of the CTOPP tasks excluding the rapid naming measures. No reliability data were collected for the CTOPP Rapid Object Naming and Rapid Color Naming tasks.

Research Question One: What is the concurrent evidence of the validity for the *Dynamic Indicators of Basic Early Literacy Skills* (Good et al., 1996) with the *Comprehensive Test of Phonological Processing* (Wagner et al., 1999)?

Concurrent evidence of validity was examined by summary statistics and an inter-correlation matrix. The coefficients were estimated for all subtests of the CTOPP including *Elision*, *Blending Words*, *Sound Matching*, *Rapid Color Naming*, *Rapid Object Naming*, *Memory for Digits*, and *Nonword Repetition* and DIBELS subtests administered at the winter benchmark in kindergarten which included *Initial Sound Fluency*, *Phoneme Segmentation Fluency*, *Nonsense Word Fluency* and *Letter Naming Fluency*. Summary statistics (i.e., means, standard deviations) are presented in Table 4.2.

These data indicate the variability of responses for each subtest. The rapid naming tasks (CTOPP Rapid Object Naming and Rapid Color Naming) have the highest standard deviation values across all tasks, 34.453 and 29.246 respectively. The summary statistics indicate that both rapid naming tasks, although they have the highest minimum values obtained, have the largest spread of responses which indicated that the task itself may have been more difficult for some students and less difficult for others. Skewness

Table 4.2

Summary Statistics

Measure	Minimum	Maximum	Mean	Standard Deviation	Skewness	Kurtosis
Initial Sound Fluency	2	64	21.09	11.740	1.267	2.107
Letter Naming Fluency	5	82	39.84	14.948	-.102	.239
Phoneme Segmentation Fluency	0	57	21.15	16.756	.350	-1.063
Nonsense Word Fluency	0	76	23.77	16.482	.817	.772
Elision	0	18	4.76	3.499	1.048	2.264
Rapid Color Naming	14	270	94.00	29.246	1.922	9.504
Blending Words	0	14	5.46	3.104	.103	-.153
Sound Matching	1	20	9.88	5.703	.220	-1.149
Rapid Object Naming	11	241	103.93	34.493	1.125	3.720
Memory for Digits	4	16	9.59	2.669	.257	-.601
Nonword Repetition	0	47	5.81	4.858	4.836	39.460

and kurtosis values indicate the relative distribution of scores compared to normal distribution. The skewness value that indicate a possible positively skewed distribution that is significant is 4.836 for *Non-word Repetition*. This indicates that scores for the Non-word Repetition subtest of the CTOPP are clustered at the lower end of the score scale (i.e. closer to zero). *Letter Naming Fluency* from the DIBELS had a skewness value of -.102 indicating the most acceptable skewness value for a normally distributed

set of test scores with this measure as it is the closest value to zero. The kurtosis values that indicate a distribution with a significant kurtosis problem are 39.460 for *Non-word Repetition* on the CTOPP, 9.504 for *Rapid Color Naming* on the CTOPP, 3.720 for *Rapid Object Naming* on the CTOPP, 2.264 for *Nonsense Word Fluency* on the DIBELS, and 2.107 for *Initial Sound Fluency* on the DIBELS. The *Non-word Repetition* subtest has the most significant kurtosis problem with such a high value, 39.460, indicating a leptokurtic distribution (i.e. a distribution that is too tall). It is important to note that the *Non-word Repetition* subtest is most problematic subtest based on the kurtosis value that has the largest distance from zero. Additional analyses were conducted, such as an exploratory factor analysis, which indicated that the rapid naming tasks loaded onto a separate factor representing something other than phonemic and orthographic awareness.

Phoneme Segmentation Fluency (PSF) and *Nonsense Word Fluency* (NWF) are the two subtests from the DIBELS and *Elision*, *Blending Words*, and *Non-word Repetition* from the CTOPP are the three subtests where the minimum score was zero. Due to the nature of these tasks, in order for kindergarten students to segment the sounds in words (DIBELS PSF), they should also be able do some additional tasks such as blending sounds together to make words (CTOPP *Blending Words*), saying words with parts or sounds of the words deleted (CTOPP *Elision*), and matching initial and final sounds of words (CTOPP *Sound Matching*). This may indicate a reason why the standard deviation for the DIBELS PSF measure is the highest value compared to the other DIBELS tasks.

Validity Coefficients

Correlation coefficients were investigated among the DIBELS and CTOPP measures as a source of concurrent evidence of validity. The correlation matrix is presented in Table 4.3.

The highest coefficients were seen with DIBELS LNF and *Nonsense Word Fluency* (DIBELS NWF), with the top coefficient value of .709, and DIBELS *Letter Naming Fluency* and *Phoneme Segmentation Fluency* with a value of .601. Coefficients that show concurrent evidence of validity for NWF were moderate with CTOPP's *Blending Words* and *Sound Matching*, .578 and .570 respectively.

Consistent with the summary statistics, both rapid naming subtests on the CTOPP have the lowest, most insignificant correlations with the other subtests, ranging from -.023 to -.235 for *Rapid Color Naming* and a range from -.014 to .318 for *Rapid Object Naming* (excluding the coefficient for *Rapid Color Naming* with *Rapid Object Naming*, .497). However, the correlations between *Rapid Color Naming* and *Letter Naming Fluency* (DIBELS LNF) and *Rapid Object Naming* and LNF have relatively low to moderate values that are significant, -.235 and -.277 respectively. This suggests that there is a weak relationship between rapid naming tasks and letter naming as measured by the tasks on the DIBELS and CTOPP. It also indicates that the rapid naming tasks are correlated with another measure on the DIBELS whereas there are no significant correlations between the rapid naming tasks and the other CTOPP measures; however, it must be noted that the *Rapid Color Naming* and *Rapid Object Naming* tasks on the CTOPP have a moderate correlation with one another that is also a significant value, .497. The CTOPP's *Non-word Repetition* subtest showed very low to low coefficient values for concurrent evidence of validity, ranging from -.023 to .318. These low

correlations indicate that the non-word repetition task may not be a task that utilizes the similar processes of tasks with more salient phonemic and orthographic features.

Convergent relations were observed with the following subtests: DIBELS' *Nonsense Word Fluency* with the DIBELS' *Letter Naming Fluency* ($r=.709$), *Phoneme Segmentation Fluency* ($r=.601$), *Initial Sound Fluency* ($r=.445$), CTOPP's *Elision* ($r=.443$), *Blending Words* ($r=.578$), and *Sound Matching* ($r=.570$). Further convergent relations were also observed with the DIBELS' *Phoneme Segmentation Fluency* and the following subtests: CTOPP's *Elision* ($r=.500$), *Blending Words* ($r=.563$), and *Sound Matching* ($r=.496$). All of these convergent relations identified by moderate to strong correlation values indicate that these subtests contend to measure a similar construct, namely phonemic awareness.

The subtests evaluated in this study that showed some divergent evidence with weak correlational values included CTOPP's *Rapid Object Naming* and *Elision* ($r=-.014$), *Blending Words* ($r=.014$), DIBELS' *Phoneme Segmentation Fluency* ($r=-.021$), CTOPP's *Sound Matching* ($r=-.109$) and *Nonsense Word Repetition* ($r=.048$). Similar divergent relations were observed with CTOPP's *Rapid Color Naming* and the following subtests: CTOPP's *Nonsense Word Repetition* ($r=-.023$), *Memory for Digits* ($r=-.083$), and DIBELS' *Phoneme Segmentation Fluency* ($r=-.092$). The negative correlations indicate an inverse relationship between the subtests. Other divergent relations were also observed with the CTOPP's *Nonsense Word Repetition* subtest and *Sound Matching* ($r=.113$), DIBELS' *Letter Naming Fluency* ($r=.141$), and *Nonsense Word Fluency* ($r=.141$). The weak correlations indicate that these subtests may be tapping into similar constructs, but to a very minimal extent.

Table 4.3

Correlation Matrix of the DIBELS and CTOPP

	LNF	PSF	NWF	Elision	Rapid Color Naming	Blending Words	Sound Matching	Rapid Object Naming	Memory for Digits	Nonword Repetition
	Scores (<i>n</i> = 133)									
1. D-ISF	.354**	.387**	.445**	.351**	-.117	.402**	.404**	-.127	.275**	.174*
2. D-LNF	--	.448**	.709**	.318**	-.235**	.373**	.453**	-.277**	.213*	.141
3. D-PSF		--	.601**	.500**	-.092	.563**	.496**	-.021	.386**	.253**
4. D-NWF			--	.443**	-.213*	.578**	.570**	-.170	.333**	.156
5. C-Elision				--	-.131	.494**	.552**	-.014	.441**	.245
6. C-Rapid Color Naming					--	-.156	-.202*	.497**	-.083	-.023
7. C-Blending Words						--	.571**	.014	.372**	.252**
8. C-Sound Matching							--	-.109	.390**	.113
9. C-Rapid Object Naming								--	.024	.048
10. C-Memory for Digits									--	.318**
11. C-Nonword Repetition										--
<p><i>Note.</i> ** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level.</p>										

Research Question Two: Are phonemic and orthographic awareness as measured on the CTOPP and DIBELS distinguishable latent constructs or are these abilities so interrelated as to be indistinguishable?

The results of the CFA with the three models indicate the strength of the relationships between the hypothesized subtests to the latent constructs of phonemic and orthographic awareness (Brown, 2006). With model one, the subtests hypothesized to measure phonemic awareness were theoretically similar as they showed strength of relationships between the tasks requiring the participants to manipulate sounds and the phonemic awareness construct defined as the ability to hear and manipulate sounds. The hypothesized subtests relating to orthographic awareness included two tests from the DIBELS that required the participants to produce sounds based on the symbols or graphemes that were presented. The other subtests hypothesized to relate to orthographic awareness were the *Rapid Object Naming* and *Rapid Color Naming* tasks from the CTOPP which the theory was supported by the evidence that individuals who have a deficit in orthographic awareness have also shown deficits in rapid naming tasks (Wolf et al., 1986; Bowers et al., 1993; Wolf et al., 1994; Badain, 1997; Wolf et al., 1999, Wolf et al., 2002). Set up of model two was guided by the theory that the tasks represented across the DIBELS and CTOPP have a strong relationship with the same latent construct. Model three was analyzed to investigate the theory that that while phonemic awareness and orthographic awareness are multidimensional, they are highly correlated.

Statistical Considerations

Missing Data. The CFA models were estimated using the multiple imputation (MI) estimation method in order to obtain the appropriate fit indices and to keep the

sample size at 133, which was a significant drop in size due to the deletion of the participants who scored either a zero on one or both rapid naming tasks. The data set had missing values because of student absences. With all of the CTOPP subtests, the participants were required to emit all correct answers in the examples in order to begin each subtest. The LISREL software program (Jöreskog & Sörbom, 2006) has the MI estimation method available to groom data sets that have missing values without using listwise deletion. LISREL has a multiple imputation module, which uses the Expected Maximization (EM) algorithm and the Markov Chain Monte Carlo (MCMC) method to impute missing values (Schafer, 1997; Du Toit & Du Toi, 2001; Du Toit & Mels, 2002).

Normality of Data. Prior to conducting the analyses, the histogram charts on each measure indicated a large number of participants who scored zero on the rapid naming tasks showing a significant departure from normality. In order to conduct further analyses that would not call into question the validity of the rapid naming results nor violate assumptions of multivariate normality, the participants who scored a zero on either one or both of the rapid naming tasks were removed from the data set. Therefore, the data analyses were normally distributed. Figures 4 and 5 show the histogram before and after the data were groomed for one representative sample of a rapid naming task from the CTOPP.

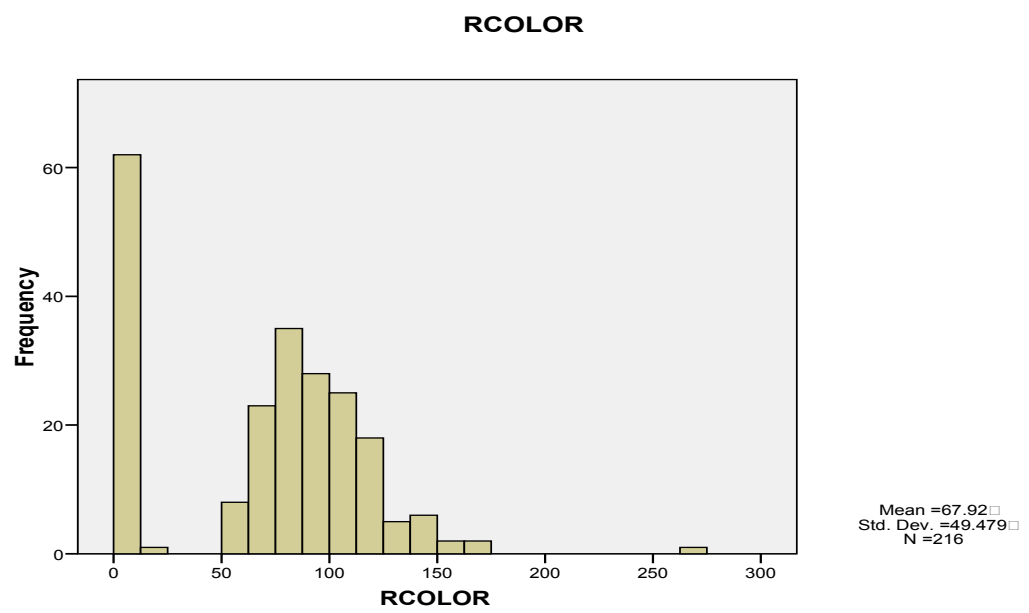


Figure 4. This histogram shows the distribution of scores for the CTOPP *Rapid Color Naming* subtest for all participants including those who scored a zero on either one or both of the rapid naming subtests on the CTOPP.

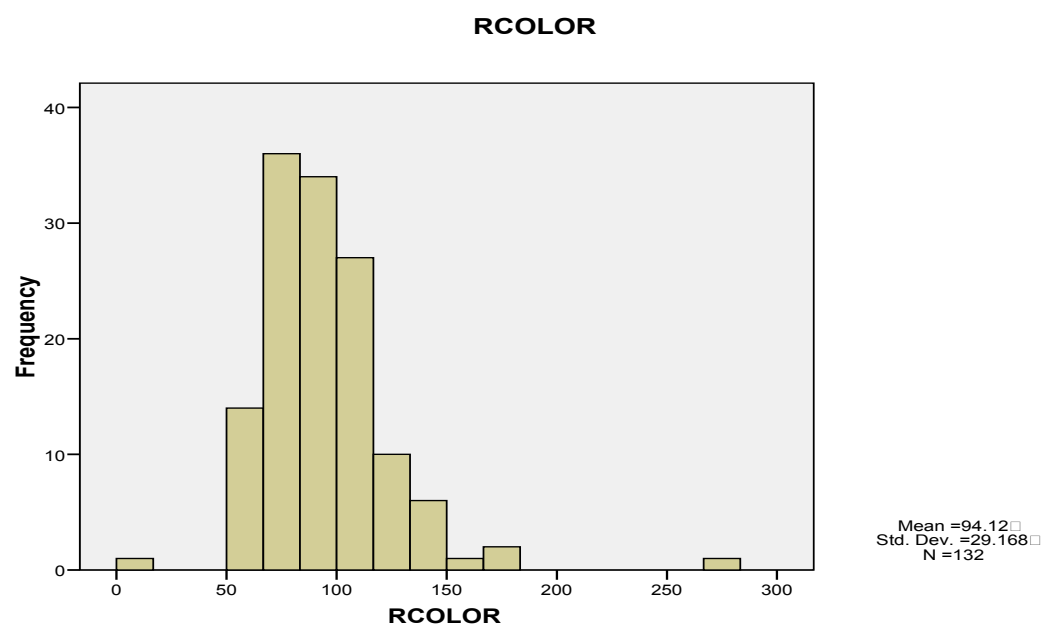


Figure 5. This histogram shows the distribution of scores for the CTOPP *Rapid Color Naming* subtest for the participants who scored a one or higher on both rapid naming subtests on the CTOPP.

Fit Indices

The three CFA models were evaluated for the best fit among the three models and overall goodness of fit. First, the model that fit the best of the three models tested was determined. Then, the model that fit the best out of the three was examined to determine if this model fit the data well enough. The fit indices statistics for model one, the best fit out of the three models evaluated, are presented in Table 4.4.

Table 4.4

Goodness-of-fit statistics CFA model of best fit (n=133)

Model	χ^2	df	CFI	NFI	RMSEA	SRMR	GFI Lower Upper Bounds (95%)	
Model 1 Baseline phonemic awareness and orthographic awareness as correlated constructs	75.68	43	0.96	0.91	0.076	0.076	0.91	0.047 0.10

Note: P-value for Model 1 was 0.00

The three types of fit indices were considered in selecting the best model that met the fit indices criteria. For an absolute fit index, where model fit is assessed at an absolute level as no comparisons are made to any alternative models, Chi-square statistics and the standardized root mean square residual (SRMR) values were reported. Indices from the parsimony class were also reported as model one was favored in comparison to models two and three due to a difference in the degrees of freedom. The recommended index from the parsimonious category that was reported was the root mean square of approximation (RMSEA, Steiger and Lind, 1980). For incremental or comparative fit indices that compare the fit of one model to the fit of another model, Bentler's comparative fit index (CFI) was reported (Brown, 2006). The Bentler-Bonett normed fit index (NFI) and LISREL's goodness of fit index (GFI) were also reported although the data were not implicated for evaluation of the best fit model.

The best fit was model one with phonemic and orthographic awareness as correlates and relating to the hypothesized subtests of each latent construct. Model one had a Chi-square value of 75.68 and 43 degrees of freedom, which was significantly lower than the chi-square values for models 2 and 3, 124.78 and 123.55 respectively with both models having 44 degree of freedom. The fit indices in Table 4.4 present all of the goodness of fit indices available in LISREL using the multiple imputation estimation method. The fit indices employed in this study were selected from Hu and Bentler's (1998) joint criteria for model fit. These criteria were used to find a goodness of fit with model one. Hu and Bentler recommend that the model fits according to the following fit indices and cut-off criteria: an incremental fit index, Bentler's Comparative Fit Index (CFI) that has a value greater than or equal to 0.96 and an absolute fit index, the

standardized root mean-square residual (SRMR) that has a value of less than or equal to 0.10 indicate goodness of fit (Hu and Bentler, 1999).

CFA Model

In order to evaluate the factor loadings between each latent variable and the observed variables, the DIBELS and CTOPP subtest scores, a salience criterion was set at the absolute value of .40. This criterion was determined by the researcher as the solutions of the CFA were carefully examined to ensure that the criterion level represented the true gaps in the data (Thompson, 2004). The strength of the factor loadings indicate the how much the early literacy subtest's variance is common with the other variables on the same factor (Wagner et al., 1999). The standardized factor loadings and standard errors for the best fit model are presented in Table 4.5 and Figure 6.

Table 4.5.

Standardized Factor Loadings and Standard Error Estimates

Measure	Baseline Model 1 (PA & OA correlated)			
	PA		OA	
	Loading	SE	Loading	SE
<i>Initial Sound Fluency</i>	0.55	0.70		
<i>Letter Naming Fluency</i>			0.74	0.45
<i>Phoneme Segmentation Fluency</i>	0.74	0.45		
<i>Nonsense Word Fluency</i>			0.86	0.08
<i>Elision</i>	0.68	0.54		
<i>Rapid Color Naming</i>			-0.24	0.94
<i>Blending Words</i>	0.76	0.43		
<i>Sound Matching</i>	0.74	0.45		
<i>Rapid Object Naming</i>			-0.19	0.96
<i>Memory for Digits</i>	0.52	0.73		
<i>Nonword Repetition</i>	0.29	0.92		

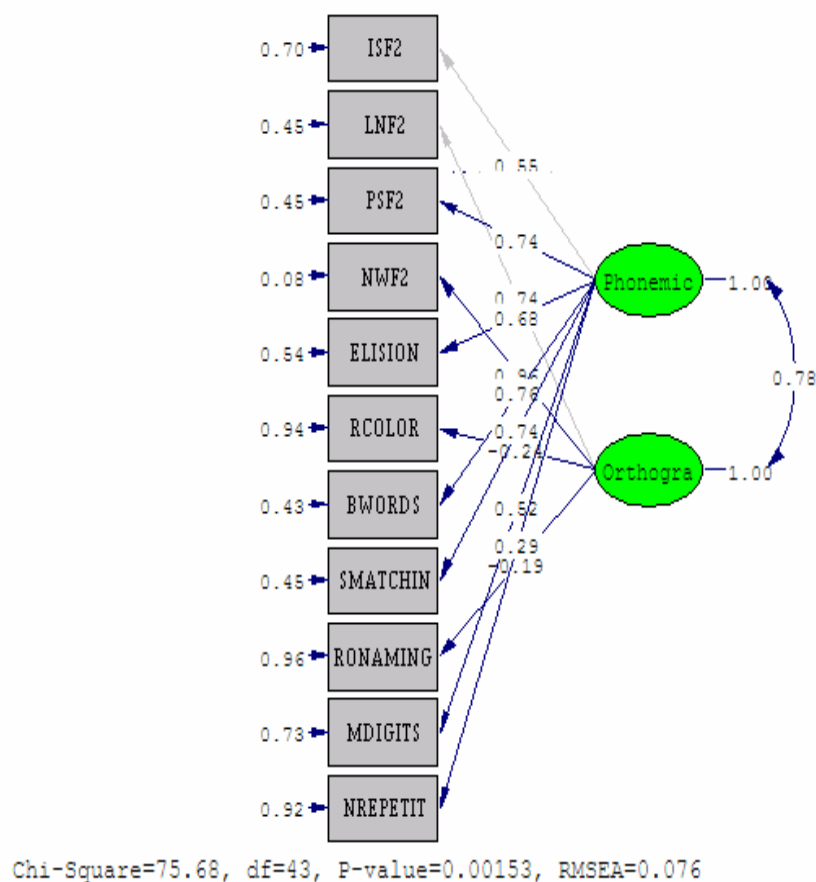


Figure 6. Best fit model (proposed baseline Model 1) with factor loadings between the DIBELS subtests: ISF2 = *Initial Sound Fluency*; LNF2 = *Letter Naming Fluency*; PSF2 = *Phoneme Segmentation Fluency*; NWF2 = *Nonsense Word Fluency*, the CTOPP subtests: ELISION = *Elision*; RCOLOR = *Rapid Color Naming*; BWORDS = *Blending Words*; SMATCHIN = *Sound Matching*; RONAMING = *Rapid Object Naming*; MDIGITS = *Memory for Digits*; NREPETIT = *Nonword Repetition*, with phonemic awareness and orthographic awareness as latent constructs that are correlated.

Model One. Phonemic Awareness and Orthographic Awareness as Correlates

For baseline model one the chi square value indicated the best fit among the three models. The CFI value, 0.96, and the SRMR value 0.076 fall within the recommended values for good overall fit. In addition to the interpretation of these values suggesting a goodness of fit, the path values in model one are all significant. As indicated in Table 4.5

and Figure 6, the factor loadings for the subtests hypothesized to be related to phonemic awareness were strongest with the following subtests and factor loadings: CTOPP *Blending Words* (0.76), CTOPP *Sound Matching* (0.74), DIBELS *Phoneme Segmentation Fluency* (0.74), CTOPP *Elision* (0.68), DIBELS *Initial Sound Fluency* (0.55), and CTOPP *Memory for Digits* (0.52). Supporting the research and definitions as distinguished in chapter two, the participants demonstrated their ability to recognize and manipulate phonemes or sounds with the subtests listed above. The one subtest with phonemic awareness that had a weak factor loading was the CTOPP *Non-word Repetition* (0.29) which did not represent sounds from real words, although it was an auditory task that required participants to repeat the sounds they heard from an audiocassette that made up pseudo-words indicating that the *Non-word Repetition* task may pull upon other processes more than phonemic awareness, such as vocabulary.

According to the results of model one in the present CFA, the DIBELS and CTOPP subtests that were hypothesized to measure the latent construct of phonemic awareness provided implications of construct validity with the DIBELS and CTOPP for phonemic awareness. The factor loadings on the other factor, orthographic awareness, present some further questions and a valuable discussion. The factor loadings with orthographic awareness and the hypothesized subtests are: *DIBELS Nonsense Word Fluency* (0.86), *DIBELS Letter Naming Fluency* (0.74), *CTOPP Rapid Color Naming* (-0.24), and *CTOPP Rapid Object Naming* (-0.19). The rapid naming tasks both fall significantly below the criterion level which is a very weak indication indicating that the rapid naming tasks on the CTOPP do not measure the construct of orthographic awareness.

Exploratory Factor Analysis

As a supplemental measure to investigate internal replicability, an exploratory factor analysis (EFA) was conducted to examine whether the results were potentially similar to the CFA. Specifically, the EFA was used to investigate the rapid naming subtests and to understand if the problems observed in the CFA were results of a forced model issue. The EFA was conducted by setting the number of possible factors to the same number of subtests in the analyses, 11. The extraction method was a principal component analysis (PCA) and the eigenvalues were considered to indicate the extent to which the factors reproduce the data presented in the correlation matrix (Thompson, 2004). PCA uses different methods that are not based on the common factor model. One of these methods is accounting for variance as opposed to explaining correlations between the observed variables (Brown, 2006). The procedures used with the EFA for factor selection were the Kaiser-Guttman rule and the scree plot test. The Kaiser-Guttman rule indicates that the number of eigenvalues greater than one determine the number of latent dimensions in the data. The scree plot indicates the number of latent dimensions by plotting the eigenvalues on a graph to provide a visual presentation of the factors represented to the left of the curve in the data where the slope changes. These methods indicated the differences between the analyses conducted, which varied by the number of components extracted in each EFA (Brown, 2006).

With the first analysis, 11 components were extracted showing that there were three factors. The first factor appeared to be phonemic awareness, the second factor appeared to be rapid naming, and the third factor included the *Memory for Digits* and *Non-word Repetition* subtests from the CTOPP. The third factor could be considered a

memory factor; however, the two “memory” subtests loaded on the phonemic awareness factor so the third factor did not have to be seriously considered. The *Nonword Repetition* subtest had a stronger factor loading in the third “memory” factor, which may indicate that it could be a separate factor (D. Hammill, personal communication March 21, 2007).

With the second analysis, only two components were extracted to evaluate the loadings of the third factor from the first analysis. The first factor again appeared to be phonemic awareness factor including the two “memory” subtests. A third analysis with three components extracted was conducted. The first two factors remained the same as in the second analysis with the rapid naming tasks on its own. The third factor indicated the two memory tasks along with *Rapid Color Naming* from the CTOPP and *Letter Naming Fluency* from the DIBELS. After the third analysis, the data were imported a second time without the rapid naming tasks included in the data set. The first two analyses were conducted again with the re-groomed data. Results indicated two factors when nine components were extracted (as the rapid naming tasks were deleted) and two components were extracted in each analysis. The first factor appeared to be a phonemic awareness factor as all subtests were represented. The *Non-word Repetition* subtest from the CTOPP had the lowest value across both analyses in the first factor. The second factor included the *DIBELS Letter Naming Fluency* subtest and the *CTOPP Memory for Digits* and *Non-word Repetition* subtests. The *Letter Naming Fluency* loading was -.346, which indicated that it is not meaningfully related to the second factor (Brown, 2006). The results of the EFA supported the CFA outcomes with the rapid naming and *Non-word Repetition* subtests suggesting that these tasks on the CTOPP do not have a strong

relationship with the latent dimensions represented by the other tasks and the rapid naming and *Non-word Repetition* tasks may be more interpretable as separate factors.

Summary

The results of this study present both empirical evidence and an exploratory cross-validation to suggest that phonemic awareness and orthographic awareness do not function independently of one another. The data indicate both variability, explained by the coefficients for concurrent evidence of validity, and the dimensionality across the DIBELS and CTOPP assessment scores to indicate a strong relationship between the latent constructs of phonemic and orthographic awareness. Furthermore, the CFA data indicated a fit model with factor loadings that were significant providing evidence of construct validity.

CHAPTER V

DISCUSSION

The purpose of the present study was to examine two sources of construct validity through summary statistics, coefficients for concurrent evidence of validity, and a confirmatory factor analysis (CFA) to indicate the degree to which the measures of the *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS) and the *Comprehensive Test of Phonological Processing* (CTOPP) provide operational definitions of the early literacy latent constructs, phonemic and orthographic awareness. The findings indicated the concurrent evidence of validity for the DIBELS with the CTOPP. The evidence also indicated a strong relationship between measures of phonemic and orthographic awareness, and a weak relationship between phonemic and orthographic awareness with rapid naming tasks. Implications of the present research are described throughout this chapter.

Major Findings

There were three major findings of the current research. First, the analyses of the data provided implications for construct validity of the DIBELS. The confirmatory factor analysis provide evidence that the four DIBELS measures have the highest factor loadings in the fit model. Implications of the current findings suggest that concurrent evidence of validity has been established with the *DIBELS Initial Sound Fluency* and *Phoneme Segmentation Fluency*, *Letter Naming Fluency*, and *Nonsense Word Fluency* subtests.

Another major finding of the study is the evidence suggesting that phonemic and orthographic awareness as they are measured on the DIBELS and CTOPP are latent constructs that do not function independently of each other as indicated by the best fit with model one where the constructs were correlated with one another. Additionally, the data in this study support the theoretical perspective in early literacy which asserts that phonemic awareness and orthographic awareness are constructs that are not independent of one another (Ehri & Wilce, 1979; Wolf, 1984; Ehri, 2005).

A third finding of this study is the non-generalizability of results. Although the CTOPP *Rapid Object Naming* and *Rapid Color Naming* subtests data analyses did not provide evidence that they were measures of orthographic awareness or phonemic awareness, the results suggest that the specification of the construct that is in fact measured by the rapid naming tasks necessitate more than just an operational definition. The data from the current research contribute to the meaning of phonemic and orthographic awareness and how the constructs, although throughout this study they were not defined by rapid naming processes, are defined by other variables and related to other constructs.

Rapid Naming Tasks

The current study generated the hypothesis that the rapid naming tasks on the CTOPP would measure the construct of orthographic awareness to a greater extent than what was evidentiary in the results. There were many reasons why the hypothesis was proposed. The first reason the rapid naming tests were hypothesized to be measures of orthographic awareness is in support of findings that naming-speed deficits are identified more often in individuals who also have orthographic awareness deficits (Wolf et al., 2002). As Mather and Goldstein (2002) expanded the definition of orthographic

awareness to include the type of access that an individual has to graphemes, they define it as “the ability to establish detailed visual or mental representations of letter strings and words and to have rapid, fluent access to these representations” (Mather & Goldstein, 2002, 165; N. Mather, personal communication, February 8, 2007). Within this definition of orthographic awareness, an individual must be able to rapidly access the visual symbol. The key feature of this definition is that the symbols must represent letter strings whereas the rapid naming tasks on the CTOPP have no letters or graphemes. The CTOPP for ages 7 and older includes rapid naming with graphemes, although this may have a phonemic awareness component (D. Hammill, personal communication, March 13, 2007). Future research could explore replicating the current study with the CTOPP for ages 7 and older to evaluate the orthographic awareness factor with a rapid naming task with graphemes.

The participants who obtained a zero score on either one or both rapid naming tasks and were removed from the data set represented a large population of students in this study. This indicates that the task itself was very difficult for children in Kindergarten possibly because that supports the “double-deficit hypothesis” which explains that individuals with both the rapid naming and orthographic awareness deficits have more difficulty acquiring reading skills as compared to individuals who have only one of the deficits (Wolf et al., 1996; Bowers et al., 1993; Wolf et al., 1994; Badain, 1997; Wolf et al., 1999; Wolf et al., 2002; D. Hammill, personal communication, March 22, 2007).

In support of the “double-deficit hypothesis,” the rapid naming tasks also had weak correlations with the other subtests and low factor loadings with phonemic

awareness. The rapid naming measures may not have been tasks that define phonemic awareness because the rapid naming tasks themselves call into question the phonemic awareness part of an individual being able to say words fast. Although other phonemic awareness tasks such as the DIBELS Initial Sound Fluency and Phoneme Segmentation Fluency as well as the CTOPP's Elision, Blending Words, and Sound Matching all have tremendous face validity. Another phonemic awareness measure, CTOPP Memory for Digits, generated moderate factor loadings in the CFA indicating that although the measure tapped into phonemic awareness, there were some other processes occurring as well. From these results, it becomes very apparent that the definition of the phonemic awareness factor greatly depends on an individual's ability to manipulate phonemes (D. Hammill, personal communication, March 22, 2007).

Non-word Repetition

The correlation coefficients indicated that the Non-word Repetition subtest on the CTOPP did not seem to belong as a measure of phonemic awareness. The CFA data generated low factor loadings across all three models with the non-word repetition measure. This particular task was proposed as a hypothetical measure of phonemic awareness. The data may have indicated that the non-word repetition task utilizes other processes that may relate to phonemic awareness, but did not relate to the other subtests evaluated in this study that define phonemic awareness. The exploratory factor analysis allowed further interpretation of the other possible factors that can be extracted from the data.

Although the purpose of conducting the EFA was to cross-validate the CFA results, the analyses nearly replicated the findings of Torgesen's CFA of the CTOPP

subtests (Torgesen et al., 1999). The principal components analysis of the EFA presented data that were open for interpretation of what the different extracted factors indicated. The present EFA showed three factors that were extracted that targeted phonemic awareness, rapid naming, and a split memory factor including the CTOPP Memory for Digits and non-word repetition. These findings indicated that the low factor loadings from the two split memory subtests on the CFA were in fact their own factor. Even though the purpose of the EFA was the next step to better understand the rapid naming tasks, it was a major strength in the interpretation of the study's findings. However, there were also many limitations to the current research.

Limitations

Throughout the course of the present study, several factors may have affected the research on different levels. The first limitation occurred during the data collection phase of the study. Several different conditions could have affected student responses and possibly interfered with the individuals administering the DIBELS and CTOPP assessments. Due to the nature of phonemic awareness tasks, the assessors must administer all measures of phonemic awareness by vocally presenting the stimuli to the students. Some difficulties that may have interfered with the administration of the assessments may include differences in speech patterns, dialects or language. The primary researcher did not have an accent, but many of the children had speech patterns and accents that are commonly heard throughout rural areas in Georgia. This is one factor that could have compromised the reliability of the test administration.

Another limitation of the study occurred when students were brought into the testing room may have been pulled from preferred activities, although it was reinforced in

the training that students were to be pulled only from instructional time. Students who were motivated to be out of the testing room did not appear to be as focused and may have compromised correct responses or emitting responses at all. Some students were pulled out of the classroom without any forewarning which may have affected their responses. The materials that were used to conduct the assessments were problematic at times throughout this assessment, which was a definite limitation of the study. For example, during the Rapid Color Naming subtest, some students mistook the color 'blue' for 'purple' because the stimulus presented for 'blue' indeed had a purple hue. In addition to physical stimuli, the voice recordings on the audiotapes may have affected responses. The assessor was required to stop the tape, fast-forward and rewind it and throughout this time the student was sitting in his or her seat, unengaged in the task, which may have affected concentration. Also, the tapes that were given to the assessors had been used before and throughout some parts of the assessment, there was jazz music droning in the background. This was a major distraction, which could have compromised responses. Other limitations included absenteeism of students who needed to finish assessments and a decreased number of participants after the removal of those students who scored a zero on one or both rapid naming tasks.

The most significant limitation of this study is the lack of reliability measures for the CTOPP rapid naming tasks. As interrater reliability values indicate the consistency of the administration of the assessment, further reliability analyses of the DIBELS could indicate error due to time sampling with the fluency measures. This stability-over-time reliability can be investigated by the test-retest method to indicate the extent to which a student's performance on the measures are consistent over time, as indicated by the

individual assessment scores (Wagner et al., 1999). Although the DIBELS interrater reliability values indicate that a reliable measure has been obtained, whether or not the interrater reliability values are sufficient remains a question. The definition of validity establishes that validity is “evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of interpretations and actions on the basis of test scores or other modes of assessment” (Messick, 1989, 13). Consequently, the CTOPP rapid naming subtests are not validated without reliability measures. In addition to the lack of reliability, one threat of the CTOPP Rapid Color Naming and Rapid Object Naming subtests is construct-irrelevant variance. Measures that are too broad may encompass areas of different constructs or that are not relevant to the investigated construct. Messick described these invalid measures as “containing excess reliable variance associated with other distinct constructs” (Messick, 742, 1995). Future research may attempt to investigate the sources of construct-irrelevant variance and examine ways in which it can be minimized in order to thoroughly define the latent constructs of phonemic and orthographic awareness as causal variables in the development of early literacy skills.

Implications for Future Research

As the need to focus on early literacy continues, implications of the current research contribute to effective intervention planning for individuals who are at risk for future reading difficulties. In order to effectively plan for reading interventions, expose individuals to literacy-related activities at their skill level and invest in preventative instructional methods to teach children using evidenced-based strategies, teachers,

parents, administrators and other educators need to be provided with the most valid and reliable instruments to identify early reading processes.

The implications of the present research respond to the need to predict early reading skills. The validity outcomes contribute to effective planning for reading interventions. To this end, predicting early literacy skills is a response to the need for determining effective instructional methods to teach beginning readers with strategies that prevent reading difficulties (Schatschneider et al., 2004). The current research indicated the extent to which an independent relationship exists between the constructs of phonemic and orthographic awareness as measured by the DIBELS and CTOPP assessments.

The confirmatory factor analysis conducted in this study indicated a strong relationship of phonemic awareness to the measures which required the participants to produce sounds used in language through segmentation, blending, identification of initial and final sounds, identification of words without sounds and compound words with one word deleted, and matching first and final sounds in words within a group of words. These tasks can help educators identify students who have difficulties in phonemic awareness. Furthermore, the results of this study, that suggested there were strong relationships between orthographic awareness and measures which required participants to identify symbols representing the sounds produced, can be used to identify individuals who have deficits in orthographic awareness. With these sound and word identification tasks administered auditorily and/or in print, teachers, administrators, parents and researchers can implicate effective interventions based on individual needs.

Another implication of the study suggests the use of the DIBELS and CTOPP assessments as curriculum-based measures for response-to-intervention (RTI) practices. As these assessment results can target individuals in need of specialized interventions, educators may employ these measures to determine the source of the difficulties students may have in early literacy tasks by specifically identifying whether the deficits are phonemic or orthographic in nature. The outcomes of these assessments and use of RTI can indicate the most effective method by identifying the underlying problems children may have in their reading skills. The findings of this research provide support that many of the DIBELS and CTOPP tasks appear to provide valid measures of phonemic and orthographic awareness. The use of this evidence with RTI practices can guide more effective instructional procedures by targeting specific areas for intervention.

A final implication of the study suggests the need for further validity studies with the DIBELS and CTOPP assessments. The present research provides information to guide future research in early literacy measures, and the degree to which they define latent constructs of early reading abilities. Further analyses will be needed to investigate the dimensionality of measures in early literacy skills in different ways. First a replication of the current study is needed to investigate both convergent and divergent validity. Although there is more of an interest to examine convergent relations between the latent and observed variables, further analyses on the divergent relations which, for example, may be indicated by low correlations, can add to the literature by providing evidence of why or how a particular task does not tap into a particular construct. Future research can include setting up the models in the same way as in the current research with the exception of the four subtests on the CTOPP that were problematic, Rapid Color

Naming, Rapid Object Naming, Memory for Digits and Nonword Repetition. Another model may include three latent constructs, phonemic awareness, orthographic awareness and rapid naming.

Some other suggested areas for future research might target the investigation of latent constructs of early reading in addition to phonemic and orthographic awareness such as morphological awareness and fluency. Additional research can be conducted to determine whether fluency and rapid naming factors are distinguishable latent constructs. By examining these additional latent constructs, outcomes may suggest further answers to the questions about rapid naming and whether or not it is its own latent construct.

Although a confirmatory factor analysis provides evidence of the dimensionality of the latent constructs, other methodological research can be useful to provide evidence of different types of validity. Future research should include further predictive validity studies to show reading outcomes with the same students assessed during winter of kindergarten. Another methodology that would be useful with these measures is item level research. By evaluating the items presented in the tasks, research will provide evidence of those tasks that reliably reflect the developmental level of students and the difficulty of items as they are presented. Item level research would also provide further evidence of the reliability of the assessment.

Further validity studies are also needed to provide evidence of generality to implicate positive outcomes for individuals with varying exceptionalities, cultural differences and different age groups. It is necessary to replicate the procedures in this study in order to provide findings that can be generalized to other groups of individuals

from different settings, cultures and age groups as well as participants randomly selected to evaluate gender differences and areas of exceptionality.

As indicated throughout this study, the information presented on the concurrent evidence of validity and factor analytic validity of the DIBELS and the CTOPP contributes to the mandated use of effective, evidence-based assessment tools to determine individuals in need of interventions in early literacy. Additionally, construct validity measures indicate the usefulness of assessments to provide markers of the early literacy processes that develop in children who are learning to read. These measures contribute to better understanding the need for valid assessments to meet the expectations of the *No Child Left Behind* mandate (NCLB, U.S. Department of Education, 2002).

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APPENDICES

APPENDIX A
CORRELATIONAL AND EXPERIMENTAL STUDIES OF CRITERION-RELATED
VALIDITY IN TESTS OF EARLY LITERACY

Appendix A

Researcher(s) & Study	Participants	Procedure	Findings
<p>Denton, C.A., Ciancio, D.J., & Fletcher, J.M. (2006). Validity, reliability, and utility of the observation survey of early literacy. <i>Reading Research Quarterly</i>, 4(1), 8-34.</p>	<p>First-grade and preschool students</p>	<p>This study evaluated validity and reliability of the Observation Survey of Early Literacy Achievement (OS, Clay, 2002).</p> <p>The researchers analyzed concurrent validity of the observation survey with instruments of known psychometric properties.</p> <p>They analyzed predictive validity of OS subtests with first grade reading development.</p>	<p>Predictive validity demonstrated that the decisions made based on the benchmarks of OS (word identification, text reading, and writing vocabulary) were valid for early screening and student outcome evaluations.</p> <p>Scores showed inadequate floors and ceilings indicating that the subtests scored by the manual recommendations were not appropriate for program evaluation.</p> <p>The researchers found validity in the implementation of OS to assess early reading development components although there were some limitations.</p>
<p>Harvey, J.M., Story, N., Baker, K. (2002). Convergent and concurrent validity of two measures of phonological processing. <i>Psychology in the Schools</i>, 39(5), 507-514.</p>	<p>Kindergarten students in their second semester</p>	<p>The Test of Phonological Awareness (TOPA, Torgesen & Bryant, 1994) and the CTOPP were administered in the spring in a counterbalanced order.</p> <p>Four to six weeks after the TOPA and the CTOPP, the researchers administered the Woodcock Johnson letter-identification subtest (Woodcock, McGrew, & Mather, 2001).</p> <p>A stepwise, multiple regression was used to examine phonological variables with the letter identification subtest.</p>	<p>Rapid naming correlated with phonological awareness, but not with phonological memory.</p> <p>Regression showed all 4 phonological predictors accounted for 51% of the variance in the reading measure (with phonological awareness accounting for the largest variance, 31%, and rapid naming accounting for 11% of the variance of letter identification).</p>

Researcher(s) & Study	Participants	Procedure	Findings
<p>Chafouleas, S.M., & Martens, B.K. (2002). Accuracy-based phonological awareness tasks: Are they reliable, efficient, and sensitive to growth? <i>School Psychology Quarterly</i>, 17(2), 128-147.</p>	<p>Kindergarten and first-grade students</p>	<p>The purpose of this study was to examine the efficiency and sensitivity of phonological awareness tasks to monitor phonological development in kindergarten and first grades.</p> <p>In experiment 1, the students responded to a varied number of items and varied items of phonological awareness.</p> <p>Experiment 2 examined interscorer reliability and concurrent validity on all five measures and compared sensitivity to growth.</p>	<p>Slopes indicated positive growth across all tasks and classes.</p> <p>Mean kindergarten slopes were steeper than first grade.</p> <p>The most sensitive task was segmentation.</p>
<p>Margolese, S.K., & Kline, R.B. (1999). Prediction of basic reading skills among young children with diverse linguistic backgrounds. <i>Canadian Journal of Behavioural Science</i>, 31(4), 209-216.</p>	<p>Kindergarten students followed through first grade</p>	<p>The researchers assessed predictive validity of phonological processing, listening comprehension, general cognitive ability, and visual-motor coordination.</p> <p>The kindergarten students were tested in all four areas listed above.</p> <p>The students were assessed in first grade for letter and word recognition.</p>	<p>Phonological processing was the only significant predictor of reading in the first grade.</p> <p>The students' languages spoken at home related to the letter recognition measure indicating that experience with language may contribute to the acquisition of early reading skills as phonological processing is predictive in children who speak one language only.</p>

Researcher(s) & Study	Participants	Procedure	Findings
<p>Wood, F.B., Hill, D.F., Meyer, M.S., & Flowers, D.L. (2005). Predictive assessment of reading. <i>Annals of Dyslexia</i>, 55(2), 193-216.</p>	<p>Experiment 1: First grade students</p> <p>Experiment 2: Representative sample of Kindergarten through third grade students</p>	<p>Experiment 1: The researchers hypothesized the following four constructs to be predictive of future reading achievement: phonemic awareness, picture naming vocabulary, rapid automatized naming (RAN), and single word reading.</p> <p>Tests were administered in all four areas.</p> <p>Experiment 2: The researchers developed new test items for all four areas.</p> <p>Except for the phonemic awareness test, the same items were used across all grades indicating a “wide range.”</p> <p>The Woodcock-Johnson III (Woodcock, McGrew, & Mather, 2000) was used as the concurrent criterion measure.</p>	<p>Regression analyses indicated: Experiment 1: Concurrent validity of the four areas: Phonemic awareness accounted for 88%, picture naming vocabulary accounted for 76%, RAN and single word identification each accounted for 69% of the variance.</p> <p>Experiment 2: This experiment cross-validated concurrent and predictive validities.</p> <p>Cross-validation accounted for 86% of the variance (with the same regression weights used in experiment 1).</p> <p>These validities were stronger than similar studies in the literature.</p>

APPENDIX B
CONCURRENT AND PREDICTIVE VALIDITY STUDIES WITH EARLY READING
MEASURES

Appendix B

<i>Author</i>	<i>Type of Validity Evidence</i>	<i>Criterion Measure</i>	<i>Measure</i>	<i>Coefficients Reported</i>	
Good, Simmons, & Kame'enui (2001)	Predictive	Woodcock-Johnson Revised Reading	D-ISF (K)	.36	
		Readiness Cluster scores (1 st grade).	D-PSF(K)	.54	
			D-LNF(K)	.65	
				D-NWF(K)	.59
			DIBELS subtests at later benchmarks:		
			D-PSF (spring K)	D-ISF (winter K)	.34
			D-NWF (winter 1 st)	D-PSF (spring K)	.38
		D-NWF (winter 1 st)	.78		
Good, Kaminski, Laimon, & Johnson (2000); Kaminski & Good (1996)	Concurrent criterion-related	Metropolitan Readiness Test	D-LNF(K)	.86	
			D-PSF(K)	.68	
		McCarthy Scales of Children's Abilities	D-LNF(K)	.67	
			D-PSF(K)	.57	
	Predictive	Stanford Diagnostic Reading Test	D-LNF(K)	.72	
			D-PSF(K)	.73	
		CBM-ORF	D-LNF(K)	.83	
			D-PSF(K)	.76	
Elliot, Lee, & Toleffson (2001)	Concurrent criterion-related	Woodcock-Johnson Psychoeducational Achievement Battery-III, Broad Reading.	D-LNF	.63	
			A-LSF	.58	

<i>Author</i>	<i>Type of Validity Evidence</i>	<i>Criterion Measure</i>	<i>Measure</i>	<i>Coefficients Reported</i>	
Elliot, Lee, & Toleffson (2001) (continued)		Test of Phonological Awareness (TOPA)	D-LNF	.50	
			A-LSF	.68	
		Kaufman Brief Intelligence Test, Verbal	D-LNF	.54	
			A-LSF	.55	
Hagan-Burke, Burke, & Crowder (2006)	Concurrent criterion-related	Test of Word Reading Efficiency, (TOWRE): Sight Words (SW) and Phoneme Decoding Efficiency (PDE) subtests	D-PSF	.32 (SW)	.29(PDE)
			D-LNF	.62(SW)	.46(PDE)
			D-NWF	.73(SW)	.74(PDE)
			WUF	.32(SW)	.29(PDE)
	Predictive	Fall DIBELS subtest scores predicting TOWRE scores in Winter	D-NWF D-LNF	D-NWF and D-LNF accounted for the majority of variance in both TOWRE subtest scores.	
VanDerHeyden, Witt, Naquin, & Noell (2001)	Concurrent criterion-related	Reading-Circle Letter (kindergarten)	D-ISF	.72	
			Letter Sound Naming	.76	
		Math-Circle Number	D-ISF	.46	
			Letter Sound Naming	.70	

APPENDIX C
TRAINING OUTLINE AND PROFICIENCY LEVELS

Appendix C

Training Outline and Proficiency Levels

Day 1:

Introduce all assessors and have everyone pick a partner to practice administering the assessments.

Pass out the manuals, examples of the measures, and scoring booklets.

Explain each measure individually and only move on based on mastery of the previous measure with every assessor.

Include all error types and common mistakes in presenting examples of the types of errors students emit.

Thoroughly check for understanding and allow plenty of time for questions.

Day 2: All assessors must meet criterion of 90% accuracy.

Full-time practice on all measures for 90% inter-rater agreement with a supervisor.

Proficiency Levels for the assessors

During training:

Reliability = 90% interobserver agreement

During administration = 90% interobserver agreement

APPENDIX D
ASSESSMENT GUIDELINES

Appendix D

Assessment Guidelines

In order for undergraduate and graduate students to administer the DIBELS and CTOPP assessments, they must achieve 90% reliability with a trainer on each measure. In addition, the assessors must follow the guidelines below:

1. **REINFORCEMENT:** Only provide praise statements for correct responses during the examples only for each measure. You may praise students for sitting appropriately in his or her chair and listening to your directions. At the end of each assessment, allow the student to pick out a sticker for their participation.
2. Remember that the timings for the measures differ across the DIBELS and the CTOPP.
3. Practice administering the test to one another and provide errors in responses in order to become fluent in the rules for scoring the measures (i.e., discontinue rule, 3-second rule, self corrects, incorrect letters, omissions, articulation and dialect, etc...)
4. ‘Schwa’ sounds are not counted as incorrect.
5. Present the examples to observe that student comprehends the directions you give him or her and ensure that you are attending to the student’s correct use of sounds, false starts, and repetitions of letters or sounds.
6. Keep the assessments flowing by minimizing conversation with the students.

*Refer to your assessment manuals on the rules for each measure. If there are questions about the reliability of the administration of the assessment, ask the supervisor.

APPENDIX E

DIBELS INITIAL SOUND FLUENCY MEASURE FOR FALL OF KINDERGARTEN

APPENDIX F
DIBELS PHONEME SEGMENTATION FLUENCY MEASURE FOR WINTER OF
KINDERGARTEN

Appendix F

Benchmark K-2
DIBELS™ Phoneme Segmentation Fluency

hat	/h/ /a/ /t/	hear	/h/ /ea/ /r/	___/6
as	/a/ /z/	punch	/p/ /u/ /n/ /ch/	___/6
means	/m/ /ea/ /n/ /z/	by	/b/ /ie/	___/6
seem	/s/ /ea/ /m/	ship	/sh/ /i/ /p/	___/6
ought	/o/ /t/	pack	/p/ /a/ /k/	___/5
jam	/j/ /a/ /m/	if	/i/ /f/	___/5
yell	/y/ /e/ /l/	ham	/h/ /a/ /m/	___/6
calls	/k/ /o/ /l/ /z/	ear	/ea/ /r/	___/6
key	/k/ /ea/	crowd	/k/ /r/ /ow/ /d/	___/6
loud	/l/ /ow/ /d/	choose	/ch/ /oo/ /z/	___/6
bare	/b/ /ai/ /r/	bills	/b/ /i/ /l/ /z/	___/7
guy	/g/ /ie/	stand	/s/ /t/ /a/ /n/ /d/	___/7

Total: ___

Error Pattern:

APPENDIX G

DIBELS LETTER NAMING FLUENCY MEASURE FOR WINTER OF KINDERGARTEN

Appendix G

Benchmark K-1
DIBELS™ Letter Naming Fluency

g	N	E	Y	R	l	V	d	H	Z
N	d	x	S	C	n	j	H	s	S
E	n	G	h	c	i	h	B	b	O
Y	F	p	D	L	i	q	c	D	Q
R	v	F	J	Z	M	P	o	p	u
l	G	A	f	V	B	P	k	m	I
V	M	e	r	y	z	a	L	U	A
d	y	q	v	w	u	T	w	N	U
H	j	K	e	r	X	T	z	Y	X
Z	x	f	m	W	W	s	J	I	k
l	E	R	K	g	N	E	Y	R	l

Total: _____

APPENDIX H

DIBELS NONSENSE WORD FLUENCY FOR WINTER OF KINDERGARTEN

Appendix H

Benchmark K-2
DIBELS™ Nonsense Word Fluency

y i z	w a n	z o c	f u l	m i k	__/15
z u m	n u f	k u n	r u v	f o d	__/15
v e p	i j	o p	j u j	s u g	__/13
z u z	o v	v i t	w a m	b u k	__/14
l e f	l u k	t e v	l o f	k o m	__/15
j u f	t a m	n o l	r e z	k e c	__/15
p u m	p o z	m u m	o l	k a v	__/14
r i v	k i c	k i s	k e m	v a k	__/15
t e k	u t	r i z	a j	v e j	__/13
y i l	j e v	n e g	s o m	j u p	__/15
Total:					_____

Error Pattern:

APPENDIX I

CTOPP ELISION SUBTEST FOR WINTER OF KINDERGARTEN

Appendix I

Section IV. Record of Item and Subtest Performance

Subtest I. Elision

MATERIALS: None

CEILING: Stop after child misses 3 test items in a row.

FEEDBACK: Give feedback on all practice items and test items 1-5 only.

SCORING: Record correct answers as 1 and incorrect answers as 0. The total raw score for this subtest is the total number of correct test items up to the ceiling.

DIRECTIONS: Say, "Let's play a word game."

PRACTICE ITEMS:

- | | Correct Response |
|--|------------------|
| a. Say <i>toothbrush</i> . Now say <i>toothbrush</i> without saying <i>tooth</i> . | brush |

If correct say, "That's right. Let's try the next one."

If incorrect say, "That's not quite right. *Toothbrush* without saying *tooth* is *brush*."

Continue to give correct/incorrect feedback as before. Say, "Let's try some more."

- | | |
|--|-----|
| b. Say <i>airplane</i> . Now say <i>airplane</i> without saying <i>plane</i> . | air |
| c. Say <i>doughnut</i> . Now say <i>doughnut</i> without saying <i>dough</i> . | nut |

TEST ITEMS: Continue to give correct/incorrect feedback as before.

- | | Correct Response | Score
(1/0) |
|---|------------------|----------------|
| 1. Say <i>popcorn</i> . Now say <i>popcorn</i> without saying <i>corn</i> . | pop | _____ |
| 2. Say <i>baseball</i> . Now say <i>baseball</i> without saying <i>base</i> . | ball | _____ |
| 3. Say <i>spider</i> . Now say <i>spider</i> without saying <i>der</i> . | spy | _____ |

PRACTICE ITEMS: Say, "Okay, now let's try some where we take away smaller parts of the words." Continue to give correct/incorrect feedback. Use the phoneme, not the letter name (e.g., /k/ is the sound of k).

- | | Correct Response |
|---|------------------|
| d. Say <i>cup</i> . Now say <i>cup</i> without saying /k/.
If correct say, "That's right. Let's try the next one."
If incorrect say, "That's not quite right. <i>Cup</i> without saying /k/ is <i>up</i> ." | up |
| e. Say <i>meef</i> . Now say <i>meef</i> without saying /f/. | me |
| f. Say <i>farm</i> . Now say <i>farm</i> without saying /f/. | arm |

TEST ITEMS: Continue to give correct/incorrect feedback as before.

- | | Correct Response | Score
(1/0) |
|--|------------------|----------------|
| 4. Say <i>bold</i> . Now say <i>bold</i> without saying /b/. | old | _____ |
| 5. Say <i>mat</i> . Now say <i>mat</i> without saying /m/. | at | _____ |

REMAINING TEST ITEMS: Provide no feedback on remaining items.

- | | | |
|---|--------|-------|
| 6. Say <i>fan</i> . Now say <i>fan</i> without saying /f/. | an | _____ |
| 7. Say <i>mike</i> . Now say <i>mike</i> without saying /k/. | my | _____ |
| 8. Say <i>time</i> . Now say <i>time</i> without saying /m/. | tie | _____ |
| 9. Say <i>tiger</i> . Now say <i>tiger</i> without saying /g/. | fire | _____ |
| 10. Say <i>powder</i> . Now say <i>powder</i> without saying /d/. | power | _____ |
| 11. Say <i>winter</i> . Now say <i>winter</i> without saying /t/. | winner | _____ |
| 12. Say <i>snail</i> . Now say <i>snail</i> without saying /n/. | sail | _____ |
| 13. Say <i>faster</i> . Now say <i>faster</i> without saying /s/. | fatter | _____ |
| 14. Say <i>sling</i> . Now say <i>sling</i> without saying /l/. | sing | _____ |
| 15. Say <i>driver</i> . Now say <i>driver</i> without saying /v/. | dryer | _____ |
| 16. Say <i>silk</i> . Now say <i>silk</i> without saying /l/. | sick | _____ |
| 17. Say <i>flame</i> . Now say <i>flame</i> without saying /f/. | lame | _____ |
| 18. Say <i>strain</i> . Now say <i>strain</i> without saying /r/. | stain | _____ |
| 19. Say <i>split</i> . Now say <i>split</i> without saying /p/. | slit | _____ |
| 20. Say <i>fixed</i> . Now say <i>fixed</i> without saying /k/. | fist | _____ |

Total Raw Score _____

APPENDIX J

CTOPP RAPID OBJECT NAMING FOR WINTER OF KINDERGARTEN

Appendix J

Subtest V. Rapid Object Naming

MATERIALS: Stopwatch, object naming pages in Picture Book (Practice, Forms A and B)

CEILING: Discontinue testing if on the practice items the child cannot name all of the objects correctly, even after error correction. If the child makes more than 4 errors on Form A, do not give Form B. If the child makes more than 4 errors on either form, do not score the subtest.

SCORING: The score for this subtest is the number of seconds that it takes the examinee to name all of the objects on Form A and Form B combined. Items are marked incorrect if the child skips the object or gives it the wrong name. If the child skips a line, score the first object on the skipped line as incorrect and try to redirect the child to the correct line. If the child hesitates for more than 2 seconds on an object, mark it as incorrect and point to the next item and say, "Go on."

DIRECTIONS

PRACTICE ITEMS: Show practice page and say, "What objects do you see on this page?" (Point to first object and continue pointing if necessary. If the child makes any errors, correct the child, and have him or her repeat all the objects again. If the child continues to make errors, discontinue testing.) Say, "You will be saying the names of some objects as fast as you can."

TEST ITEMS: Say, "Now I want you to say the names of the objects on this page as fast as you can. When I tell you to start, you will begin here (point to upper left corner on Form A), and name this row (point to top row) before you go on to the next row. Just name the objects in each row as fast as you can until you come to the end. Try not to skip any objects. Do you understand?"

Put a blank sheet on top of Form A to cover the objects for about 5 seconds. Say, "You will begin as soon as I uncover the page. Ready? Begin."

Quickly take cover off the page, and start timing as soon as the child says the first object's name. Stop timing when the name of the last object is pronounced. Keep track of errors by putting a slash through each wrong item. When the child is finished, record time and errors. Continue with Form B unless the child made more than 4 errors on Form A.

Form A: pencil star fish chair boat key star pencil key **Time** _____
 fish boat chair key chair star boat fish pencil **Errors** _____
 star chair key pencil fish boat star key fish
 chair boat pencil fish key chair pencil star boat

Form B: After items on Form A are completed, open to Form B and say, "Now we will do it one more time. Remember, say the objects as fast as you can." (Follow the same procedure as for Form A.)

boat star pencil chair key fish pencil boat chair **Time** _____
 fish key star boat fish pencil key chair star **Errors** _____
 pencil fish boat star chair key chair boat fish
 key pencil star key boat chair fish star pencil

Score _____ (Time for Form A + Time for Form B)

APPENDIX K

CTOPP BLENDING WORDS SUBTEST FOR WINTER OF KINDERGARTEN

Appendix K

Subtest III. Blending Words

MATERIALS: Audiocassette recorder and "Blending Words" section of cassette

CEILING: Stop after child misses 3 test items in a row.

NOTE: If the child asks you to repeat the sounds, you may play the taped sounds one more time.

PROMPT: If the child says the sounds separately (e.g., m-e, rather than *me*), prompt by saying, "Try to say the sounds all together as a real word." This prompt can be used as often as needed on practice words *only*.

FEEDBACK: Give feedback on all practice items and the *first 3 test items only*.

SCORING: Record correct answers as 1 and incorrect answers as 0. The total raw score for this subtest is the total number of correct test items up to the ceiling.

DIRECTIONS

PRACTICE ITEMS: Say, "Listen to the audiocassette recorder. You will hear some words in small parts, one part at a time. I want you to listen carefully, and then put these parts together to make a whole word. Ready? Let's try one."

a. Play the taped instruction that says, "What word do these sounds make? Can-dy." Then pause to allow the child to answer.

If correct say, "That's right. Let's try the next one."

If incorrect say, "That's not quite right. When you put *can-dy* together, it makes *candy*. You try it: *can-dy* makes _____? (Pause.) "Let's try the next one."

Continue the taped items listed below, pausing after each item, and give corrective feedback as above).

		Correct Response
b. What word do these sounds make?	hām-ār	hammer
c. What word do these sounds make?	s-ūn	sun
d. What word do these sounds make?	t-āk	take
e. What word do these sounds make?	n-ō	no
f. What word do these sounds make?	m-ād	mad

TEST ITEMS: Say, "Let's try some more words. Each time you will hear the word one part at a time. Listen carefully and put the parts together to make a whole word." (Continue the taped items below, pausing after each item.) Items may be repeated once.

FEEDBACK on Items 1-3 only:

If correct say, "That's right."

If incorrect say, "When you put *nūm-bār* together, it makes *number*."

	Correct Response	Score (1/0)	
1. nūm-bār	number	_____	
2. pēn-sāl	pencil	_____	
3. ān-sār	answer	_____	Stop Feedback
4. ī-t	it	_____	
5. t-ol	toy	_____	
6. s-ō	saw	_____	
7. sh-ē	she	_____	
8. n-āp	nap	_____	
9. m-ī-s	miss	_____	
10. b-ō-n	bone	_____	
11. m-ōō-n	moon	_____	
12. s-t-ā-m-p	stamp	_____	
13. j-ū-m-p	jump	_____	
14. m-ī-s-t-ā-k	mistake	_____	
15. s-ū-r-k-ūs	circus	_____	
16. ō-l-m-ō-s-t	almost	_____	
17. g-r-ā-s-h-ō-p-ār	grasshopper	_____	
18. t-ē-s-t-ā-f-ī	testify	_____	
19. ū-n-d-ār-s-t-ā-n-d	understand	_____	
20. m-ā-th-ā-m-ā-t-ī-k-s	mathematics	_____	
Total Raw Score		_____	

Note. Pronunciation guide is from *American Heritage Dictionary of the English Language*, 1976, Boston: Houghton Mifflin.

APPENDIX L

CTOPP SOUND MATCHING FOR WINTER OF KINDERGARTEN

Appendix L

Subtest IV. Sound Matching

MATERIALS: Picture Book

CEILING: Stop when child misses 4 out of 7 test items (give at least 7 test items).

NOTE: Items can be repeated once if child appears to forget names given to pictures. For practice and test items, pause 1 second after pronouncing the target word before pronouncing the three alternative answers. Point to the pictures as their names are pronounced. Child may point to or say correct response.

FEEDBACK: Give feedback on all practice items and the *first three test items only*.

SCORING: Record correct answers as 1 and incorrect answers as 0. The total raw score for this subtest is the total number of correct responses up to the ceiling.

PART 1—FIRST SOUND

DIRECTIONS

PRACTICE ITEMS: Open Picture Booklet to the example page for Subtest 4. Say, "We're going to play a game with words. I will show you pictures to help you remember the words."

a. Look at the first picture. This is a sock. Now look at these two pictures. This is the sun and this is a bear. The word *sock* starts with the /s/ sound. Which of these picture words starts with the /s/ sound like sock: *sun* or *bear*?" Point to the pictures as you say their names.

If correct say, "That's right; *sock* and *sun* start with the same sound, /s/. Let's try the next one."

If incorrect say, "That's not quite right. The answer is *sun*, because *sock* and *sun* (emphasize the first sound) start with the same sound, /s/. Let's try another one."

Continue correct/incorrect feedback as above; point to each picture as you say the names.

Correct Response

b. Which word starts with the /n/ sound like *neck*? *Nut*, *bed*, or *cake*?

nut

c. Which word starts with the same sound as *foot*? *Bat*, *hook*, or *fish*?

fish

TEST ITEMS: Point to each picture as you say the names. Provide feedback on Items 1–3 only.

If correct say, "That's right. *Pan* and *pig* start with the same sound, /p/. Let's try the next one."

If incorrect say, "That's not quite right. The answer is *pig*, because *pan* and *pig* (emphasize the first sound) start with the same sound, /p/. Let's try another one."

	Correct Response	Score (1/0)
1. Which word starts with the same sound as <i>pan</i> ? <i>pig</i> , <i>hat</i> , or <i>cone</i> ?	pig	___
2. Which word starts with the same sound as <i>duck</i> ? <i>run</i> , <i>kick</i> , or <i>dice</i> ?	dice	___
3. Which word starts with the same sound as <i>fan</i> ? <i>fire</i> , <i>can</i> , or <i>sack</i> ?	fire	___ Stop Feedback
4. Which word starts with the same sound as <i>man</i> ? <i>cat</i> , <i>fin</i> , or <i>mouse</i> ?	mouse	___
5. Which word starts with the same sound as <i>love</i> ? <i>dive</i> , <i>light</i> , or <i>tub</i> ?	light	___
6. Which word starts with the same sound as <i>nap</i> ? <i>tape</i> , <i>net</i> , or <i>man</i> ?	net	___
7. Which word starts with the same sound as <i>cake</i> ? <i>bike</i> , <i>coat</i> , or <i>game</i> ?	coat	___
8. Which word starts with the same sound as <i>bag</i> ? <i>bone</i> , <i>dad</i> , or <i>pig</i> ?	bone	___
9. Which word starts with the same sound as <i>rain</i> ? <i>tape</i> , <i>line</i> , or <i>rope</i> ?	rope	___
10. Which word starts with the same sound as <i>house</i> ? <i>mice</i> , <i>ham</i> , or <i>couch</i> ?	ham	___

Proceed to **Part 2 (on page 6)** unless child reaches a ceiling on **Part 1** (misses 4 of 7 items).

APPENDIX M

CTOPP RAPID COLOR NAMING SUBTEST FOR WINTER OF KINDERGARTEN

Appendix M

Subtest II. Rapid Color Naming

MATERIALS: Stopwatch, color naming pages in Picture Book (Practice, Forms A and B)

CEILING: Discontinue testing if on the practice items the child cannot name all of the colors correctly after error correction. If the child makes more than 4 errors on Form A, discontinue testing at that point. If child makes more than 4 errors on either form, do not score subtest.

SCORING: The score for this subtest is the number of seconds that it takes the examinee to name all of the colors on Form A and Form B combined. Items are marked incorrect if the child skips the color or gives it the wrong name. If the child skips a line, score the first color on the skipped line as incorrect and try to redirect the child to the correct line. If the child hesitates for more than 2 seconds on a color, mark it as incorrect and point to the next item and say, "Go on."

DIRECTIONS

PRACTICE ITEMS: Show practice page and say, "What colors do you see on this page?" (Point to the first color and continue pointing if necessary. If the child makes any errors, correct the child, and have him or her repeat all the colors again. If the child continues to make errors, discontinue testing.) Say, "You will be saying the names of some colors as fast as you can."

TEST ITEMS: Say, "Now I want you to say the names of the colors on this page as fast as you can. When I tell you to start, you will begin here (point to upper left corner on Form A), and name this row (point to top row) before you go on to the next row. Just name the colors in each row as fast as you can until you come to the end. Try not to skip any boxes. Do you understand?"

Put a blank sheet on top of Form A to cover the colors for about 5 seconds. Say, "You will begin as soon as I uncover the page. Ready? Begin."

Quickly take cover off the page, and start timing as soon as the child says the first color name. Stop timing when the name of the last color is pronounced. Keep track of errors by putting a slash through each wrong item. When the child is finished, record time and errors. Continue with Form B unless the child made more than 4 errors on Form A.

Form A:

blue	red	green	black	brown	yellow	red	black	blue	Time _____
yellow	green	brown	blue	red	green	black	yellow	brown	Errors _____
green	yellow	black	red	brown	blue	green	red	blue	
black	brown	yellow	brown	green	red	yellow	blue	black	

Form B: After colors on Form A are completed, open to Form B and say, "Now we will do it one more time. Remember, say the colors as fast as you can." (Follow the same procedure as for Form A.)

black	blue	yellow	red	green	brown	yellow	brown	black	Time _____
blue	red	green	blue	brown	red	black	yellow	green	Errors _____
brown	yellow	black	green	red	blue	brown	green	yellow	
blue	black	red	yellow	brown	black	green	red	blue	

Score _____ (Time for Form A + Time for Form B)

APPENDIX N

CTOPP MEMORY FOR DIGITS SUBTEST FOR WINTER OF KINDERGARTEN

Appendix N

Subtest VI. Memory for Digits

MATERIALS: Audiocassette recorder and "Memory for Digits" section of cassette

CEILING: Stop after child misses 3 test trials in a row.

FEEDBACK: If the child makes an error, supply the correct answer only on the practice items.

NOTE: Record the child's complete response to the right of the item on the response sheet. If the child wants a trial repeated, say you are not allowed to repeat the numbers.

SCORING: Score 1 point for each test trial completed without error.

DIRECTIONS: Say, "On this one, you will hear some numbers, one after another on the audiocassette recorder. After you hear the numbers, I want you to say them in the same order that you heard them. Listen carefully because I can't repeat the numbers. Let's try a couple for practice." Play the cassette, pausing after each trial to allow the child to respond. (*Note:* Try to keep your finger on or near the pause button, so that hand movement does not result in anticipation of end of trial.) Do the practice series. If the child makes an error on the practice series, supply the correct answer.

PRACTICE ITEMS: a. 52
b. 73
c. 971
d. 615 Stop Feedback

TEST ITEMS: Say, "Okay, now let's do some more. Just listen carefully, and do your best."

Score (1/0)	Response	Score (1/0)	Response
1. ___ 16	_____	12. ___ 92483	_____
2. ___ 72	_____	13. ___ 849713	_____
3. ___ 94	_____	14. ___ 641397	_____
4. ___ 521	_____	15. ___ 438975	_____
5. ___ 648	_____	16. ___ 3197426	_____
6. ___ 836	_____	17. ___ 9251638	_____
7. ___ 5318	_____	18. ___ 7145283	_____
8. ___ 3741	_____	19. ___ 46359271	_____
9. ___ 7596	_____	20. ___ 97412536	_____
10. ___ 41839	_____	21. ___ 49673165	_____
11. ___ 63258	_____	___ Total Raw Score	

APPENDIX O

CTOPP NONWORD REPETITION SUBTEST FOR WINTER OF KINDERGARTEN

Appendix O

Subtest VII. Nonword Repetition

MATERIALS: Audiocassette recorder and "Nonword Repetition" section of cassette

CEILING: Stop after child misses 3 test items in a row.

FEEDBACK: Give feedback on all practice items and the first 3 test items.

NOTE: If child asks to have an item repeated, say, "I can only play the taped sounds once."

SCORING: Record correct answers as 1 and incorrect answers as 0. The total raw score for this subtest is the total number of correct responses up to the ceiling.

DIRECTIONS

PRACTICE ITEMS: Say, "I want you to listen to some made-up words on the audiocassette recorder. After you hear each made-up word, I want you to say it exactly as you heard it and as clearly as you can. Even if it's hard to say, give it your best try. Listen carefully because I can't repeat the words. Okay? Let's try some." **Start cassette.**

If correct say, "That's right. Now try the next word."

If incorrect say, "That's not quite right. The word was _____. Let's try another word."

- a. ral (rāl)
- b. sarf (sārf)
- c. ballop (bāl-ōp)

DIRECTIONS

TEST ITEMS: Say, "Let's try a few more. Listen to the made-up word. Then say it exactly as you hear it. Ready?"

FEEDBACK on items 1-3 only:

If correct say, "That's right."

If incorrect say, "Good try. The word was _____."

TEST ITEMS

**Score
(1/0)**

1. jup (jōōp)	_____	
2. zid (zīd)	_____	
3. pate (pāt)	_____	Stop Feedback
4. meb (mēb)	_____	
5. wudoip (wōō-doiip)	_____	
6. nigong (nī-gōng)	_____	
7. chaseedoolid (chā-sē-dōō'-līd)	_____	
8. bleleedoge (bī-lē-dōj)	_____	
9. voesutoov (vōz'-ā-tōōv)	_____	
10. lisashrul (līs-ā-shrūl)	_____	
11. wulanuwup (wōō-lān-ā-wūp)	_____	
12. teebudleshawit (tē-būd'-ī-shōIt)	_____	
13. viversoomouj (vīv-ār-sōō'-mouj)	_____	
14. burloogugendaplo (būr-lōō-gū'-jēn-dā-plō)	_____	
15. gekleziesaeekad (gēk'-ē-zī-sā-kād)	_____	
16. mawgeebooshernooshlek (mōg'-ē-bōō-shār-nōō'-shīk)	_____	
17. dookershatapletazawm (dōōk'-ār-shā'-tā-pī-tā-zōm)	_____	
18. shaburlehuvoimush (shā'-būr-t-hū'-voī-mūsh)	_____	
Total Raw Score	_____	