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Vocabulary and Reading Growth in Children with Intellectual Disabilities: The Influences of Risks, Adaptive Behavior, and a Reading Intervention

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VOCABULARY AND READING GROWTH IN CHILDREN WITH INTELLECTUAL
DISABILITIES: THE INFLUENCES OF RISKS, ADAPTIVE BEHAVIOR, AND A
READING INTERVENTION

by

DANA K. DONOHUE

Under the Direction of Rose A. Sevcik

ABSTRACT

Risk factors tend to be negatively associated with developmental outcomes such as academic achievement and language skills. Promotive factors, on the other hand, may foster resilience in at-risk children. Some children, such as children with intellectual disabilities, experience relatively more risks than other children do. The purpose of this study was to examine the effects

of risks, adaptive behavior, and an intervention on the language and reading growth of children with intellectual abilities over the course of a yearlong reading intervention in which they were participants. The results suggested that, on average, risks were negatively associated and adaptive behaviors were positively associated with initial language and reading scores. Additionally, participants evidenced significant progress on their language and reading scores over the course of the intervention, but neither adaptive behavior nor risk was related to this growth, which may suggest that students from differing backgrounds and with differing levels of adaptive skill can profit from high-quality reading instruction.

INDEX WORDS: Disability, Risk, Achievement, Adaptive Behavior, Intervention

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DANA K. DONOHUE

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Doctor of Philosophy

in the College of Arts and Sciences

Georgia State University

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1 INTRODUCTION

Over the years, the field of developmental science has shifted from using deficit paradigms to understand and explain poor developmental outcomes to models that highlight how both risk factors and factors associated with resilience can contribute to children's development (Margalit, 2003). Risk and resilience paradigms demonstrate that most children have features in their lives that can promote or inhibit positive growth. Positive growth has been suggested to be "success in meeting stage-salient developmental tasks" (Luthar & Cicchetti, 2000; p. 1002); for example, positive growth for young children could be viewed as having secure parental attachments, while older children may exhibit positive development by achieving academically and through social competence with their peers.

Child development is a fluid process and developmental outcomes result from the constant interplay between personal and environmental variables (Luthar, Cicchetti, & Becker, 2000). Risk factors are conceptualized as those that increase the likelihood of experiencing poor developmental outcomes, whereas promotive factors facilitate resilience (Burchinal, Roberts, Zeisel, Rowley, 2008). Resilience is a process where individuals display positive adaptation in spite of significant risks or adversity (Luthar & Cicchetti, 2000) and is sometimes mistaken for an innate attribute that individuals may or may not possess. On the contrary, children's outcomes result not only from their own individual characteristics, but also from aspects of their families and their social and physical environments (Luthar et al., 2000). Hence, because of the interactions among myriad factors, people may exhibit resilience during some times of their lives but not at others and their resilience also may differ depending on the situation at hand.

Research that has examined the effects of risks on children's IQ scores has found that it is probably not one risk factor in particular, but the accumulation of factors that best predicts

children's developmental outcomes (e.g., Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987). Sameroff and his colleagues (1987) studied the predictive power of a global measure of socioeconomic status (SES) and compared it with a risk index to determine which measure accounted for more variance in the verbal IQ scores of a heterogeneous group of children four years of age who lived in families from a range of socioeconomic backgrounds. The risk index was a count of the number of risk factors present in the participants' lives and provided each child a score from 0 to 10 depending on the number of risk factors present in his or her family. Risks included whether children lived in single parent families, ethnic minority status, and the prestige of the occupations which their parents held. Global SES was calculated using a Hollingshead score (Hollingshead, 1975) which is derived from a calculation of numerical values given to the prestige of various parental occupations along with the number of years of parental education.

The results demonstrated that when compared to any single measure of risk or to a global SES score (global SES score, $r^2 = .35$), scores derived from the risk index accounted for a larger proportion of variance (risk index, $r^2 = .51$) in children's verbal IQ outcomes. Additionally, the data exhibited a negative linear trend, where higher risk scores were associated with lower IQ scores, suggesting that as children's risks accumulate, their probability for poor cognitive outcomes may increase. Sameroff and colleagues (1987) suggested that because multiple risk factors tend to cluster together, families' capacities to cope are overwhelmed and parents often are not able to provide their children with financial and emotional resources that can foster optimal child development.

Certainly, some children face more risks than others do. Children with intellectual disabilities, for example, often experience disadvantages due to their cognitive impairments.

According to the American Association on Intellectual and Developmental Disabilities (AAIDD; 2010), intellectual disability is a condition "...characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social, and practical adaptive skills" (p. 6). Moreover, children with intellectual disabilities often need supports to participate in typical daily activities. Because of their relatively slow cognitive development, children with intellectual disabilities often experience academic problems, but they also often face social isolation (Zigler & Hodapp, 1986) and an elevated risk for behavioral concerns (Huston et al., 2001; McIntyre, Blacher, & Baker, 2006). Cumulatively, these risks suggest that the school experiences of children with intellectual disabilities may be difficult relative to those of their typically developing peers.

In order to create the most appropriate educational interventions and inform social policy, researchers must aim to identify protective factors for children with intellectual disabilities, especially because children with intellectual disabilities may be more likely to experience multiple risks when compared to typically developing children. In so doing, researchers may identify "modifiable modifiers," or factors that are known to influence children's achievement outcomes (Luthar & Cicchetti, 2000). To date, few studies have examined how particular features of the lives of children with intellectual disabilities, such as various risk, adaptive behavior, and instructional factors, influence their academic achievement. The purpose of this study is to examine different patterns of relationships in children's vocabulary and reading achievement growth in relation to other factors in their lives, such as risks and adaptive behaviors. Specifically, it will examine how the accumulation of risk factors, along with children's adaptive behavior, and a reading intervention influence the growth in expressive and receptive vocabulary scores and growth in sight word and decoding skills for children with

intellectual disabilities over the course of a yearlong reading intervention in which they are participants.

2 INTELLECTUAL DISABILITY AND RISK FACTORS

Because of cognitive impairments and other related cognitive issues (e.g., motivation, self-concept) that stem from intellectual deficits, children with intellectual disabilities tend to be more at-risk for deleterious outcomes than are typically developing children. Children with intellectual disabilities who live in low-income families, however, may experience more risks than children with similar intelligence levels who live in higher SES families. This may result from the cumulative and interconnected nature of risks, that can consequently produce a “double burden” (Emmett, 2005) for low-income children with disabilities. Despite this contention, there are few systematic studies examining the relationship between the factors of disability and poverty (Elwan, 1999), even though both conditions are associated with a variety of risks and the association between the two is frequently noted.

Risks such as poverty or disability can be detrimental when experienced in isolation, yet many risks occur jointly and accumulate concurrently or over time, which compounds people’s probability for poor outcomes (Cicchetti & Toth, 1997). Children who evidence multiple potential risk factors, therefore, may be especially likely to have negative developmental outcomes. For example, children’s risks may be increased when they live in low-income families, come from ethnic minority backgrounds, and have intellectual disabilities, in part because all of these factors are associated with some degree of societal stigma and discrimination, in addition to their association with lower levels of education and employment (Emmett, 2005). Thus, due to the cumulative and deleterious nature of risks, those children who

evidence multiple risk factors may be more likely to have poorer outcomes than those who have just one or two.

2.1 Socioeconomic status and ethnicity as risk factors

Poverty is most often discussed in terms of a family's finances. This definition is useful for measurement reasons, yet poverty is multifaceted and is associated with various deleterious correlates; risks may include feelings of powerlessness, lack of motivation, substandard educations, and encountering bad role models (Alant & Lloyd, 2005). These negative corollaries may provide one explanation why poverty often is intergenerational. If children are provided with educations that are not challenging, are surrounded by people who are not excelling in life, and they are not motivated or think they can do any better than their parents and peers, poor children are likely to achieve similarly to those around them and repeat the cycle of poverty. Nevertheless, because features of poverty tend to be interrelated, addressing one or more of the corollaries of poverty may, in turn, affect the other associated factors (Alant & Lloyd, 2005). For example, by providing positive role models and improving education, poor children may increase their motivation to do well in school. In fact, connections to competent adults outside of their family are strongly associated with evidence of resilience for typically developing children (Masten, 2001).

While living in poverty can increase the likelihood of disability, the converse is also true, disability can increase the chances of living in poverty. There often are additional expenses of raising children with disabilities. In fact, when compared to parents of typically developing children, families supporting a child with intellectual disabilities have been found to be significantly more economically disadvantaged (Emerson, 2003). When children develop atypically, for example, parents must make accommodations for them, including finding

alternative means of transportation, supplying their necessary medications, and paying for special services related to their child's disability. These added expenditures can create financial strains for many families, but may be especially difficult for families who already have low incomes.

Poverty influences many developmental spheres though its strongest effects appear to be on children's cognitive development and academic achievement (Ramey & Ramey, 1998). Although some researchers have solely implicated fixed biological factors, such as heredity, for the relationship between low-incomes, ethnic minority status, and poor academic achievement (Hernnstein & Murray, 1995; Jensen, 1969), studies of identical twins suggest environmental factors may have a stronger influence on children's academic achievement than biology does (Brooks-Gunn & Markman, 2005). Despite this finding, a large gap in academic achievement remains between White children and children from ethnic minority backgrounds. It has been suggested that these achievement differences may be attributed, in part, to both the distinct economic conditions and home environments between White and ethnic minority children (Brooks-Gunn & Markman, 2005) and to differences in school quality (Lott, 2002).

Children from economically disadvantaged families tend to face many risks as they develop; these risks include home qualities that are limited in rich and varied learning opportunities (Brooks-Gunn & Markman, 2005; Hart & Risley, 1995) that restrict early learning experiences and limitations in exposure to Standard American English, which relates to early and future academic success (Sampson, Sharkey, & Raudenbush, 2008). When low-income children start school with less linguistic and basic academic knowledge, they tend to remain behind academically and are disproportionately referred for special education services. These factors contribute to the phenomenon frequently referred to as the "achievement gap" (Brooks-Gunn &

Markman, 2005; Ramey & Ramey, 2004; Sampson et al., 2008) between White and ethnic minority children. Early interventions aimed at children from low socioeconomic backgrounds who are at a high risk of experiencing cognitive delays, however, have been found to be effective at improving children's later cognitive outcomes (Ramey & Ramey, 2004). Ramey and Ramey (1998) suggest that early interventions promote positive long-term outcomes through improving children's intellectual skills, enhancing children's motivations for learning, increasing their knowledge base, and facilitating the production of more supportive learning environments via parents and teachers.

2.2 Gender as a risk factor

Males are about twice as likely to be diagnosed with intellectual disabilities when compared to females, but this may be primarily attributed to disorders linked to the X-chromosome and the nature of genetic inheritance (Batshaw & Shapiro, 2002). Differential risks between males and females have been found in learning disabilities (Flannery, Liederman, Daly, & Schultz, 2000) with much of the research suggesting that boys are more likely to exhibit learning disabilities than girls are. Yet, it is unclear how much these dissimilarities can be attributed to actual gender differences, or whether they may be due to referral biases because of the differences in externalizing behaviors that boys and girls tend to display (e.g., Abikoff et al., 2002).

Some studies suggest that teachers are twice as likely to refer boys for special education testing, suggesting that referral bias may be the source of gender differences in learning disabilities (Shaywitz, Shaywitz, Fletcher, & Escobar, 1990). In contrast, other research has found that when compared to girls, boys are more at-risk for behavioral and academic problems (Huston et al., 2001) and that even after controlling for referral bias, boys are still twice as likely

to have learning disabilities (Flannery et al., 2000). Although the research findings in this area are mixed, it appears that boys and girls evidence differing levels of risk in regards to learning difficulties.

Taken as a whole, the literature suggests that males tend to exhibit more externalizing behaviors and potentially higher rates of learning disabilities than females do. Both of these factors may influence a child's academic achievement. Because these gender differences are found in children with learning disabilities, they also may be found in children with intellectual disabilities, thereby placing males with intellectual disabilities at a higher risk for academic difficulties than females with intellectual disabilities

3 INTELLECTUAL DISABILITY

Intellectual disability is characterized by delayed but not qualitatively different cognitive development (Rosenburg & Abbeduto, 1993). The causes of intellectual disability are heterogeneous; four general etiologies have been identified: biomedical (e.g., extra chromosomes), social (e.g., parental neglect), behavioral (e.g., parental drug use), and educational (e.g., poor instructional practices; Wehmeyer, 2003). While the rates of intellectual disability caused by biomedical events is equivalent across the socioeconomic spectrum, children from low-income families have disproportionately higher rates of intellectual disabilities that can be attributed to environmental factors (Batshaw & Shapiro, 2002; Rosenberg & Abbeduto, 1993; Zigler & Hodapp, 1986), likely because children from low-income backgrounds often experience environmental risks that increase the likelihood of poor developmental outcomes. For example, living in a low-income family is associated with poor medical care, substandard housing conditions, and residing in high-crime neighborhoods (Brooks-Gunn & Duncan, 1997).

Contemporary frameworks view disability as occurring through a mismatch between a person's abilities and the context in which they are. The premise for this framework is that conceptualizing disability in this fashion allows attention to be focused more on the supports needed to help a person function in their environment rather than focusing on deficits that hinder their adaptation. Additionally, intellectual disability increasingly is understood as multidimensional, with five general dimensions that influence the functioning of children with intellectual disabilities: intellectual abilities, adaptive behavior, health, participation, and context (AAIDD, 2010). It is the interactions among these dimensions that influence how well a person functions in any given situation.

3.1 Adaptive behaviors and supports

Adaptation to one's environment is facilitated by the congruence between the demands of a particular setting and the skills or behaviors that a person possesses. Adaptive behaviors signify the success with which people operate in their various environments and may be a determining factor for whether individuals can live independently or whether they require continuous supervision from others (Liss et al., 2001). Adaptive behaviors have been defined as social, practical, and conceptual skills that help people in their daily lives (Batshaw & Shapiro, 2002) and include a variety of behaviors such as the ability to effectively communicate, get along with others, and the capability to clean and dress oneself.

Adaptive behaviors are learned rather than innate and can be affected by both internal factors such as intellectual abilities as well as by external factors such as an individual's opportunities to participate in various life activities. The necessity of adaptive behaviors also depends on the demands of the situation at hand. For example, adaptive behaviors related to attending to instruction or getting along with peers may play a role in shaping the academic

outcomes of school-age children because they affect how well children can adjust to and perform in an educational setting (Mistry, Vandewater, Huston, & McLoyd, 2002). Adaptive behaviors related to handling and counting money, on the other hand, may be more necessary for the capacity to independently purchase items at a grocery store.

For individuals with intellectual disabilities, supports often are provided to facilitate participation in their environments. “Supports are resources and strategies that aim to promote the development, education, interests, and personal well-being of a person and that enhance individual functioning” (p. 109; AAIDD, 2010). The provision of allowing extra time on an exam or participation in an academic intervention program, for example, can be conceptualized as types of supports that can improve the academic functioning of a student with intellectual disabilities.

Similar to the method for determining limitations in intellectual functioning, deficits in adaptive behaviors are assessed using standardized measures and scores are considered maladaptive when they fall at least two standard deviations below the mean. One widely-used measure is the Vineland Adaptive Behavior Scales-II (VABS-II; Sparrow, Cicchetti, & Balla, 2005), which is the second version of the Vineland Adaptive Behavior Scales I (VABS-I; Sparrow, Balla, & Cicchetti, 1984). The VABS-II assesses four domains of adaptive behavior: Communication, Socialization, Daily Living Skills, and Motor Skills. The Motor Skills subdomain was not included in the VABS-I.

Research using the VABS-I often has suggested that there is a positive correlation between adaptive behavior and global measures of intelligence in children with intellectual disabilities (e.g., Carpentieri & Morgan, 1996; de Bildt, Systema, Kraijer, Sparrow, & Minderaa, 2005) but this relationship appears to be more pronounced at the lower end of the IQ spectrum

(Liss et al., 2001). Some have indicated that when considering lower scores on the IQ continuum, IQ and adaptive behavior could assess similar factors, such as the ability to understand directions and the capability to complete simple tasks (Liss et al., 2001).

In summary, adaptive behaviors help children function in their everyday environments. Moreover, adaptive behaviors may be indicative of how well children can perform in school, likely because academic achievement depends, in part, upon the ability to listen, understand, and concentrate on schoolwork for extended periods of time. Because they are associated with other factors that can facilitate academic success, relatively high levels of adaptive behaviors may serve as a type of protective factor for children with intellectual disabilities. Thus, students with intellectual disabilities who evidence more adaptive behaviors may have an advantage over their peers with fewer adaptive behaviors because they may be better equipped to navigate the demands and tasks associated with the school environment.

3.2 Language abilities in children with intellectual disabilities

Linguistic communication involves the process of imparting or receiving information through speech, reading, gestures, or writing. In general, the language abilities of children with intellectual disabilities frequently are characterized by skills that are delayed, develop at a slower rate, and reach a lower final level of achievement when compared to chronologically age-matched typically developing children (Rosenberg & Abbeduto, 1993). However, it is important to bear in mind that there are many variations in individuals' development.

Delays often are found in the linguistic communication for children with intellectual disabilities, but are especially evident in those areas that typically occur later in linguistic development. For example, pragmatic linguistic skills that usually are learned earlier in life (e.g., linguistic turn-taking) are mastered by children with intellectual disabilities much more easily

than pragmatic linguistic skills that are typically learned several years later (e.g., linguistic politeness; Rosenberg & Abbeduto, 1993). This seems to suggest that children with intellectual disabilities acquire and utilize pragmatic linguistic skills similar to children who are typically developing, but because of their slower rates of development and lower ultimate levels of achievement, those linguistic skills learned later in life sometimes are never acquired by children with intellectual disabilities or are eventually learned at relatively later dates when compared to typically developing children.

Mental age is considered a fairly strong predictor of the language abilities of children with intellectual disabilities (Ratner, 2005) with studies finding positive correlations between mental age and vocabulary sizes (Rosenberg & Abbeduto, 1993). Still, there are many individual variations in children's language development and profiles, with some children with intellectual disabilities evidencing language profiles that are significantly above or below what would be expected given their mental ages. Children with Williams syndrome, for example, often display language skills that are considered precocious given their cognitive skills (e.g., Bellugi, Marks, Bihrlé, & Sabo, 1988), while children with Down syndrome tend to have language profiles that are limited when their mental age is considered (e.g., Chapman, 1999).

While it is often assumed that slow cognitive growth can affect language development, language deficits also may inhibit cognitive growth. For example, some have suggested that language delays can compromise cognitive growth because words and sentences provide people with the means of complex thought (e.g., Buckley, Bird, Sacks, & Archer, 2006). That is, people think and reason using words and so language not only provides a way of communicating with others, but also provides a means of thinking. In addition to language delays inhibiting cognition, language deficits can potentially suppress scores on tests of cognitive abilities, such as IQ tests.

This is because most contemporary IQ tests rely, at least in part, on oral and reading comprehension. For this reason, difficulties with language production and comprehension can attenuate the IQ scores of children with intellectual disabilities.

3.3 Language skills and environmental context

Language development is affected by the environments in which people live. Hoff (2006) explains that, "...like other aspects of interpersonal behavior, language use is socialized to match community expectations from an early age" (p. 59). Thus, very early in life, children observe and participate in linguistic interactions and, in so doing, they learn when, how, and with whom to use language. They also learn that the appropriateness of different forms of linguistic communication (e.g., slang) may differ depending on the context.

Children's language abilities tend to be affected by their early home environments and their linguistic role models. Home environments are associated with the quality and amount of language input that children receive (Hart & Risley, 1995). Moreover, in contrast to higher socioeconomic families, low-income caregivers are more likely to speak to their children about their behavior rather than attempting to elicit conversations (Hoff, 2006); they also have been found to speak to their children less and engage in less diverse conversations while incorporating a smaller range of topics and asking fewer follow-up questions (Hart & Risley, 1995).

Hart and Risley (1995) have suggested that when accumulated over a three-year period, children from low-income families are exposed to 30 million fewer words than children from affluent backgrounds. These differences in children's language environments have been found to fully mediate the effects of SES on children's productive vocabularies (Hoff, 2003). These findings suggest that SES affects whether parents think speaking to young children is important and that language input, in turn, is the method by which children learn and develop their lexicon,

by providing children with a richer vocabulary and more information about the meaning of words.

Typically developing children from higher socioeconomic backgrounds tend to exhibit more proficiency in all areas of language. They score higher on standardized measures of vocabulary, they produce longer and more complex utterances, and they understand and produce more syntactically complex sentences (Hoff, 2006). This may occur, in part, because the language encountered on standardized vocabulary measures tends to be more similar to the language environments of children from more economically advantaged families. Therefore, there is much less overlap between the language spoken in the homes of children from low socioeconomic backgrounds and the language they experience in educational and assessment settings (Hoff, 2006).

In addition to the diverse linguistic environments found between families from different SES, ethnic differences also have been demonstrated. In comparison to White children, African American children tend to fall behind linguistically around 30 months of age, even after controlling for income (Roberts, Burchinal, & Durham, 1999). This discrepancy, too, may be partly attributed to differences in the amount of language input found in the home. Research comparing the linguistic environments of children from African American and White families from both middle-class and working-class backgrounds have found significant effects for both SES and ethnicity (Lawrence & Shipley, 1996). The results demonstrated that while middle-class White families spoke more to their children than middle-class African American families, both of these groups spoke to their children more than either African American or White working-class families did. These results may indicate that there are cultural differences between African American and White families about the appropriateness of speaking to young children.

Children's early experiences appear to relate to their early language skills (Hart & Risley 1995). Children who live in families with less complex and varied language environments often obtain lower scores on standardized language measures, such as on receptive and expressive vocabulary tests (Hoff, 2003). Like IQ tests, standardized language measures can be controversial, however, because they rely heavily upon children's previous experiences. Instead of using measures based largely on previous experience, some have suggested that linguistic measures that are processing-dependent, i.e., reliant on psycholinguistic processing speed, should be used in order to reduce some of the cultural and socioeconomic bias inherent in many widely-used language measures (Campbell, Dollaghan, Needleman, & Janosky, 1997). To do this, processing-dependent measures utilize very common vocabulary that is expected to be familiar to all ethnic and socioeconomic groups regardless of their previous language experiences.

Research has examined ethnic differences for performance on knowledge- and processing-dependent measures (Campbell et al., 1997). The performance of 156 typically developing White and African American boys 11 to 14 years of age was compared on the Oral Language Scale of the Woodcock Language Proficiency Battery – Revised (Woodcock, 1991). This measure was used as the knowledge-dependent measure because its subscales rely mostly on prior vocabulary knowledge. For the processing-dependent measures, the Nonword Repetition Task (Dollaghan & Campbell, 1998) and the Revised Token Test (Arvedson, McNeil, & West, 1985) were used. During the Revised Token Test, participants are asked to perform actions, such as touch or point to various shapes and colors in response to commands given by the test administrator. The results demonstrated that the African American participants significantly underperformed on the knowledge-dependent measures when compared to White participants, but there were no significant ethnic differences in performance on either of the processing-

dependent measures. These findings may indicate that processing-dependent language measures provide a less biased way to measure language performance in different cultural groups when compared to more traditional language measures.

In summary, the development of language skills is affected by a multitude of factors, including children's intellectual abilities as well as their home environments and experiences, cultural expectations, and language role models. Children's difficulties with language performance could result from one or several of these factors. Hence, when examining children's language outcomes, the effects of these factors should be taken into consideration, especially because they may influence how children respond to different types of intervention.

3.4 Development of reading skills in children with intellectual disabilities

The oral language abilities of both typically and atypically developing children are believed to be an important predictor of their reading acquisition (Laws & Gunn, 2002). Typically developing children who evidence developmental delays in receptive and expressive vocabulary, for instance, often exhibit difficulties learning to read (Scarborough, 1990). Research suggests that this relationship may be mediated by children's phonological awareness skills (Cooper, Roth, Speece, & Schatschneider, 2002), where early language environments influence children's oral language abilities, which then affect children's phonological awareness, and their ease of reading acquisition. Children who evidence reading difficulties may not efficiently segment oral language sounds which can create difficulty segmenting written language into smaller components that match onto these sounds. Deficits in phonological processing seem to constitute the majority of causes of reading disabilities (Gombert, 2002).

Early vocabulary knowledge also has been found to be associated with pre-reading abilities (e.g., letter-sound knowledge, print awareness) and word identification skills (Lindsey,

Manis, & Bailey, 2003). Vocabulary knowledge has both phonological (i.e., sound) and semantic (i.e., meaning) components (Levelt, Roelofs, & Meyer, 1999). This knowledge has been suggested to influence word identification skills in two ways: through an association between stored phonological representations coupled with specific orthographic patterns and through the depth of vocabulary knowledge that a person possesses (Wise, Sevcik, Morris, Lovett, & Wolf, 2007).

Some researchers have argued that intelligence is not a primary factor underlying reading difficulties (Stanovich & Siegel, 1994) and that, instead, most reading deficits can be attributed to problems with phonological processing (Conners, Atwell, Rosenquist, & Sligh, 2001). In a study that compared the decoding abilities of a heterogeneous sample of 64 elementary school children with mild intellectual disabilities, it was found that after chronological age and language abilities were controlled for, the only significant difference between children who were strong and weak decoders was phonological memory (Conners et al., 2001). These results were interpreted to mean that IQ scores do not predict literacy skills and that, instead, children's phonological memory was the primary predictor. Conners and colleagues (2001) suggested that children who have the ability to quickly refresh phonological information in their working memories are better at decoding since it allows them the time to work on subsequent letter-sound correspondences while still retaining the previous phonological information.

Other research has suggested that children with intellectual disabilities employ phonological processing skills to read. Gombert (2002) compared 11 children with Down syndrome (mean IQ score = 46; mean age = 13 years) with 11 typically developing children (mean age = 7 years) who had been matched on reading ability. Various assessments of phonological awareness were used including measures of phoneme synthesis, phoneme deletion,

and rhyme judgments. Reading skills were assessed by measures of sight word and non-word identification. The results suggested that while children with Down syndrome scored lower on the phonological and non-word recognition tasks when compared with the typically developing children, phonological skills and reading were significantly correlated for both groups of children. Gombert (2002) argued that these results indicate that children with Down syndrome use phonological knowledge while reading.

3.5 Reading instruction for children with intellectual disabilities

Because of their cognitive and linguistic impairments, parents and teachers may have low academic and reading expectations for children with intellectual disabilities. These beliefs, in turn, can affect the amount of instruction that children receive both in the home and at school. For example, research has examined the expectations that parents had for the development of reading skills in children with mild intellectual disabilities (Fitzgerald, Roberts, Pierce, & Schuele, 1995). In this study, parents reported lower expectations for their children's reading abilities; consequently, they read to their children less often and provided their children with less exposure to print materials (e.g., books and magazines) than typically developing children generally received. This lack of home literacy experiences may contribute, in part, to the difficulties that children with intellectual disabilities experience learning to read. Moreover, in a study of teachers' attitudes about the inclusion of children with Down syndrome in general education classes, many respondents explained that while they understood the benefits of inclusion for both typically and atypically developing children, the needs of children with intellectual disabilities were best met in segregated, special education classrooms (Gilmore, Campbell, & Cuskelly, 2003).

Perhaps because of low expectations, the reading instruction provided for children with intellectual disabilities often is not comparable to that received by typically developing students. For years, some researchers have argued that children with intellectual disabilities, such as those with Down syndrome, should be taught functional literacy skills through sight word recognition (e.g., Cossu, Rossini, & Marshall, 1993) rather than receive instruction in phonics. Increasingly researchers are finding that children with intellectual disabilities, indeed, can learn to read through phonics instruction (e.g., Gombert, 2002) and this provides them with much more flexible reading strategies than they have with sight word instruction alone.

4 INTERVENTIONS AS SUPPORTS

Early intervention programs often are designed to improve the developmental outcomes of high risk children. For instance, because of their health status, early interventions are mandated for children with developmental disabilities under the Individuals with Disabilities Act (IDEA) of 1997. These interventions offer a variety of services in the attempt to positively affect children's development by altering their experiences in some way (Ramey & Ramey, 1998). In fact, interventions potentially can be conceptualized as a type of "modifiable modifier" (Luthar & Cicchetti, 2000) that encourages positive change. For example, interventions can provide children with more protective factors, such as high-quality educations or parental information about how to best care for their children. When they are effective, interventions can enhance children's cognition, social skills, or behaviors when compared to similar children who receive no intervention (e.g., Ramey & Campbell, 1984).

Probably the most well-known childhood intervention is the national Head Start program, which began in 1964 in response to the "War on Poverty." Head Start is a federal program for children from three to five years of age who are either low-income, have disabilities, or both. It

provides an array of services, such as cognitive and behavioral instruction in addition to a variety of health services, with the goal of providing high risk children an educational advantage or “head start,” so they are prepared for the academic and behavioral expectations they face in first grade. Some research has suggested that Head Start has significantly more beneficial long-term effects for White children than African American children (Currie & Thomas, 1995). These results may be due to the fact that African American children disproportionately live in more high risk and economically disadvantaged areas; therefore, while African American children may initially reap rewards from Head Start, these effects cannot overcome the daily and long-term influences of their high crime neighborhoods and low quality schools.

According to Luthar and Cicchetti (2000), early intervention programs are a type of applied developmental science that seek to determine whether the developmental trajectories of high risk children can be changed or at least altered in some way. Most researchers suggest that interventions should begin soon after children are born if they are to reap the most beneficial outcomes (Ramey & Ramey, 1998) because during this time of life the focus is on prevention of maladjustment rather than the remediation of disorder. The Abecedarian Project (Ramey & Campbell, 1984), for example, was an intensive, early intervention program for low-income, high risk children that began in early infancy. It provided intensive health supports and cognitive services to both children and their families with the goal of establishing children’s school readiness. The results of the Abecedarian Project demonstrated that the children who participated in the program continued to perform significantly better than similar children who did not receive the intervention on measures of academic achievement up to 15 years after the intervention (Ramey & Ramey, 2004). It was suggested that the intervention may have provided

long-term benefits for children by promoting skills associated with resilience, such as cognitive skills and motivation to learn.

Interventions also can have more specific foci. The effectiveness of reading interventions has been studied in elementary school children with learning disabilities. Morris and colleagues (in press) compared different types of reading instruction for 279 elementary school children with learning disabilities. Participants were provided daily instruction in small groups over the course of one school year. The participants were randomly assigned to one of four instructional conditions: 1) a program with an emphasis on phonological instruction; 2) condition 1 plus reading strategy instruction; 3) condition 1 plus instruction about linguistic factors related to word knowledge; and 4) a contrast math group.

The findings revealed that children's growth did not differ by IQ, SES, or racial group. However, immediately following the intervention and at a one year follow-up, participants in the multi-component reading conditions (2 and 3) scored significantly higher on measures of single word and non-word fluency as well as on reading comprehension measures than participants in condition 1, and all of the groups performed significantly better on the reading measures than participants in the contrast math group. The authors concluded that multi-component reading interventions appear to evidence superior effects for reading achievement when compared to programs that focus exclusively on phonics instruction. Moreover, the results indicated the multi-component reading interventions facilitated positive growth in achievement for children from diverse demographic backgrounds.

Recent research also has examined the effects of reading interventions for children with intellectual disabilities (e.g., Sevcik, Ronski, & Morris, 2010). Sevcik and colleagues (2010) compared the effectiveness of two reading instructional programs and a math contrast group for

elementary school children with mild intellectual disabilities who were struggling to learn how to read. To date, the performance of 238 children with intellectual disabilities (mean IQ: 63.06) between 7 to 12 years of age have been compared during this ongoing intervention. The two reading programs focused on the development of phonological and blending skills. One program also incorporated an emphasis on the development of vocabulary and reading fluency skills. An instructional math program was included as a contrast.

The results suggested that children in both reading instructional programs evidenced a greater increase in reading skills (e.g., single word identification, decoding, phonological analysis) when compared to children in the comparison math group. Additionally, the results confirmed that phonological skills appeared to be important for the reading performance of children with intellectual disabilities (Wise, Sevcik, Ronski, & Morris, 2010). Thus, in contrast to reading research that has found that children with intellectual disabilities do not use phonological skills to read (e.g., Cossu, Rossini, & Marshall, 1993), the findings from this investigation suggest that, like typically developing children who are learning to read, phonological awareness plays a role in the development of reading skills for children with intellectual disabilities.

5 CURRENT STUDY

While the relationship between risk and disability is often cited in the literature, this relationship has not been systematically examined with mild intellectual disabilities, especially with regard to how these factors relate to children's achievement. The primary focus of this study was to determine whether the accumulation of risk factors, adaptive behavior, and a reading intervention affected children's academic growth. To address the exploratory questions in this study, a three-level multilevel growth model was employed. The first level consisted of the

growth curves of scores measuring participants' language and reading skills. The second level was composed of children's scores on a risk index, which provided participants with a score of 0-5 depending on how many predetermined risk factors children had upon entry into the study, as well as on an adaptive behavioral measure, measured by the Vineland Adaptive Behavior Scales-II (Sparrow et al., 2005) and on a variable coded for the type of reading instruction received, in an attempt to account for some of the variability in their beginning achievement and/or growth. A variable coded for the schools that children attended was included in the third level in order to account for mean differences in students' beginning achievement levels between schools. This was done in order to adjust the standard errors associated with students' scores that may have been biased due to the clustering of participants within schools. This exploratory research examined the following four questions:

- 1) **Do risk factors predict beginning achievement and the rate of growth?** It was hypothesized that participants with higher scores on the risk index would begin the study with lower beginning achievement scores and would evidence slower rates of growth when compared to children with fewer risks. These associations were expected on all outcome measures except for the measure of psycholinguistic processing because this assessment tool is suggested to be less biased against children from disadvantaged backgrounds since they utilize language that should be familiar to all participants (Campbell et al., 1997).
- 2) **Does adaptive behavior predict beginning achievement and the rate of growth?** It was hypothesized that participants with higher behavior scores (i.e. more adaptive behaviors) would begin the study with higher beginning achievement scores and would

evidence faster rates of growth because associations have been found between adaptive behaviors and achievement for typically developing children (e.g., Lonigan et al., 1999).

- 3) **Does intervention group predict rate of growth?** Differences in beginning achievement scores between intervention groups were not expected because of the random assignment of students to groups, but because of the additional components of the *PHAB/DI + RAVE-O* (Wolf, Miller, & Donnelly, 2000) program (e.g., focus on vocabulary development and fluency with orthographic recognition) when compared to the *PHAB/DI* (Engelmann & Bruner, 1988) program alone, students participating in the *PHAB + RAVE-O* condition were expected to make more growth over the course of the intervention.
- 4) **Does adaptive behavior moderate the relationship between risk and initial achievement and/or achievement growth?** Risks were hypothesized to be negatively related to language and academic achievement but the presence of adaptive behaviors may have attenuated this association.

6 METHOD

6.1 Participants

The original sample consisted of 162 participants, but 3 participants were not included in the final results because they were missing data on at least one measure in the test battery. Results of Little's MCAR test indicated data were missing completely at random $\chi^2(17) = 15.10, p = .59$. The final sample was $N = 159$.

Participants attended elementary schools in the metro-Atlanta area and met district eligibility criteria as having a mild intellectual disability. They were identified as struggling to learn to read by their classroom teacher and had been referred for participation in a larger intervention study

that examined the effectiveness of different types of reading instruction for children with mild intellectual disabilities. Participants were heterogeneous both in terms of the etiologies of their disability (e.g., Down syndrome, Autism Spectrum Disorder, unknown etiology) and in their language skills.

The sample consisted of 61 females and 98 males with an ethnic composition of 82 African Americans, 45 White students, 21 Latinos, 9 Bi-racial students, and 2 Asians. Children were between 84 and 152 months of chronological age (mean = 9.62 years of age) and the mean school-reported IQ score was 62.69 (range = 44-90). Participants were recruited from grades 2-5: 2nd grade n = 42; 3rd grade n = 27; 4th grade n = 43; and 5th grade n = 47. To be included in the study, participants must have been English proficient. Exclusionary criteria included evidence of a hearing impairment, uncorrected visual impairment, and co-morbid emotional problems.

6.2 Schools

The 12 schools included in this study were in the metro-Atlanta area (i.e., Fulton and Gwinnett counties). Participants in the sample attended one of twelve schools with each school contributing between 3 to 31 students (mean = 14 students) to this study. Six of the schools in the sample were categorized as Title 1 schools and six were not. A Title 1 school is characterized by a high rate of low-income students and is determined by the number of students enrolled in the free and reduced lunch program (i.e., at least 40% of students who attend the school).

Beginning levels of mean reading achievement (WLPB Letter-Word ID) was compared between schools to see whether students in the higher poverty schools (i.e., Title 1) performed significantly differently from the non-Title 1 schools. A one-way ANCOVA (controlling for chronological age) was run, $F(1, 160) = 11.36, p < .01$, which suggested that, when compared to

the low poverty schools, students in the higher poverty schools significantly underperformed in mean initial reading achievement.

6.3 Reading Interventions

All children participated in one of two reading interventions. Both reading interventions focused on facilitating growth in decoding, fluency, and comprehension. One instructional program, *The Phonological Analyses and Blending/Direct Instruction (PHAB/DI)*; Engelmann & Bruner, 1988), emphasizes the development of phonological processing skills in word recognition. During the first phase of the program, children are taught the sounds of individual letters. In the second phase of the program, the children are taught to parse the individual phonemes of a word orally and then blend the individual sounds together as they would normally be spoken in the speech stream. The second intervention, *PHAB/DI + Retrieval-rate, Accuracy, Vocabulary Elaboration and Orthography program (RAVE-O)*; Wolf et al., 2000), uses the base of the first program in addition to incorporating a focus on the development of vocabulary, orthographic knowledge, and naming speed.

Participants were randomly assigned to one of two instructional reading interventions: 83 were assigned to *PHAB/DI* and 76 were assigned to *PHAB/DI + RAVE-O*. All participants received 120 hours of instructional time with their project-based reading intervention teachers. The larger reading intervention includes a contrast mathematics group, but these participants were not included in this study. Also, this intervention spanned five consecutive years and children included in this study participated in the intervention in any one of those five years.

6.4 Measures

A battery of language and reading measures were included in this study to obtain a comprehensive assessment of participants' performances over the course of the reading intervention.

Woodcock Language Proficiency Battery – Revised (WLPB-R; Woodcock, 1991). The WLPB-R is a widely used standardized measure of abilities and achievement in oral language, writing, and reading proficiency for people 3 years of age through late adulthood. For this study, the subtests of 1) Letter-word Identification; 2) Word Attack; and 3) Memory for Sentences were used. Letter-word Identification is a scale that measures children's ability to read letters and sight words. Word Attack provides a measure of decoding and requires the student to read aloud nonsense or unfamiliar words that are linguistically logical. Memory for Sentences provides a measure of phonological memory and requires students to repeat phrases or sentences that increase in length. The authors report estimates of internal consistency ranging from .80 - .95 and overall test-retest reliability from .70 - .86.

Peabody Picture Vocabulary Test-III (PPVT-III; Dunn & Dunn, 1997). The PPVT-III is a standardized measure of receptive vocabulary and a screening test of verbal ability for people from 2 years of age through adulthood and for those who speak English as a first language. Each easel page of the PPVT-III contains four numbered pictures and the child is asked to select a drawing that matches a word spoken by the examiner. The depicted words are nouns, verbs, or adjectives. The test manual reports internal consistency coefficients that ranged from .67 to .88 (median = .80) for Form L and from .62 to .86 (median = .81) for Form M. Additionally, the manual reports that 44 individuals with intellectual disabilities from 6 to 18 years of age were given the PPVT-III. They were expected to evidence vocabulary skills similar to their level of

cognitive functioning or skills about 2 standard deviations below the mean. The results demonstrated that, when compared to a typically developing control group matched on chronological age, the mean score for the individuals with intellectual disabilities (mean standard score = 75.2) was significantly lower than the control group (mean standard score = 104.7).

Expressive Vocabulary Test (EVT; Williams, 1997). The EVT is an individually administered, norm-referenced measure of expressive one word vocabulary and word retrieval. Each individual item is depicted on an easel page and children identify the item (ages 2-4) or give a synonym for the item (ages 5-adult). The pictures were nouns, verbs, or adjectives. The examiner's manual reports internal consistency coefficients range from .90 to .98, with a median of .95. Test-retest reliabilities are reported to range from .77 to .90 with a median score of .85.

Additionally, the manual reports that 44 individuals with intellectual disabilities from 6 to 18 years of age were given the EVT. They were expected to evidence EVT scores similar to their level of cognitive functioning, or skills about 2 standard deviations below the mean. The results demonstrated that, when compared to a typically developing control group matched on chronological age, the mean score for the individuals with intellectual disabilities (mean standard score = 64.8) was significantly lower than the control group (mean standard score = 101.9).

Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen & Rashotte, 1999). The CTOPP assesses phonological awareness, phonological memory, and rapid naming. Two subtests that measure phonological awareness were used in this study: Elision and Blending Words. These subtests were combined to provide a phonological analysis composite measure in the analyses. The authors report the average internal consistency or alternate forms reliability coefficients exceed .80. The test/retest coefficients range from .70 to .92.

Clinical Evaluation of Language Fundamentals – 3 (CELF – 3; Semel, Wiig, & Secord, 1995). One subtest of the CELF-3 was used in this analysis. Concepts and Following Directions assesses the ability to interpret, recall, and execute oral commands of increasing length and complexity that contain concepts requiring logical operations. The CELF-3 Concepts and Following Directions was chosen for this study because of its similarity to the Revised Token Test. The authors report the CELF-3 has high internal consistency, moderate to high test-retest reliability, high inter-rater reliability, and good construct validity.

The Vineland Adaptive Behavior Scales II (VABS- II; Sparrow, Cicchetti & Balla, 2005). The VABS-II is a nationally standardized interview instrument that assesses adaptive functioning. It consists of four domains: Communication, Daily Living, Socialization, and Motor Skills. Each domain contains several subdomains. Within each subdomain, the VABS-II is divided into sets of items that probe a particular area of development. Each item within the set is scored as a 0 (never), 1 (sometimes; partially), or 2 (usually), according to criteria detailed its manual. The authors report that split-half and test-retest reliability coefficients for the composite scores are good, ranging from median values of .83 to .94. Inter rater reliability coefficients are lower for the same measures ranging from .62 to .78.

Risk Index. The Hollingshead Four Factor Scale (Hollingshead, 1975) is a widely-used index of a family's socioeconomic status. The SES score is computed from education and occupation information from each parent/guardian. If information is provided for two parents, the scores are averaged to obtain a single score. Education scores can range from 1 to 7, with 1 equivalent to less than a 7th grade education and 7 equal to graduate training. Occupation scores range from 1 to 9, with 1 equivalent to service workers and 9 equal to executives and major professionals. Caregivers whose primary activities are attending school or homemaking receive an SES score

of 1. Participants were given a point on the risk index if neither of their parents received a score of 4 or above on the education scale or a 4 or above on the occupation scale. Other experiences for which participants were given a point included ethnic minority status, male gender, and whether they lived in a single-parent family, for a total risk score ranging from 0-5.

6.5 Procedure

Trained research assistants administered a comprehensive battery of achievement and language measures, including the EVT, PPVT, CTOPP, and WLPB, to children before they received instruction (time 0) and repeated again after 60 hours of instruction (approximately mid school year) and 120 hours of instructional time (approximately one school year). Teachers completed the VABS-II shortly after they began instruction, i.e., after about 10 to 20 hours of instructional time.

7 DATA ANALYSIS

Data screening and analyses were conducted using the Statistical Package for the Social Sciences 18.0 (PASW MIXED MODELS). The hypotheses were addressed using multilevel models (MLM) in order to account for the nesting of time within participants and participants within schools. Level 1 consisted of the repeated measures of the outcome variables, while Level 2 predictor variables (between participants) were used to account for variability in Level 1 intercepts and slopes, and Level 3 was composed of a school variable to account for the nested data (i.e., participants nested within schools).

Multilevel models are those in which data collected at different levels of analysis (e.g., achievement measures, participants, schools) can be studied without violating assumptions of the independence of errors in linear multiple regression. For example, children who attend the same school are more likely to have similar educational experiences when compared to children who

attend different schools and therefore the errors associated with their scores are more likely to be related to one another (i.e., a violation of independence). Multilevel modeling accounts for these dependencies by estimating variance associated with group differences in average response (i.e., intercepts) and group differences in associations (i.e., slopes) between predictors and outcome variables. This is accomplished by declaring intercepts and/or slopes to be random effects (Tabachnick & Fidell, 2007). Other advantages of multilevel modeling include examining situations where there may be missing data for the outcome variables, varying occasions of measurement, and more complex error structures. Complex error structures are more commonly considered, however, when there are many measurements per participant and therefore can be relaxed in less complex models (Heck, Thomas, & Tabata, 2010).

The models for the various outcome measures were built in three stages. First, the null model, or unconditional model, was run to partition the variance into its within-individual and between-individual components. These components were used to calculate an intraclass correlation (ICC). High ICC values imply that grouping level, in this case students and schools, influences the data and that student and school grouping must be modeled in order to account for these violations of independence of errors. Thus, the ICC implied whether a multilevel model was appropriate for the data at hand. Following the unconditional model, growth rates for achievement (i.e., time) were added into the model to determine whether linear or quadratic polynomials best described the shapes of participants' growth trajectories. Additionally, these unconditional growth models were used as comparison models for the subsequent model with predictors. Because students were expected to vary in their rates of growth, the parameter for time (e.g., achievement over time) was set as random in the analyses. As DeLucia and Pitts (2006) claim, "Given that a basic tenet of developmental theory is that individuals vary in their

rates of development over time, eliminating this variability will often fail to capture the richness of the data” (p.1004). The distinction between fixed and random slopes is that fixed slopes have the same regression slope for each participant, whereas random slopes compute a separate regression coefficient for each participant. During the third step of model building, predictors were added to the models to determine whether they accounted for any existing variance.

8 RESULTS

8.1 Hypothesized Model

Three-level multilevel models analyzed the effects of risk, behavior, and reading intervention group on five reading and language outcome measures: the WLPB Letter-word Identification and Word Attack subtests along with CELF Concepts and Following Directions, the EVT, and the PPVT. Repeated academic outcome measures (i.e., time) comprised the first level of the model. The second level consisted of the three predictors, risk index, behavioral scores, and intervention group, along with the predictors’ interactions with time and a risk by behavior interaction. It was expected that higher scores on the risk index (i.e., more risks) and lower scores on the behavioral measure (i.e., fewer adaptive behaviors) would be negatively related to initial achievement and rate of growth. Risk was not expected to influence initial scores on the CELF, however, because psycholinguistic processing measures have been suggested to be less biased against children from less advantaged backgrounds (Campbell et al., 1997). Because of the additional components of its program, participants in the *PHAB/DI + RAVE-O* condition were expected to make more progress on the outcomes when compared to children in the *PHAB/DI* condition. Furthermore, an interaction among the predictor variables was hypothesized, where risk might moderate the association between adaptive behavior and achievement.

Both risk and behavior variables were grand-mean centered in order to prevent multicollinearity from occurring between the main effect and interaction terms. The control variables: chronological age, phonological memory (WLPB memory for sentences), and the phonological processing composite (CTOPP blending words plus CTOPP elision) also were grand-mean centered in order to facilitate the interpretation of the intercept. The third level of the model consisted of school intercepts. Random school intercepts were included at the third level because they adjusted for the group differences in Level 1 values (e.g., similarities in responses given by children in the same school when compared to children in different schools) that can increase Type I error rate. Random intercepts at Level 3 therefore corrected for the increased rate of Type I error by accounting for differences between schools in their average value of the outcome variables (Tabachnick & Fidell, 2007).

The first-level unit in all analyses was participants' achievement or language growth, which was entered as a predictor to model growth over time. Each participant was measured during three equally spaced data waves over the course of the intervention (pre-, mid-, and post-intervention), resulting in a total of 477 cases for analysis. Second-level units were the 159 participants, while the third-level units were the 12 schools in which the participants were nested.

8.2 Multilevel Modeling

The algorithm used to compute coefficients was restricted maximum likelihood (REML) estimation which was chosen because it tends to perform better than full maximum likelihood when sample sizes are small (Heck et al., 2010). In all five models, two time-varying covariates, phonological memory (WLPB memory for sentences) and a phonological analysis composite (CTOPP blending words plus CTOPP elision), along with participants' chronological age were included as control variables in order to determine the effects of risk, adaptive behavior, and

intervention group on the outcome variables above and beyond those of chronological age and phonological processing (WLPB memory for sentences; CTOPP composite). Additionally, while both linear and quadratic rates of change were tested in all models, the quadratic slopes were found to be non-significant and therefore were not included in the subsequent analyses. The slope for time was set as random because it was hypothesized that students may not evidence similar rates of growth in achievement. Next, predictors were added at Level 2 to determine whether they could account for any of the existing variability in participants' initial achievement and rates of growth. No predictors were added at Level 3; instead, a school-level grouping variable was included to adjust the standard errors at Level 1 in order to account for the nesting of participants within schools.

Initially, a full model was run that included three-way interactions between risk, behavior, and time as well as interactions between risk, intervention group, and time but these interactions were found to be non-significant in all of the models. In order to create more parsimonious and better-fitting models, these interactions were subsequently dropped. The final model for each outcome measure consisted of the predictors (i.e., risk, intervention group, behavior), their associations with time, and a risk by behavior interaction.

8.3 Descriptives

Prior to the analyses, the data were examined for accuracy of entry, missing values, outliers, and patterns of distributions. All missing data were deleted listwise. The normality of the data distributions also was checked. The only outcome variable found to be non-normally distributed was Word Attack, which was significantly negatively skewed. Because logarithmic transformations did not substantively change the results, however, it was left in its original form. All of the results are presented with data in raw form, i.e., scores are not standardized.

Descriptives, means, and standard deviations for the variables included in the analyses can be found in Table 1. Results for the three-level MLMs can be found in the following tables (2-21).

	Possible Range	Range (Time 0)	Mean (Time 0)	SD (Time 0)	Mean (Time 60)	SD (Time 60)	Mean (Time 120)	SD (Time 120)
<i>Descriptives</i>								
Chronological age (in months)	--	84-152	115.12	16.91	--	--	--	--
Grade	--	2-5	3.62	1.17	--	--	--	--
IQ	--	44-90	62.69	9.30	--	--	--	--
<i>Independent variables</i>								
VABS	0-488	207	298.52	65.68	--	--	--	--
Risk index	0-5	5	2.16	1.25	--	--	--	--
WLPB phon memory	0-56	33	31.69	5.48	32.66	5.91	33.01	6.33
CTOPP Phon composite	0-40	20	7.46	5.19	10.57	5.80	12.30	5.75
<i>Dependent variables</i>								
WLPB letter-word	0-57	39	19.78	7.38	22.72	7.49	24.77	7.53
WLPB word attack	0-30	17	2.46	3.58	3.96	4.20	5.19	4.98
CELF concepts	0-54	44	13.31	9.57	16.04	9.77	17.51	11.00
EVT	0-190	71	51.16	11.15	55.55	12.25	58.53	12.50
PPVT	0-204	126	70.75	23.68	73.31	22.93	76.32	21.40

*Note: scores are presented in raw form

8.4 WLPB Letter-word Identification

The first step of the analysis for the Letter-word ID outcome model was to run the unconditional model in order to compute ICCs (see Table 2). The ICC is computed by dividing the variance at a given level by the total variance. The between-subjects variability (Level 2) was $38.07 / 66.31 = .57$, meaning that 57% of the variability in participants' outcome scores was between participants. The between-schools variability (Level 3) was $17.04 / 66.31 = .27$, indicating that 27% of the variability in scores was between schools. Thus, the ICCs for Letter-word ID indicated that a three-level MLM was warranted. Following the unconditional model, an unconditional growth model was run to create a base model with which the subsequent model with predictors could be compared. Examination of the Level 2 (Wald $Z = 10.37$, $p < .01$) and Level 3 (Wald $Z = 1.94$, $p < .05$) variance components suggested that there was significant variability in Letter-word ID between participants and between schools to be explained (see Table 3).

Table 2.
Estimate of covariance parameters for unconditional model: Letter-word ID

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	11.195	.884	12.670	.000
Intercept [subject = id * school_code]	38.073	4.896	7.776	.000
Intercept [subject = school_code]	17.036	10.711	1.590	.056

Table 3.
Estimate of covariance parameters for unconditional growth model: Letter-word ID

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	4.009	.475	8.431	.000
Intercept + time [subject = id * school_code]	18.762	1.810	10.368	.000
Intercept [subject = school_code]	22.713	11.707	1.940	.026

Predictors were then added to the model in the attempt to explain the observed variability at Levels 2 and 3 (see Table 4). The initial intercept for the PHAB/DI group was 20.65 and for the PHAB/DI + RAVE-O group was 19.73 (20.65 - .92). This can be interpreted as students' true initial status adjusted for the covariates and predictors. The coefficients suggested that behavior ($\gamma = .04$, $p < .01$) was significantly related to initial achievement scores, where a 1 unit increase in behavior scores was associated with a .04 unit increase in Letter-word ID scores at baseline. However, because significant interactions were found between behavior and other variables in the analysis, this result should be interpreted cautiously. Risk also was significant ($\gamma = -.62$, $p < .02$), which suggested that participants with more risks evinced lower initial Letter-word ID scores. For the time parameter, the average gain over time was 1.88, suggesting that, on average, participants increased by about 2 scores on Letter-word ID during each successive measurement.

Table 4.
Estimates of Fixed Effects: Letter-word ID

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	20.652	.725	10.507	28.491	.000
Age	.148	.019	316.311	7.689	.000
phon_composite	.212	.045	400.643	4.682	.000
mem_sentences	.157	.040	352.521	3.952	.000
centered_risk	-.615	.257	336.473	-2.398	.017
centered_behavior	.036	.006	168.656	5.727	.000
group_assignment	-.923	.655	300.306	-1.408	.160
Time	1.876	.400	286.020	4.686	.000
centered_risk * time	.166	.222	254.882	.749	.455
centered_behavior * time	-.001	.004	254.595	-.303	.762
group_assignment * time	.025	.558	255.131	.044	.965
centered_risk * centered_behavior	-.002	.004	300.757	-.480	.632

Note: Bold font signifies results, $p < .05$

Akaike's Information Criterion (AIC) provided a test for model fit. The AIC estimates the goodness-of-fit of a model based on the estimates of previous models and it also penalizes models for lack of parsimony; thus models can be compared simply by determining whether the AIC statistics have been reduced (smaller estimates suggest better fit) by the addition of predictors (Roberts, 2004). The AIC statistics suggested that the addition of predictors increased model fit: unconditional growth = 2902.22 vs. full model = 2734.17. Thus, as a group, the

predictors improved the model beyond the unconditional growth model. Although the addition of predictors substantially improved the model, inspection of the statistically significant residuals for Level 2 (Wald $Z = 8.80$, $p < .01$) suggested that there was still variability between participants to be explained (see Table 5).

Table 5.
Estimate of covariance parameters for random effects: Letter-word ID

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald <i>Z</i>	<i>p one-tailed</i>
Repeated Measures	4.041	.501	8.103	.000
Intercept + time [subject = id * school_code]	9.900	1.123	8.799	.000
Intercept [subject = school_code]	3.880	2.630	1.475	.140

8.5 WLPB Word Attack

The ICCs suggested that a three-level model was appropriate for Word Attack: Level 2 was $11.66 / 21.11 = .55$ and Level 3, $3.77 / 21.11 = .18$ (see Table 6). The unconditional growth model was then run. Examination of the Level 2 (Wald $Z = 9.44$, $p < .01$) and Level 3 (Wald $Z = 1.72$, $p < .05$) variance components suggested that there was significant variability in Word Attack scores between participants and between schools (see Table 7).

Table 6.
Estimate of covariance parameters for unconditional model: Word Attack

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	5.678	.448	12.668	.000
Intercept [subject = id * school_code]	11.664	1.591	7.331	.000
Intercept [subject = school_code]	3.769	2.554	1.476	.070

Table 7.
Estimate of covariance parameters for unconditional growth model: Word Attack

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	2.590	.280	9.261	.000
Intercept + time [subject = id * school_code]	4.947	.524	9.435	.000
Intercept [subject = school_code]	3.596	2.085	1.724	.043

Predictors were then added to the model and the results for fixed effects can be found in Table 8. The initial achievement intercept for the PHAB/DI group was 2.89 and for the PHAB/DI + RAVE-O group, 2.26. The parameter for time suggested that participants significantly increased in Word Attack achievement growth over the intervention ($\gamma = .86$, $p < .01$). No other significant effects were found for Word Attack. The AIC suggested that the addition of predictors increased model fit: unconditional growth = 2446.11 vs. full model = 2370.73, but the statistically significant estimate for Level 2 suggested that some variability between participants remained to be explained (Wald Z = 8.24, $p < .01$; see Table 9).

Table 8.
Estimates of Fixed Effects: Word Attack

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	2.886	.408	13.691	7.075	.000
Age	.059	.012	340.148	4.908	.000
phon_composite	.218	.032	460.136	6.873	.000
mem_sentences	.023	.028	440.277	.827	.409
centered_risk	.117	.163	396.218	.714	.476
centered_behavior	.002	.004	164.876	.554	.580
group_assignment	-.630	.414	348.835	-1.522	.129
Time	.856	.251	329.590	3.407	.001
centered_risk * time	-.085	.138	302.559	-.617	.537
centered_behavior * time	.003	.003	302.275	1.325	.186
group_assignment * time	-.056	.346	302.705	-.161	.872
centered_risk * centered_behavior	.000	.003	329.618	.150	.881

Note: Bold font signifies results, $p < .05$

Table 9.
Estimate of covariance parameters for random effects: Word Attack

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	2.639	.287	9.193	.000
Intercept + time [subject = id * school_code]	3.256	.395	8.237	.000
Intercept [subject = school_code]	1.035	.715	1.447	.148

8.6 CELF Concepts and Following Directions

The ICCs suggested that a three-level model was appropriate for the CELF Concepts and Following Directions: Level 2 was $73.33 / 106.43 = .69$ and Level 3 $11.40 / 106.43 = .11$ (see Table 10). The unconditional growth model was then run. Examination of the Level 2 (Wald Z = 9.17, $p < .01$) and Level 3 (Wald Z = 1.68, $p < .05$) variance components suggested that there was significant variability in CELF scores between participants and between schools (see Table 11).

Table 10.
Estimate of covariance parameters for unconditional model: Concepts and Following Directions

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	21.699	1.708	12.708	.000
Intercept [subject = id * school_code]	73.330	9.340	7.851	.000
Intercept [subject = school_code]	11.399	8.574	1.329	.092

Table 11.
Estimate of covariance parameters for unconditional growth model: Concepts and Following Directions

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	15.509	1.727	8.980	.000
Intercept + time [subject = id * school_code]	29.584	3.227	9.169	.000
Intercept [subject = school_code]	15.519	9.213	1.684	.046

Predictors were then added to the unconditional growth model (see Table 12). The estimate for the initial CELF score was 13.37 for the PHAB/DI + RAVE-O group and 13.93 for the PHAB/DI group. A significant interaction was found between risk and time ($\gamma = .61$, $p < .05$) which suggested that participants with more risks had faster rates of growth in their CELF scores (see Figure 1). Probing of the interaction (as suggested by Preacher, Curran, & Bauer, 2006) revealed that children who were at low risk (1 SD below the mean) were not making significant improvement in their scores on the CELF over time, $\beta = .31$, $p = .66$. In contrast, children with more risks (1 SD above the mean) significantly improved their CELF scores over time, $\beta = 1.43$, $p = .03$.

Table 12.
Estimates of Fixed Effects: Concepts and Following Directions

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	13.925	.890	13.804	15.642	.000
Age	.143	.027	310.967	5.406	.000
phon_composite	.303	.074	466.985	4.093	.000
mem_sentences	.513	.066	464.969	7.724	.000
centered_risk	-.082	.368	424.915	-.222	.825
centered_behavior	.013	.009	162.908	1.473	.143
group_assignment	-.563	.931	372.113	-.605	.546
Time	.725	.555	344.544	1.308	.192
centered_risk * time	.613	.302	323.496	2.030	.043
centered_behavior * time	.003	.006	323.254	.499	.618
group_assignment * time	.660	.759	323.554	.869	.385
centered_risk * centered_behavior	.011	.005	303.300	1.975	.049

Note: Bold font signifies results, $p < .05$

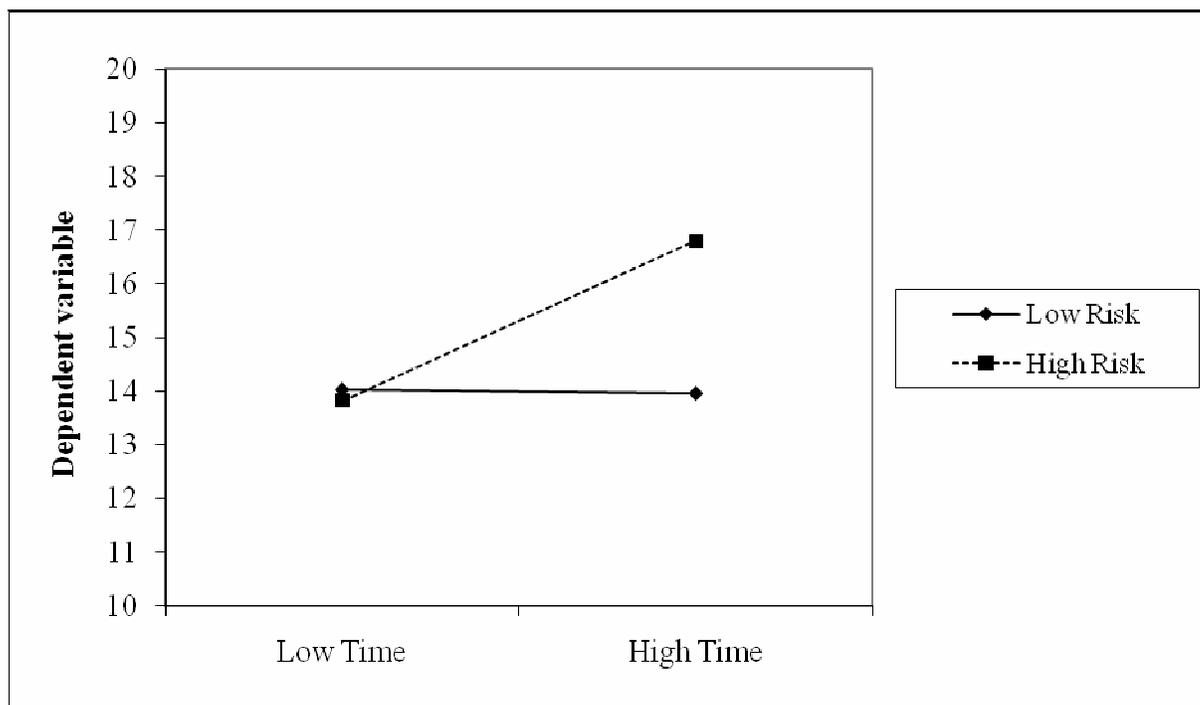


Figure 1. Graph of CELF risk x time interaction

Additionally, a significant relationship between adaptive behavior and risk ($\gamma = .01$, $p < .05$) was found, which suggested that the association between risk and initial CELF scores was moderated by adaptive behavior (see Figure 2). The probing of this interaction revealed that the association between risk and CELF language scores was not moderated by adaptive behavior when behavior was low (1 SD below the mean; $\beta = -.01$, $p = .55$), but the association between risk and language was significantly moderated by high adaptive behavior (1 SD above the mean; $\beta = .02$, $p = .03$). This finding suggested that children's adaptive behaviors did not affect their CELF scores when participants were at low risk. The relationship between adaptive behaviors and CELF scores for students at high risk, on the other hand, was significantly different, where children at high risk, with high adaptive behavior scored significantly higher on their initial CELF scores than children at high risk, with low adaptive behavior.

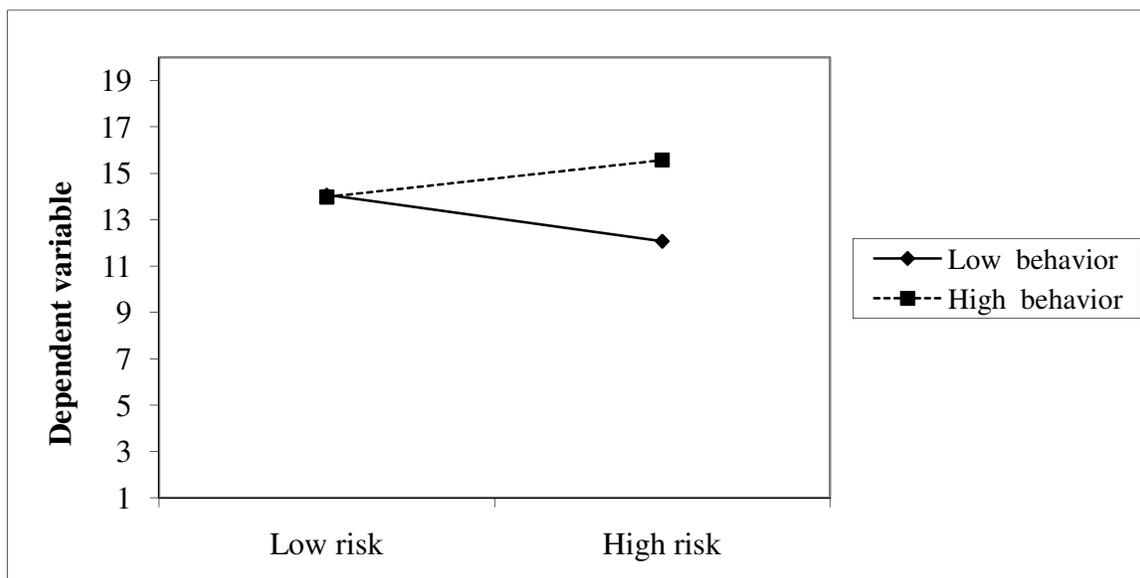


Figure 2. Graph of CELF risk x behavior interaction

The AIC suggested that the addition of predictors increased model fit: unconditional growth = 3316.02 vs. full model = 3159.94. Significant variability still remained to be explained at Level 2: Wald $Z = 6.73$, $p < .01$ (see Table 13).

Table 13.

Estimate of covariance parameters for random effects: Concepts and Following Directions

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	18.020	1.977	9.116	.000
Intercept + time [subject = id * school_code]	12.971	1.928	6.728	.000
Intercept [subject = school_code]	4.646	3.380	1.374	.169

8.7 EVT

The ICCs suggested that a three-level model was appropriate for the EVT: Level 2 was $96.94 / 160.19 = .61$ and Level 3, $24.22 / 160.19 = .15$ (see Table 14). The covariance estimates for the unconditional growth model suggested that there was significant variability to be explained at both Level 2 (Wald $Z = 9.02$, $p < .01$) and Level 3 (Wald $Z = 1.81$, $p < .05$; see Table 15).

Table 14.
Estimate of covariance parameters for unconditional model: EVT

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	39.026	3.081	12.668	.000
Intercept [subject = id * school_code]	96.941	12.963	7.478	.000
Intercept [subject = school_code]	24.221	18.603	1.302	.097

Table 15.
Estimate of covariance parameters for unconditional growth model: EVT

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	21.994	2.465	8.921	.000
Intercept [subject = id * school_code]	40.001	4.434	9.022	.000
Intercept [subject = school_code]	48.085	26.555	1.811	.035

After predictors were added to the model (see Table 16), the intercept for the PHAB/DI group was 52.08 and 50.53 for the PHAB/DI + RAVE-O group. The results demonstrated that

adaptive behavior was positively associated with initial EVT scores ($\gamma = .03$, $p < .01$). The parameter for time suggested that participants' expressive language scores significantly increased over time ($\gamma = 2.02$, $p < .01$), meaning that, on average, children's expressive language scores increased over the course of the intervention. The AIC suggested that the addition of predictors increased model fit: unconditional growth = 3466.49 vs. full model = 3272.02, but significant variability remained to be explained at Level 2 (Wald $Z = 6.92$, $p < .01$; see Table 17).

Table 16.
Estimates of Fixed Effects: EVT

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	52.082	.788	27.286	66.131	.000
Age	.182	.030	310.417	6.100	.000
phon_composite	.492	.085	464.609	5.812	.000
mem_sentences	.534	.076	445.219	7.038	.000
centered_risk	-.544	.415	371.217	-1.310	.191
centered_behavior	.029	.009	88.912	3.175	.002
group_assignment	-1.553	1.035	347.190	-1.501	.134
Time	2.021	.635	366.313	3.183	.002
centered_risk * time	.353	.348	351.339	1.014	.312
centered_behavior * time	.004	.007	347.783	.535	.593
group_assignment * time	.288	.870	348.532	.331	.741
centered_risk * centered_behavior	-.009	.006	310.262	-1.367	.173

Note: Bold font signifies results, $p < .05$

Table 17.
Estimate of covariance parameters for random effects: EVT

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	24.808	2.612	9.497	.000
Intercept [subject = id * school_code]	16.303	2.357	6.916	.000
Intercept [subject = school_code]	1.494	1.703	.878	.380

8.8 PPVT

The ICCs suggested that a three-level model was appropriate for the PPVT: Level 2 was $362.82 / 525.89 = .69$ and Level 3 was $78.88 / 525.89 = .15$ (see Table 18). The covariance estimates for the unconditional growth model suggested that there was significant variability to be explained at both Level 2 (Wald Z = 8.09, $p < .01$) and Level 3 (Wald Z = 1.89, $p < .01$; see Table 19).

Table 18.
Estimate of covariance parameters for unconditional model: PPVT

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	84.194	6.675	12.614	.000
Intercept [subject = id * school_code]	362.820	45.327	8.004	.000
Intercept [subject = school_code]	78.877	52.964	1.489	.068

Table 19.
Estimate of covariance parameters for unconditional growth model: PPVT

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	95.705	11.475	8.340	.000
Intercept [subject = id * school_code]	142.796	17.653	8.089	.000
Intercept [subject = school_code]	144.263	76.517	1.885	.003

Predictors were then added to the model (see Table 20). The intercept for the PHAB/DI group was 73.26 and for the PHAB/DI + RAVE-O group, 68.48. Risk was significantly associated with initial receptive language scores ($\gamma = -1.76$, $p < .05$) which suggested that participants with higher scores on the risk index began the intervention with lower PPVT scores. Behavior also was significantly associated with initial receptive language scores ($\gamma = .05$, $p < .05$) which suggested that for every one unit increase on behavior, participants scored .04 units higher on the PPVT initially. Additionally, group assignment was significant ($\gamma = -4.78$, $p < .05$) which suggested that participants in the PHAB/DI + RAVE-O group began the intervention with lower scores on the PPVT. No other significant predictors for the PPVT were found. The AIC suggested that the addition of predictors increased model fit: unconditional growth = 4102.05 vs. full model = 3904.32. Inspection of the significant residual at Level 2 (Wald Z = 6.59, $p < .01$), however, suggested that there was still significant variability between participants to be explained (see Table 21).

Table 20.
Estimates of Fixed Effects: PPVT

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	73.258	2.083	17.538	35.167	.000
Age	.442	.061	310.476	7.289	.000
phon_composite	.715	.172	460.074	4.155	.000
mem_sentences	.901	.154	462.026	5.835	.000
centered_risk	-1.756	.849	434.520	-2.069	.039
centered_behavior	.051	.020	197.963	2.550	.012
group_assignment	-4.777	2.146	391.526	-2.226	.027
Time	.109	1.268	357.898	.086	.932
centered_risk * time	.218	.689	340.598	.316	.752
centered_behavior * time	-.002	.013	340.394	-.160	.873
group_assignment * time	.671	1.733	340.625	.387	.699
centered_risk * centered_behavior	-.017	.013	306.221	-1.323	.187

Note: Bold font signifies results, $p < .05$

Table 21.
Estimate of covariance parameters for random effects: PPVT

Parameter	<i>Unstand. estimate</i>	<i>SE</i>	Wald Z	<i>p one-tailed</i>
Repeated Measures	100.536	10.977	9.159	.000
Intercept + time [subject = id * school_code]	64.231	9.750	6.587	.000
Intercept [subject = school_code]	26.223	16.426	1.596	.110

9 DISCUSSION

The primary purpose of this study was to examine the effects of risks, adaptive behavior, and a reading intervention for the language and reading achievement of elementary school children with mild intellectual disabilities. Because previous research has found that the accumulation of risks negatively affects children's verbal IQ scores (Sameroff et al., 1987) and language development (Hart & Risley, 1995), children in this study were hypothesized to evidence initial achievement and growth that was negatively associated with risks. Adaptive behavior, on the other hand, was hypothesized to be positively associated with participants' performance. All children in this study were participating in one of two reading interventions; the effects of these interventions on children's performance were compared to determine whether one had a more positive effect than the other.

Several general patterns were found across all five of the outcome measures. First, participants' growth over time generally was found to be linear in nature. Quadratic slopes were tested but were not found to fit the data. Next, the ICCs indicated that three levels were appropriate for all of the models. Appropriate modeling is important because ignoring nested

data can bias standard errors and increase the chance of Type I error (Heck et al., 2010; Tabachnick & Fidell, 2007). Last, examination of the covariance parameters suggested that after predictors were added to the models, variability still remained to be explained between participants (Level 2). This finding is not unusual; statistical models often have residual unexplained variability after all predictors have been entered. The addition of predictors, however, significantly reduced the random variability in language and achievement scores found between schools.

9.1 Question 1: Do risk factors predict beginning achievement and rate of growth?

On average, participants with more risks had lower initial scores on receptive vocabulary (i.e., PPVT) and a measure of letter and word reading achievement (i.e., WLPB Letter-word ID). These results were expected because typically developing children from disadvantaged backgrounds have been shown to exhibit poorer performances on standardized measures of language and reading (Hoff, 2006; Ramey & Ramey, 2004). As hypothesized, there was no significant main effect of risk on CELF Concepts and Following Directions scores. Because they utilize language that should be familiar to all participants, measures like the CELF Concepts and Following Directions subtest have been suggested not to be as affected by children's previous experiences and to be more dependent on psycholinguistic processing speed (Campbell et al., 1997). WLPB Word Attack also was not significantly related to risk. This may be because it is arguably the most complicated task in the battery since it requires children to use their phonological knowledge to decode by sounding out non-words. Children who participated in this study struggled to learn how to read and came to the task with little or no phonological training or experience and so the majority of participants had low scores at baseline on the Word Attack, regardless of whether they had risks or not.

Previous research has indicated that the language input received by typically developing high risk children often is not equivalent to that of their more affluent peers (e.g., Hart & Risley, 1995; Ramey & Ramey, 1998); therefore, it was unexpected that expressive vocabulary scores (i.e., EVT) were not significantly associated with risks for this sample of children with mild intellectual disabilities. Yet, children with mild intellectual disabilities tend to develop their language skills at a slower rate when compared to typically developing children (Rosenberg & Abbeduto, 1993) and because expressive vocabulary skills are arguably more complicated to master than receptive vocabulary skills (since they require additional motor demands), perhaps both low and high risk children in this sample did not have sophisticated expressive vocabulary skills. As a consequence of their relatively slower linguistic development, risk may not systematically relate to expressive vocabulary scores for elementary school children with mild intellectual disabilities.

A risk by time interaction was found for the CELF Concepts and Following Directions model. This result indicated that when compared to participants with fewer risks, participants with higher scores on the risk index significantly improved their scores over the course of the intervention. While the CELF Concepts and Following Directions subtest was suggested to be a measure of linguistic processing that would not necessarily be expected to be affected by risk, it is possible that through their participation in a reading intervention, high risk children with mild intellectual disabilities learned to process information at a faster rate. Perhaps this is because children who are subjected to many risks tend to have a dearth of quality learning experiences both at home and at school. Indeed, the experiences of disability and risk both have been associated with fewer language learning opportunities (e.g., Alant & Lloyd, 2005). Through their

participation in a phonologically-based reading intervention, children in this sample may have increased their linguistic processing rates, though this is of course speculative.

Conversely, perhaps the CELF subtest was more of a test of attention and following directions rather than processing speed. In contrast to Campbell and colleagues (1997), other researchers have suggested that measures like the Revised Token Test (Arvedson et al., 1985) assess factors such as attention to complicated directions (Liss et al., 2001). The CELF Concepts and Following Directions subtest was chosen for this study because of its similarity to the Revised Token Test and so perhaps it, too, is a measure of attention rather than processing speed. If this is the case, then it is possible that by participating in one of these interventions, high risk children not only learned how to read, but also learned how to attend to instruction. In fact, this intervention experience could be the first time that high risk children with mild intellectual disabilities have been required to sit and attend to instruction for extended periods of time.

Besides the CELF Concepts and Following Directions model, risk did not significantly affect growth for any other outcome measure. Risk was assumed to influence language and reading growth because it has been found to be negatively related to a variety of factors such as IQ (Sameroff et al., 1987), language input (Hart & Risley, 1995), and learning experiences (Brooks-Gunn & Markman, 2005; Ramey & Ramey, 1998) for typically developing children. This finding was unanticipated, but recent reading intervention research with elementary school children with reading disabilities also has found that potential risk factors such as low SES and IQ, along with ethnic minority status, did not affect participants' growth in reading achievement over time (Morris et al., in press). Collectively, these findings seem to indicate that while risks are negatively associated with initial PPVT receptive language and WLPB letter-word reading

achievement scores for children with mild intellectual disabilities, risks do not negatively impact the positive effects of high-quality instructional reading interventions.

9.2 Question 2: Does adaptive behavior predict beginning achievement and rate of growth?

On average, children with higher VABS-II scores had higher initial scores on the EVT, PPVT, and Letter-word ID. This effect was hypothesized because of the link between adaptive behavior and achievement that has been found with typically developing children (e.g., Lonigan et al., 1999). Children with intellectual disabilities who have more adaptive behaviors may be successful in school because they have less difficulty attending to instruction, concentrating for extended periods of time, and persevering while learning relatively difficult tasks. Like the effect for risk, participants' adaptive behavior scores also were not found to be related significantly to the CELF Concepts and Following Directions or the Word Attack.

Adaptive behaviors were hypothesized to be positively related to rates of growth; however, VABS-II scores were not found to be significantly associated with growth in language or reading achievement for any of the models. Although there was significant variability in participants' VABS-II scores, most children participating in the intervention probably had sufficient adaptive behaviors (mean VABS-II score: 298.52) to capitalize on the intervention. That is, participants who exhibited relatively lower adaptive behaviors when compared to other participants in the intervention still were able to profit from high-quality reading instruction. Hence, that adaptive behaviors were not related to growth in language and achievement over time may emphasize the effectiveness of the reading interventions.

9.3 Question 3: Does intervention group predict rate of growth?

Participants in the *PHAB/DI + RAVE-O* condition were expected to evidence significantly more growth in the outcome measures because of its additional instructional

components. Previous research has suggested that, for elementary school children with reading disabilities, multi-component reading programs facilitated faster rates of growth and higher final outcome scores when compared to instructional programs that focused primarily on phonological skills (e.g., Lovett, LaCrenza, Borden, Frijters, Steinback, & DePalma, 2000; Morris et al., in press). With this sample of children, however, one intervention did not appear to have a significantly stronger effect on children's language and reading performance over the other; children in both conditions improved their scores over time. This finding may suggest that there may be multiple methods to successfully teach children with mild intellectual disabilities to read and once they are provided with quality instruction they are capable of learning, but because the control group was not included in these analyses it is not possible to solely attribute this growth over time to the interventions.

Children in both reading interventions significantly improved their scores over the course of the year on each of the outcomes except for the CELF Concepts and Following Directions and PPVT. Inspection of the means over time suggested that, on average, participants progressed at each successive time point on both of these two measures: mean CELF Concepts and Following Directions scores: (Time 0: 13.31, Time 60: 16.04, Time 120: 17.51) and PPVT (Time 0: 70.75, Time 60: 73.31, Time 120: 76.32). These trends may not have reached statistical significance, however, because all of the effects in the full models controlled for the other variables in the model. Thus, after controlling for the other variables in the model, the effects for progress over time on the CELF Concepts and Following Directions and the PPVT may not have been large enough to cross the threshold for statistical significance.

On average, the *PHAB/DI + RAVE-O* group exhibited significantly lower initial scores on the PPVT than participants in the *PHAB/DI* group. Examination of the intercepts

demonstrated that this pattern was evident for all of the outcome measures, though this effect did not usually cross the threshold of statistical significance. Though participants were randomly assigned to their reading intervention, these may have been relatively small effects that became more substantial when collapsed across many children in different schools over different intervention years.

9.4 Question 4: Does adaptive behavior moderate the relationship between risk and initial achievement and/or achievement growth?

A significant interaction confirmed that the relationship between risk and initial CELF Concepts and Following Directions scores was moderated by adaptive behaviors. Children who experienced few risks did not significantly vary in their beginning CELF Concepts and Following Directions scores; children with both high and low adaptive behaviors scored, on average, about the same. Those who were high risk, on the other hand, significantly differed in their beginning CELF Concepts and Following Directions scores; those with fewer adaptive behaviors scored significantly lower than those with higher behavior scores. Thus, the children who were high risk, high behavior scored significantly higher on the CELF Concepts and Following Directions than children who were high risk, low behavior. This finding suggested that risk did, in fact, attenuate the relationship between adaptive behavior and participants' initial CELF Concepts and Following Directions performance.

Because risk was hypothesized to have no effect on initial CELF Concepts and Following Directions scores, this result was unexpected. The CELF Concepts and Following Directions was hypothesized to tap factors related to linguistic processing rather than experience and, if this is the case, risk factors should not have significantly impacted participants' scores. Therefore, this finding may provide more credibility to the assertion that the CELF Concepts and Following

Directions measured attention to instructions rather than processing speed. If the CELF Concepts and Following Directions did indeed measure attention, then these results may indicate that the effect of adaptive behavior for attention to instruction depended on children's level of risk; adaptive behaviors were significantly more important for high risk children than low risk children.

9.5 Study limitations

There were a couple of limitations to this study. First, a control group was not included in these analyses. Including a control group may have helped to extricate the effects of the intervention programs and whether participants' progress over time was mainly due to maturation or primarily due to instructional effects. A second limitation was the sample size. For statistical techniques like MLM, sample sizes are ideally much larger (e.g., over 1000), especially when a third level is included in the analyses. Yet, when conducting research with special populations like children with intellectual disabilities, small samples often are the rule rather than the exception. Given this fact, the sample used in this study is considered quite large when compared to other studies examining a similar population of children.

10 CONCLUSIONS

Collectively, these results suggested that risk was negatively associated with language and achievement, and adaptive behavior was positively associated with language and achievement for children with mild intellectual disabilities. These findings can inform interventions, e.g., risk indices may facilitate the early identification of children who may need additional or more intensive instruction. When identification occurs early, academic services may shift from remediation to prevention. Furthermore, perhaps academic instruction for children with mild intellectual disabilities should incorporate a stronger focus on fostering

adaptive behavior given its association with achievement. Adaptive behaviors may act as a protective factor that promotes resilience because they allow children to adjust to different settings such as school. Additionally, this study suggested that high-quality phonologically-based reading instruction is one effective method to teach children with mild intellectual disabilities how to read. The importance of reading skills cannot be underestimated; reading is the foundation upon which subsequent academic skills are built. Providing children with mild intellectual disabilities quality reading instruction, therefore, may present them with an additional factor that can promote resilience in the presence of challenging conditions.

The results also indicated that participants' growth in language and reading achievement generally was not affected by risk nor adaptive behaviors. These findings may highlight the efficacy of the reading interventions for a variety of children. Moreover, participants in both conditions improved their scores over time. This may suggest that reading instructional programs that incorporate a focus on addressing deficits in phonological awareness can promote successful reading development in multiple formats, although a control group would be needed in the analyses to definitively conclude that growth over time was largely the effect of the reading instruction that was provided to participants.

Additionally, the results suggest that the CELF Concepts and Following Directions subtest may not be a measure of linguistic processing, but more a measure of ability to listen and follow instructions. Children who were identified as high risk had significantly faster rates of growth on the CELF Concepts and Following Directions; additionally, the relationship between adaptive behavior and initial CELF Concepts and Following Directions scores was significantly more pronounced for high risk children. Together these findings may underscore the need for

high risk children with mild intellectual disabilities to receive quality instruction along with a focus on behavioral skills in order to foster a greater focus and attention to their schoolwork.

In conclusion, this study indicated that children with mild intellectual disabilities evidence negative relationships between risk factors and vocabulary and reading achievement. These patterns are similar to what has been found with typically developing children (e.g., Burchinal et al., 2008; Sameroff et al., 1987). Additionally, adaptive behaviors were positively related to participants' language and reading scores. These findings suggest that researchers and educators may be able to make early identification of students who might need additional services through risk indices. Further, the promotion of adaptive behaviors may act as a protective factor to foster resilience and create more opportunities for children with mild intellectual disabilities to concentrate on relatively difficult tasks to learn, such as reading. Taken as a whole, this study emphasized the importance of high-quality instruction for children with mild intellectual disabilities in addition to the significance of attending to other factors, such as risks and adaptive behaviors that may be related to their academic performance. By concentrating on these aspects of their academic experiences, greater opportunities can be created for children with intellectual disabilities to obtain a quality education.

REFERENCES

- Abbeduto, L. (1991). Development of verbal communication in persons with moderate to mild mental retardation. In N. Bray N (Ed.) *International review of research in mental retardation*. New York: Academic Press, p. 91 – 115.
- Abikoff, H., Jensen, P., Arnold, L.E., Hoza, B., Hechtman, L., Pollack, S., Martin, D., Alvir, J., March, J.S., Hinshaw, S.P., Vitiello, B., Newcorn, J., Greiner, A., Cantwell, D.P., Conners, C.K., Elliott, G., Greenhill, L.L., Kraemer, H., Pelham, W., Severe, J.B., Swanson, J.M., Wells, K., & Wigal, T. (2002). Observed classroom behavior of children with ADHD: relationship to gender and comorbidity. *Journal of Abnormal Child Psychology*, 30, 349–359.
- Alant, E. & Lloyd, L. L. (2005). *Augmentative and alternative communication and severe disabilities : Beyond poverty*. London: Whurr Publishers Lmtd.
- American Association on Intellectual and Developmental Disabilities (2010). *Intellectual disability: Definition, classification, and systems of supports*. Washington, DC: American Association on Intellectual and Developmental Disabilities.
- Arvedson, J.C., McNeil, M.R., & West, T.L. (1985). Prediction of Revised Token Test overall, subtest, and linguistic unit scores by two shortened versions. *Clinical Aphasiology*, 15, 57-63.
- Batshaw, M. L. & Shapiro, B. (2002). Mental retardation. In M. L. Batshaw (Ed.) *Children with Disabilities, 5th ed.* (pp. 287-306). Washington D.C.: H. Paul Brookes Publishing Company.
- Bellugi, U., Marks, S., Bihrlé, A., & Sabo, H. (1988). Dissociation between language and cognitive functions in Williams syndrome. In D. Bishop & K. Mogford (Ed.), *Language*

- Development in Exceptional Circumstances* (pp. 177- 189). London: Churchill Livingston.
- Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology*, 22, 723-742.
- Brooks-Gunn, J. & Duncan, G.J. (1997) The effects of poverty on children. *Children and Poverty* 7, 55-71.
- Brooks-Gunn, J. & Markman, L.B. (2005) The contribution of parenting to ethnic and racial gaps in school readiness. *The Future of Children*, 15, 139-168.
- Browman, S., Nichols, P.L., Shaughnessy, P. & Kennedy, W. (1987). *Retardation in young children*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Buckley, S.J., Bird, G., Sacks, B., & Archer, T. (2006). A comparison of mainstream and special education for teenagers with Down syndrome: Implications for parents and teachers. *Down Syndrome Research and Practice*, 9, 54-67.
- Burchinal, M.R., Roberts, J.E., Zeisel, S.A., & Rowley, S.J. (2008). Social risk and protective factors for African American children's academic achievement and adjustment during the transition to middle school. *Developmental Psychology*, 44(1), 286-292.
- Campbell, T., Dollaghan, C., Needleman, H., & Janosky, J. (1997). Reducing bias in language assessment: Processing-dependent measures. *Journal of Speech, Language, and Hearing Research*, 40, 519-525.
- Carpentieri S. & Morgan S. B. (1996) Adaptive and intellectual functioning in autistic and nonautistic retarded children. *Journal of Autism and Developmental Disorders* 26, 611–20.
- Chapman, R. (1999). Language development in children and adolescents with Down syndrome.

- In J. Miller, M. Leddy, & L. Leavitt (Eds.), *Improving the communication of people with Down syndrome* (pp. 41-60). Baltimore: Paul H. Brookes.
- Cicchetti, D. & Toth, S.L. (1997). Transactional ecological systems in developmental psychopathology. In S.S. Luthar, J.A. Burack, D. Cicchetti, & J.R. Weisz (Eds.), *Developmental Psychopathology: Perspectives on adjustment, risk, and disorder* (pp. 273-313). New York: Cambridge University Press.
- Conners, F.A., Atwell, J.A., Rosenquist, C.J., & Sligh, A.C. (2001). Abilities underlying decoding differences in children with intellectual disability. *Journal of Intellectual Disability Research, 45*, 292-299.
- Cossu, G., Rossini, F. & Marshall, J.C. (1993). When reading is acquired but phonemic awareness is not: A study of literacy in Down's syndrome, *Cognition, 46*, 129-138.
- Cooper, D. H., Roth, F. P., Speece, D. L., & Schatschneider, C. (2002). The contribution of oral language skills to the development of phonological awareness. *Applied Psycholinguistics, 23*, 399-416.
- Cossu, G., Rossini, F., & Marshall, J.C. (1993). When reading is acquired but phonemic awareness is not: A study of literacy in Down's syndrome. *Cognition, 46*, 129-138.
- Currie, J. & Thomas, D. (1995). Does Head Start make a difference? *The American Economic Review, 85*, 341-364.
- Dollaghan, C. & Campbell, T.F. (1998). Nonword repetition and child language impairment. *Journal of Speech, Language, and Hearing Research, 41*, 1136-1146.
- deBildt, A., Systema, S., Kraijer, D., Sparrow, S., & Minderaa, R. (2005). Adaptive functioning and behavior problems in relation to level of education in children and adolescents with intellectual disabilities. *Journal of Intellectual Disability Research,*

49, 672-681.

- DeLucia, C. & Pitts, S.C. (2006). Applications of individual growth curve modeling for pediatric psychology research. *Journal of Pediatric Psychology, 31*, 1002-1023.
- Dunn, L.M. & Dunn, L.M. (1997). *Examiner's manual for the PPVT-III Peabody Picture Vocabulary Test. Third Edition*. American Guidance Service.
- Eisenhower, A. & Blacher, J. (2006). Mothers of young adults with intellectual disability: Multiple roles, ethnicity, and well-being. *Journal of Intellectual Disability Research, 50*, 905-916.
- Elwan, A. (1999). *Poverty and disability: A survey of the literature*. Washington, DC: World Bank.
- Emmett, T. (2005). Disability and poverty. In E. Alant & L. L. Lloyd. *Augmentative and alternative communication and severe disabilities: Beyond poverty*. (pp. 68-94). London: Whurr Publishers Lmtd.
- Emerson, E (2003). Mothers of children and adolescents with intellectual disability: social and economic situation, mental health status, and the self-assessed social and psychological impact of the child's difficulties. *Journal of Intellectual Disability Research, 47*, 385-399.
- Engelmann, S., & Bruner, E. C. (1988). *Reading Mastery I/II Fast Cycle: Teacher's guide*. Chicago: Science Research Associates.
- Fagan, J.F. (2000). A theory of intelligence as processing: Implications for society. *Psychology, Public Policy, and Law, 6*, 168-179.
- Fagan, J.F. & Haiken-Vasen, J. (1997). Selective attention to novelty as a measure of information processing across the lifespan. In J.A. Burack & J.T. Enns (Eds.), *Attention, development, and psychopathology* (pp. 55 – 73), New York: Guilford Press.

- Fitzgerald, J., Roberts, J., Pierce, P., & Schuele, C. M. (1995). Evaluation of home literacy environment: An illustration with preschool children with Down syndrome. *Reading and Writing Quarterly, 11*, 311-334.
- Flannery, K.A., Liederman, J., Daly L., & Schultz, J. (2000). Male prevalence for reading disability is found in a large sample of black and white children free from ascertainment bias. *Journal of International Neuropsychological Society, 6*, 998-1002.
- Gilmore, L., Campbell, J., & Cuskelly, M. (2003). Developmental expectations, personality stereotypes, and attitudes towards inclusive education: community and teacher views of Down syndrome. *International Journal of Disability, Development and Education, 50*, 67-78.
- Gombert, J. (2002). Children with Down syndrome use phonological knowledge in reading. *Reading and Writing, 15*, 455-469.
- Hart, B. & Risley, T.R. (1995) *Meaningful differences in the everyday experience of young American children*. Baltimore: Brooks Publishing Company.
- Heck, R., Thomas, S.L., & Tabata, L. (2010). *Multilevel and longitudinal modeling with IBM SPSS*. New York: Routledge.
- Herrnstein, R.J. & Murray, C. (1995). *The bell curve: Intelligence and class structure in American life*. New York: Free Press.
- Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development, 74*, 1368-1378.
- Hoff, E. (2006). *How social contexts support and shape language development*. *Developmental Review, 26*, 55-88.
- Hollingshead, A.B. (1975). *Four factor indices of social status*. Unpublished manuscript, Yale

University, New Haven, CT.

- Huston, A., Duncan, G., Granger, R. Bos, H., McLoyd, V., Mistry, R., Crosby, D., Gibson, C., Magnuson, K., Romich, J., & Ventura, A. (2001). Work-based antipoverty programs for parents can enhance the school performance and social behavior of children. *Child Development, 72*, 318-336.
- Individuals with Disabilities Education Act Amendments (1997). *U.S. Department of Education, 1997*, <http://www2.ed.gov/offices/OSERS/Policy/IDEA.html>.
- Jensen, A.R. (1969). How Much Can We Boost IQ and Scholastic Achievement? *Harvard Educational Review, 39*, 1-123.
- Lawrence, V. W. & Shipley, E. F. (1996). Parental speech to middle- and working-class children from two racial groups in three settings. *Applied Psycholinguistics, 17*, 233–255.
- Laws, G., & Gunn, D. (2002). Relationships between reading, phonological skills and language development in individuals with Down syndrome: A five year follow-up study. *Reading and Writing: An Interdisciplinary Journal, 15*, 527–548.
- Levelt, W., Roelofs, A., & Meyer, A. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences, 22*, 1-45.
- Lindsey, K. A., Manis, F. R., & Bailey, C. E. (2003). Prediction of first-grade reading in Spanish- speaking English-language learners. *Journal of Educational Psychology, 95*, 482–494.
- Liss M., Harel B., Fein D., Allen D., Dunn M., Feinstein C., Morris R., Waterhouse L. & Rapin, C. (2001). Predictors and correlates of adaptive functioning in children with developmental disorders. *Journal of Autism and Developmental Disorders 31*, 219–30.
- Lonigan, C.J., Bloomfield, B.G., Anthony, J.L., Bacon, K.D., Phillips, B.M., & Samwel, C.S.

- (1999). Relations among emergent literacy skills, behavior problems, and social competence in preschool children from low- and middle-income backgrounds. *Topics in Early Childhood Special Education, 19*, 40-54.
- Lott B. (2002). Cognitive and behavioral distancing from the poor. *American Psychologist, 57*, 100-110.
- Lovett, M.W., Laczrenza, L., Borden, S.L., Frijters, J., Steinback, K.A., & DePalma, M. (2000). Components of effective remediation for developmental reading disabilities: Combining phonological and strategy-based instruction to improve outcomes. *Journal of Educational Psychology, 92*, 263-283.
- Luthar, S. S., & Cicchetti, D. (2000). The construct of resilience: Implications for interventions and social policies. *Development and Psychopathology, 12*, 857–885.
- Luthar, S.S., Cicchetti, D. , & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development, 71*, 543-562.
- Margalit, M. (2003). Resilience models among individuals with learning disabilities: Proximal and distal influences. *Learning Disabilities Research & Practice, 18*, 82-86.
- Masten, A. (2001). Ordinary magic: Resilience processes in development. *American Psychologist, 56*, 227-238.
- Masten, A.& Coatsworth, D.J. (1998). The development of competence in favorable and unfavorable environments: Lessons from research on successful children. *American Psychologist, 53*, 205–220.
- McIntyre, L.L., Blacher, J., & Baker, B.L. (2006). The transition to school: Adaptation in young children with and without intellectual disability. *Journal of Intellectual Disability Research, 50*, 349–361.

- Mistry, R. S., Vandewater, E. A., Huston, A. C., & McLoyd, V. C. (2002). Economic well-being and children's social adjustment: The role of family process in an ethnically diverse low-income sample. *Child Development, 73*, 935–951.
- Morris, R.D., Lovett, M.W., Wolf, M., Sevcik, R.A., Steinbach, K.A., Frijters, J., & Shapiro, M. (in press). Multiple component remediation of developmental reading disabilities: IQ, SES, and race as factors in remedial outcome. *Journal of Learning Disabilities*.
- Office for Civil Rights (2006). *Projected Values for the Nation, 2006*. <http://ocrdata.ed.gov>
- Preacher, K.J., Curran, P.J., & Bauer, D.J. (2006). Computational tools for probing interactions in multiple linear regression, multilevel modeling, and latent curve analysis. *Journal of Educational and Behavioral Statistics, 31*, 437-448.
- Ramey, C.T. & Campbell, F.A. (1984). Preventive education for high-risk children: Cognitive consequences of the Carolina ABC. *American Journal of Mental Deficiency, 88*, 515-523.
- Ramey, C.T. & Ramey, S.L. (1998) Early intervention and early experience. *American Psychologist, 53*, 109-120.
- Ramey, C.T. & Ramey, S.L. (2004). Early learning and school readiness: Can early intervention make a difference? *Merrill-Palmer Quarterly 50*, 471-491.
- Ratner, R.B. (2005). Atypical language development. In J.B. Gleason (Ed.) *The development of language. 6th ed.* Boston: Pearson.
- Roberts, J.K. (2004). An introductory primer on multilevel and hierarchical linear modeling. *Learning Disabilities: A Contemporary Journal, 2*, 30-38.
- Roberts, J.E., Burchinal, M. & Durham, M. (1999). Parents' report of vocabulary and grammatical development of African American preschoolers: Child and environmental

- associations. *Child Development*, 70, 92-106.
- Rosenberg, S., & Abbeduto, L. (1993). *Language and Communication in Mental Retardation: Development, Process, and Intervention*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Sameroff, A.J., Seifer, R., Barocas, R. Zax, M. & Greenspan, S. (1987). Intelligence quotient scores of four-year-old children: Social-environmental risk factors. *Pediatrics*, 79, 343-351.
- Sampson, R. J., Sharkey, P., & Raudenbush, S. W. (2008). Durable effects of 16 concentrated disadvantage on verbal ability among African-American 17 children. *Proceedings of the National Academy of Sciences of the USA*, 18, 845-852.
- Scarborough, H.S. (1990). Very early language deficits in dyslexic children. *Child Development*, 61, 1728-1743.
- Seml, E., Wiig, E., & Secord, W. (2005). *Clinical Evaluation of Language Fundamentals - Third Edition (CELF-3)*. San Antonio: Psychological Corporation.
- Sevcik, R.A., Wise, J.C., Morris, R.D., & Ronski, M.A. (2010). Evaluating the effectiveness of reading interventions for students with mild intellectual disabilities. Poster session presented at the national conference of the Institute of Education Sciences, Washington, D.C.
- Shaywitz, S.E., Shaywitz, B.A., Fletcher, J.M. & Escobar, M.D. (1990). Prevalence of reading disability in boys and girls: Results of the Connecticut longitudinal study. *Journal of the American Medical Association*, 22, 998-1002.
- Sparrow, S.S., Balla, D.A., & Cicchetti, D.V. (1984). *Vineland Adaptive Behavior Scales: Survey form manual*. Circle Pines, MN: American Guidance Service.
- Sparrow, S.S., Cicchetti, D.V., & Balla, D.A. (2005). *Vineland Adaptive Behavior Scales II:*

- Survey form manual*. Circle Pines, MN: American Guidance Service.
- Stanovich, K. E., & Siegel, L. (1994). Phenotypic performance profile of children with reading disabilities: A regression-based test of the phonological-core variable-difference model. *Journal of Educational Psychology, 86*, 24-53.
- Tabachnick, B.G. & Fidell, L.S. (2007). *Using multivariate statistics, 5th ed.* Boston: Allyn and Bacon.
- Wagner, R., Torgesen, J., & Rashotte, C. (1999). *Comprehensive Test of Phonological Processing*. Austin, TX: PRO-ED.
- Wehmeyer, M.L. (2003) Defining mental retardation and enduring access to the general curriculum. *Education and Training in Developmental Disabilities, 38*, 271-282.
- Whitehurst, G.J., Arnold, D.S., Epstein, J.N., Angell, A.L., Smith, M., & Fischel, J.E. (1994). A picture book reading intervention in day care and home for children from low-income families. *Developmental Psychology, 30*, 679-689.
- Williams, K.T. (1997). *Expressive Vocabulary Test (EVT)*. Circle Pines, MN: American Guidance Service, Inc.
- Wise, J. C., Sevcik, R. A., Morris, R. D., Lovett, M. W., & Wolf, M. (2007). The relationship among receptive and expressive vocabulary, listening comprehension, pre-reading skills, word identification skills, and reading comprehension by children with reading disabilities. *Journal of Speech, Language, and Hearing Research, 50*, 1093-1109.
- Wolf, M., Miller, L., & Donnelly, K. (2000). Retrieval, automaticity, vocabulary elaboration, orthography (RAVE-O): A comprehensive, fluency-based reading intervention program. *Journal of Learning Disabilities, 33*, 375-386.
- Woodcock, R.W. (1991). *Woodcock Language Proficiency Battery-Revised: Examiner's*

Manual, 1st ed. Chicago: Riverside Publishing Company.

Zigler, E. & Hodapp, R.M. (1986) *Understanding mental retardation*. New York: Cambridge University Press.