Examination of the Usefulness of the Picture Naming Individual Growth and Development Indicator for Preschoolers with Disabilities

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Abstract

Data-based decision making is at the forefront of educational research, policy, and practice (Barnett, Bell, & Barnett, 1999; Barnett, VanDerHeyden, & Witt, 2007; NCLB, 2001). While the practice of using data to make decisions about children with disabilities has been a part of early childhood special education services, there have been limitations to the usefulness and meaningfulness of these data (McConnell, 2000). One aspect of this is the lack of quality tools with which to make decisions. The goal of this study was to further evaluate the potential of one such tool for preschool children with disabilities to assess expressive language growth.

The Pre-Elementary Education Longitudinal Study (PEELS), a large national dataset, provided a unique opportunity to further the validity-related evidence and usefulness of the Picture Naming–Individual Growth and Development Indicator (PN–IGDI) for a larger and broader sample of children with disabilities. The purpose of the study was twofold: (1) to examine validity-related evidence (e.g., construct-related validity, predictive-related validity) and usefulness of the PN–IGDI and (2) to determine if disability category (i.e., Autism spectrum disorder, developmental delay, or speech or language impairment) influenced these results.

Results provided continued support for the validity-related evidence for the PN–IGDI for children with language-related disabilities. In particular, the predictive-related validity evidence showed a promising relationship between the PN–IGDI and the Dynamic Indicator for Basic Literacy Skills Oral Reading Fluency (DIBELS ORF). Further establishing its usefulness, the PN–IGDI was sensitive enough to detect change over time for children with disabilities. However, evidence from this study did not indicate that there were substantial differences in how well the PN-IGDI measures expressive vocabulary among the disability groups. The merits, limitations, and directions for future research were also discussed.

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CHAPTER 1

Introduction

Learning to read is a critical life skill. It has been shown that poor readers are at greater risk for academic and social failure, including being less likely to graduate from high school, less likely to be employed, less likely to earn a higher income, and less likely to have a bank account (National Center for Educational Statistics [NCES], 1992; Snow, Burns, & Griffin, 1998). Ergo, reading achievement has been at the forefront of educational research (e.g., Adams, 1990; Chall, 1983; Chall, Jacobs, & Baldwin, 1990; Cunningham & Stanovich, 1997; NCES, 2007; National Education Panel, 2000), initiatives (e.g., Educate America, 1994; Goals, 2000), and legislation (e.g., Good Start, Grow Smart, 2002; No Child Left Behind Act [NCLB], 2001) for several decades. More recently, a growing body of evidence highlights the significance of the preschool period for the development of several critically important early literacy skills (e.g., Lonigan, Burgess, & Anthony, 2000; Lonigan, Schatschneider, & Westberg, 2008, National Early Literacy Panel [NELP], 2008; Spira & Fischel, 2005; Storch & Whitehurst, 2002; Snow et al., 1998; Whitehurst & Lonigan, 1998). The skills children develop in preschool, prior to the beginning of formal reading instruction, are often referred to as emergent literacy skills, which Whitehurst and Lonigan (1998) defined as the "developmental precursors to conventional forms of reading and writing" (p. 849).

From an emergent literacy perspective, children acquire literacy skills and knowledge in the years prior to formal reading and writing instruction (Whitehurst & Lonigan, 1998). The development of these prereading behaviors sets the stage for a child to become a skilled and fluent reader. A report by the National Early Literacy Panel (NELP; 2008) synthesized research on the development of emergent literacy skills in children birth to 5 years. The report identified 10 specific skills (e.g., phonological awareness [PA], alphabet knowledge [AK], oral language) as being moderate to strong predictors of later outcomes in conventional literacy. These 10 skills were the strongest or among the strongest predictors of decoding, reading comprehension, and spelling, accounting for 27–61% of the variance in these conventional reading skills (NELP, 2008). Accordingly, there is also a growing body of research supporting the use of instructional practices and activities that promote the development of these emergent literacy skills (Lonigan, Allan, & Lerner, 2011). Research reviews have identified that interventions that promote skills primarily associated with decoding print (i.e., code-related skills) and those that promote the skills primarily associated with comprehending what is read (i.e., meaning-related skills) yielded moderate to large effects on the predictors of later reading and writing (i.e., PA, AK, print knowledge, oral language; NELP, 2008).

Of the 10 skills identified by the NELP report (2008) as important predictors of later conventional reading abilities, oral language has been shown to provide the greatest contribution to reading comprehension (Anderson & Freebody, 1981; Cunnigham & Stanovich, 1997; Hart & Risley, 2003; Hirsch, 2003; Stahl & Fairbanks, 1986; Roth, Speece, Cooper, & De La Paz, 1996; Speece, Roth, Cooper, & De La Paz, 1999; Storch & Whitehurst, 2002). Oral language refers to all of the words in a child's vocabulary as well as his or her ability to use these words to understand and convey meaning successfully. Oral language processes encompass various skill sets including vocabulary (receptive and expressive), syntactic and semantic knowledge, and narrative discourse processes (memory, comprehension, and storytelling; Bishop & Adams, 1990; Cabell, Justice, Konold, & McGinty, 2011; NELP, 2008; Whitehurst & Lonigan, 1998). Vocabulary is at the heart of oral language comprehension and has been described as the bedrock of language and early literacy (Cabell, Justice, Konold, & McGinty, 2011; Hart & Risley, 2003; Hirsch, 2003). Vocabulary knowledge has been associated with the ability to decode words, recognize sight words, and comprehend what is read (Nation & Snowling, 2004; NELP, 2008; Ouellette, 2006; Storch & Whitehurst, 2002). Research has determined that the size and quality of a child's vocabulary has consequences for early literacy development and school readiness (Hart & Risley, 1995; NELP, 2008). That is, children with larger vocabularies, relative to their same-age peers, become more proficient readers (e.g., Bishop & Adams, 1990; NELP, 2008; Scarborough, 1989).

Poor vocabulary is a hallmark of language, literacy, and cognitive disabilities (Charman, Drew, Baird, & Baird, 2003; Hick, Joseph, Conti-Ramsden, Serratice, & Faragher, 2002; Luyster, Lopez, & Lord, 2007; Sheng & McGregor, 2010; Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998). Children with language-related disabilities arrive at school with weaker oral language skills than their typically developing peers; they are more likely to experience difficulties in reading and will have difficulty catching up (Catts, Fey, Zhang, & Tomblin, 1999; Catts, Fey, Tomblin, & Zhang, 2002; McCardle, Scarborough, & Catts, 2001; Torgesen, 1998). Children with language-related disabilities, often in conjunction with other issues, continue to constitute a large portion of students in early childhood special education programs (Dale, Crain-Thoreson, Notari-Syverson, & Cole, 1996; U.S. Department of Education–Office of Special Education Programs, [OSEP] 2008). In fact, National Early Intervention Longitudinal Study (NEILS) reported that at least 41% of children entering early intervention had a speech/communication impairment or delay (Hebbler et al., 2007).

Oral language is a distinguishing characteristic, and an indicator of risk for later reading difficulties, particularly for children identified for special education during preschool. The majority of children ages 3 through 5 who received special education services in 2007 were identified, using the federal special education criteria, as having either Speech or Language Impairment (SLI; 46.2%), Developmental Delay (DD; 38.0%), or Autism Spectrum Disorder (ASD; 5.5%; OSEP, 2008). A key feature of the special education qualification criteria for SLI and ASD are delays in the area of speech or communication. The federal criteria for DD, however, describes children with a deficit in 1 or more of the 5 developmental domains of physical, cognitive, communication, social or emotional, and adaptive skills (OSEP, 2008). While the delay for a child with DD could be in any of these areas of development, research shows that communication delays are common in DD (Cihak, Smith, Cornett, & Coleman, 2012). Therefore, it was important to include all three disability categories when addressing special education preschoolers with language-related delays.

Given that a large portion of preschoolers with disabilities are at an increased risk for failing to develop foundational literacy skills (Catts et al., 1999; Catts et al., 2002; Hebbler et al., 2007; OSEP, 2008), attention must be paid to the development of literacy for these children. One important aspect of supporting language and literacy development for all young children is the use of valid, sensitive growth assessment measures (McConnell, 2000; McConnell, Priest, Davis, & McEvoy, 2002; Walker, Carta, Greenwood, & Buzhardt, 2008). Growth measures are designed to serve as indicators of progress on a general outcome (Walker et al., 2008). These measures are specifically designed for use by educators who use them to determine if a child is not making adequate short-term progress toward a larger outcome (e.g., oral language production). In this way, a child's functioning on the growth measure points to or helps predict success or failure in future functioning.

Recently, there has been resurgence of the importance of making decisions about children's education using sound, data-based measures with the introduction of the response to intervention model (RTI). RTI uses the quality of student responses to empirically-supported interventions as the basis for decisions about needed services (Barnett et al., 1999; Barnett, VanDerHeyden, & Witt, 2007). This concept closely mimics a practice that has been ingrained in the makeup of early childhood special education (ECSE; McConnell, 2000). Since the inception of ECSE in the United States, a central focus has been the use of assessment practices linked to interventions to provide high quality service to children with special needs and their families. Yet, ECSE has had its limitations when it comes to useful and meaningful assessment practices (McConnell, 2000) that a more contemporary, responsive view of assessment could address. That is, the use of a general growth outcome measures can be used to inform and enhance instructional efforts, which should in turn help to promote skill development. However, researchers have noted that assessment tools specifically for monitoring the growth rate and development for young children have been limited (McConnell et al., 2002), especially for young children with disabilities.

One measure that was specifically developed for the monitoring of emergent literacy growth is the Early Literacy Individual Growth and Development Indicators (EL–IGDls; Early Childhood Research Institute on Measuring Growth and Development [ECRI–MGD], 1998a). EL–IGDIs for preschool-aged children are a general outcome measure (GOM; McConnell et al., 2002; Priest et al., 2001). The GOM approach identifies key skill elements that have been specifically linked to important outcomes. These skill elements are then selected to be regularly monitored over time in order to determine if a child is “on track” to meet established goals. With regard to the EL–IGDIs, researchers (ECRI–MGD, 1998a) conducted an extensive literature search to gather information regarding important outcomes of children birth to 8 years of age. Expressive language was identified by researchers and other stakeholders (e.g., parents, teachers, professionals) as one of the more important early childhood outcomes (ECRI–MGD, 1998b; Priest et al., 2001). The Picture Naming IGDI was developed as a general outcome measure for expressive language (Priest et al., 2001).

Evidence demonstrates that the Picture Naming IGDI (PN–IGDI) measures children’s expressive language skills for typically developing children, children enrolled in Head Start, children who are English language learners, and children with disabilities (Cadigan & Missall, 2007; ECRI-MRD, 2004b; McConnell et al., 2002; Missall, McConnell, & Cadigan, 2006; Priest, Davis, McConnell, McEvoy, & Shin, 1999; Priest et al., 2000; ECRI-MRD, 2007). Criterion-related validity evidence for the PN–IGDI has been established in research studies with other standardized measures of language development and with presumed correlates of language (e.g., literacy; Cadigan & Missall, 2007; McConnell et al., 2002; McCormick & Haack, 2010; Missall et al., 2007; Priest et al., 1999; Priest et al., 2000). Construct-related validity evidence has also been reported in a few studies with significant correlations between children's PN–IGDI scores and chronological age for children without identified risks, children enrolled in Head Start, and children with disabilities (McConnell et al., 2002; Priest et al., 1999). Research has also demonstrated that the PN–IGDI is sensitive to growth differences due to age, level of risk, and disability status (Cadigan & Missall, 2007; Missall et al., 2006; Priest et al., 2000).).

Taken together, there is sufficient validity-related evidence for the use of the PN–IGDI with a diverse sample of preschool children. However, the validity-related evidence that specifically addresses children with disabilities is limited. For example, in the Priest et al. (1999), Priest et al. (2000), and McConnell et al. (2002) studies, the only characteristic known about the sample of children with disabilities is that they were all enrolled in an early childhood special education classroom. This factor potentially limits the level to which the interpretation of the PN–IGDI scores can be generalized to specific groups of children (e.g., SLI, ASD, DD). Missall et al. (2006), on the other hand, examined the PN–IGDI measures with 26 children who were receiving services for speech or language disabilities in an early childhood special education classroom. Cadigan and Missall (2007) also identified and evaluated 11 preschoolers with ASD on the PN-IGDI measure. While both of these studies identified specific disabilities categories upon which score interpretations would be appropriate, the samples were small and not drawn in a way that broader generalization is possible. Additionally, evidence supporting the predictive-related validity is extremely limited. Research supports that PN-IGDI scores for children with disabilities do change significantly over time (Cadigan & Missall, 2007; Missall et al., 2006). However, not many studies have focused on the influences of this growth on later reading achievement. Even more, studies have not examined whether or not the initial PN-IGDI scores influences that predictive relationship. In a study focusing on typically-developing children, it was found that children who scored lower on the PN-IGDI tended to have more rapid rates of increase on the PN-IGDI over 2 years of preschool and kindergarten than children scoring higher (Missall et al., 2007).

The establishment of validity is an ongoing process that grows stronger with more robust evidence (American Education Research Association [AERA], American Psychological Association [APA], National Council on Measurement in Education [NCME], 1999; Cronbach, 1971), so it would be useful to further examine the validity-related evidence of the PN–IGDI as it relates to preschoolers with disabilities. The Pre-Elementary Education Longitudinal Study (PEELS) provides a unique opportunity to look at a large national dataset for young children in special education (Carlson et al., 2008b, 2009; Markowitz et al., 2006). PEELS, sponsored by the National Center for Special Education Research in the U.S. Department of Education, followed a sample for 4 years that is representative of the population of preschool-aged children who were receiving special education services beginning in the 2003–2004 school year. This dataset provides PN–IGDI assessment data for a nationally representative group of children with SLI, DD, and ASD ranging in age from 36 months to 87 months.

Purpose of this Study and Research Questions

Given the continued need for data-based decision making in early childhood special education, the mounting evidence for the role of preschool language and literacy development on preventing later reading and academic failure, and the importance of continuing to establish validity-related evidence for growth indicators, this study attempts to further examine the usefulness of the PN–IGDI for children with language-related disabilities. To that end, the following research questions will be addressed:

1. At Wave 1 and Wave 3, to what extent do children with disabilities (SLI, ASD, and DD) PN–IGDI scores correlate with age to demonstrate construct-related validity evidence?
2. At Wave 1 and Wave 3, to what extent does the PN–IGDI correlate the PPVT for children with SLI, ASD, and DD to demonstrate concurrent criterion-related validity evidence?
3. To what degree can predictive criterion-related validity evidence be demonstrated for the PN–IGDI with DIBELS Oral Reading Fluency (ORF)?
    a. To what extent does the change in PN–IGDI scores from Wave 1 to Wave 3 (PN–IGDI change score) predict the DIBELS Oral Reading Fluency (ORF)?

b. Does a child's identified disability label moderate the relationship between the PN–IGDI change score and DIBELS ORF?

c. To what extent does the PN–IGDI score at Wave 1 (PN1) improve the prediction of the PN–IGDI change score on the DIBELS ORF?

d. Is this improvement in the prediction between the PN–IGDI change score and DIBELS ORF with the addition of PN1 moderated by a child's identified disability label?

4. To what extent is the PN–IGDI sensitive to yearly growth for children with disabilities between 3 and 7 years of age? To what extent does this sensitivity to growth vary as a function of disability status?

By supplementing the research with the results of this study, it is my hope to shed a little more light on the effectiveness of GOMs for preschoolers with disabilities when looking at response to interventions. There is substantial evidence of the importance of early intervention and the predictive relation between preschool literacy development and subsequent academic and behavioral success (Catts et al., 1999; Catts et al., 2002; NCES, 1992; Snow et al, 1998). General outcome measures, like the PN–IGDI, provide educators with important information about whether or not a child's development trajectory is satisfactory. If the developmental trajectory is not satisfactory, educators can implement interventions and continue to use the measures to monitor the influence of the intervention on continued growth and development.

CHAPTER 2

A Review of the Literature

In 2007, approximately 639,000 children with language-related disabilities (for the purposes of this review, children identified as those with Autism Spectrum Disorder, Speech or Language Impairments, or Developmental Delays) ages 3 through 5 received special education services through IDEA (OSEP, 2008). Research suggests that these children are among a larger group of children who are at particular risk for failing to develop later reading proficiency (Catts et al., 2002; Jenkins et al., 1994; McNamara, Van Lankveld, Vervaeke, & Gutknecht, 2010; Rescorla, 2002). Recognizing the relationship between early language and reading, there is an increased need to explore the efficacy of specific general outcome measures aimed at evaluating the oral language development of young children with language delays. Therefore, the purpose of this chapter is to (a) review what is currently known about emergent literacy, specifically oral language development; (b) examine what is currently known about emergent literacy development for children with speech or language impairment (SLI), autism spectrum disorder (ASD), and developmental delay (DD); (c) highlight the unique role of general outcome measures (GOMs) in depicting children's skill growth; (d) examine the current research and limitations of the picture naming Individual Growth and Development Indicator (IGDI) tool for children with disabilities; and (e) discuss the possible implications for early childhood special education services.

Emergent Literacy

Reading is an essential academic skill that translates into meaningful personal, social, and economic outcomes for individuals (Good, Simmons, & Smith, 1998; Snow & Van Hemel, 2008). Research over the last 2 decades has illustrated that the reading path on which a child begins is a strong predictor of where he or she will end up. Those who have reading difficulties are more likely to be paid lower wages, are more likely to unemployed, are more likely to not vote, are more likely to be uninformed about civic affairs, are more likely to be unable to meet the mental health care needs of their families, and are more likely to have trouble with the law or participate in other socially harmful activities (Bennett, Brown, Boyle, Racine, & Offord, 2003; Haigler, Harlow, O'Connor, & Campbell, 1994; Kirsch, Jungeblut, Jenkins, & Kolstad, 1993; Matson & Haglund, 2000; NCES, 1992; Snow et al., 1998). In all, not being able to read inhibits one's ability to contribute to society in a positive manner.

These outcomes are harrowing because recent results from the National Assessment of Educational Progress's (NAEP) the Nation's Report Card (NCES, 2009) indicated that nearly two thirds of the fourth-grade children in the United States performed below the proficient level in reading. The implications for early childhood education are noteworthy because research has demonstrated that the attainment of the early precursor skills provides a springboard for later literacy learning (Fletcher & Lyon, 1998; Juel, 1988; Scarborough, 2001; Torgeson, 2002; West, Denton, & Germino-Hausken, 2000; West, Denton, & Reaney, 2000). For instance, Scarborough (1998) found that various measures administered at the preschool and kindergarten levels revealed that patterns of preschool learning are closely linked with reading achievement in the primary grades. This means that learning achieved during these early years is likely to be sustained throughout the primary school years and is an important basis for successful early performance in school.

Children develop the concepts about the functions of language, reading, and writing before entering formal schooling (Reese & Cox, 1999; Sulzby, 1985; Teale & Sulzby, 1986). As children continue to develop and actively engage their environment, they develop a set of early literacy skills. The skills that develop prior to the formal reading process provide the foundation for reading competence. The current and dominant perspective of early literacy development is oftentimes expressed in analyses of a construct referred to as *emergent literacy*. Emergent literacy, first introduced by Clay (1967), connotes the understanding that children's reading, writing, and oral language develop in an interdependent fashion along a developmental continuum, beginning in the years prior to formal reading and writing instruction (Whitehurst & Lonigan, 1998). From the growing body of research on literacy development since Clay's introduction of the term *emergent literacy*, this construct has evolved to include key elements. Research that I will describe in following sections has identified that (a) emergent literacy begins early in life; (b) emergent literacy is acquired along a developmental continuum; (c) reading, writing, and oral language develop concurrently and interdependently; (d) emergent literacy is the integration of inside-out and outside-in processes; and (e) phonological processing, print knowledge, and aspects of oral language are the most substantive emergent literacy skills.

Beginnings Early in Life

The emergent literacy perspective proposes that literacy development begins well before children start formal reading instruction (Teale & Sulzby, 1986). Children start to learn from the day they are born. This learning begins with a child's early nonverbal and verbal interactions with others, awareness of the environment, and explorations. The child continues to gain intentional language, broaden explorations, and build concepts that are important to the development of literacy (i.e., reading and writing). Literacy progresses as the child gains an understanding of the functions of symbols and language (Clay, 1991; Neuman & Roskos, 1993), has experiences with books (Arnold, Lonigan, Whitehurst, & Epstein, 1994; Briesch, Chafouleas, Lebel, & Blom-Hoffman, 2008; Bus, Van IJzendoorn, & Pelligrini, 1995; Clay, 1991; Justice & Kaderavek, 2002; Zevenbergen & Whitehurst, 2003), and experiments with writing (Aram & Biron, 2004). Out of these experiences, the child gradually builds concepts about reading and writing.

Development Along a Continuum

Learning to speak, read, and write is a continuous and developmental process (Clay, 1967; Sulzby, 1985; Whitehurst & Lonigan, 1998); it begins early and continues to develop over a lifetime. Looking at early literacy development as a dynamic developmental process, the connection is evidenced by an infant mouthing a book, the book handling behavior of a 2-year-old, and the page turning of a 5-year-old. Thus, the formative years of exploring and playing with books, singing nursery rhymes, listening to stories, recognizing words, and scribbling are the building blocks for language and literacy development. Through continued everyday exposure to these beginning literacy activities, skills begin to emerge (International Reading Association [IRA] & National Association for the Education of Young Children [NAEYC], 1998).

Concurrent and Interdependent Development

Emergent literacy evolves from complex interactions involving reading, writing, speaking, and listening (Whitehurst & Lonigan, 1998). This differs significantly from other perspectives (i.e., reading readiness) that believe that there is a clear demarcation between prereading skill development and reading. Rather, emergent literacy is an interactive process of skills, knowledge, and attitudes that continually develop over time to set the stage for later reading to occur (Kenedou, van den Broek, White, & Lynch, 2009; Storch & Whitehurst, 2002; Sulzby & Teale, 1991; Whitehurst & Lonigan, 1998). The growth of certain literacy skills have been shown to be intertwined in unique ways that are optimal for literacy development (Shanahan, 2012). For instance, while the awareness of a phoneme does not require any simultaneous knowledge of letter names, it appears that awareness of individual phonemes develops more quickly when children know letters or when letters are used within phonemic awareness instruction (Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh, & Shanahan, 2001; Lonigan, 2007). Oral vocabulary development may also play a causal role in helping to stimulate the development of phonological awareness (Cooper, Roth, Speece, & Schatschneider, 2002) though phonological awareness has not been shown to have the reciprocal impact on vocabulary development (Lonigan, 2007). Thus, the areas of development link in important ways that must be closely integrated and coordinated if literacy is to be fully attained.

In order to promote the integrated developmental process of literacy, a balance between explicit and embedded practices has been suggested (Justice & Pullen, 2003). This means that children should be continually engaged in child-centered, contextualized, meaningful literacy activities as well as adult-directed, structured opportunities that specifically address literacy concepts. Examples of some of these activities include print and literacy-rich classroom environments (IRA & NAEYC, 1998, 4; Neuman & Roskos, 1997), dialogic reading (Arnold et al., 1994; Whitehurst & Lonigan, 1998), phonological awareness and alphabet knowledge training interventions (NELP, 2008).

Inside-out and Outside-in Processes

Whitehurst and Lonigan (1998, 2001) were the first to conceptualize that literacy involves two sets of skills: inside-out and outside-in. The inside-out components involve sources of information within the printed word that foster the child's ability to translate print into sounds and sounds into print (e.g., phonemic awareness and letter knowledge). The outside-in components involve sources of information that directly support a child's understanding of the meaning of print (e.g., vocabulary, conceptual knowledge, and story schemas). These inside-out and outside-in skills have also been referred to as code-related skills and oral language skills, respectively (NELP, 2008).

Both the inside-out (or code-related skills) and outside-in (or oral language skills) are essential to reading. A child's ability to say the sentence, "Finally, she started to look for it" or to decode the letters in that sentence into correct phonological representations depends on a number of inside-out skills such as a child's knowledge of letters, sounds, punctuation, sentence grammar, and sequencing. If a child cannot translate the words

"Finally, she started to look for it" into sounds, he or she cannot understand the text. However, even if the child can read the sentence aloud, he or she may not know what the sentence means: Who is s*he*? What is s*he* looking for? These questions cannot be answered if the child not does have a firm grasp on outside-in skills involving knowledge of the world, semantic knowledge, and knowledge of the written context in which the particular sentence occurred (Justice & Pullen, 2003; Whitehurst & Lonigan, 1998; 2001). While these domains are described separately, there is a bidirectional relationship between them, and it is proficiency in both domains that characterizes a good reader (Kendeou et al., 2009; Whitehurst & Storch, 2002; Wilkinson & Silliman, 2000).

Print Knowledge, Phonological Processing, and Oral Language

The National Early Literacy Panel (NELP, 2008) meta-analysis of approximately 300 studies included data about the predictive relation between a skill measured in preschool or kindergarten and reading outcomes (i.e., word decoding, reading comprehension, spelling) for children learning to read in an alphabetic language. The results of this meta-analysis indicated that children's skills related to phonological processing skills (i.e., phonological awareness, phonological access to lexical store, phonological memory), print knowledge (e.g., alphabet knowledge, print concepts), and aspects of oral language (e.g., vocabulary, syntax/grammar, word knowledge) were significant and independent predictors of children's later reading outcomes.

Phonological awareness refers to the ability to detect and manipulate the sounds of language independent of meaning (Lonigan, 2006; Wagner & Torgesen, 1987). It is commonly measure by tasks requiring matching, blending, deleting, or counting sounds within words (Phillips, Menchetti, & Lonigan, 2008; Wagner & Torgesen, 1987). The ability to access smaller and smaller units of sound within spoken words helps children make the connection between the sounds and the letters that represent them in print (i.e., the alphabetic code; Adams, 1990; Lonigan et al., 2009; Whitehurst & Lonigan, 1998). Research has demonstrated that phonological awareness is strongly related to the acquisition of reading (Perfetti, Beck, Bell, & Hughes, 1987; Wagner, Torgesen, & Rashotte, 1994).

Print knowledge is the understanding of how print is organized. First, children must learn the process of knowing how text on a page moves from left to right and top to bottom, identifying which part of the book is the front, understanding the purpose of punctuation, and learning the alphabet, including letter names and letter sounds. Then, children learn the alphabet, including letter names and letter sounds. Stevenson and Newman (1986) found that knowledge of letter names prior to kindergarten was predictive of reading ability in fifth and tenth grade.

Even if a child can sound out a word, this does not necessarily convey meaning; this meaning must be in place before the word will be understood. Understanding what is read is dependent upon a child’s oral language skills. Oral language skills can be defined as the ability to produce, comprehend, and convey meaning successfully through the use of words (Bishop & Adams, 1990; Scarborough, 1989). Children who have large vocabularies and who can map complex sentence structures have a clear advantage in reading compared to children with poorer language proficiency. A considerable body of research has documented the role of various aspects of oral language in emerging literacy

(Beron & Farkas, 2004; Scarborough, 1989; Senechal, Ouellette, & Rodney, 2006; Whitehurst & Lonigan, 1998).

Oral Language

A substantial body of research has demonstrated positive correlations and longitudinal continuity between individual differences in oral language skills and later differences in reading (e.g., Adams, 1990; Bishop & Adams, 1990; Pikulski & Tobin, 1989; Scarborough, 1990; 2001; Storch & Whitehurst, 2002; Walker, Greenwood, Hart & Carta, 1994). Language skills are important precursors for all aspects of development because of their close links to conceptual and social development (Samuelson & Smith, 2005) and to literacy skills and school success (National Institute of Child Health and Human Development [NICHD], 2000; Shonkoff & Phillips, 2000; Snow et al., 1998; Whitehurst & Lonigan, 2001).

Various studies have addressed the role of oral language skills in literacy and reading development (e.g., Bishop, 1991; Bryant, MacLean, & Bradley, 1990; Catts et al., 1999; Speece, Roth, Cooper, & de la Paz, 1999; Vellutino et al., 1996); however, for the purposes of this study I focus on oral language skills in the context of emergent literacy development. As noted previously, Whitehurst and colleagues (Storch & Whitehurst, 2002; Whitehurst & Lonigan, 1998, 2001) proposed that children’s emergent literacy skills are separated into two distinct, although interrelated, domains that relate to subsequent reading achievements: oral language and code-related skills. Oral language skills, specifically, comprise the modalities of both expression and comprehension in the areas of form (e.g., syntax) and content (i.e., vocabulary).

There is mounting research that the development of both code-related and oral language skills are integral to emergent literacy skills (e.g., Lonigan et al., 2000; Pressley et al., 2001; Gough & Tunmer, 1986; Hoover & Gough, 1990; Storch & Whitehurst, 2002; Tunmer & Hoover, 1992). However, the role that oral language skills serve and timing in which they are served continues to be debated. The relative contribution of oral language skills in early reading comprehension has been contradictory. On the one hand, the results of some studies suggest that oral language skills are not central to early reading comprehension and that they become fully operative only when the child has acquired decoding skills (Bryant et al., 1990; Speece et al., 1999; Vellutino, Tunmer, Jaccard, & Chen, 2007). The results of other studies suggest the importance of oral language skills in early reading comprehension (Bishop & Adams, 1990; Catts et al., 1999; Paris & Paris, 2003). Recent research has helped to navigate this debate.

Studies have demonstrated that oral language skills are predictive of decoding early in the reading process (e.g., NELP, 2008; NICHD Early Child Care Research Network [ECCRN], 2005). Storch and Whitehurst (2002) first proposed a structural model for language and literacy development that provided a basis for understanding the influence of oral language and code-related skills on later reading achievement. Results from this study revealed that in preschool, oral language skills accounted for 48% of the variance in code-related skills. In other words, Storch and Whitehurst demonstrated that oral language skills were predictive of code-related skills. More recently, Kendeou et al. (2009) utilized the same structural model to extend these findings. They also determined that in preschool, oral language skills predicted decoding skills but that this became weaker in kindergarten and second grade. These two studies have been pivotal in demonstrating the contribution of oral language skills to literacy skill development during the early years.

While oral language skills play an integral role in emergent literacy skill development, there is more support that young children's oral language skills provide their greatest contribution to reading comprehension abilities later in the reading process (Dickinson & Tabors, 2001; Roth, Speece, Cooper, & de la Paz, 1996; Speece et al., 1999; Roth, Speece, & Cooper, 2002; Storch & Whitehurst, 2002; Vellutino et al., 2007). It has been shown that as children progress and attempt to comprehend units of text larger than individual words, oral language skills become increasingly important (Nation & Snowling, 1998; Snow, Barnes, Chandler, Hemphill, & Goodman, 1991). Storch and Whitehurst (2002) demonstrated that oral language abilities reemerge as a strong, direct force later in the sequence of learning to read (i.e., 3rd and 4th grades). Kendeou et al. (2009) not only found that oral language skills contributed to reading comprehension, but that oral language skills accounted for more variance in reading comprehension than did code-related (i.e., decoding) skills. Likewise, when the contributions of these skills were assessed in second/third grade and in sixth/seventh grade, the contribution of oral language skills on reading comprehension was found to increase across age.

Oral language is comprised of a various set of skills, which includes vocabulary (receptive and expressive), syntactic and semantic knowledge, and narrative discourse processes (memory, comprehension, and storytelling; Bishop & Adams, 1990; Cabell, Justice, Konold, & McGinty, 2011; NELP, 2008; Whitehurst & Lonigan, 1998). For the purposes of this study, vocabulary development will be the focus. Researchers have long recognized the important and central role that vocabulary knowledge plays in becoming a successful reader (Anderson & Nagy, 1992; Kamil & Hiebert, 2005; Stahl & Nagy, 2006). Vocabulary has been found to play an essential role in emergent literacy by supporting phonological awareness (Bowey, 1994; Metsala, 1999), to play a direct role in reading (e.g., Chaney, 1992; Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003), and to predict later reading comprehension competence (Davis, 1942; Mason, Stewart, Peterman, & Dunning, 1992; Ricketts, Nation, & Bishop, 2007; Whitehurst & Lonigan, 2001). More specifically, researchers have determined that it is the size of children's vocabulary that supports the ability to recognize sight words and to develop decoding skills by providing a storehouse of linguistic information (sounds, rhymes, meanings) to map onto printed words (Wagner et al., 1997) and to sharpen phonological sensitivity (Metsala, 1999; Nation & Snowling, 2004; Ouellette, 2006; Stahl & Nagy, 2006).

Studies have also revealed a substantial relationship between vocabulary size and future reading comprehension (Cunningham & Stanovich, 1997; Hirsch, 2003; NELP, 2008; Scarborough, 2001; Stahl & Fairbanks, 1986). Walker, Greenwood, Hart, and Carta (1994) reported that vocabulary at age 3 is strongly associated with reading comprehension at the end of grade 3. Cromley and Azevedo's (2007) direct and inferential mediation model extended the impact of vocabulary knowledge on comprehension to later grades. They found that vocabulary was one of the largest contributors to ninth-grade students' reading comprehension. Even more, studies have found that vocabulary knowledge was the most important factor in reading comprehension in adult skilled readers (Braze, Tabor, Shankweiler, & Mencl, 2007; Guo, Roehig, & Williams, 2011; Landi, 2009). Research conducted with adults has demonstrated correlations between vocabulary knowledge and reading comprehension of about .50 or greater (Braze et al., 2007; Dixon, LeFevre, & Twilley, 1988; Landi, 2009; Stanovich & Cunningham, 1992).

This has huge implications for early childhood because children begin building their vocabulary knowledge long before entering kindergarten. Early vocabulary development during preschool years has been found to be predictive of subsequent vocabulary growth (Storch & Whitehurst, 2002). Because children experience vast differences in exposure to rich oral and written language in their early years, it is not surprising that students enter school with considerable differences in vocabulary knowledge (Hart & Risley, 1995). These initial differences in vocabulary knowledge become even more discrepant over time, thus widening the gap between students with strong vocabularies and students with limited vocabularies (Biemiller & Slonim, 2001; Hart & Risley, 1995; Stanovich, 1986). Presumably, children with stronger oral vocabulary skills will have a richer representation of word parts, and these represented segments facilitate growth in phonological awareness (Senechal & LeFevre, 2002) as well as sight words (Nation & Snowling, 2004; Ouellette, 2006). On the other hand, young children with limited oral language skills typically have difficulty with phonological awareness tasks, and consequently, demonstrate later challenges in reading comprehension, and thus, reading achievement at the school-aged level (Catts et al., 2002; Ezell & Justice, 2005; Storch & Whitehurst, 2002; Wagner et al., 1997). This is commonly referred to as the Matthew effect, essentially “the rich get richer, and the poor get poorer” (Merton, 1968). In essence, children with a larger, more quality vocabulary tend to acquire more reading-related skills and work to becoming more successful readers, whereas children with limited vocabularies continue to struggle.

In all, oral language development is an integral part of emergent literacy development. The size and quality of a child’s vocabulary, in particular, has important implications for phonological awareness, sight word reading, and reading comprehension. Thus, difficulties in this area of development have negative implications for a child’s reading success.

Language Impairments and Emergent Literacy

For young children with disabilities, a lack of foundational experiences in early language and literacy has lasting deleterious effects on literacy skills (Aram, Ekelman, & Nation, 1984; Bashir & Scavuzzo, 1992; Catts, Fey, Tomblin, & Zhang, 2002; Scarborough, 2001; Snow et al., 1998). More specifically, children with disabilities that affect language development are at particular risk for difficulties in reading (Tunmer, Herriman, & Nesdale, 1988; Adams, 1990; Chaney, 1992). Estimates have ranged as high as 40–75% of preschoolers with diagnosed language impairments will develop reading difficulties at school age (Bashir & Scavuzzo, 1992). Preschool children who remain language impaired by age 5 are significantly more likely to remain language impaired and to develop later literacy difficulties than children whose early language delay resolves by age 3 or 4 (Aram et al., 1984). Connections have also been made between language skills as young as 30 months old and reading ability at age 5 (Scarborough, 1990). In a meta-analysis, Scarborough (1998) summarized several follow-up studies that confirmed that preschoolers with language impairments are at considerable risk to develop continued language difficulties and reading disabilities at older ages.

The severity of the impairment also plays a significant role in determining outcomes. Children who have impairments in a wider range of language skills (e.g., expressive and receptive skills) are more likely to develop later reading difficulties than those with impairment in a narrow range of language skills (e.g., expressive skills only; Scarborough, 1998). Researchers contend that reading is a language-based skill; therefore, deficits in language development can negatively affect reading achievement (Catts et al., 2002; Puranik, Petscher, Al Otaiba, Catts, & Lonigan, 2008). In other words, the risk for reading problems is greatest when the language delay is severe, broad, or persistent. This means that, preschoolers with severe language impairments experience difficulties not only with oral language development but with emergent literacy development (Gilliam & Johnston, 1985; Snow et al., 1998; Boudreau & Hedberg, 1999). This is particularly poignant for three particular special education groups within the early childhood special education population: Speech or Language Impairment (SLI), Autism Spectrum Disorder (ASD), and Developmental Delay (DD).

Speech or Language Impairment (SLI)

SLI refers to a primary impairment of language (Tomblin, Records, Buckwalter, Zhang, Smith, & O'Brien, 1997). IDEIA (2004) defines speech or language impairment as a communication disorder, such as stuttering, impaired articulation, language impairment, or voice impairment that adversely affects a child's educational performance." [34 CFR §300.8(c)(11)]. The accumulated research convincingly shows that children with SLI are, by virtue of group membership, 'at risk' for later reading difficulties (e.g., Aram et al., 1984; Bishop & Adams, 1990; Catts, 1991, 1993; Hammer, Farkas, & Maczuga, 2010; Johnson, Beitchman, & Brownlie, 2010; Larney, 2002; Schuele, 2004; Schuele, Spencer, Barako-Arndt, & Guillot, 2007; Schuele & Boudreau, 2008).

Studies have identified children with SLI in preschool or kindergarten and have investigated their reading development in the early school grades (Beitchman, Wilson, Brownlie, Walters, & Lancee, 1996; Bishop & Adams, 1990; Catts, 1993). It has been shown that as many as 83% of kindergarten children with speech and language delays eventually qualify for reading intervention services (Catts, 1993). According to Bishop and Adams (1990), who proposed the *critical age hypothesis*, children whose early language impairments had resolved between 5 and 6 years of age, or by the time they begin to receive formal reading instruction, were not at risk for developing reading difficulties. In contrast, children whose language problems persisted beyond the beginning of formal reading instruction were at an increased risk for reading difficulties (Bishop & Adams, 1990; Bishop & Edmundson, 1987; Larney, 2002). More recent studies have provided support for the critical age hypothesis (Catts et al., 2002; Puranik et al., 2008). They determined that children whose language impairments resolved by the beginning of formal reading instruction did make significant gains in word recognition, oral reading fluency, and reading comprehension; however, these researchers also noted that this group of children's 'at-risk' level was not completely eliminated. These studies have strong implications for the importance of addressing the language needs of children with SLI prior to kindergarten.

There is a reciprocal and robust association between young children's oral language proficiency and emergent literacy development (Boudreau & Hedberg, 1999; Chaney, 1992; Dickinson & Tabors, 1991; Lonigan et al., 2000). Evidence supports this connection for children with SLI. Cabell et al. (2011) identified positive correlations between SLI children's expressive vocabulary and emergent literacy skills. Likewise, Justice et al. (2003) found that among preschoolers with SLI, oral language proficiency was the best predictor of literacy growth during a 12-week intensive literacy intervention. Oral language skill explained nearly 25% of the variance in literacy outcome. This finding demonstrates the impact of oral language proficiency to children's responsiveness to emergent literacy intervention. Thus, if we are to be sensitive not only to current speech and language problems but also related problems that children with language impairments are likely to experience in the future (Fey et al., 1994), early support for literacy acquisition is critical. This conclusion is not limited to children with SLI.

Autism Spectrum Disorder (ASD)

Language delays are also a hallmark of ASD (American Psychiatric Association [APA], 2000; Lord & Paul, 1997; Tager-Flusberg, 1996; Thurm, Lord, Lee, & Newschaffer, 2007). The course of language and communication development in individuals with ASD varies greatly. Some children with ASD never develop verbal communication whereas others do. Of the group of children with ASD who do develop language, the onset and rate at which these children pass through linguistic milestones are often delayed compared to children without ASD (e.g., no single words by age 2 years, no communicative phrases by age 3; APA, 2000). Research has shown that early language ability is related to positive long-term outcomes for children with ASD (Gillberg, 1991; Howlin, Mahood, & Rutter, 2000; Liss et al., 2001) and that verbal skills are the strongest longitudinal predictors of social-adaptive functioning (Venter, Lord, & Schopler, 1992). In other words, language skills in children with ASD are excellent predictors of current functioning and an important predictor of future outcomes (Rutter, 1970; Lord & Paul, 1997; Kobayashi, Murata, & Yoshinaga, 1992). Yet, language skills as a predictor for later reading achievement in children with ASD are relatively unclear.

Currently, there is limited research regarding the development of skills most associated with early literacy development for children with ASD. There is some research; however, that speaks to the complicated interrelationships among early literacy skills in this population. In contrast to children with typical development, children with ASD are likely to exhibit an uneven profile in developing skills associated with reading achievement. For example, data-based case studies and Individualized Education Plan (IEP) chart reviews revealed that children with ASD acquired some specific early literacy skills, such as letter name identification, while also having expressive and/or receptive language difficulties (Church, Alisanski, & Amanullah, 2000; Craig & Sexton Telfer, 2005; Diehl, Ford, & Federico, 2005; Koppenhaver & Erickson, 2003).

Additionally, little is known about what specific oral language skills of children with ASD may contribute to their reading success. However, I can extrapolate from the literature about known predictors of reading achievement (e.g., vocabulary development) for children without ASD. One study indicated that preschool children with ASD are severely delayed in their vocabulary relative to their nonverbal mental ages (Charman, Drew, Baird, & Baird, 2003). Modeling the Charman et al. study, Luyster and colleagues (2007) extended these results. They found that while advances in language and communication skills were observed with increases in chronological age and nonverbal mental age, the majority of children with ASD exhibited significant delays in receptive and expressive vocabulary. Although the discrepancies between nonverbal and verbal abilities often diminish with age in higher functioning individuals with ASD (Joseph, Tager-Flusberg, & Lord, 2002), the majority nevertheless continue to show limited vocabulary knowledge as adults (Howlin, Goode, Hutton, & Rutter, 2004).

These studies indicate that oral language development can be delayed for children with ASD; however, research studies suggest that via participation in literacy interventions, some children with ASD improved their oral language skills (Broun, 2004; Colascent & Griffith, 1999; Koppenhaver & Erickson, 2003). More specifically, qualitative and data-based case studies demonstrate that when students with ASD are included in frequent and repeated shared book reading interventions, some children showed increases in their oral language and attention and decreases in echolalia, stereotypic behaviors, and verbal outbursts (Bellon, Ogletree, & Harn, 2000; Colasent & Griffith, 1998; Koppenhaver & Erickson, 2003).

In sum, children with ASD have uneven profiles of oral language development. Yet, their oral language skills, including vocabulary, have been shown to improve over time, especially when participating in a literacy intervention. This has noteworthy implications for future success. By acquiring even basic literacy skills, students with autism are able to succeed in school, achieve independence, and participate in their community (Copeland & Keefe, 2007).

Developmental Delay (DD)

Another population of children to which language and literacy issues can apply are those referred to as having *developmental delay* (DD). The Individuals with Disabilities Education Act (IDEA) and the 1991 amendments (P.L. 102–119) introduced DD as a category of preschool eligibility. DD is general term that characterizes preschool-age children who demonstrate significant delays in one or more domains of physical, cognitive, communication, social or emotional, or adaptive skills (OSEP, 2004). There is a limited age range associated with DD (up to 5 to 9 years, depending on the state). This means that children must be reevaluated around that age to determine (a) if special education services are still warranted and (b) what special education category better describes their current delay. Delgado, Vagi, and Scott (2006) investigated the educational outcomes of 2,046 preschool children identified with DD. Results indicated that 74% continued to need special education services. Of that group, 34% of children reclassified under the category of specific learning disability (SLD), 18% as SLI, and 6% as ASD. As noted earlier, children with SLI and ASD are at risk for reading delays. Even more, it has been shown that reading disabilities is the highest incidence disability of SLD students (Learning Disabilities Association of America [LDA], 2001).

Even though nearly half of the children who are initially identified as DD remain at risk for literacy and reading issues, little attention has been paid to oral language and literacy development of these preschoolers. It has been proposed that the presence of DD may shape parental attitudes and expectations about literacy skills, which in turn may affect the frequency and types of interactions parents and/or educators have with their children that set the occasion for emergent literacy experiences. Marvin (1994) and Marvin and Mirenda (1993), for example, administered a questionnaire to the parents of preschool children both with and without delays and found that the home literacy environments of children with delays were less supportive and stimulating than the home environments of typical children. As a result, Marvin and Mirenda reported that "…a large number of children who graduate from early childhood special education programs experience notable difficulties with the literacy demands of the academic curriculum in the primary grades (p. 352)."

The only study specifically related to preschool children with DD and literacy concepts was completed by O'Connor, Jenkins, Slocum, and Leicester (1993). This study focused on the feasibility of teaching phonological manipulation skills to young children with DD. There were 47 children between the ages of 4–6 years with developmental delays enrolled in preschool at the Experimental Education Unit at the University of Washington. Eighty percent of the children were identified as having significant language delays. Results indicated that preschool children with DD could be taught phonological skills prior to the development of functional reading ability.

Summary of Oral Language Effects for Three Special Education Categories

In all, this research indicates that children with language-related impairments (i.e., SLI, ASD, and DD), regardless of disability category, are less likely to acquire emergent literacy skills and if they do, they gain them at a slower rate than their same-aged peers (e.g., Boudreau & Hedberg, 1999; Saint-Laurent, Giasson, & Couture, 1998). However, certain studies noted that with explicit literacy interventions, some of these children demonstrated growth in literacy skills, specifically vocabulary. The growth, however, was still at a slower rate than their same-aged peers. While growth in oral language skills is important, the rate is particularly crucial for children with disabilities.

Expressive Language Growth Measurement

An increasingly well-known approach to measuring rates of growth is General Outcome Measurement (GOM; Deno, 1997; Fuchs & Deno, 1991). GOM is distinguished by its continuous, frequent, and standard assessment of child progress toward a long-term desired goal (Fuchs & Deno, 1991; Fuchs, Deno, & Mirkin, 1984; Fuchs, Fuchs, & Compton, 2004; Missall, 2004). In a GOM approach, increasing proficiency is indicated by improved performance on the same key skill elements repeatedly measured. These innovative assessment tools offer ease of use, instructional relevance, robustness, accuracy, and longevity (Fuchs & Deno, 1991; Deno, 1985).

There are guiding principles that make GOMs so valuable for children with language-related disabilities. Rather than evaluating a child on mastery of specific skills (e.g., mastery monitoring), GOM looks at the rate of growth on a general outcome. As noted earlier, children with language-related impairments do not necessarily acquire literacy skills in a linear fashion. For instance, children with ASD were shown to identify the letters in their name but have trouble with expressive and receptive language skills (Church et al., 2000; Diehl et al., 2005; Koppenhaver & Erickson, 2003). Therefore, collecting multiple behavior samples related to a desired outcome and creating a trend line for development rather than a single snapshot of behavior will allow for flexibility in the path that growth takes. Second, GOMs are typically brief measures that would likely provide more reliable scores for children with poor attention or low motivation. This is particularly useful for children with ASD and DD, as research has indicated that motivation and attention affect their test performance (Koegel, Koegel, & Smith, 1997). Finally, the primary goal of GOM is to inform instruction; it has been described as a form of formative evaluation. As a type of formative evaluation progress can be assessed during instruction for purposes of determining whether students are developing the skill that is being measured. This allows data-based decisions can be made about the effectiveness or ineffectiveness of instruction/intervention.

Currently, few GOMs exist to assess emergent literacy. Examples include: DIBELS, a set of standardized, individually administered, 1-minute measures designed to assess fluency and development of emergent literacy skills (Good & Kaminski, 2002), and EL–IGDIs (ECRI–MGD 1998a), a set of brief, standardized measures that assess the development of expressive language, rhyme awareness, alliteration, and beginning phonological awareness (www.getgotgo.net). Three of the preschool EL–IGDIs, including the Rhyming IGDI, Alliteration IGDI, and Segment Blending IGDI, measure phonological awareness that indicate a child's progress toward a literacy outcome and a child's ability to “demonstrate a conceptual and practical understanding of early literacy skills." Picture Naming IGDI (PN–IGDI), on the other hand, intends to specifically measure vocabulary acquisition as a means of expressive language (McConnell, Priest, Davis, & McEvoy, 2002; ECRI–MGD, 1998a; Phaneuf & Silberglitt, 2003).

PN–IGDI is one indicator that was developed as part of a larger movement in educational accountability. In 1990, as part of the National Education Goals Panel, Goal 1 stated that “By the year 2000, all children in America will begin school ready to learn.” As part of the movement toward all children being ready to learn, there was an increased focus on children with disabilities. The Office of Special Education and Rehabilitation Services (OSERS) called for the creation of a comprehensive, individualized measurement system for children with disabilities between birth and age 8, and their families (ECRI–MGD, 1998b). The *Early Childhood Research Institute on Measuring Growth and Development* (ECRI–MGD), a collaborative project between investigators at the Universities of Minnesota, Kansas, and Oregon responded to this request. This measurement system needed to include two major elements: (a) growth and development indicators for monitoring the progress of individual young children on a continuous basis; and (b) solutions-oriented assessment procedures that would allow families and early childhood and elementary-grade educators to identify features of classroom and home settings they could change to optimize children’s developmental outcomes.

ECRI–MGD followed four steps to identify a set of developmental outcomes that they believed described young children’s growth between birth and age 8: (a) selection criteria for outcomes; (b) identification of action steps to generate prospective outcomes;

(c) initial selection of outcomes for three age groups of children (birth to 3 years old, 3 to 5 years old, and 5 to 8 years old); and (d) review of age-based outcomes by the entire ECRI–MGD staff. This information was then condensed into a single set of outcomes to describe children across the entire age range of birth to 8. In the end, ECRI–MGD researchers selected 15 general growth outcomes that represented 5 developmental domains. The general growth outcomes related to language development included: (a) child uses gestures, sounds, words, or sentences to convey wants and needs or to express meaning to others; (b) child responds to others' communication with appropriate gestures, sounds, words, or word combinations; and (c) child uses gestures, sounds, words, or sentences to initiate, respond to, or maintain reciprocal interactions with others.

A mail survey was conducted to gauge the acceptance of these early childhood outcomes. Parents of young children with and without disabilities and professionals in early childhood and early elementary education generally converged on their evaluation of the overall importance of the outcomes. In particular, 32% of parents and 57% of professionals rated the "child uses gestures, sounds, words, or sentences to convey wants and needs or to express meaning to others" outcome first on their list of the five most important outcomes. Empirical investigations of procedures for operationalizing measures of young children's progress toward these outcomes were undertaken (McConnell, 2000; McConnell et al., 2002). A cross-sectional and a longitudinal study were conducted to further develop the PN–IGDI. The cross-sectional study assessed 39 English speaking children without identified disabilities. These children ranged in age between 35–69 months. The longitudinal study included 58 children ages 32–66 months.

Ten children were receiving services through early childhood special education (ECSE), 14 were at Head Start, and 34 were in a childcare center. Results of these initial studies provided support for initial validity and reliability-related evidence.

To date a variety of validity-related evidence has been accumulated for the PN–IGDI. Research has examined the criterion-, construct-, and social-related validity evidence for the IGDI measures. Picture Naming IGDI has demonstrated concurrent-related validity evidence with the Peabody Picture Vocabulary Test, (3rd Edition; PPVT–III; Dunn & Dunn, 1997) and the *Preschool Language Scale, 3* (PLS–3; Zimmerman, Steiner, & Pond, 1992; ECRI–MGD, 2004; McConnell, Priest et al., 2002; Priest et al., 1999) with correlation coefficients ranging from .47–.69, as well as the Peabody Picture Vocabulary Test–Revised (PPVT–R; Dunn & Dunn, 1981; r = .80). Concurrent-related validity evidence has also been established with the Dynamic Indicators of Basic Early Literacy Skills (DIBELS; Kaminski & Good, 1996) measures of Letter Naming Fluency (LNF; r = .32 to .37) and Onset Recognition Fluency (r = .44 to .49; McConnell et al., 2002).

Construct-related validity evidence has also been reported in a few studies with significant correlations between children's PN–IGDI scores and chronological age (*r* = .41–.60), including typically developing children (*r* = .63) and children enrolled in Head Start (*r* = .32; McConnell et al., 2002; Priest et al., 1999). Additionally, the PN–IGDI is sensitive to growth differences with mean picture naming scores of 22.2 for typically developing children in one study and 26.90 in another study (slope = .44 pictures per month), 19.01 for low-income children (slope = .28 pictures per month), 22.6 for children living in poverty, and 7.2 for Spanish-speaking children learning English (ECRI–MGD, 2004a; Missall et al., 2006). Researchers have also recently looked at the sensitivity of growth on IGDIs across time. Preschool administrations of the IGDIs have been moderately correlated with kindergarten measures of alphabetic principle and phonological awareness. They were also found to be significantly predictive of later outcomes in oral reading fluency both at the end of kindergarten and at the end of first grade (Missall, Reschley, et al. 2007; Priest, McConnell, et al., 2000). Finally, researchers have established social validity-related evidence for IGDI picture naming data (Phaneuf & Silberglitt, 2003).

Limited evidence exists about the soundness of the PN–IGDI for children with language-related disabilities. McConnell, Priest, et al. (2002) identified that the PN–IGDI is sensitive to growing expressive language skills, with significant correlations between children's scores and their chronological age for children with unspecified disabilities who were in an early childhood special education classroom ($r = .48$, $p < .001$). Additionally, PN–IGDI is sensitive to growth over time for these children with an average score of 16.88 (growth of .36 pictures per month; Priest et al., 2000). The limitation of this study is the lack of description of the types of disabilities these children had. It might have been that children with language-related disabilities would have a different growth rate than did ECSE children without language-related disabilities. Missall et al., (2006) specifically identified children with SLI to be included in their literacy skill growth and its relation to classroom variables. The 26 children with SLI demonstrated growth on the PN–IGDI measure with an average score of 18.9. Finally, Cadigan and Missall (2007) looked specifically at the usefulness of the PN–IGDI for children with ASD. They demonstrated the sensitivity of this measure to the growth of expressive vocabulary skills for this group of children. The correlation coefficient for criterion-related validity with the PPVT–R was also promising ($r = .80$). While the Missall et al. and the Cadigan and Missall studies provide validity-related evidence for the PN–IGDI with respect to children with SLI and ASD, the sample sizes were small.

"Evaluating test validity is not a static, one-time event; it is a continuous process" (Sireci, 2007, p. 477). Validity is a key principle of assessment, a central aspect of which relates to whether the interpretations and uses of test scores are appropriate and meaningful (Kane, 2006). Providing appropriate evidence for validity is not a simple undertaking and requires multiple sources of evidence collected through a range of methods (Bachman, 1990). Although evidence can be accumulated in many ways, validity refers to the degree to which that evidence supports the inferences that are made from the test scores. To garner further support for the validity-related evidence for the PN–IGDI, the Pre-Elementary Education Longitudinal Study, referred to as the PEELS study, provided an opportunity to examine data on a large scale. PEELS collected PN–IGDI data over time on a nationally representative sample of preschool children with disabilities. The use of large sample data allows for the generalization of conclusions to a larger group of children, which in turn, produce more robust results.

Bringing it All Together

Throughout its history, early childhood special education has had a central focus of the role of high quality assessment practices in services to young children with disabilities and their families (McConnell, 2000). At the beginning of early intervention programs in the United States in 1960s and 1970s, early childhood special educators used checklists as a basis for the type of intervention as well as a mode of evaluation of instructional activities. In order words, the field of early childhood special education has had a clear belief and frequent practice of data collection for child performance data in order to assess intervention effectiveness (McLean, Bailey, & Wolery, 2004; McConnell, 2000).

Interestingly, the use of research-based instruction and interventions, regular progress monitoring of student progress, and the subsequent use of the data to make educational decisions is the current trend throughout education. These ideas are tied to Response to Intervention (RTI). RTI was first introduced as a method of academic interventions to provide systematic assistance to children who are having difficulty learning (Fuchs & Fuchs, 2006). However, RTI has gained attention recently as a framework that could have considerable promise for enhancing outcomes for young children (VanDerHeyden & Snyder, 2006; VanDerHeyden, Snyder, Broussard, & Ramsdell, 2008). This means, however, that the intervention practices and assessment tools must be evidenced based.

The PN–IGDI has demonstrated some evidence to supports it ability to be sensitive and useful for preschool children with disabilities. However, stronger validity evidence provides the opportunity for stronger and more valid interpretations. The *Standards for Educational and Psychological Testing* defines validity as “the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests" (AERA, APA, NCME, 1999, p. 9). Validity is a property of the interpretations assigned to the test scores. These interpretations are considered valid if they are supported by convincing evidence (AERA, APA, NCME, 1999; Cronbach, 1971). Thus, we know that expressive vocabulary is one key component in the development of oral language and emergent literacy skills that are directly and indirectly related to later reading achievement. The more effectively we can measure the rate of growth of these skills for children with language-related disabilities, the better we are to adjust interventions or services accordingly.

CHAPTER 3

Methods

PEELS Research Design and Sampling

The Pre-Elementary Education Longitudinal Study (PEELS) was funded by the U.S. Department of Education's National Center for Special Education Research (NCSER) to collect data on the early experiences of children with disabilities. The study was designed to describe a nationally representative sample of children ages 3 through 5 with disabilities, the services they received, their transitions from both early intervention to preschool and preschool to elementary school, and their performance in preschool and elementary school. The sample included 3,100 children with disabilities receiving special education services. In addition to collecting data on the participating children, data were collected on the parents and family, teachers, service providers, the child's preschool program, LEA, and SEA. Data collection began in 2003–2004 (i.e., Wave 1) and data were collected annually through 2006–2007 (i.e., Waves 2–4).

To obtain a nationally representative sample of children ages 3–5 with disabilities, PEELS used a two-stage sample design: (a) a national sample of local education agencies (LEAs) was selected; and (b) a sample of preschoolers with disabilities was selected from lists of eligible children provided by the participating LEAs. This process resulted in a sample of children age 3 through 5 with disabilities that is representative of the national population of children with disabilities in 2003–2004.

LEA Sample

To obtain the LEA sample, the universe of LEAs serving preschoolers with disabilities was stratified by 4 Census regions, 4 categories of estimated preschool special education enrollment, and 4 categories of district poverty level, resulting in 64 cross-classified stratum cells (Markowitz et al., 2006).

A total of 710 LEAs were contacted in 2001 and, of these, 250 agreed to participate. In 2003 when the LEAs were recontacted, 50 of the original 250 LEAs recruited dropped out of the study. The remaining 200 LEAs agreed to remain in the study and supplied a list of all preschool children receiving special education services (Carlson et al., 2008b).

There was serious undercoverage in one region caused by a large state that refused to participate. Additionally, a large district in the same geographic region as this state was 1 of the 46 that dropped out in 2003. By spring 2003, this large state agreed to participate in the study and an attempt was made to sample some of the large districts of this state. Only 1 of the 4 LEAs from this state agreed to participate in PEELS. Between the lack of participation from some districts and low recruitment in other districts undercoverage remained an issue. In order to ensure the final sample was nationally representative, a supplemental sample of LEAs stratified by size was randomly selected from that state in Wave 2, or the second year of data collection(supplemental sample; Carlson et al., 2008a). The sample in Wave 1 (the first year of data collection) continued to have the issue of undercoverage in the one region; however, researchers weighted the Wave 1 sample as though the state had been covered in order to obtain reasonable national estimates. Based on the Wave 2 data, imputation was also used to create missing Wave 1 data for the supplemental sample. The Wave 1 sample was then reweighted. The weights included in the PEELS dataset adjust for the undercoverage in Wave 1 (Carlson et al., 2008b).

Nonresponse study. In Wave 1, among the contacted 710 LEAs, only 200 LEAs participated in the study. Poor response raised a concern about nonresponse bias. To address it, the U.S. Department of Education funded a nonresponse study. A random sample of 30 LEAs, stratified only by district size, was selected among the 460 nonparticipating LEAs originally contacted but not recruited in Wave 1. Of the 30 LEAs, 30 agreed to participate in the nonresponse study. The nonresponse study indicated that there were no systematic differences between the Wave 1 respondents and nonrespondents on key variables. Because no systematic differences were identified, the two samples (main and nonresponse bias samples) were amalgamated into a single sample (230 LEAs) as if they had been selected as one based on the original sample design (Carlson et al., 2008b).

Child Sample

A sample of children was selected from each of the 230 LEAs using two different selection methods. Because LEAs are required to keep track of all children who receive special education services, the PEELS researchers were able to sample from the complete population of children ages 3 through 5 who were receiving special education services. However, because children with disabilities are identified on an ongoing basis, two methods were used for sampling children. One method was used for the Wave 1 main sample and the nonresponse sample and a separate method was used for the supplemental sample. Therefore, these two sampling methods are discussed separately.

Wave 1 main sample and nonresponse sample. In Wave 1, the participating LEAs submitted two types of lists of eligible children: a historical list and ongoing lists. The historical list identified age-eligible children who had an IEP (or IFSP in districts that used IFSPs for children ages 3–5) prior to March 1, 2003. The ongoing lists were submitted by the LEAs monthly for 1 year, identifying newly eligible children in the district (i.e., children who received their first IEP or IFSP during that month). Children were recruited into PEELS as 3-, 4-, and 5-year-olds. All participating 3-year-olds were newly enrolled in special education during the recruitment period (i.e., ongoing lists); participating 4- and 5-year-olds included children both newly enrolled in special education during the recruitment period and those who had already been identified as eligible for services (i.e., historical lists). Additionally, the samples of children were divided into three age cohorts (A, B, and C) based on the child's age at the first data collection. Consequently, there were five combinations of age cohort and list type for each district (see Table 1).

Table 1

Definition of PEELS Age Cohorts

Cohort	*Source List*	*Age at Entry into PEELS*	*Date of Birth*
A	Ongoing	3 years old	3/1/00–2/28/01
B	Historical and Ongoing	4 years old	3/1/99–2/28/00
C	Historical and Ongoing	5 years old	3/1/98–2/28/99

Each district had a predetermined sampling rate for each of the five groups. The sampling rates for the five sampling groups in each district were determined based upon district-level sampling weights and the district-level child counts, by cohort. Additionally, the rates were determined to achieve the target sampling rates within each five groups and efforts were made to keep the weights within the groups as equal possible. When districts provided the historical lists, children were sampled from the historical list using the predetermined sampling rates. Children were sampled from the ongoing lists as the districts sent the lists during the recruitment period. A total of 5,260 children were selected from Wave 1 main sample and the nonresponse sample (Carlson et al., 2008b).

Supplemental sample. A similar sampling procedure was used to select children for the supplemental sample; however there were two important exceptions to the procedure. First, the age cohort was determined based on the children's age in Wave 1. Second, the children were not selected on an ongoing basis because by Wave 2 every child was on a historical list. In order to simulate the sampling procedure used for the

Wave 1 main sample and the nonresponse sample, the date of the children’s special education enrollment was taken into account when selecting the children. A sample of 540 children was selected from the supplemental sample, increasing the total number of selected children to 5,800 (Carlson et al., 2009).

Family recruitment. Once children were sampled from either the historical or ongoing lists, recruitment packets were sent to the district site coordinators. The site coordinators were then responsible for determining if children were eligible, and if so, inviting the child’s parents or guardians to participate in the study. Eligibility criteria for study participation were: (a) there was an English- or Spanish-speaking adult or an adult who used signed communication in the household or could respond to questions using a telephone relay service or interpreter for the hearing impaired; (b) this was the family's first child sampled for PEELS; and (c) the sampled child's family resided in the participating school district at the time of enrollment of the study. Families who met the criteria were asked to complete an enrollment form. Upon returning the forms, parents received $15. Enrollment forms were completed for 4,370 children. Based on the information gathered from the enrollment forms, 3,900, or 89.4% of the families were found eligible for the study, and 79.5% of those eligible agreed to participate. In all, 3,100 families took part in PEELS (Carlson et al., 2008a).

PEELS Instrumentation

Data for the PEELS were collected from the children, parents, teachers, program directors, LEA directors of special education, and state preschool special education coordinators. Data collection instruments included direct child assessments, parent interviews, teacher questionnaires, principle or program director questionnaires, LEA questionnaires and state agency questionnaires. Data were collected in five waves over the course of 5 years, from 2003–2004 through 2007–2008. For the purposes of this study, only direct child assessments were used, which is a small subset of the available PEELS instruments. For a complete list of PEELS instrumentation and their collection schedules see Carlson et al. (2008a).

Direct Child Assessments

Direct child assessments were administered in all four waves of data collection. The assessments were administered by more than 400 assessors who were employed and trained to administer the one-on-one assessments to the participants. The assessors consisted of school psychologists, teachers, administrators, and other individuals experienced in administering standardized assessments to young children with disabilities. The assessors included employees of participating districts, neighboring districts, and health care agencies, as well as retired individuals. The use of local assessors potentially threatens the objectivity of the test results; however the use of local assessors was necessary because it facilitated access to the children and their families (Markowitz et al., 2006). The assessors received an initial 1½-day training that was conducted a locations throughout the country. In addition, the training was supplemented with video-based instruction on test procedures and biweekly phone calls with a supervisor. At the in-person training, the administrative procedures were explained and the assessors practiced each subtest following the PEELS protocol then completed a quiz on the assessment procedures. In Waves 2, 3, and 4, assessors who participated in previous in-person trainings were only required to participate in a telephone training rather than repeating the in-person training.

Prior to the assessment, a screening interview was conducted with the child's teacher, service provider, or parent in order to determine whether the child should be administered the direct or alternate assessment, the language of the assessment, and whether or not accommodations were needed. For children who were not able to follow simple directions, who had a visual impairment that would interfere with the administration of the direct assessment, or who began the direct assessment but could not meaningfully participate, the ABAS–II which was administered as a part of the teacher questionnaire was used as an alternate assessment. A Spanish version of the direct assessment, which included 8 subtests of the same instruments as the English assessment, was administered to children who primarily spoke Spanish (see Carlson et al., 2008 for detailed descriptions of the alternate assessment and Spanish assessments). However, because of the small number of children completing the direct assessment in Spanish (Wave 1 had 25, Wave 2 had 4, Wave 3 had 2, and Wave 4 had none), those data were not included in the data set. Finally, the following accommodations were provided: (a) enlarged print, (b) assessments administered by someone familiar with the child, (c) assessments administered with someone familiar with the child present, (d) someone to help the child respond, (e) specialized scheduling, (f) adaptive furniture, (g) special lighting, (h) abacus, (i) communication device, and (j) multiple testing sessions.

The direct one-to-one assessment included one or more of the following assessments: (a) the PreLanguage Assessment Scales (PreLAS 2000), (b) the Peabody

Picture Vocabulary Test (PPVT), (c) the Woodcock-Johnson III (WJ–III), (d) Leiter International Performance Scale–Revised (Leiter–R), (e) the Individual Growth and Development Indicators (IGDIs), (f) the Test of Early Math Skills, and (g) the Dynamic Indicators of Basic Early Literacy Skills (DIBELS). Table 2 shows the waves in which each of these assessments were administered.

Table 2

PEELS Child Assessment Schedule

Assessments	Wave 1			Wave 2			Wave 3			Wave 4		
	A	B	C	A	B	C	A	B	C	A	B	C
Pre-LAS–Simon Says	X	X	X	X	X	X	X	X	X			
Pre-LAS–Art Show	X	X	X	X	X	X	X	X	X			
PPVT III	X	X	X	X	X	X	X	X	X	X	X	X
Leiter-R Attention Sustained	X	X	X	X	X	X	X	X	X			
IGDI–Picture Naming	X	X	X	X	X	X	X	X	X			
IGDI–Alliteration		X	X	X	X	X	X	X	X			
IGDI–Rhyming		X	X	X	X	X	X	X	X			
IGDI–Segment Blending		X	X	X	X	X	X	X	X			
WJIII–Letter Word Identification	X	X	X	X	X	X	X	X	X	X	X	X
WJIII–Quantitative Concept–Number Series			X		X	X	X	X	X			
WJIII–Quantitative Concepts–Concepts			X		X	X	X	X	X			
WJIII–Applied Problems	X	X	X	X	X	X	X	X	X	X	X	X

(continued)

Assessments	Wave 1			Wave 2			Wave 3			Wave 4		
	A	B	C	A	B	C	A	B	C	A	B	C
Table 2, continued												
WJIII–Passage Comprehension										X	X	X
WJIII–Calculation										X	X	X
Test of Early Math Skills	X	X	X	X	X	X						
PIAT-R Reading						X		X	X			
DIBELS–Oral Reading Fluency[1]										X	X	X

Note. Table adapted from Carlson et al., 2009.

[1]The DIBELS was administered based on grade, not age. It was administered in grade 1 and higher

PEELS Data Cleaning and Imputation

Data Cleaning

In order to minimize missing data, PEELS researchers conducted data cleaning and editing procedures that involved calling respondents to clarify responses, reviewing electronically recorded parent interviews, conducting frequency and cross-tabulation reviews, and completing structural and data integrity edits. In addition, they used a proprietary editing system called COED to identify errors in data, check for consistency of logic edits, and check skip patterns for accuracy. These data cleaning procedures were conducted to ensure the accuracy of the data by identifying responses that were out of the range of valid responses to an item, comparing items that should correspond with one another to make sure they did not conflict, and checking that the skip patterns within the parent interviews were accurately followed. Although these procedures helped to ensure the accuracy of the data, no data on the technical properties of the data from the PEELS questionnaires were available, therefore the reliability and validity of data from the LEA and parent questionnaires is not known.

Data Imputation

PEELS researchers imputed values for specific items on the parent interview, teacher questionnaire, and child assessment data. Overall, the item missing rate was rather low for most variables, mostly less than 10%. For many of these variables, single imputation was used. Missing rates for some variables in the principal/program director file were high, over 20%, so multiple imputation was conducted. Imputation for item missing values was performed cross-sectionally in each wave for all types of data.

Different methods of imputation were used depending on the type of missing data and available information. The imputation methods included hot-deck imputation-based regression models, external data source, and deterministic or derivation method. In some cases, a postulated value was imputed after analyzing missing patterns. All imputed variables were noted in the data files.

Imputation of all missing data values was determined to be impractical, so values that were deemed more important were imputed (Carlson et al., 2008b). The number of imputed variables was limited when imputation first began; however, this restriction was relaxed as imputation capabilities improved over the course of the study. Most necessary variables were imputed using AutoImpute software, a hot-deck imputation method that creates cells based on regression models (Carlson et al., 2008b).

Weighting

The PEELS data provided weights to allow for nationally-representative estimates. Different weights were used depending on the source of the data (e.g., cross-sectional parent interview weights, longitudinal child assessment weights). The weights adjusted the child base weights given to the 3,100 recruited families to account for nonresponse on specific data collections in specific waves and groups of waves. See Markowitz et al. (2006) for further details about PEELS weighting.

The goal of survey weights was to provide estimates of the population so that results can be generalized to a nationally-representative group of children. However, survey weights are not attributes of individuals, rather they are constructions based on an entire survey. Substantial amounts of missing individual data, particularly when these data were not missing completely at random, affected the generalizability of these results. Further imputation of missing data was not an option (see discussion below). In order to best represent my sample, I chose to subset the sample for each analysis. This allowed for a more limited, yet accurate picture of children who had complete data. Given these constraints, I proceeded with using unweighted survey data that were nationally drawn but not necessarily nationally-representative.

The Study Sample

Identification of the Study Sample

For purposes this study, I utilized the PEELS longitudinal child assessment data along with the longitudinal demographic data file. This child assessment dataset included 2,260 children's assessment data. My sample was then narrowed by child cohort and disability category.

Child cohort. As noted above, the PEELS sample includes three cohorts that entered the study at different ages: Cohort A, children who were age 3 at the first year (or wave) of data collection; Cohort B, where children were age 4 during the first year of data collection; and Cohort C, with children age 5 during the first year of data collection. Children typically begin to enter kindergarten around age 5. For the purpose of all of my analyses, I wanted to look at assessment scores for children who were most likely to be in preschool during Wave 1 (year 1 of data collection). So, only children in Cohorts A and B were included.

Disability category. Information on children's primary disability category was obtained from their teachers or service providers. If those data were missing, disability information was obtained from enrollment forms submitted by district personnel or from the parent interview. I chose to specifically look at children with language-related delays, so in this study, children who were identified as having a primary disability in 1 of the following 3 categories were included : autism spectrum disorder (ASD), developmental delay (DD), or speech or language impairment (SLI).

The two primary exclusionary criteria (i.e., disability category, child cohort), reduced the sample to 1,230 children. A complete demographic profile of the sample included in this investigation is presented in Table 3.

Table 3

Demographic Characteristics of Study Population

Disability	Characteristic	Frequency[a]
	Child's Age	
ASD	A (3-year-olds)	20
	B (4-year-olds)	30
DD	A (3-year-olds)	210
	B (4-year-olds)	190
SLI	A (3-year-olds)	300
	B (4-year-olds)	480
Total		1,230
	Gender	
ASD	Female	0
	Male	50
DD	Female	130
	Male	270
SLI	Female	230
	Male	550
Total		1,230
	Race/ethnicity[b]	
ASD	American Indian/Alaska Native	0
	Asian/Pacific Islander	0
	Black	0
	Hispanic/Latino/Spanish Origin	10

(continued)

Disability	Characteristic	Frequency[a]
Table 3, continued		
	White	40
DD	American Indian/Alaska Native	20
	Asian/Pacific Islander	10
	Black	40
	Hispanic/Latino/Spanish Origin	50
	White	280
SLI	American Indian/Alaska Native	20
	Asian/Pacific Islander	20
	Black	60
	Hispanic/Latino/Spanish Origin	110
	White	580
Total		1240
	Language other than English spoken in the home regularly	
ASD	Yes	10
DD	Yes	50
SLI	Yes	90
	Total	150
	Household income	
ASD	$25,000 or less	10
	$25,001–$50,000	20
	More than $50,000	20
DD	$25,000 or less	100

(continued)

Disability	Characteristic	Frequency[a]
Table 3, continued		
	$25,001–$50,000	110
	More than $50,000	110
SLI	$25,000 or less	160
	$25,001–$50,000	200
	More than $50,000	290
Total		1,020

[a] Sample sizes were all rounded to the nearest 10.

[b] If respondents says mixed race or bi or multiracial, they could answer all that apply.

Variables

Age at Time of Assessment

The PEELS dataset included variables representing the children's age in months at the time of each assessment. The child's age at Wave 1 (ASSESSAGEMW1) was chosen because I wanted to examine the relationship between the PN-IGDI and age closer to the beginning preschool. The average ages for children at Wave 1 were 50.35 (SD = 5.90) for children with ASD, 48.85 (SD = 6.02) for children with DD, and 50.68 (SD = 6.06) for children with SLI. The child's age at Wave 3 (ASSESSAGEMW3) was chosen because I wanted to examine the relationship between age and the PN-IGDI near the end of their preschool education. At Wave 3, the average ages for children with SLI were 74.69 (SD = 6.18), for children with DD were 73.09 (SD = 6.37), and for children with SLI were 74.64 (SD = 6.25).

Picture Naming–Individual Growth and Development Indicator (PN–IGDI)

PN–IGDI is a timed task that presents children with pictures of objects found in natural environments (e.g., cake, book, rabbit, train). Children were asked to name pictures as quickly as possible. The number of pictures named correctly in 1 minute is the child's score.

Research on the psychometric properties of PN–IGDI has suggested it demonstrates validity and reliability-related evidence in support of it as n indicator of children's expressive language skills. Criterion-related concurrent validity evidence for *PN–IGDI* was found in research with other standardized measures of language development and with presumed correlates of language (e.g., literacy). For instance, in the longitudinal investigation by Priest and colleagues with approximately 90 preschool children from 36 to 60 months of age (including children with disabilities and those living in poverty), it was found that the PN–IGDI was positively correlated with the *Peabody Picture Vocabulary Test–Third Edition* (PPVT–3; Dunn & Dunn, 1997; $r = .56$ to 75, $p < .001$) and with the *Preschool Language Scale–3* (PLS–3; Zimmerman, Steiner, & Pond, 1992; $r = .63$ to .79, $p < .001$; Priest et al., 1999; Priest et al., 2000). The PN–IGDI has also been found to be strongly correlated ($r = .80$, p = .01) with the PPVT–R for a group of 11 preschool children with ASD (Cadigan & Missall, 2007). Additionally, McConnell and colleagues correlated PN–IGDI with the Dynamic Indicators of Basic Early Literacy Skills (DIBELS; Kaminski & Good, 1996) measures of Letter Naming Fluency (LNF; $r = .32$ to .37) and Onset Recognition Fluency (OnRF; $r = .44$ to .49; McConnell et al., 2002). More recent studies have begun to look at the predictive nature of the PN–IGDI. Missall and colleagues (2007) found that the PN–IGDI throughout preschool correlated with a first grade oral reading fluency curriculum-based measure (R–CBM; r = .37 to .48). Even more, they demonstrated positive predictive power of the PN–IGDI on the R–CBM. Another study has specifically looked at the relationship between the PN–IGDI and the DIBELS ORF finding a significant correlation between these two measures at preschool and 1st (r = .26; McCormick & Haack, 2010).

Evidence of construct-related validity evidence has also been reported with significant correlations found between PN–IGDI and chronological age (r = .41–.60), including preschool children without identified risks (r = .63), children enrolled in Head Start (r = .32), and preschool children with disabilities (r = .48; McConnell et al., 2002; Priest et al., 1999). This measure has also been shown to be sensitive to growth differences due to age, level of risk, and disability status. Hierarchical linear modeling (HLM) centered at 66 months of age showed an average PN–IGDI score of 26.90 for children without risks or disabilities (growth of .44 pictures per month), 19.01 for children from low-income families (growth of .28 pictures per month), and 16.88 for children with identified disabilities (growth of .36 pictures per month; Priest et al., 2000). In another study, HLM centered at 59 months of age found an average PN–IGDI score of 22.2 for children without risks or disabilities, 22.6 for children living in poverty, 18.9 for children with speech or language disabilities, and 7.2 for Spanish-speaking children who are learning English (Missall et al., 2006). Cadigan and Missall (2007) specifically looked at the expressive language growth for children with ASD. With HLM centered at

56 months of age, the average PN–IGDI score was 15.71 with a growth rate of .12 pictures every 2 weeks.

Research has also demonstrated reliability-related evidence of the PN–IGDI. One-month alternate-form reliability coefficients have ranged from r = .44 to .78 (McConnell et al., 2002). Additionally, For a sample of 29 children between 35 and 69 months of age without identified risks or disabilities, test–retest reliability across 3 weeks was r = .67.

The PN–IGDI scores from the first three waves (or years of data collection) of data were used for this study (C1IGDIPNSCORE, C2IGDIPNSCORE, and C3IGDIPNSCORE). To address the research question 2, the PN–IGDI scores at waves 1 and 3 were converted to z-scores in order to run correlations with the standardized PPVT scores.

Peabody Picture Vocabulary Test (PPVT)

The PPVT is a measure of vocabulary. The standard administration of the PPVT–III involves the assessor showing the child four pictures on a single page then asking the child to point to the picture that matches a word the assessor speaks aloud. PEELS used a psychometrically adapted and shortened version of the PPVT–III. With the shortened version, all children are presented a core set of 14 items. If their performance on the core set of items was extremely low (responding incorrectly on 8 to 14 of the 14 items in Wave 1, 10 to 16 of the 16 items in Waves 2 and 3, and 14 to 18 of the 18 items in Waves 4 and 5), they were administered an easier basal set of items. If their performance on the core set of items was high (responding incorrectly on 0 to 2 of the 14 items in Wave 1, 0 to 2 of the 16 items in Wave 2, 0 to 3 of the 16 items in Wave 3, 0 to 2 of the 18 items in

Wave 4, and 0 to 4 of the 18 items in Wave 5), they were administered a harder ceiling set of items to determine their basic or extended level of performance. Children's scores on the various parts of the test were transformed into a single score and placed on a standardized scale with a mean of 100 and a standard deviation of 15 (Carlson et al., 2009).

This adaptation was based on the full-length PPVT III and earlier work for the Head Start Family and Child Experiences Survey (FACES) (www.acf.hhs.gov/programs/opre/hs/faces/index.html) and Head Start Impact Study (HSIS) (www.acf.hhs.gov/programs/opre/hs/impact_study/index.html). The 32-item PEELS PPVT was developed using the same approach as the one used for the 40-item HSIS (2002) test. In selecting items for PEELS, the goal was to select a core set of items so 67% of the PEELS children (i.e., those scoring within 1 standard deviation of the mean) would only need to be administered that core set of items (i.e., the core set alone would provide a good estimation of their skills).

The Item Response Theory (IRT) true score for the items in the core item set was used to determine basal and ceiling decision rules appropriate for the PEELS target population. The IRT true score is a model-based estimate of the number right raw score. Raw scores on the core item set were used to determine whether a child would actually receive either the additional basal or ceiling item set. The IRT estimate of test reliability for a population having distribution parameters equal to those of the PEELS latent ability distribution was $r_{xx} = 0.781$. The sample-based IRT reliability obtained from ability estimates and standard errors of measurement in PEELS was $r_{xx} = 0.861$. PEELS IRT proficiency scores were put on the publisher's *W*-ability scale through a linking process. As a result, the PPVT–III (adapted version) scores for the PEELS children can be compared to the national norming sample of the publisher (Dunn and Dunn 1997b).

The standard version of the PPVT–III had high alternate form reliability for the standardized scores (.88 to .96). Split-half reliability coefficients were also high (.86 to .97). Test–retest reliability coefficients on the PPVT standard form were in the .90s (Dunn and Dunn 1997). Standard form PPVT–III scores were significantly correlated with age; the steepest part of the growth curve occurred from age 2 ½ to 12. Dunn and Dunn (1997) reported that the PPVT–III correlated with the Wechsler Intelligence Scale for Children–Third Edition (Wechsler 1991; r = .82 to .92), Kaufman Adolescent and Adult Intelligence Test (Kaufman and Kaufman 1993; r = .76 to .91), Kaufman Brief Intelligence Test (Kaufman and Kaufman 1990; r = .62 to .82), and the Oral and Written Language Scales (Carrow-Woolfolk 1995; r = .63 to .83). PPVT standard scores were generated for 2,352 PEELS participants in Wave 1 and 2,669 in Wave 2. The estimated reliability of the PPVT short form was .86, meaning that about 86% of what the test measured reflected the true underlying construct (Carlson et al., 2009). The PPVT scores from waves 1 and 3 were used for the purposes of this study (C1PPVTSTDZ and C3PPVTSTDZ).

Dynamic Indicators of Basic Early Literacy Skills–Oral Reading Fluency (DIBELS ORF)

DIBELS ORF is a measure that assesses oral reading fluency in grade-level connected text. The DIBELS ORF was used in PEELS to assess children’s general reading achievement. Students read three passages aloud for 1 minute each, with the cue to “be sure to do your best reading” (Good, Kaminski, Smith, Laimon, & Dill, 2001, p. 30). Words omitted, substituted, and hesitations of more than 3 seconds were scored as errors. Words self-corrected within 3 seconds were scored as accurate (Good, Wallin, Simmons, Kame'enui, & Kaminski, 2002). The assessor noted errors, and the score is the number of correct words read per minute; the median score from the three passages is the data point for decision making. DIBELS was administered based on grade level rather than age, so children were administered this assessment in grades 1, 2, or 3. The DIBELS was only administered in the fourth and final wave of data collection. Children who were included in this study sample were primarily in the first grade assessment group, so only first grade DIBELS were included (C4DIBELS1).

Analysis

The PEELS dataset uses complex sample designs such as poststratification whenever possible to enhance the precision of the survey estimates (Carlson et al., 2008b). Poststratification is a commonly used technique for improving the efficiency of estimators. Survey weights are adjusted to force the estimated numbers of units in each of a set of estimation cells to be equal to known population totals. The resulting weights are then used in forming estimates of means or totals of variables collected in the survey. The use of estimates helps to adjust for over- and under-sampling. Although there are many benefits to weighting data, I determined that weighting this sample was not appropriate given the constraints of the data for the variables of interest in my study. The decision not to weight the data was due to the fact that there were large amounts of missing data and an inability to resolve this issue. Because I chose to not weight my data, the results of this study will represent a large but specific group of preschool children with SLI, DD, and ASD, rather than a nationally representative sample.

Missing Data

Despite the imputation methods used by PEELS researchers, there were still missing data in the PEELS dataset. In survey research, missing data problems are particularly acute, with substantial amounts of missing data frequently appearing (McKnight & McKnight, 2011). The most serious concern is that missing data can introduce bias into estimates derived from a statistical model (Becker & Powers, 2001; Rubin, 1987). Furthermore, it has been shown that the mechanism and the pattern of missing data have greater impact on research results than does the amount of data missing (Tabachnick & Fidell, 2001, p. 58). According to Little and Rubin (1987), mechanisms that lead to missing data can be classified as: *missing completely at random* (MCAR), *missing at random* (MAR), and *missing not at random* (MNAR). Little's chi-square statistic is suggested as one way to determine whether values are MCAR. For this test, the null hypothesis is that the data are missing completely at random, and the p value is significant at the 0.05 level.

To conduct valid analyses with incomplete data, the pattern of missing data was examined. First, the values of -1, -5, -7, -8, and -99999 in the PEELS database indicate missing values. Second, the cases with missing values on all five variables (PN–IGDI at waves 1, 2, and 3; PPVT; and DIBELS) were deleted (N = 43). Finally, these five variables were tabulated to examine the pattern of missing data on the remaining cases.

The original tabulation showed that there are 573 complete cases (46.47% of the 1230 cases). The amount of complete cases was affected primarily by the amount of missing DIBELS ORF data. However, further examination of the missing data revealed that DIBELS ORF was not collected until the child reached at least first grade, which limited the number of children in this sample to be evaluated. Therefore, the sample of children who were given the DIBELS ORF measure were further reduced to only include those children who were in first grade at the time. This reduced the amount of missing data for the DIBELS ORF from approximately 45% to 13%. Little MCAR test was conducted and the *p* value was not significant, indicating that the missing data for this study is not missing completely at random. The rates of missing data for each of the five variables are displayed in Table 4.

Table 4

Missing Values of Key Variables

Variable Name	Missing Count	Percentage Missing (N = 1230)
Wave 1 IGDI Picture Naming	135	10.9%
Wave 2 IGDI Picture Naming	53	4.3%
Wave 3 IGDI Picture Naming	32	2.6%
Wave 1 PPVT	38	3.1%
Wave 3 PPVT	15	1.2%
	Missing Count	Percentage Missing (N = 768)
DIBELS ORF First Grade	103	13.4%

Using the missing data analysis function in SPSS, further analysis of the missing data was conducted. T-tests indicated that the mean scores on the PPVT, DIBELS ORF, and the PN–IGDI at waves 2 and 3 were higher when PN–IGDI was present at Wave 1. Groups that were slightly more likely to have missing PN–IGDI data at Wave 1 were part of Cohort A (3-year-olds) and had a label of DD. Overall, ethnicity and race did not appear to affect missing rates. In fact, children who were identified as Asian or Black had lower missing rates on both the PN–IGDI at Wave 1 and the DIBELS ORF. Language, as measured in the parent questionnaire, did not appear to play a significant role in the missing data. With respect to household income, the missing rates for the PN–IGDI at

Wave 1 appeared to decline as the household income level increased. Missing rates for DIBELS ORF were not affected by household income.

Multiple imputation procedure was considered to address the missing data for the PN–IGDI at all three waves of data collection. However, further analysis of the imputations already conducted and email discussions with Westat researchers lead me to determine that no further imputation should be conducted. Based on the imputation flags in the data files, Westat researchers imputed 92 PN–IGDI scores (7.5%) at Wave 1, 5 PN–IGDI scores (0.4%) at wave 2, and 1 PN–IGDI score (0.1%) at Wave 3; 79 PPVT scores at Wave 1 (6.4%), 0 PPVT scores at Wave 3; 4 DIBELS scores (0.3%).

There are other ways to handle missing data including using a listwise deletion procedure. Listwise deletion involves deleting all cases with missing data. The use of listwise deletion must be used with great caution as it greatly limits sample size, which reduces statistical power (McKnight & McKnight, 2011). However, for the purposes of my study, I chose use listwise deletion and run analyses on complete cases only. More specifically, the deletion of cases depended on the question being asked. Therefore, the cases with missing data pertinent to that particular question were excluded.

Statistical Methods

Question 1–At Wave 1 and Wave 3, to what extent do children with disabilities (SLI, ASD, and DD) PN–IGDI scores correlate with age to demonstrate construct-related validity evidence? The goal of the first question is to examine the construct-related validity evidence of the PN–IGDI based on its relation to other variables (Goodwin & Leech, 2003). To support construct-related evidence, previous studies have looked specifically at the relationship between the PN–IGDI and chronological age for preschooler–aged children (Missall & McConnell, 2004). In order to extend these findings, correlation analyses were conducted between chronological age and the PN–IGDI scores at Wave 1, which was presumed to be a year when children were near the beginning of their preschool education. Additionally, correlations were conducted between PN-IGDI and chronological age at Wave 3, which was presumed to be closer to the end of preschool education.

Question 2–At Wave 1 and Wave 3, to what extent does the PN–IGDI correlate the PPVT for children with SLI, ASD, and DD to demonstrate concurrent criterion-related validity evidence? Previous research has also evaluated concurrent criterion-related evidence for the PN–IGDI with standardized measures of language development (McConnell et al., 2002; Missall & McConnell, 2004). To extend support for criterion-related validity evidence for the PN–IGDI measure as it specifically relates to each disability group, similar to previous studies, correlations were completed between the PEELS PPVT and the PN–IGDI. In other words, correlations between the PPVT and PN–IGDI were conducted for each group of preschoolers (i.e., SLI, ASD, and DD).

Question 3–(a) To what extent does the change in PN–IGDI scores from Wave 1 to Wave 3 predict the DIBELS Oral Reading Fluency (ORF)? (b) Does a child's identified disability label moderate the relationship between the PN–IGDI change score and DIBELS ORF? (c) To what extent does the PN–IGDI score at Wave 1 (PN1) improve the prediction of the PN–IGDI change score on the DIBELS ORF? (d) Is this improvement in the prediction between the PN–IGDI change score and DIBELS ORF *with the addition of PN1 moderated by a child's identified disability label?* Studies have begun to address the predictive criterion-related validity evidence for the PN–IGDI with the DIBELS ORF and curriculum-based fluency measures (McCormick & Haack, 2010; Missall et al., 2007). In accordance with these previous studies, correlations were conducted between the DIBELS ORF and the PN–IGDI at each wave of data collection.

The primary goal of this question was to further examine the predictive relationship between PN–IGDI and DIBELS ORF. Multiple regression is a method that investigates the pattern among many variables (Howell, 2002). It is a complex statistical procedure that allows the researcher to understand and analyze a complex situation by dealing with many variables simultaneously. To address the above questions, four multiple regression models were analyzed. For each of the four models, a PN–IGDI *change score* was calculated by subtracting the PN–IGDI score at Wave 3 minus the score at Wave 1. *Change score* was chosen as predictor in these models because I wanted to determine if the change over time on the PN-IGDI influenced later literacy measures (i.e., DIBELS ORF). Moreover, the PN-IGDI score at Wave 1 was added to the model to determine if the score at which children were first measured on the PN-IGDI together with a change in score over time influenced the predictive relationship. Finally, I wanted to see if and/or how these predictive relationships varied based on a child's disability category The regression models are described in Table 5.

Table 5

Multiple Regression Models

Measure	Model 1	Model 2
PN–IGDI *change score* alone	$Y = \beta_o + \beta_1 change\ score + \varepsilon$	$Y = \beta_0 + \beta_1\ change\ score + \beta_2\ ASD + \beta_3\ DD + \beta_4\ change\ score * ASD + \beta_5\ change\ score * DD + \varepsilon$
	Model 3	**Model 4**
PN–IGDI change score and PN–IGDI score Wave 1 (PN1)	$Y = \beta_o + \beta_1 change\ score + \beta_2\ PN1$	$Y = \beta_0 + \beta_1\ change\ score + \beta_2\ ASD + \beta_3\ DD + \beta_4\ PN1 + \beta_5\ change\ score * ASD + \beta_6\ change\ score * DD + \beta_7\ PN1 * ASD + \beta_8\ PN1 * DD + \beta_9\ PN1 * change\ score + \beta_{10}\ change\ score * PN1 * ASD + \beta_{11}\ change\ score * PN1 * DD + \varepsilon$

Question 4 – To what extent is the PN–IGDI sensitive to yearly growth for children with disabilities between 3 and 7 years of age? To what extent does this sensitivity to growth vary as a function of disability status? This question more specifically addresses the idea of test usefulness. The premise of the IGDI is that it is a growth outcome measure. Previous studies have shown that the PN–IGDI is sensitive to growth for children with SLI (Missall et al., 2007) and ASD (Cadigan & Missall, 2006). The hope is to further extend these findings to a larger national sample of children with language-related disabilities. The extent to which this measure is sensitive to growth for these groups of children has huge implications for the benefits of these measures. This provides a foundation for the use of this measure to support data-based decision making.

In order to answer this question, a repeated-measures ANOVA, also known as within-subjects ANOVA, was conducted. The repeated measures ANOVA allows a researcher to determine whether or not changes in scores have occurred over time. Repeated measures ANOVA can be chosen for a study design that investigates changes in mean scores over 3 or more time points (Howell, 2002). The PN–IGDI was collected over 3 consecutive years, so the repeated measure ANOVA was an appropriate fit for this analysis. Additionally, a between subjects factor (i.e., disability category) was added to address the second part of the question. Post hoc analyses were conducted when the repeated measures ANOVA was statically significant.

CHAPTER 4

Results

Descriptive Statistics

To examine the distributions of the data for this study, descriptive statistics were calculated for the sample. The following frequencies were reported in accordance with the requirements of the Institute of Education Sciences (IES) National Center for Education Statistics (NCES; 2012). NCES requires that unweighted sample entities (e.g., sample size) must be rounded to the nearest 10.[1]

Table 6

Descriptive Statistics

Measure	*Disability*	*N*	*Mean*	*SD*
PN–IGDI – Wave 1	ASD	50	12.26	6.17
	DD	320	11.72	5.47
	SLI	640	13.92	5.88
PN–IGDI – Wave 2	ASD	50	16.08	6.22
	DD	380	16.06	5.96
	SLI	750	18.89	6.44
PN–IGDI – Wave 3	ASD	50	20.36	6.86
	DD	390	19.48	6.15

(continued)

[1] All data and analyses of this document were reviewed and accepted by the IES Data Security Office of NCES.

Measure	*Disability*	*N*	*Mean*	*SD*
Table 6, continued				
	SLI	770	21.84	5.83
PN-IGDI *change score*	ASD	50	9.22	5.19
	DD	330	8.23	5.30
	SLI	700	8.29	6.17
PPVT – Wave 1	ASD	40	89.30	14.14
	DD	290	85.93	14.57
	SLI	570	94.39	13.99
PPVT – Wave 3	ASD	50	95.07	14.79
	DD	390	93.84	12.05
	SLI	770	99.66	11.74
DIBELS ORF – Wave 4	ASD	30	62.50	51.89
	DD	210	30.87	36.48
	SLI	430	42.15	36.31
Age in Months – Wave 1	ASD	50	50.35	5.90
	DD	400	48.85	6.02
	SLI	780	50.68	6.06
Age in Months – Wave 3	ASD	50	74.69	6.18
	DD	400	73.09	6.37
	SLI	780	74.64	6.25

Disability Categories: Autism Spectrum Disorder (ASD), Developmental Delay (DD), Speech or Language Impairment (SLI); Measures: Picture Naming – Individual Growth and Development Indicators (PN-IGDI), Peabody Picture Vocabulary Test (PPVT), Dynamic Indicators of Basic Early Literacy Skills – Oral Reading Fluency (DIBELS ORF)

A summary of basic descriptives for the Picture Naming–Individual Growth and Development Indicators (PN–IGDI), the Peabody Picture Vocabulary Test (PPVT), and the Dynamic Indicators of Basic Early Literacy Skills–Oral Reading Fluency (DIBELS–ORF) measures was presented in Table 6. In general, the average score on the PN–IGDI measures for children with DD was lower than children with ASD and SLI across all three waves of data collection. While the mean scores for children with DD were a little lower on the PN–IGDI, their standard deviations were smaller and sample sizes larger than children with ASD, for instance. This indicates that the distribution of scores for children with DD were a little less spread out from the mean when compared to children with DD. The average scores for children with ASD on the PN–IGDI increased over time as did the standard deviations indicating some more variability in the distribution of scores by Wave 3. This distribution of scores for children with SLI varied based on the wave of the assessment. By Wave 3, the mean score for children with SLI was highest with the lowest standard deviation, indicating scores are less spread out around the mean.

The change score for the PN-IGDI is the score difference between Wave 1 of data collection and Wave 3. The average change score ranged from 8.23 for children with DD to 9.22 for children with ASD. The standard deviations for these groups were quite large, indicating a large variation of scores around the mean. While the standard deviations were large, this was consistent across all three groups.

With respect to the PPVT, the average scores were higher for children with SLI at both waves 1 and 3. Additionally, the standard deviations for children with SLI were the lowest of the three groups, indicating that the distribution of these scores were a little less spread out than children with ASD or children with DD. Overall, the standard deviations for all three groups of children were fairly consistent at both Wave 1 and Wave 3.

For this sample, the DIBELS ORF demonstrated variability with large standard deviations for all three groups of children. In particular, scores for children with DD varied so much around the mean that the standard deviation was larger than the sample mean. The large standard deviations indicate a large range in the distributions of scores about the mean on the DIBELS ORF.

The average age for all three groups of children was calculated for Wave 1 and for Wave 3. At Wave 1, both children with ASD and children with SLI had an average age of approximately 50 months (4 years, 2 months). The average age for children with DD was just a bit lower at approximately 48 months (4 years). The standard deviation for all three groups was approximately 6 months of age. At Wave 3, children from all three groups were approximately 73 to 74 months of age (6 years, 1-2 months). The ages varied by just over 6 months for all three groups.

To further examine the data, effect sizes were computed using Cohen's *d* (1988). Effect sizes were computed for each measure (i.e., PN–IGDI, PPVT, and DIBLES) between groups of children based on their disability label (i.e., ASD, DD, SLI).

Table 7

Effect Sizes

Measure	*Disability Comparisons*	*Effect Size*
PN–IGDI – Wave 1	ASD–DD	0.09
	ASD–SLI	0.27
	DD–SLI	0.38
PN–IGDI–Wave 2	ASD–DD	0.003
	ASD–SLI	0.44
	DD–SLI	0.46
PN–IGDI–Wave 3	ASD–DD	0.14
	ASD–SLI	0.23
	DD–SLI	0.39
PPVT–Wave 1	ASD–DD	0.23
	ASD–SLI	0.36
	DD–SLI	0.59
PPVT–Wave 3	ASD–DD	0.09
	ASD–SLI	0.34
	DD–SLI	0.49
DIBELS ORF	ASD–DD	0.71
	ASD–SLI	0.45
	DD–SLI	0.31

Note. All effect size computations were completed using the formula $d = \frac{M_2 - M_1}{\sigma_{pooled}}$

According to Cohen's *d* (1988) interpretation values (i.e., *d* of 0.2 = small, 0.5 = medium, 0.8 = large), effect sizes for all three groups of children (ASD, SLI, and DD) varied. The differences between children with ASD and children with SLI showed small to medium (*d* = 0.23–0.44) effect sizes on the PN–IGDI. The differences between children with DD and children with SLI also demonstrated small to medium effects (*d* = 0.38–0.46) on the PN-IGDI. However, the difference between children with ASD and children with DD were quite small (*d* = 0.003–0.14) on the PN-IGDI. The effect sizes for all three groups on the PPVT ranged from small to medium based on Cohen's criteria (*d* = 0.09–0.59). The effect sizes for the DIBELS ORF, a fluency measure, showed a different pattern than the previous vocabulary measures. The effect sizes were the most disperse ranging from small (*d* = 0.31) to large (*d* = 0.71).

Research Question 1.

To address the first research question, "At Wave 1 and Wave 3, to what extent do PN–IGDI scores correlate with age by disability group?" Spearman's rho correlations were performed comparing the PN–IGDI measure with age in months for children with SLI, ASD, and DD.

Table 8

Spearman's Rho Correlations (and sample size) PN–IGDI and Chronological Age by Disability Category and Wave of Assessment

	Wave of Assessment	
Disability	*Wave 1*	*Wave 3*
ASD	0.36*	0.28*
	n = 50	n = 50
DD	0.31**	0.19**
	n = 320	n = 390
SLI	0.36**	0.20**
	n = 640	n = 770

*Correlation is significant to the $p < .05$ level.
**Correlation is significant to the $p < .01$ level.

The distributions for both the PN-IGDI and chronological age were examined by disability category to determine if they were normally distributed. The assumption of normality was violated for these groups; therefore, Spearman's rho correlations, a nonparametric correlation, were conducted. Correlations significant at $p < .01$ ranged from $r = .19$ to .36. The squared correlation coefficient (R^2) provides a better index of the magnitude of the correlation and will therefore be reported. The relationship between chronological age and the PN–IGDI was somewhat stronger for children with ASD and SLI. For both groups of children with ASD and SLI, approximately 13% of the variance in the PN–IGDI score could be explained by chronological age ($R^2 = 0.13$). The strength of the relationship between the PN–IGDI and chronological age decreased at Wave 3 for all three groups of children. Overall, the strength of the relationship between the PN–IGDI and chronological age was not as strong for children with DD compared to children with ASD and SLI. Further, given confidence intervals for these correlations, there were no major differences between the groups at Wave 1 and Wave 3.

Research Question 2

To answer the second research question, “At Wave 1 and Wave 3, to what extent does the PN–IGDI correlate the PPVT for children with SLI, ASD, and DD to demonstrate concurrent-related validity?” Spearman’s rho correlations were performed comparing the PN–IGDI measure with a standardized measure of vocabulary, the PPVT, for children with SLI, ASD, and DD.

Table 9

Spearman's Rho Correlations (and sample size) PN–IGDI and PPVT by Disability Category and Wave of Assessment

	Wave of Assessment	
Disability	*Wave 1*	*Wave 3*
ASD	0.51**	0.54**
	n = 30	n = 50
DD	0.43**	0.43**
	n = 250	n = 380
SLI	0.46**	0.38**
	n = 520	n = 760

** Correlation is significant to the $p < .01$ level.

The distributions for both the PN-IGDI and the PPVT were examined by disability category to determine if they were normally distributed. The assumption of normality was violated for these groups; therefore, Spearman's rho correlations were conducted. Correlations significant at the $p < .01$ accounted for all of the relations and ranged from $r = .38$ to .54. The strength of the relationship between the PPVT and PN–IGDI was strongest for children with SLI at Wave 1, which was closer to the beginning of preschool and for children with ASD at Wave 3 or closer to the end of preschool. For children with SLI, 26% of the variance in their PN–IGDI scores could be explained by their PPVT scores at Wave 1 ($R^2 = 0.26$). For children with ASD, 29% of the variance in their PN–IGDI scores could be explained by their PPVT scores nearer the end of preschool ($R^2 = 0.29$). The relationship between the PN–IGDI and the PPVT became weaker for children with DD and children with SLI at Wave 3, whereas this relationship became stronger for children with ASD at Wave 3. In all, there were not major differences between the correlation coefficients at Wave 1 for all three groups, nor at Wave 3 for all three groups.

Research Question 3

To answer the third research question, “To what degree can predictive-related validity evidencde be demonstrated for the PN–IGDI with DIBELS Oral Reading Fluency (ORF)?” Correlations and multiple regression analyses were conducted. First, I will review bivariate correlations between the PN–IGDI at all three waves of data collection and the DIBELS ORF. Then, I will present results from a simple as well as multiple linear regressions that address four subquestions (Questions 3a–3d). These four subquestions address the predictive-related validity evidence of the PN–IGDI *change score* (i.e., difference between Wave 1 and Wave 3) on DIBELS ORF.

Table 10

Pearson Product-Moment Correlations (and sample size) PN–IGDI and DIBELS ORF by Disability Category and Wave of Assessment

Measure	*Disability Category*	*N*	*Correlation with DIBELS ORF*
PN–IGDI Wave 1	ASD	30	0.30
	DD	170	0.37**
	SLI	350	0.33**
	All	550	0.35**
PN–IGDI Wave 2	ASD	30	0.32
	DD	200	0.39**
	SLI	410	0.31**
	All	640	0.34**
PN–IGDI Wave 3	ASD	30	0.50**
	DD	210	0.35**
	SLI	420	0.27**
	All	660	0.32**
Change Score	ASD	30	0.16
	DD	180	0.01
	SLI	380	-0.08
	All	590	-0.04

** Correlation is significant to the $p < .01$ level.

Correlation coefficients were computed between the PN–IGDI scores as well as *change score* and DIBELS ORF for each wave of data by disability group (see Table 10). Correlation coefficients appeared to strengthen between the PN–IGDI and DIBELS ORF for children with ASD over time; by Wave 3 approximately 25% of the variance in DIBELS ORF could be explained by the PN–IGDI. The strength of the relationship between PN–IGDI and DIBELS ORF remained fairly consistent for children with DD over three waves. Interestingly, the strength of the relationship for children with SLI decreased over time. That is, the PN–IGDI accounted for less variability in the DIBELS ORF at Wave 3 (~7%) when compared to Wave 1 (~11%). When all three disability categories were combined the correlation coefficients remained fairly steady across the waves of data. The relationship between *change score* and DIBELS ORF was neither strong nor significant for any of the disability groups.

Research question 3a. To address this first subquestion, "To what extent does the change in PN–IGDI scores from Wave 1 to Wave 3 predict the DIBELS Oral Reading Fluency (ORF)?" a simple regression was conducted. In this regression model, the difference between PN–IGDI at Wave 1 and Wave 3 (i.e., *change score*) was used to predict the DIBELS ORF scores of first graders.

Table 11

Change Score Coefficients

Parameter	*B*	*SE*	*t-value*	*Sig.*
Constant	43.74	2.84	15.41	0.00
Change score	-0.24	0.27	-0.88	0.38

A simple regression was conducted to predict DIBELS ORF from *change score*. This regression equation was not significant, $R^2 = 0.00$, $F(1,587) = 0.77$, $p = 0.38$. This means that *change score* alone did not explain any of the variance in the DIBELS ORF scores in this model.

Research question 3b. To address this second subquestion "Does a child's identified disability category moderate the relationship between the PN–IGDI change score and DIBELS ORF?" a multiple regression was conducted. In the models presented below, disability category was added to the model to determine if a child's disability category helped to moderate the predictive relationship between *change score* and DIBELS ORF score in first grade. Disability category was dummy coded, so children with SLI were coded as the comparison group.

Table 12

Regression with Interaction Goodness of Fit Statistics

Model	*R*	*R Square*	*Adjusted R Square*	*SE*	*F*	*df1*	*df2*	*Sig.*
1	0.19	0.04	0.03	37.93	7.16	3	585	0.00
2	0.20	0.04	0.03	37.91	4.84	5	583	0.00

1. Predictors: (Constant), Change Score, ASD, DD
2. Predictors: (Constant), Change Score, ASD, DD, Change Score*ASD, Change Score*DD

Table 13

Regression with Interaction Coefficients

Model	*Parameter*	*B*	*SE*	*t-value*	*Prob > |t|*
1	Constant	46.08	3.04	15.18	0.00
	Change Score	-0.25	0.27	-0.95	0.34
	ASD	20.70	7.31	2.83	0.01
	DD	-10.62	3.44	-3.09	0.00
2	Constant	48.11	3.40	14.15	0.00
	Change Score	-0.48	0.32	-1.52	0.13
	ASD	3.76	13.78	0.27	0.79
	DD	-15.60	6.28	-2.48	0.01
	Change Score*ASD	1.92	1.32	1.45	0.15
	Change Score*DD	0.57	0.61	0.94	0.35

A hierarchical multiple regression analysis was conducted to determine if disability category moderated the predictive relationship between *change score* and DIBELS ORF. The first step in this hierarchical regression analysis included only the main effect terms, while the second step included the interaction terms between disability categories and *change score*. The first equation without the interaction terms was significant, $R^2 = 0.04$, adjusted $R^2 = 0.03$, $F(3,585) = 7.16$, $p < .01$. The second equation with the interaction terms included was also significant $R^2 = 0.04$, adjusted $R^2 = 0.03$, $F(5,583) = 4.84$, $p < .01$. However, by adding the interaction terms, and thus letting the model take account of the differences between disability categories, the R^2 value did not change.

Table 13 revealed that the addition of disability category explained some variance in DIBELS ORF. In the first equation, a significant positive *B* indicated that children with ASD tended to have higher DIBELS ORF scores. A significant negative *B* for children with DD indicated that they tended to scores lower on DIBELS ORF. However, the second equation revealed that disability category does not significantly moderate the *change score* to DIBELS ORF relationship.

Research question 3c. A third multiple regression model was constructed to address the third subquestion, "To what extent does the PN–IGDI score at Wave 1 (PN1) improve the prediction of the PN–IGDI change score on the DIBELS ORF?" This regression model included the potential influence of a child's PN–IGDI score nearer the beginning of preschool.

Table 14

Regression Model: Change Score and Picture Naming–Individual Growth and Development Indicator (PN–IGDI) at Wave 1

R	*R Square*	*Adjusted R Square*	*SE*	*F*	*df1*	*df2*	*Sig.*
0.38	0.15	0.14	35.68	46.44	2	548	0.00

Table 15

Change Score and PN–IGDI at Wave 1 Coefficients

Parameter	*B*	*SE*	*t-value*	*Prob* > |*t*|
Constant	-7.78	6.06	-1.28	0.20
Change Score	1.20	0.31	3.95	0.00
PN–IGDI Wave 1	3.02	0.32	9.60	0.00

This multiple regression analysis was conducted to predict DIBELS ORF scores from *change score* and a child's PN–IGDI score at Wave 1 or nearer the beginning of preschool (PN1). The results of this analysis indicated that change score and PN1 accounted for a significant amount of variability in DIBELS ORF scores, $R^2 = 0.15$, adjusted $R^2 = 0.15$, $F(2,548) = 46.44$, $p < .01$. An R^2 of 0.15 suggests that PN–IGDI at the beginning of preschool and *change score* together explain approximately 15% of the variance in the DIBELS ORF score. Interestingly, in this model both *change score* and PN–IGDI Wave 1 were statistically significant predictors and had positive effects on DIBELS ORF scores. This indicated that children with higher scores on the PN1 and a larger *change score* are expected to have higher DIBELS ORF scores.

Research question 3d. Finally, the fourth multiple regression model was built to address the fourth subquestion, "Is this improvement in the prediction between the PN–IGDI change score and DIBELS ORF with the addition of PN1 moderated by a child's identified disability label?" This model concentrated on the influence of a child's identified disability.

Table 16

Regression with Interaction Goodness of Fit Statistics

Model	*R*	*R Square*	*Adjusted R Square*	*SE*	*F*	*df1*	*df2*	*Sig.*
1	0.42[a]	0.17	0.17	35.15	28.61	4	546	0.00
2	0.43[b]	0.18	0.17	35.13	13.38	9	541	0.00
3	0.43[c]	0.19	0.17	35.10	11.20	11	539	0.00

3. Predictors: (Constant), Change Score, Wave 1 PN–IGDI, ASD, DD
4. Predictors: (Constant), Change Score, Wave 1 PN–IGDI, ASD, DD, Change Score*ASD, Change Score*DD, Change Score*Wave 1 PN–IGDI, Wave 1 PN–IGDI*ASD, Wave 1 PN–IGDI*DD
5. Predictors: (Constant), Change Score, Wave 1 PN–IGDI, ASD, DD, Change Score*ASD, Change Score*DD, Change Score*Wave 1 PN–IGDI, Wave 1 PN–IGDI*ASD, Wave 1 PN–IGDI*DD, Change Score*Wave 1 PN–IGDI*ASD, Change Score*Wave 1 PN–IGDI*DD

Table 17

Change Score, PN–IGDI at Wave 1, Disability Category, and Interaction Coefficients

Model	*Parameter*	*B*	*SE*	*t-value*	*Prob > |t|*
1	Constant	-7.13	6.41	-1.11	0.27
	Change Score	1.19	0.30	3.94	0.00
	PN1	2.99	0.32	9.44	0.00
	ASD	26.18	6.93	3.78	0.00
	DD	-4.83	3.34	-1.44	0.15
2	Constant	-4.63	9.38	-0.49	0.62
	Change Score	1.18	0.65	1.82	0.07
	PN1	2.97	0.51	5.88	0.00
	ASD	-23.28	24.72	-0.94	0.35
	DD	-9.31	12.56	-0.74	0.46
	Change Score*ASD	3.38	1.47	2.30	0.02
	Change Score*DD	0.40	0.67	0.60	0.55
	Change Score*PN1	-0.02	0.04	-0.51	0.61
	PN1*ASD	1.71	1.27	1.35	0.18
	PN1*DD	0.07	0.67	0.10	0.92
3	Constant	-4.39	9.65	-0.46	0.65
	Change Score	1.15	0.71	1.62	0.11
	PN1	2.96	0.53	5.59	0.00
	ASD	8.12	33.25	0.24	0.81

(continued)

Model	*Parameter*	*B*	*SE*	*t-value*	*Prob > |t|*
Table 17, continued					
	DD	-16.52	16.23	-1.02	0.31
	Change Score*ASD	-0.91	3.37	-0.27	0.79
	Change Score*DD	1.32	1.47	0.90	0.37
	Change Score*PN1	-0.02	0.05	-0.39	0.70
	PN1*ASD	-0.14	1.83	-0.07	0.94
	PN1*DD	0.59	1.00	0.59	0.56
	Change Score*PN1*ASD	0.30	0.22	1.41	0.16
	Change Score*PN1*DD	-0.08	0.11	-0.70	0.48

A hierarchical multiple regression analysis was conducted to determine if disability category moderated the prediction of *change score* and the Picture Naming–IGDI nearer the beginning of preschool (PN1) on DIBELS ORF scores. The first step in the analysis included only the main effects of each predictor on DIBELS ORF scores. The second step in the hierarchical regression analysis included two-way interactions among all of the predictors. The third step in analysis included all of the above with the addition of three-way interactions among the predictors (e.g., change score*PN1*ASD).

The first equation with only the main effects was found to be significant, R^2 = 0.17, adjusted R^2 = 0.17, $F(4,546) = 28.61$, $p < .01$. In this equation, change score, PN1, and having a label of ASD were all significant positive predictors of DIBELS ORF.

The second step in the analysis that included two-way interactions between the predictors was also found to be significant, $R^2 = 0.18$, adjusted $R^2 = 0.17$, $F(9,541) = 13.38$, $p < .01$. The only significant predictor in this regression equation was PN1. PN1 was a positive predictor showing that a higher score on PN1 was associated with higher scores on DIBELS ORF. In looking at the two-way interaction terms, the interaction between *change score* and children with ASD was significant. More specifically, this means that when children with ASD were not accounted for, every 1.18 difference in *change score* was positively associated with 1 unit increase in DIBELS scores ($p = .07$). When *change score* was 0 (no change in children's scores from Wave 1 to Wave 3), there was a negative relation. This means that as children with ASD had more positive scores, DIBELS scores went down ($p = .35$). These effects were not significant. However, when children with ASD were accounted for, every 4.56 difference in *change score* was positively associated with 1 unit increase in DIBELS scores ($p < .01$). The remainder of the two-way interaction terms in the model it appeared that there were no significant terms.

The third step in the regression analysis that included three-way interactions among the predictors was found to be significant, $R^2 = 0.19$, adjusted $R^2 = 0.17$, $F(11,539) = 11.20$, $p < .01$. Similar to the second step, the PN1 was a significant positive predictor. None of the interaction terms were found to be significant, which suggested that disability category did not moderate the predictive relationship between *change score* and PN1 on DIBELS ORF in this equation.

Research Question 4

The fourth research question asked "To what extent is the PN–IGDI sensitive to yearly growth for children with disabilities between 3 and 7 years of age? To what extent does this sensitivity to growth vary as a function of disability status?" This question was answered in two parts.

To answer the first part of this question a repeated measures ANOVA was conducted to compare the PN–IGDI scores across each wave of data collection. The goal of procedure was to assess the change in PN–IGDI over time.

Table 18

Repeated Measures ANOVA

Source	*SS*	*df*	*MS*	*F*	*Sig.*
Time (Wave)	33,837.45	2	16,918.73	1,191.54	.000
Error	27,716.55	1952	14.20		

Table 19

Bonferroni Post Hoc Comparisons

Wave (a)	*Wave (b)*	*Mean Difference (a–b)*	*SE*	*Sig.*	*95% Confidence Interval for Difference*	
					Lower Bound	*Upper Bound*
PN–IGDI 1	PN–IGDI 2	-5.15*	0.17	.000	-5.56	-4.75
	PN–IGDI 3	-8.24*	0.18	.000	-8.66	-7.81
PN–IGDI 2	PN–IGDI 3	-3.08*	0.17	.000	-3.48	-2.69

* p<.05

A repeated measures ANOVA was conducted to determine if the mean PN–IGDI score differed statistically significantly between time points. Mauchly's test of sphericity was not found to be significant (p = 0.073); therefore, sphericity was assumed. There was a significant effect of IGDI scores ($F(2,1952) = 1{,}191.54$, $p < .01$). Post hoc tests using the Bonferroni correction were used to make comparisons between scores at different waves (or years). A first paired samples t-test indicated that there was a significant difference in the scores for PN–IGDI Wave 1 (M = 13.26, SD = 5.84) and PN–IGDI wave 2 (M = 18.41, SD = 5.90); t =-5.15, p<.05. Another paired samples t-test indicated that there was a significant difference in the scores for PN–IGDI wave 2 (M = 18.41, SD = 5.90) and PN–IGDI Wave 3 (M = 21.49, SD = 5.60); t = -3.08, p<.05. A third paired samples t-test indicated that there was a significant difference in the scores for PN–IGDI

Wave 1 (M = 13.26, SD = 5.84) and PN–IGDI Wave 3 (M = 21.49, SD = 5.60) conditions; t = -8.24, p <.05. These results suggest that the PN–IGDI does grow over time. Specifically, these results suggest that across the 3 years of data collection, the PN–IGDI scores increased significantly from Wave 1 to Wave 3 for children with language-related disabilities.

To address the second part of this question, a disability category was added as a between-subjects measure to create a 3 x 3 repeated measures ANOVA. The goal of this procedure was to assess the change in PN–IGDI over time by disability category.

Table 20

Repeated Measures ANOVA

Source	*SS*	*df*	*MS*	*F*	*Sig.*
Time (Wave)	11,941.01	2	5,970.50	421.31	0.00
Disability	3,678.26	2	1,839.13	26.96	0.00
Time * Disability	110.93	4	27.73	1.96	0.10
Error	27,605.62	1948	14.17		

Mauchly's test of sphericity was conducted to determine if sphericity was violated. The test was not found to be significant ($p = 0.056$); therefore, sphericity was assumed. This 3 x 3 repeated measures ANOVA yielded a main effect for the PN–IGDI over time (waves; $F(2, 1948) = 421.31$, $p < .01$). The main effect for disability category was also significant ($F(2, 974) = 26.96$, $p < .01$), meaning that at least one of the disability categories has an effect on the PN–IGDI, ignoring the other effects of the other independent variables (or disability categories). However, the interaction effect was not significant $F(4, 1948) = 1.96$, $p = 0.10$), indicating that the growth on the PN–IGDI over time did not consistently change depending on a child's disability categorical label.

The significance of main effects for disability category as well as for time indicated that there were significant differences. Figure 1 displays the average scores for each group of children over time. The lines indicate that all groups of children demonstrated growth on the measure over time. Children with SLI tended to have higher average scores than children with ASD and children with DD. The lines for children with

DD and children with ASD tend to follow the same trend at the first two waves of data collection.

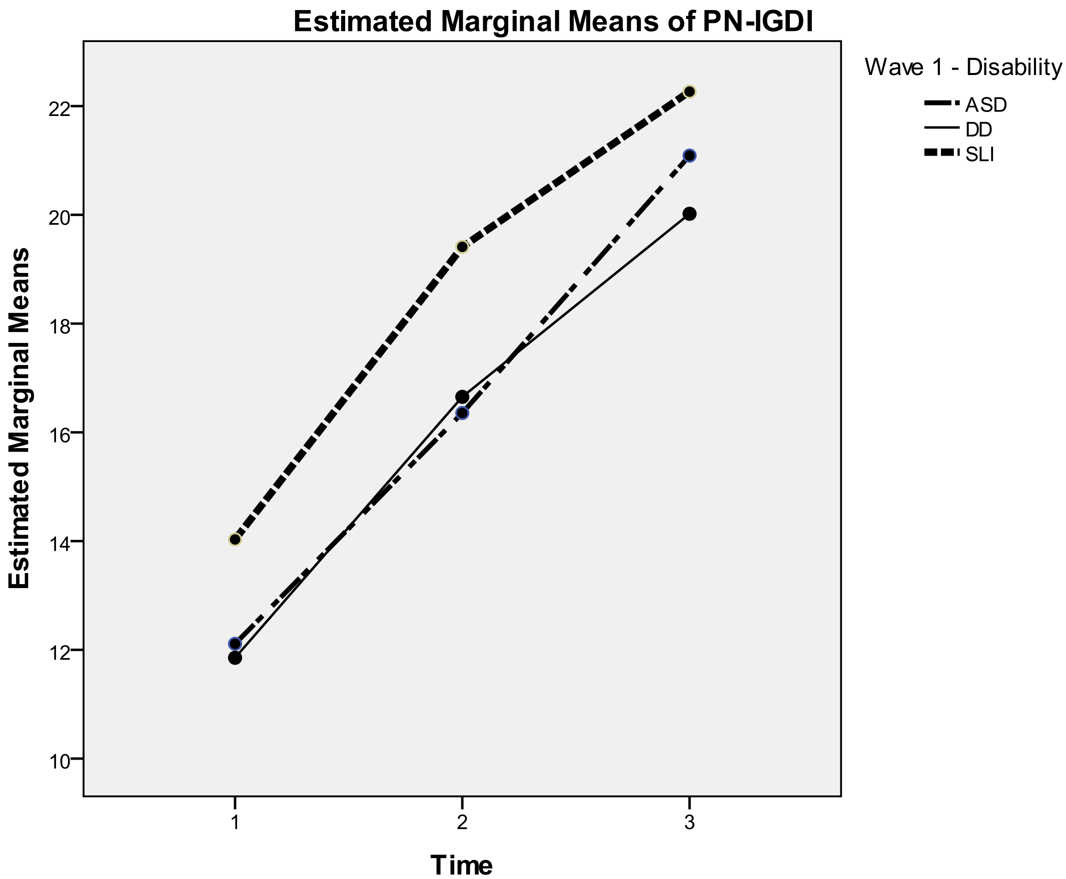

Figure 1. PN–IGDI growth by disability.

This figure illustrates the differences in change over time among the three disability groups.

Table 21

Bonferroni Post Hoc Comparisons

Disability (a)	*Disability (b)*	*Mean Difference (a–b)*	*SE*	*Sig.*	*95% Confidence Interval for Difference*	
					Lower Bound	*Upper Bound*
ASD	DD	0.34	0.76	1.00	-1.48	2.17
	SLI	-2.05*	0.74	0.02	-3.81	-0.29
DD	SLI	-2.39*	0.33	0.00	-3.19	-1.60

Note. * p<.05

Post hoc tests using the Bonferroni correction were used to make comparisons between the scores of the groups of children based on their disability category (see Table 21). A first paired samples t-test indicated that there was a nonsignificant difference in the PN–IGDI scores for children with ASD and children with DD (t = 0.33, p = 1.00). Another paired samples t-test indicated that there was a significant difference in the PN–IGDI scores for children with ASD and children with DD (t = 2.05, p <.05). A third paired samples t-test indicated that there was a significant difference in the PN–IGDI scores for children with SLI and children with DD (t = 2.39, p <.05). These t-tests indicate that PN–IGDI scores vary for children based on their disability category for children with SLI compared to children with ASD and children with DD.

CHAPTER 5

Discussion

Purpose of Study

The purpose of this study was to investigate the validity-related evidence and usefulness of the Picture Naming–Individual Growth and Development Indicator (PN–IGDI) for a large sample of preschool-aged children with disabilities. The PEEL study (Markowitz et al., 2006) provided a unique opportunity to extend the current validity-related research of the PN–IGDI to a larger, broader, more categorically defined sample of children with disabilities. It was an additional goal of this study to determine if disability category (i.e., ASD, DD, and SLI) influenced the relation between the PN–IGDI scores with later literacy measures. Results of this study provide continued to support the validity-related evidence of the PN–IGDI, specifically for children with disabilities. Ideally, these results will supplement the ongoing need for quality growth monitoring measures needed at the preschool level in order to make data-based decisions (McConnell, 2000; VanDerHeyden, 2005) for children with special needs.

Summary of Findings

Preliminary Findings

Initial descriptive results revealed children with Speech or Language Impairments (SLI) earned higher scores than children with Developmental Delays (DD) or Autism Spectrum Disorder (ASD) on the PN–IGDI at all three waves of data collection. For children with DD, scores on the PN–IGDI were lower than those children with SLI and ASD on all three waves of data collection. However, the distribution of scores for children with DD were less spread out around the mean when compared to children with ASD. Regardless of disability category, however, scores on the PN–IGDI increased for each group of children over time. Similar to the PN–IGDI scores, scores on the Peabody Picture Vocabulary Test (PPVT) at both waves of data collection revealed that children with SLI tended to have higher average scores and children with DD tended to have lower average scores. This same pattern was not true for the Dynamic Indicators of Basic Early Literacy Skills–Oral Reading Fluency (DIBELS ORF). Interestingly, children with ASD scored higher than children with SLI and children with DD. Thus, children with ASD in this study scored higher on tasks that required oral fluency compared to measures that focused only on vocabulary skills (i.e., PN–IGDI, PPVT). The standard deviations for all three groups of children were quite large indicating a large spread of scores around the mean.

To further quantify the size difference between the means of the groups of children on the early literacy measures, effect sizes were calculated. With respect to the PN–IGDI and the PPVT measures across the 3 years of data collection, small effect size differences in the magnitude of 0.003 to 0.23 were found between children with ASD and DD. This seems somewhat plausible as both groups have been described as being characteristically similar in that they are both delayed in certain developmental milestones (Cihak et al., 2011). Studies have identified similarities in certain developmental domains. For instance, Griffith, Pennington, Wehner, & Rogers (1999) and Dawson et al. (2002) found that young children with ASD performed similarly to mental age-matched children with DD on executive functioning tasks. Even more, when measured on motor skills, score of young children with ASD did not differ significantly from the scores of children with DD (Provost, Lopez, & Heimerl, 2006). Although the eligibility criteria for children with ASD and DD differ, these studies have identified that similarities exist among certain skill developmental areas.

Interestingly, PN–IGDI scores for children with DD and children with SLI differed more than any other between-group differences. This seems to imply that children with DD may have more broad and persistent delays with respect to vocabulary development than children with SLI, which could affect their literacy development. As noted above, studies have identified similarities in the development of certain skills between children with ASD and DD, implying that there may be more to the delays experienced by children with DD at the preschool level. However, when children are identified for special education under the category of speech or language impairment, delays are found only within the areas of speech and/or language development.

When it came to the DIBELS ORF scores in first grade, however, effect sizes for differences between children with ASD and DD (d =.68) were larger than those for children with DD and SLI (d = .32). This suggests that depending on which literacy construct (i.e., vocabulary vs. fluency) is being measured children with these language-related disabilities tended to differ.

Research Question 1

The first research question addressed construct-related validity evidence of the PN–IGDI by exploring the extent to which the PN–IGDI correlated with chronological age for children with language-related disabilities (i.e., ASD, DD, and SLI). It is believed that a stronger correlation between test scores and chronological age provides evidence of a developmental progression of that skill (Salvia & Ysseldyke, 2001). Interestingly, the relationship between chronological age and PN–IGDI was lower (r = .31 to .36 at Wave 1; r = .19 to .28 at Wave 3) than that found in a previous study of children with disabilities (r = .48; McConnell et al., 2002). It is possible that relationships observed here were less strong because this sample of children was comprised of children who were more likely to have a language-related disability, whereas McConnell and colleagues' (2002) previous study included all children with disabilities in an early childhood special education (ECSE) classroom. In other words, these groups may have been more homogenous than previous groups, indicating less variability in scores, which in turn leads to lower correlations. Additionally, research has indicated that some of groups of children in this study have an uneven profile of language and language development (Cihak et al., 2011), which could influence the strength of these relationships. While the relationships were not as strong as previous research, all of the correlations were found to be significant. Being mindful of the large sample size for SLI and DD groups, nonetheless this finding is consistent with construct-related validity evidence demonstrated for the PN–IGDI for children with ASD, DD, and SLI. It can be said then that chronological age accounted for 10–13% of the variance at Wave 1.

An additional component of this first research question was to see if the correlation between chronological age and PN–IGDI scores differed when assessed nearer to the beginning of preschool (Wave 1) or nearer the end of preschool (Wave 3). Overall, test scores remained positively correlated with chronological age, suggesting a measure of construct validity evidence at both time periods. However, the strength of the relationship nearer the at Wave 1 was stronger (*r* = .31 to.36) than at Wave 3 (*r* = .19 to.28). The strength of the relationship remained fairly stable for children with ASD (*r* = .36 to *r* = .28). The strength of the relationship dropped a bit for children with SLI (*r* = .36 to *r* = .20) and DD (*r* = .31 to *r* = .19), indicating that the linear relationship between PN–IGDI scores and age decreases for these groups of children as they get older. Overall, considering confidence intervals for obtained coefficients, we cannot conclude that there were differences in strength of this relation across the three groups.

Research Question 2

The second research question addressed the extent to which criterion-related validity evidence was demonstrated by relations between the PN-IGDI with the PPVT. Overall, correlations continued to demonstrate moderate relationships for all three groups of children with language-related disabilities (*r* = .38 to .54; ASD, DD, and SLI). Previous research found relationships to be a bit stronger (*r* = .56 to .80; Cadigan & Missall, 2007; Priest et al. 1999, 2000) however, the samples in these previous studies were smaller and less defined by their disability category (e.g., ECSE classroom) than the sample in this study (i.e., ASD, DD, and SLI).

Overall, the correlations between the PPVT and PN–IGDI remained positive throughout the preschool period, providing further evidence of criterion-related concurrent validity. However, the strength of these relationships differed a bit by disability category and year of assessment. The correlation between the PPVT and PN–IGDI remained stable for children with DD from Wave 1 to Wave 3 (*r* = .43 to *r* = .43).

The relationship between the PPVT and PN–IGDI was stronger for children in the SLI disability category at Wave 1 (r = .46 to r = .38), but declined a bit over time. Similarly, the strength of the relationship between the PPVT and PN–IGDI changed a bit for children with ASD; however, the correlation became stronger at Wave 3 (r = .51 to r = .54). Although changes were noted in the strength of the relations between PN-IGDI and PPVT within groups over time, these changes were not large. Additionally, the coefficients for the three disability categories were similar and within confidence intervals, suggesting no differences between groups.

Research Question 3

The goal of the third research question was to determine if a change in the PN–IGDI over time was predictive of the DIBELS ORF measure to demonstrate predictive criterion-related validity evidence. The *change score* was intended to capture the change in PN-IGDI scores from Wave 1 to Wave 3. In an effort to extend previous research, correlations were conducted between the DIBELS ORF and each of the waves of the PN–IGDI, along with the *change score*. McCormick and Haack (2010) began to explore the predictive-related validity evidence between the PN–IGDI and DIBELS ORF at first grade with correlations coefficients between 0.19–0.26. The current study expanded the findings between the PN–IGDI and the DIBELS ORF in first grade with correlation coefficients that were a bit stronger than that of McCormick and Haack (r = 0.32–0.35). Even further, correlations were conducted between the PN–IGDI and DIBELS ORF by disability at all three waves of data collection. These coefficients demonstrated a moderate relationship for all three groups of children (r = 0.27–0.50).

However, the correlation between *change score* and DIBELS ORF in first grade was a weak, nonsignificant, negative relationship. Not surprisingly, the results of the first regression model showed that the *change score* did not significantly predict DIBELS ORF. This indicates that it is not necessarily the change in the PN–IGDI over time alone that is predictive of fluency in first grade. Accordingly, the model that included both the PN–IGDI score at Wave 1 along with *change score* was found to be significant, explaining nearly 15% of the variance in DIBELS ORF scores. This suggests that when we account for both initial performance and change over time on the PN-IGDI, we are better able to predict DIBELS ORF. Additional analyses in future research may further clarify this relation, and may be important for expanding our understanding of the effects of preschool intervention for later reading performance.

Another aspect of these questions was to examine the contribution of disability category to the predictive validity of the PN–IGDI. In other words, did a child's disability category moderate the relationship between the PN–IGDI and DIBELS ORF? When looking at only the main effects of the first hierarchical regression model that included *change score* and disability category, certain disability categories were found to be significant. Children with ASD tended to have higher DIBELS ORF scores, whereas children with DD tended to have lower DIBELS ORF scores. However, for both this regression model and the model that included *change score* and PN–IGDI at Wave 1, disability category did not moderate the strength of the predictive relationship between PN–IGDI and DIBELS ORF. This means that although children tended to have higher scores or lower scores based on their disability category, the addition of disability category did not alter the strength of the relationship between *change score* and DIBELS ORF. Nor did it contribute to the predictive relationship between both *change score* and PN–IGDI at Wave 1 on DIBELS ORF.

Research Question 4

The fourth research question was intended to address the extent to which scores on the PN–IGDI changed over time for children with disabilities. Results were similar to previous studies that looked specifically at growth over time (Cadigan & Missall, 2007; Missall et al., 2006; Priest et al., 2000); there was a significant difference between scores throughout preschool. Post hoc tests revealed that there were significant differences between each year (or wave) of data collection. There were significant differences between PN–IGDI Wave 1 (M = 13.26) and PN–IGDI wave 2 (M = 18.41) as well as significant differences between PN–IGDI wave 2 (M = 18.41) and PN–IGDI Wave 3 (M = 21.49). These differences suggest that the PN–IGDI measure can detect change in expressive vocabulary growth over time for children with disabilities.

Interestingly, when disability category was added the interaction between time and disability was not significant. This means that although the PN–IGDI can measure change in expressive language growth for children with disabilities, it did not necessarily depend on disability category. Post hoc analyses were conducted for disability groups because main effects were found for each time and disability category. These analyses revealed that the mean scores on the PN–IGDI for children with SLI differed significantly from the scores of children with ASD and children with DD.

Limitations

Missing Data

Missing data are frequently prevalent in large-scale datasets and this was true in the case of the data I used from the PEELS. Overall, I excluded between 13.7% to 18.4% (depending on the question) of the potential cases from my analyses due to missing data. This can have an effect on both the internal and external validity of the findings (McKnight & McKnight, 2011). Because I excluded such a large amount of data, I used a smaller sample, which also potentially decreased the statistical power to detect significant differences. As noted earlier, I conducted missing data analyses prior to beginning substantive analyses, and based on this examination elected to use the PEELS dataset as an unweighted sample. This allowed me to reduce missing data by specific analyses; for instance, many of the children in Cohort A were not administered DIBELS ORF, and were thus not included *by* design in assessments reported here.

These analyses indicated that there are some differences between my analytic samples and the full PEELS data set. My analytic samples tended to have fewer 3-year-old children (cohort A) and fewer children with DD. In addition, there tended to be more missing information from children in households whose income levels were lower. Because of my decision to use PEELS data in an unweighted sample, results here cannot be assumed to represent the population of children with ASD, SLI and DD in the United States; rather, the reader will have to draw more restricted generalizations from these results.

In addition to the missing assessment data that related directly to my analyses, there also was substantial missing information on variables that related to socioeconomic status. For instance, over 90% of the respondents in my sample did not report the mother's highest level of education. Similarly, approximately 75% of the respondents did not answer the question related to the highest level of education attained by the biological father. These missing rates were fairly reflective of the overall missing rates in the larger PEELS sample for Wave 1 for both mother's highest level of education (90.3% in the PEELS sample) and father's highest level of education (73.1% in the PEELS sample).

According to the American Psychological Association (2012), socioeconomic status (SES) is often measured as a combination of education, income, and occupation. Research indicates that children from low-SES households and communities develop academic skills at a slower rate compared to children from higher SES groups (Morgan, Farkas, Hillemeier, & Maczuga, 2009). Thus, SES is an important variable to consider. Due to the large amount of missing data regarding parent education level and the lack of a composite SES variable in the PEELS dataset, it was difficult to control for this factor. Future studies should consider accounting for SES-related variables.

Sample Limitations

The sample in the present study tended to have more White participants (79.5%) when compared to both the PEELS sample (67%) and the general population (58%). Consequently, there were fewer children of Black (8.4% in this study; 11% in the PEELS study; 15% in general population), Hispanic (15.3% in this study; 22% in the PEELS study; 20% in general population; Markowitz et al., 2006) and other racial or ethnic groups (e.g., Asians and Pacific Islanders: 3.4%, and Native American or Alaska Native; 3.5%). The percentages in the PEELS sample above were presented in the Final Wave 1 Report (Markowitz et al., 2006) However, the variables used throughout this analysis were taken from the longitudinal combined dataset of parent interviews and child assessment data (i.e., w1w2w3w4parentassess), which was a more comprehensive variable for a child's race (e.g., DP1_3CHRACEBL for child's race: black). Information gleaned from the codebooks regarding the frequencies and percentages about race using this code revealed the following percentages: White 88.3%, Black 10.2%, and Hispanic 17.3%. Thus, while my study does not reflect national distributions for all racial and ethnic groups, it may have been that the variable in which I chose to address race was different than the initial racial data presented by PEELS (Markowitz et al., 2006).

In addition to having White children, the sample in this study had more children from homes in which the income level was $50,000 or more. The sample in this study represented approximately 25.2% of children in homes that had income levels $25,000 or less, whereas the general PEELS population represented closer to 35% at this income level. There were more children in families whose income level was greater than $50,000 (41.8% here; approximately 34% in the PEELS sample; Markowitz et al., 2006). Similar to the issues raised with race/ethnicity above, the variables I chose to represent income level were taken from the longitudinal combined dataset of parent interviews and child assessment data (i.e., P1HOWMCH for income levels at $25,000 or less; P1INC25_50 for income levels more than $25,000). Based on the frequencies from the codebooks that represent these data, there were 27% of children from homes that had income levels of

$25,000 or less were and 47% of children from families whose income level was greater than $50,000. The percentages in this study were a little closer to these data.

Regardless, of the variables chosen, the conclusions of my study are limited to the children whose demographic information is represented. This factor should be considered when generalizing the results.

Sample Weights

In nationally representative samples such as PEELS that were obtained through complex sampling procedures, sampling weights are typically used to generate estimates that generalize to the national population. In addition weights are used to account for the complex sampling procedures in order to more accurately calculate the standard error of estimates. However, due to the large amount of individual missing data, the use of sampling weights would not have accurately represented my sample of interest. Therefore, for the purposes of my study, weighting the data was not appropriate given these constraints. This significantly limits the generalization of my results, as my sample could no longer be described explicitly as a nationally representative of children with language-related disabilities. These differences should be considered when generalizing the results of this study. Future research should examine the validity-related evidence for the PN–IGDI using a sample that generalizes to a nationally representative group.

However, while the sample was not representative of the nation as a whole, this study does rely on substantial, broadly selected samples particularly for the DD and SLI groups. As a result, this study can be seen to contribute to the research literature on PN–

IGDI by providing results from a broader, larger, and likely more representative (but not *nationally* representative) sample.

Data Collection

While the PEELS provided a wealth of information on a large national group of preschool children, there were many limitations to the use of a large-scale dataset. One of those limitations is with respect the type and amount of assessment data gathered. The PN–IGDI was developed to measure expressive vocabulary on a regular basis (e.g., every 2 weeks, monthly). The PEEL study collected data on an annual basis. This has implications for the inferences of this study. While significant differences were found over time on the PN-IGDI for children with disabilities, this change was measured yearly. It may be that if the PN-IGDI was collected more frequently for this sample, changes in scores over time might not be as easily detected. Future research should continue to explore the sensitivity of this growth measure on a more regular basis for children with disabilities.

Additionally, the types of assessments in the PEELS study were predetermined based on the primary goals of this large-scale analysis. While research supports the strength of the predictive relationship between vocabulary development and later reading comprehension, there were limited test options in which to compare this predictive relationship.

Future Implications

The current study has both merits and limitations that should stimulate continued investigation of the usefulness of this measure for children with disabilities. The current study provided validity-related evidence for the PN–IGDI for a broader, larger, and likely more representative group of children with disabilities. Overall, results supported the fact that there were significant differences with positive growth across 3 years for this large national sample of children with disabilities. This means that the PN–IGDI is a promising measure in detecting differences in vocabulary development for children with language-related disabilities over time. Additionally, there was some initial promising evidence of the predictive nature of this measure for this sample of children. This could have major implications for targeting vocabulary development early, so that adjustments could be made to interventions even earlier.

Moreover, these findings highlight the need to further investigate more literacy-related progress monitoring tools for various groups of children with disabilities. Education continues to move toward a more research-based, responsive model of teaching and learning. By continuing to gather validity-related and reliability evidence for progress monitoring measures, educators are equipped to make decisions with quality data.

Directions for Future Research

The results of this study were mixed. Overall, results continued to reveal support for the PN–IGDI being a valid and useful tool for children with disabilities. The PN–IGDI demonstrated sensitivity in detecting a change in scores for this group of children with language-related disabilities over the course of 3 years. However, the strength of the relationship between the PN–IGDI and chronological age as well as with the PPVT was weaker than in previous studies (for instance, Cadigan & Missall, 2007; McConnell et al., 2002; Priest et al., 1999, 2000). Furthermore, there was evidence that together *change score* and the PN–IGDI at Wave 1 are predictive of DIBELS ORF scores. This suggests that the number of words that children with language-related disabilities know nearer the beginning of preschool in combination with their change in score over time has some influence on their DIBELS ORF score in first grade. Considering these findings, continued investigation of the predictive validity -related evidence for children with other disabilities in an important research effort for future studies.

Future research should continue to focus efforts on the predictive-related validity evidence of this PN–IGDI for children with disabilities. General outcome measures in early childhood were devised to evaluate skills that were indexed against known outcomes of established importance (McConnell, McEvoy, & Priest, 2002). While the importance of expressive language development is evident, the more support for the predictive nature of the PN–IGDI, the stronger the measure will become in informing intervention efforts. Results of this study provide preliminary evidence of predictive validity with respect to oral reading fluency. Research should try to gain a clearer focus as to whether the predictive relationship is stronger when considering a certain PN–IGDI score (e.g., beginning of preschool, end of preschool) or whether the growth over time on this measure is predictive of later literacy skills. A better understanding of this relationship might allow for a better understanding of when and where to focus intervention efforts throughout early intervention.

Additionally, future research should consider the influence of other factors that could affect these results. When thinking about the growth of children's scores on the

PN–IGDI there are a variety of variables, such as socioeconomic status, amount of special education service, or type of special educations service, that could potentially have an influence on growth patterns. These factors should be considered in future work to further define the predictive relationship for children with disabilities.

In addition, research efforts should examine the population of children with lower incidence disabilities. The study focused primarily on preschoolers whose disabilities related to language delays. Early childhood special education serves children with a variety of delays (e.g., emotionally impaired, other heath impairments, mild mental retardation) who might also be at an increased risk for literacy and reading delays. Thus, efforts should be made to explore potential differences and/or similarities in the assessment of their expressive vocabulary skills.

Future research efforts should also continue to explore more specifically the validity-related evidence of the other IGDI measures. Research has indicated that oral language development is only part of the picture of literacy development (Lonigan et al., 2011; Whitehurst & Lonigan, 1998). The EL–IGDIs have measures that evaluate phonological awareness skills (i.e., rhyming, alliteration). Exploration of the validity-related evidence specific to children with disabilities for these measures would also be useful to extend the quality, evidenced-based progress monitoring tools for language and literacy development.

Finally, further investigations should address the limitations of this particular sample. There is a significant advantage to complex datasets in the potential to generalize results to a nationally representative sample. Future research should explore these type of analyses with weighted data in order to generalize them to a nationally representative group of children with disabilities.

In conclusion, this study revealed that the PN–IGDI continues to demonstrate validity-related evidence for the expressive language growth for children with ASD, DD, and SLI. Further analyses determined that children with SLI differed significantly in their growth on this measure compared to both children with ASD and DD. However, there was no evidence to indicate that the PN-IGDI did not work equally well for all three groups of children. While the results are promising, validity-related evidence is moderate regarding predictive validity suggesting future studies investigating the connection between the PN–IGDI and literacy outcomes is warranted.

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