READING FIRST, OR IS IT? AN EXAMINATION OF THE INTERRELATIONSHIP BETWEEN READING ACHIEVEMENT AND BEHAVIORAL PROBLEM TRAJECTORIES ACROSS ELEMENTARY SCHOOL FOR CHILDREN FROM DISADVANTAGED CIRCUMSTANCES

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ABSTRACT

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Reading is a necessary skill in our modern society and is increasingly critical for success in our highly technological society. Yet many children from low-SES backgrounds struggle to develop reading proficiency (Lee, Grigg, & Donahue, 2007) and continuing concerns about this pervasive relationship has led to an increased focus on creating more effective interventions to address these differences in reading development. Despite these efforts this disparity in reading proficiency continues (Lee, Grigg, & Donahue, 2007), but most of the intervention efforts to date have been focused almost exclusively on improving a limited set of early reading sub-skills and ignores the larger context of child development within a low-SES family. This heavy focus on ameliorating early deficits in reading proficiency is founded upon a belief in a *Matthew Effect* for reading. The *Matthew Effect* model hypothesizes that early deficits are expected to lead to a cumulative disadvantage over time, with lower entry skills leading to a slower rate of growth in future reading skills. However, there is contradictory findings concerning the existence of a *Matthew Effect* for reading with several studies suggesting that children follow a more compensatory trajectory in reading development (Aarnouste et al., 2001; Parrila et al., 2005; Phillips et al., 2002) and others suggesting that that there are multiple trajectories of reading development (Aunola et al., 2002; Lepannen et al., 2004; Parrila et al., 2005). Further, very few studies have specifically looked at the reading development of American children from low-SES families. If factors other than initial endowment are related to

the slower rate of growth for children from low-SES families, then early intervention alone may not be sufficient to effectively address the reading deficits typically found in this population. One of these other factors may be the higher rate of behavior problems typically displayed by these children (NCES, 2000; Zill et al., 1995). A better understanding of the reading development of children from low-SES families is essential to guide effective interventions to address their persistent deficit in reading proficiency. In order to extend the research regarding the reading development of children from low-SES families, the present study used the Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K) dataset to examine: 1.) What trajectories the reading development of children follow and whether the *Matthew Effect* model is the most representative model for the reading development of children from low-SES families and 2.) Whether the presence of comorbid behavior problems is related to the slower growth in reading skills commonly found for children from low-SES families. Results suggested that on average children from low-SES families did enter school with lower initial reading skills and a higher rate of teacher reported behavior problems. Further children followed multiple trajectories of reading development, with the largest percentage following a parallel trajectory and two smaller groups following either a cumulative or compensatory trajectory. Socioeconomic status was associated with the type of trajectory followed; children from lower SES families were significantly more likely to follow a cumulative trajectory consistent with the *Matthew Effect.* However, analyses showed that children from low-SES families demonstrated slower growth in reading even when initial reading scores were controlled for suggesting that other factors than reading proficiency at school entry may be associated with this slower growth. There was limited support for the hypothesis that a higher rate of behavior problems was associated with the slower reading growth of children from low-SES families.

DEDICATION

This dissertation is dedicated in memory of my father, Willis D. Parton, who always emphasized the importance of education. His constant support and encouragement was invaluable in helping me achieve my goals.

I would also like to dedicate this dissertation work in memory of Dr. Jean Baker, who taught me many valuable lessons about life, research and being a professional. Her patience and mentorship were greatly appreciated.

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CHAPTER 1

INTRODUCTION

Reading is a necessary skill in our society and is increasingly critical for success in our highly technological society. Yet approximately 30 million American adults leave school without having attained the necessary proficiency skills in reading (Kutner et al., 2007). While children from all SES backgrounds can struggle in developing proficient reading skills, children from low-SES families are historically more likely to become poor readers (Lee, Grigg, & Donahue, 2007; Lonigan, Burgess, Anthony, & Barker, 1998; Molfese, Modglin, & Molfese, 2003). Continuing concerns about this pervasive relationship between low-SES and poor reading skills has led to an increased focus on creating more effective interventions to address these differences in reading development, but unfortunately this disparity in reading skills continues (Gamse, Bloom, Kemple, Jacob, 2008; Lee, Grigg, & Donahue, 2007; Russell et al., 2007). Much of the research which has examined the relationship between low-SES and poor reading skill has narrowly focused on improving a limited set of reading sub-skills and ignores the larger context of child development within a low-SES family (Bowey, 1995; Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003; Foorman, Anthony, Seals, & Mouzaki, 2002; Torgeson, 1998; Whiteley, Smith, & Connors, 2007; Yeh, 2003). It is necessary to develop a deeper understanding of the proximal processes that influence the reading development of children from low-SES families in order to create more effective interventions to address these deficits in reading proficiency.

Most of the current interventions to address these differences in reading proficiency are focused on ameliorating deficits in early reading sub-skills before or soon after school entry (Snow, Burns & Griffin, 1998). Previous research has indicated that children from low-SES

families enter school with less knowledge of print concepts, lower phonemic awareness, a less developed understanding of the alphabetic principle and smaller vocabulary (Adams, 1990; Anthony & Lonigan, 2004; NCES, 2000). The *Matthew Effect* model hypothesizes that these early deficits are expected to lead to a cumulative disadvantage for children from low-SES families, with lower entry skills leading to a slower rate of growth in future reading skills. This expectation of a *Matthew Effect* has led to an increased emphasis on targeting interventions to reach "at-risk" populations early in their educational trajectories. If rates of gain are relative and proportional to initial endowment, as predicted by the *Matthew Effect* model, then strengthening the early reading skills of children from low-SES families should lessen the academic gap by placing these children on an equal footing with their more advantaged peers. However, if factors other than initial endowment are related to this slower rate of growth for this group of children, then early intervention alone may not be sufficient to effectively address the reading deficits typically found in this population. At present, federal policy is almost exclusively focused on addressing this deficit in the reading skills of children from low-SES families through early reading intervention. *Early Reading First* and *Reading First,* both billion-dollar-a-year federal initiatives have been in place to address the deficits in the reading skills of children from low-SES families. However, early evaluations of these initiatives have found that children are not making as many gains as hoped (Gamse et al., 2008; Russell et al., 2007), a finding consistent with earlier research showing that children with weak oral language and impoverished home environments are less likely to respond to early literacy instruction (Al Otaiba, Conner, Lane, Kosanovich, Schatschneider, Dyrlund et al., 2008; Al Otaiba & Fuchs, 2002; Lonigan, 2003; Torgeson, 2000; Torgeson, Wagner, Rashotte, Rose, Lindamood, Conway, & Garvan, 1999).

While these programs are fairly new and more time or some adjustments may be needed to see the expected gains, it is still unclear if providing early intervention to place these children on an equal footing with their more advantaged peers is sufficient to close the gap in reading proficiency long-term. It is clear that more needs to be known about the reading development of children from low-SES families. In particular, what trajectories of reading development do children from low-SES families follow and is the *Matthew Effect* model the best representation of their reading development?

While there has been some evidence to support the *Matthew Effect* model (Cunningham & Stanovich, 1997; Durham et al., 2007; Juel, 1988), many of the studies have significant limitations and other studies have provided evidence of a *compensatory model* of reading development (Aarnouste et al., 2001; Parrila et al., 2005; Phillips et al., 2002). Many children who enter school with lower reading skills follow a *compensatory trajectory* of reading development and experience more growth than students with higher initial skills even in the absence of any additional educational interventions (Phillips et al., 2002; Spira, Bracken, & Fischel, 2005), while other students continue to struggle with reading in spite of receiving evidence-based interventions targeted at improving reading proficiency (Al Otaiba et al., 2008; Al Otaiba & Fuchs, 2002; Rabiner, Coie et al., 2000; Torgeson, 2002; Torgeson, 1999). There is also evidence that children's reading development follows many different trajectories (Aunola et al., 2002; Lepannen et al., 2004; Parrila et al., 2005), but no study has identified what trajectories the reading development of children from low-SES families may follow. Identifying the specific developmental reading trajectories followed by children from low-SES backgrounds is essential for creating the most effective educational interventions to improve the reading proficiency of this population. Some students who enter school with poor reading skills manage to benefit from

classroom instruction, while others struggle and continue to fall behind. Delineating specific trajectories and then identifying the factors related to these trajectories can support more informed, effective, research-based intervention strategies to improve the reading proficiency of these children.

One such factor that may be related to slower growth in reading skills for children from low-SES backgrounds is comorbid behavior problems. The same demographic factors related to lower early reading skills are also associated with increased problem behaviors (NCES, 2000; Zill et al., 1995), which have been shown to hinder the effectiveness of classroom instruction (Gunter & Coutinho, 1997; Hamre & Pianta, 2001; Kochenderfer & Ladd, 1996). There has been a consistent relationship found between reading difficulties and behavior problems, with anywhere from 50% to 85% of children with reading difficulties also being described as having behavior problems (Greenbaum et al., 1996; Nelson et al., 2004). There is evidence that early behavior problems that predate school entry or that occur before the child has experienced a history of learning failure are associated with slower growth in reading skills (Deater-Deckard et al., 2009; Rabiner, Coie et al., 2000; Smart et al., 2001). There is also evidence that children with behavior problems have more difficulty effectively engaging in classroom instruction (DuPaul & Stoner, 1994; Mantzicopoulos, 2005; Rothbart & Bates, 1998) and often do not benefit from evidence-based reading interventions (Al Otaiba & Fuchs, 2002; Nelson, Benner, & Gonzalez, 2003; Torgeson et al., 1999). Both of these findings suggest that early behavior problems may be associated with slower reading growth. The comorbid behavior problems of children from low-SES families may not be the cause of their reading difficulties, but it is certainly a relationship in need of closer examination.

Developing a more explicit understanding of these issues should provide a foundation for further inquiry that will guide the development of more effective interventions to address the persistent reading deficits experienced by children from low-SES backgrounds. Given the importance of reading in our society and the critical need to identify the more proximal processes that influence the reading development of children from low-SES backgrounds to inform effective intervention strategies, the present study addressed two questions:

1.) What trajectories does the reading development of children follow and is the *Matthew Effect* model the most representative model for the reading development of children from low-SES families?

2.) Is the presence of comorbid behavior problems related to the slower growth in reading skills commonly found for children from low-SES families?

CHAPTER 2

LITERATURE REVIEW

Reading is a necessary skill for participation in modern American society. Every day Americans are inundated with written information. Public signs, menus, written notices, brochures, medication labels, job applications, and rental agreements are just a few examples of the written material encountered daily. Individuals who are not proficient in reading are at a significant disadvantage in every domain of American life. When compared to adults with average reading skills, adults with less proficient reading skills are less likely to be employed full time, receive significantly lower salaries when employed and are more likely to receive public assistance (Finnie & Meng, 2005; Kutner, Greenberg, Jin, Boyle, Hsu, & Dunleavy, 2007). They are also less likely to vote, to participate in community service activities and as parents are less likely to support literacy in the home and to be involved in their children's education (Kutner et al., 2007). Unfortunately, approximately 30 million American adults lack the ability to read and understand information found in the short, simple texts required by everyday literacy activities and more than 50 percent of this population live in households with incomes of less than 20 thousand dollars a year (Kutner et al., 2007). Clearly, children who become adults without proficient reading skills are at an increasing disadvantage in our society and this disadvantage is likely to be exacerbated by the increasing literacy demands required by a highly technological society. This awareness has led to increased emphasis on improving the reading skills of all children, but especially those from low socioeconomic status (SES) backgrounds.

Socioeconomic Status

Current thinking recognizes that healthy child development occurs within a context of adequate resources and appropriate parenting (Parker, Piotrkowski, Horn, & Green, 1995). SES, as a global index of family resources, has been shown to be moderately associated with the nature of the developmental context. As early as 1929, Van Alstyne recognized SES to be a distal variable that indirectly affects child development through its influence on such factors as the family's lifestyle, availability of resources, and sociopolitical status. Numerous studies since then have further supported the relationship between SES and various health, psychological, academic, and social outcomes (Bradley & Corwyn, 2002; Duncan & Brooks-Gunn, 1997; Evans, 2004).

Children raised in families with a higher SES are more likely to benefit from their parents' greater knowledge about typical child development and effective parenting strategies (Benasich & Brooks-Gunn, 1996; Goodenow & Collins, 1990; Laosa, 1982; McGillicuddy-DeLisi & Sigel, 1995; Reich, 2005), which helps parents be better equipped to create an environment more appropriate to a child's emerging abilities and to promote the child's healthy development (Benasich & Brooks-Gunn, 1996; Miller, 1988). This greater level of parental knowledge has been associated with more cognitively stimulating home environments (Benasich & Brooks-Gunn, 1996); higher cognitive scores for children (Dichtelmiller, Meisels, Plunkett, Bozynski, Claflin, & Mangelsdorf, 1992); higher maternal sensitivity (Tarabulsy, Bernier, Provost, Maranda, Larose, Moss, Larose, & Tessier, 2005; Van Doesum, Hosmanm, Riksen-Walraven, & Hoefnagels, 2007); improvements in children's behavior (Benasich & Brooks-Gunn, 1996; Neitzel & Stright, 2004); less child aggression (Benzies, Keown, Magill-Evans, 2009; Côté, Boivin, Nagin, Japel, Xu, Zoccolillo, Junger, & Tremblay, 2007); and reduced

parental stress, lowered child maltreatment, and overall better child outcomes (Culp, Culp, Blankemeyer, & Passmark, 1998; Honig & Wittmer, 1991). Further, parents from higher SES are more likely to use more effective problem-solving strategies during interactions with their children (Blechman & McEnroe, 1985). Neitzel and Stright (2004) found that on average mothers with more education were better at regulating the task difficulty for their children while encouraging the child's active role in the problem-solving task. More educated mothers were more likely to provide more cognitive and emotional support for their children and were better able to successfully modify their interactions to support children with more difficult temperaments.

Also, parents of higher socioeconomic status are more likely to have higher status occupations, which may also influence parenting practices. Earlier work by Kohn (1959, 1963, 1977, 1979) found a relationship between occupational status and parenting practices, which has been supported in more recent work (Cooksey, Menaghan, & Jekielek, 1997; Luster, Rhoades, & Haas, 1989; Mengahan & Parcel, 1991, 1995; Parcel & Menaghan, 1990; Piotrkowski & Katz, 1982; Rogers, Parcel, & Menaghan, 1991). According to Kohn, parents working in jobs with low occupational status are more likely to value conformity to external authority and to emphasize obedience and good manners, while parents possessing jobs with higher status are more likely to value autonomy, self-control and personal responsibility. Luster and colleagues (1989) demonstrated that these work-related value systems do affect parenting practices in a distinct manner. A mother's value of conformity was associated with lower levels of maternal involvement, lower maternal warmth and less reading to the child. Additionally, mothers who highly valued conformity were more likely to use harsh, restrictive discipline and were less likely to encourage exploration.

Other factors associated with occupational status have also been shown to affect parenting practices. Parents whose jobs involve more complex work (occupations usually associated with higher SES), requiring them to interact more with people and ideas than with objects, tend to create more cognitively enriching and emotionally supportive home environments for their children (Cooksey, Menaghan, & Jekielek, 1997; Menaghan & Parcel, 1991, 1995; Parcel & Menaghan, 1990; Piotrkowski & Katz, 1982; Rogers, Parcel & Menaghan, 1991). Job stress and dissatisfaction has also been associated with more negative developmental outcomes potentially through its association with the negative quality of marital and child relationships (Kinnunen, Gerris, & Vermulst, 1996; Wilson, Ellwood, & Brooks-Gunn, 1995). Further non-standard work schedules (e.g., late night shifts, weekends) have been related to lower family functioning, more parent distress and more hostile and ineffective parenting (Han, 2008; Joshi & Bogen, 2005; Strazdins, 2006). While it is true that families from any SES category can experience job stress, job dissatisfaction and non-standard work schedules, typically low-SES families are overrepresented within these categories (Strazdins, 2006). Parents with less education and fewer job skills tend to have a more limited range of jobs to choose from and are often required to take the less desirable positions (Rogers, Parcel, & Menaghan, 1991; Strazdins, 2006; Wilson, Ellwood, & Brooks-Gunn, 1995).

The lower level of economic resources associated with low-SES also can have a profound influence on developmental outcomes, such as lower levels of physical, cognitive and social/emotional development, as well as lower levels of academic achievement and more negative self-esteem (Bradley & Corwyn, 2002; Duncan & Brooks-Gunn, 1997; Hanson, McLanahan, & Thomson, 1997). From an investment perspective the parents of low-SES families may not have sufficient economic resources to support the healthy development of their

children (Bradley & Corwyn, 2002, Conger & Donnellan, 2007; Duncan & Magnuson, 2003; Haveman & Wolfe, 1994; Linver, Brooks-Gunn, & Kohen, 2002). This lack of resources can often have adverse effects before birth because low-income families frequently do not have sufficient resources to provide adequate maternal nutrition, to obtain the necessary prenatal care or to afford appropriate housing (Larson, 2007; U.S. Department of Health & Human Services, 2005). Children from low-income families are more likely to be born prematurely, at low birth weight or with some type of birth defect (Crooks, 1995, U.S. Department of Health & Human Services, 2005; Vrijheid, Dolk, Stone, Alberman, & Scott, 2000). After birth, inadequate nutrition and poor quality housing can place these children at greater risk for a number of other health problems and physical injuries (Aber, Bennett, Conley, & Li, 1997; Brooks-Gunn & Duncan, 1997; Chen, Matthews, & Boyce, 2002; Guo & Harris, 2000; Sampson, 2003; Scholer, Hickson, & Ray, 1999) and these greater health risks are exacerbated by the lack of access to adequate healthcare (Ma, Gee, & Kushel, 2008; Owens, Zodet, Berdahl, Dougherty, McCormick, & Simpson, 2008; Porr, Drummond, & Richter, 2006). This lack of economic resources can also affect the parents' ability to create a cognitively stimulating home environment. Children from low-income families often have access to less reading material in the home and are less likely to go on trips, visit a library or museum, or to attend a theatrical performance (Bradley, Corwyn, Burchinal, McAdoo, & Garcia-Coll, 2001; Brooks-Gunn, Klebanov, & Liaw, 1995; Entwisle, Alexander, & Olson, 1994; Guo & Harris, 2000). Further, the stress often experienced by families with few resources, such as difficulty obtaining adequate basic necessities (e.g., food, clothing, housing), inability to pay bills, poor or non-existent healthcare, job instability and higher rate of daily hassles has been associated with lower quality of parenting (Conger & Conger, 2002; Conger et al., 2002; McLoyd, 1998). These financially related stressors predict

increased parental emotional distress, more marital conflict and less supportive parenting leading to poorer emotional, behavioral, cognitive and physical outcomes for the children (Conger, 1995; Conger et al., 2002).

SES and Reading Achievement

While children from all SES backgrounds can struggle developing proficient reading skills, children from families with a lower socioeconomic status are at substantially higher risk to become poor readers (Bowey, 1995; Lonigan, Burgess, Anthony, & Barker, 1998; Molfese, Modglin, & Molfese, 2003; Whitehurst, 1997). Socioeconomic status, as a global index of all family resources, social, cultural as well as economic, has consistently been associated with lower reading proficiency for children. The most recent *National Assessment of Educational Progress* (*NAEP*; Lee, Grigg, & Donahue, 2007) report showed only 17 percent of fourth graders and 15 percent of eighth graders from low-income families had reached proficiency in reading in comparison to the 44 percent of fourth graders and the 40 percent of eighth graders from middle to upper income families who reached the same level (Lee, Grigg & Donahue, 2007). These findings are not surprising; the *NAEP* has reported similar discrepancies in reading achievement for children from low-income families in every report since 1971. Continuing concern about this persistent relationship between low-SES and lower reading proficiency has led to an increased focus on creating more effective interventions to address these differences. Yet much of this growing body of research narrowly focuses on improving a limited set of reading sub-skills (Bowey, 1995; Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, & Poe, 2003; Foorman, Anthony, Seals, & Mouzaki, 2002; Torgeson, 1998; Whiteley, Smith, & Connors, 2007; Yeh, 2003) ignoring the larger context of child development within a low-SES family. According to

Bronfenbrenner's socio-ecological model (1979, 1999) child development is conceptualized as occurring within a dynamic environment consisting of nested interactive and interdependent systems that directly and indirectly influence the developmental course. Many of the environmental factors (i.e., inadequate resources, maternal education, and parental support) that influence the development of early reading skills also influence socioemotional development, making it critical to identify the association between these interdependent systems (socioemotional development and reading development) for children from low-SES backgrounds. This study will provide a more thorough understanding of the reading development of children from low-SES backgrounds by exploring the nature of this dynamic interaction between the growth in reading skills and socioemotional development.

SES and Early Reading

Many have argued the reading difficulties experienced by children from low-SES backgrounds begin before school entry (Burns, Griffin, & Snow, 1999; Entwisle & Alexander, 1993; McCardle, Scarborough, & Catts, 2001; Shonkoff & Phillips, 2000; Storch & Whitehurst, 2002; Torgeson, 2002). Research, using very different measurements of SES, suggests that on average many children from low-SES families experience less rich language environments and enter school with fewer linguistic skills than their more advantaged peers (Evans, 2004; Gershoff, 2003; Hart & Risley, 1995). On average, children from disadvantaged backgrounds have less exposure to books at home and are less likely to be read to by parents (Evans, 2004; Federal Interagency Forum on Child and Family Statistics, 2005; Korat, Klein, & Segal-Drori, 2007; Lee & Burkam, 2002; U.S. Dept. of Ed., NCES, 2000; Whitehurst & Lonigan, 1998). Many of these children also receive less language exposure and what language exposure they do

have is often of lower linguistic quality in comparison to children from higher SES families. Hart and Risley (1995) found that SES was correlated with the number of words spoken per hour by the parent; in a typical hour-long observation period they found that the average family receiving welfare addressed 616 words to the child compared to the 2153 spoken by the average parent from the higher SES family. This more limited early literacy environment has repeatedly been associated with lower early reading skills for children from low-SES families (Morrow, O'Connor' & Smith, 1990; Snow, 1991).

By the time children enter kindergarten these differences in their early literacy environments have had a significant influence on the early reading skills of children from different backgrounds. Children from low-SES families tend to enter school with lower levels of oral language, phonological sensitivity, phonemic awareness, letter knowledge, knowledge of print concepts; all skills which have been associated with much lower reading proficiency (Aram, 2005; Bowey, 1995; Christian, Morrison, & Bryant, 1998; Hood, Conlan, & Andrews, 2008; Korat, Klein, & Segal-Drori, 2006; Spira, Bracken, & Fischel, 2005; Walker, Greenwood, Hart & Carta, 1994). A survey of 2,000 children about six months from entering kindergarten drawn from the 1993 National Household Education Survey (NHES) found there was a significant difference in the skills children bring with them upon school entry. Only 57% of the children from low-SES families showed signs of what they termed literacy indicators (e.g., recognizes most or all letters, pretends to read or reads stories and writes own name) compared to 76% of children from families with higher SES (Zill, Collins, West, & Hausken, 1995). This finding seems to be related to the level of maternal education because only 49% of the children with mothers with less than a high school diploma demonstrated these literacy indicators compared to 74% of the children with mothers with a high school diploma or higher. Similar

findings were reported by the U.S. Department of Education, National Center for Education Statistics (NCES) for a nationally representative sample of 22,000 children entering kindergarten in the fall of 1998. Forty-nine percent of children from families receiving welfare scored in the lowest quartile on a reading assessment (measuring knowledge of print conventions, letter recognition, phonological sensitivity, word reading and comprehension of written text) compared to 22% of children from families who have never received welfare. Fifty-two percent of children with mothers with less than a high school diploma scored in the lowest quartile on the reading assessment compared to 32% for children with mothers with a high school diploma and 8% for children with mothers with a Bachelor's degree or higher (NCES, 2000). In sum, these findings support the contention that children from low-SES families are more likely to enter school with lower levels of oral language, phonological sensitivity, phonemic awareness, letter knowledge, and knowledge of print concepts than their same age peers from higher SES families.

Matthew Effect

The difference in entry skills is expected to create a cumulative advantage for children from higher SES families, with superior entry skills leading to a faster rate of growth in future skill development, often called the *Matthew Effect*. This "rich get richer" or *Matthew Effect* model was first proposed by Merton (1968) to explain variation in scientific productivity. Merton developed this principle drawing from the Gospel of Matthew (25:29; KJV- "For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath"). His observations of career advancement in scientific fields led him to conclude that the initial advantage of working with prominent scientists in prestigious universities leads to better job placement and more frequent citations in the scientific literature.

Over time this early advantage provides cumulative benefits such that these better known individuals receive greater recognition for similar scientific observations or discoveries than their less well-known peers. Walberg and Tsai (1983) applied the *Matthew Effect* model to an educational setting and described the cumulative advantages of early educational experiences for later science achievement. Their "fan-spread" hypothesis suggested that rates of gain are relative and proportional to initial endowment and when plotted over time the increasing variance will lead to a fan-spread of data points. Based on these earlier findings, Stanovich (1986) concluded, " [this] cumulative advantage phenomenon is almost inextricably embedded within the developmental course of reading progress." Students entering school with fewer reading skills would be at a decided disadvantage when compared to their more skilled peers.

The *Matthew Effect* model of Stanovich (1986) can be described as a set of interrelated mechanisms: reciprocal causation, developmentally limited relationships and organism-environment correlation. Reciprocal causation occurs when individual differences in a particular process cause differential gains in reading efficiency and in turn reading itself causes further individual differences in the process in question. For example, phonological awareness is necessary to gain sufficient early word recognition skills that lead to reading independence. Reading itself facilitates increased phonological awareness and better word recognition skills. Further, the additional practice in reading gained by the more proficient reader leads to a more rapid development of reading fluency. Higher rates of fluency reduce the cognitive demands of reading and allow these cognitive resources to be allocated to the higher-level processes of text integration and comprehension. Reading then facilitates further growth in reading comprehension ability by increasing general knowledge, improving syntactic awareness and augmenting vocabulary. However, Stanovich (1986) suggests these relationships are

developmentally limited. That is, individual differences in processes that cause variance in reading ability early in development at some point cease to be causal factors. Although phonological awareness is critical early in the reading developmental trajectory, it becomes less important as direct visual access predominates and is less likely to be related to differences in reading ability in middle school and beyond. Finally, Stanovich (1986) describes the effects of three types of organism-environment correlations: active, evocative and passive. Active organism-environment correlations occur when individuals select and shape their environment by the choices they make. Students experiencing early success in reading are more likely to find reading enjoyable and be motivated to engage in reading activities. These children create environments that are conducive to continued improvement in reading by associating with peers who also enjoy reading, gaining access to reading materials, and finding opportunities to read. This is not usually the case for children who have struggled to develop reading skills; these children usually find reading aversive and lack motivation to engage in reading activities. Evocative organism-environment correlations occur when the individual evokes certain responses from the environment. Successful readers who enjoy reading are likely to evoke more support from family members, teachers and peers than less successful readers. Finally, a passive organism-environment correlation is a relationship between the individual and the environmental quality that is completely beyond the control of the individual. For instance, innate ability, neighborhood environment, or the quality of education they receive. Stanovich (1986) predicted the effect of these mechanisms would inevitably lead to a "rich get richer" or cumulative advantage phenomenon within reading development, such that children entering school with higher early reading skills would develop reading proficiency at a faster rate.

This differential in skill growth should lead to divergent achievement over time, possibly explaining the substantial discrepancy in reading achievement found between children from different socioeconomic backgrounds. Juel (1988) provided evidence for this "cumulative advantage" reporting the probability that a child would remain a poor reader at the end of fourth grade if a child was a poor reader at the end of first grade was .88, and the probability that a child would become a poor reader in fourth grade if the child had average reading skills in first grade was .12. Cunningham and Stanovich (1997) provided support for a reciprocal relationship between reading and print exposure. The first grade reading of 27 children from a predominately middle-class school predicted significant variance in the eleventh grade print exposure when controlling for eleventh grade reading comprehension and cognitive ability. The speed of initial reading acquisition was moderately correlated with reading comprehension (.44), vocabulary (.37), print exposure (.48) and general knowledge (.33) in the eleventh grade. A more recent study (Durham, Farkas, Hammer, Tomblin, & Catts, 2007) indicated kindergarten language skills have a statistically significant association with the development of reading skills in second and fourth grade. The oral language skills measured in kindergarten explained 75% of the variance in second grade reading scores and an additional 26% of the variance in fourth grade even when controlling for the effect of second grade scores. This finding is substantial considering the second grade reading scores explained 68% of the variance in fourth grade scores.

Other studies have also shown a significant relationship between various measures of early reading skills and later reading achievement, but explaining considerably less variance than the study conducted by Durham and colleagues. An Australian study of 479 children from nine schools indicated that letter naming and phonemic segmentation measured at the beginning of kindergarten explained 51 percent of the variance in first grade reading achievement (Share,

Jorm, Maclean, & Matthews, 1984). Another study looking at the reading development of 286 Australian children from Kindergarten to the end of sixth grade showed that early reading skills measured in kindergarten (e.g., letter naming, phonemic awareness, sentence memory and vocabulary) were the single most important predictor of reading ability in sixth grade. Students who were the poorest readers in the early years of elementary school remained the poorest readers at the end of sixth grade. The kindergarten measures explained 34 percent of the variance in first and second grade reading scores and 49 and 44 percent of the third and sixth grade reading scores (Butler, Marsh, Sheppard, & Sheppard, 1985). A study of 95 students from two schools in North Carolina showed that early reading skills (e.g., alphabet recognition, concept of word in text, spelling with beginning and ending consonants, and word recognition) in kindergarten predicted up to 31 percent of the variance in reading achievement in first and second grade (Morris, Bloodgood, & Perney, 2003). A study of 38 Israeli students from a predominately low-SES population showed early reading skills (e.g., word recognition, word writing, orthographic awareness, phonological awareness) measured in kindergarten were highly correlated with reading skill at the end of second grade (e.g., spelling, word writing, text reading and reading comprehension), explaining 27 percent of the variance in second grade reading scores (Aram, 2005).

According to this cumulative reading trajectory model, children from low-SES backgrounds entering school with less proficient skills would be at a distinct disadvantage in relation to their more proficient peers. Effective intervention should of necessity be targeted at reaching "at-risk" populations early in their educational trajectories. If rates of gain are relative and proportional to initial endowment, strengthening the early reading skills of children from low-SES families should lessen the academic gap by placing these children on an equal footing

with their more advantaged peers. As stated in the 1998 national report, *Preventing Reading Difficulties in Young Children* (Snow, Burns & Griffin, 1998):

> Primary prevention steps designed to reduce the number of children with inadequate literacy-related knowledge (e.g., concepts of print, phonemic awareness, and receptive vocabulary) at the onset of formal schooling would considerably reduce the number of children with reading difficulties and, thereby, the magnitude of the problem currently facing schools.

This sentiment continues to be echoed in more recent research published in the *Journal of School Psychology* (Al Otaiba et al., 2008):

> Additionally, converging research findings have demonstrated that reading trajectories, which are established early in children's school careers, are remarkably stable and therefore difficult to change. Specifically, the success with which children acquire foundational skills in two domains of early literacy – code-focused skills (letter knowledge and phonemic awareness) and meaning-focused skills (oral language and comprehension) - shapes their future reading development. A gap between weak and strong reading achievement in these two domains begins early and subsequently widens over the elementary years and becomes increasingly difficult to close, particularly after third grade. Our increasing knowledge about the difficulty of remediating poor reading achievement has led to a heightened focus on preventing reading difficulties by helping children in first grade with established emergent literacy and reading readiness skills.

National Policy Implications

The *Early Reading First* (Title I, Part B, Subpart 2) and the *Reading First* (Title I, Part B, Subpart 1) initiatives were created in 2002 as part of the *No Child Left Behind Act* (P.L. 107-110) in an attempt to eliminate discrepancies in reading achievement between children from low-SES families and their more advantaged peers. The *Early Reading First* initiative provides federal monies to help early childhood centers that serve children from low-income families to more effectively provide support for pre-school children's early language and pre-reading skills. The *Reading First* initiative is a billion dollar a year federal reading program providing federal grant money to low-income, low-performing schools to support evidence-based reading interventions designed to ensure all children learn to read proficiently by third grade. The goal of these programs are laudable if, as stated above, future academic success can be predicted with reasonable accuracy by third grade reading proficiency (Snow, Burns & Griffin, 1998), but early evaluations of these initiatives have found that children are not making as many gains as hoped. While the *National Evaluation of Early Reading First: Final Report* (Russell et al., 2007) found that this program had a statistically significant positive effect (effect size of .34) on children's print and letter knowledge, there was no significant effect on phonological awareness or oral language, both early reading skills strongly associated with later reading achievement (Adams, 1990; Anthony & Lonigan, 2004; Burgess, Hecht, & Lonigan, 2002; Lonigan, Burgess, & Anthony, 2000). Further, the *Reading First Impact Study: Interim Report* (Gamse, Bloom, Kemple, Jacob, 2008) indicated significant increases in instructional time spent on the five essential components of reading instruction, but failed to show any increases in reading achievement. These findings are consistent with earlier research showing that children with weak oral language and impoverished home environments are less likely to respond to early literacy

instruction (Al Otaiba et al., 2008; Al Otaiba & Fuchs, 2002; Lonigan, 2003; Torgeson, 2000; Torgeson et al., 1999). While these programs are fairly new and more time or some adjustments may be needed to see the expected gains, it is still unclear if providing early intervention to place these children on an equal footing with their more advantaged peers is sufficient in and of itself to close the gap in reading proficiency long-term. It is clear that more needs to be known about the reading development of children from low-SES families in order to design the most effective interventions for all children.

These federally funded interventions are consistent with a cumulative reading trajectory model (or *Matthew Effect*). An intensive focus on improving the early reading skills of children from low-SES backgrounds is expected to place these children on an equal footing with their more advantaged peers and to therefore improve the reading proficiency of these children long-term. However, if factors other than initial endowment are related to the slower development for children from low-SES families, then early intervention alone may not be sufficient to effectively address the reading deficits typically found in this population. These federal programs are an attempt to address the continued reading difficulties of children from low-SES families, but more needs to be discovered about the reading development of these children. One of the questions that needs to be answered is what trajectories best characterize the reading development of children from low-SES families and is the *Matthew Effect* the most accurate representation of the reading development of all children, especially those from low-SES backgrounds?

Many children who enter school with lower reading skills develop proficient reading without any educational interventions (Aarnouste, Van Leeuwe, Voeten & Oud, 2001; McCoach, O'Connell, Reis, & Levitt, 2006; Phillips, Norris, Osmond, & Maynard, 2002; Scarborough, 1998; Shaywitz et al., 1995; Spira, Bracken, & Fischel, 2005), while a significant number of

children fail to develop reading proficiency despite receiving effective evidence-based interventions (Al Otaiba & Fuchs, 2002; Dally, 2006; Nelson, Benner, & Gonzalez, 2003; Rabiner, Coie, & the Conduct Problems Prevention Research Group, 2000; Torgesen, Alexander, Wagner, Rashotte, Voeller, & Conway, 2001). Further, the presence of a *Matthew Effect* for reading development is much less established than many researchers contend and very few studies have been conducted with populations containing a high proportion of children from low-SES families. While there is some research to support the validity of a *Matthew Effect* in reading (Aram, 2005; Butler et al., 1985; Cunningham & Stanovich, 1997; Durham et al., 2007; Juel, 1988; Morris, Bloodgood, & Perney, 2003; Share et al., 1984), there are an equal number of studies that show children with lower initial reading skills following a cumulative trajectory (Aarnouste et al., 2001; McCoach et al., 2006; Phillips et al., 2002; Scarborough, 1998; Shaywitz et al., 1995: Spira, Bracken, & Fischel, 2005) and even others suggesting that children's reading development may follow many different trajectories (Aunola, Leskinen, Onatsu-Arvilommi & Nurmi, 2002; Leppanen, Niemi, Aunola, & Nurmi, 2004; Lerkkanen, Rasku-Puttonen, Aunola, Nurmi, 2004; Parrila, Aunola, Leskinen, Nurmi, & Kirby, 2005). The divergent findings of this research makes it essential to identify the specific developmental trajectories followed by all children and especially those from low-SES backgrounds. This additional research is needed in order to create the most effective educational interventions to improve the reading proficiency of children from low-SES families.

Trajectories of Reading Development

There has been some limited support for a *Matthew Effect* or cumulative model of reading. Significant correlations between early and later reading achievement have been found in

several studies (Aram, 2005; Cunningham & Stanovich, 1997; Durham et al., 2007 Juel, 1988); however many of these studies have limited generalizability because of small and in some cases biased samples. The Aram (2005) study had a sample of only 38 children and the Cunningham and Stanovich (1997) study had an even smaller sample of 27 children. Juel's (1988) reporting of an .88 probability that a child would remain a poor reader at the end of fourth grade, if a child were a poor reader at the end of first grade has been cited often (413 citations according to *Web of Science Citation Index* and 598 citations according to *Google Scholar*). Although, these finding seem quite compelling, the size and nature of the sample used in this study raises a number of significant concerns. The sample was drawn from one school, in a low-SES, urban, Southern community with a highly transient, unique population (military families) with only 54 participants. Further, the high attrition rate in this study, especially considering the much higher attrition rate among the average to good readers (34%) when compared to poor readers (17%) and the largely minority population (74%) certainly raises questions about the validity of these findings. The study conducted by Durham and colleagues reported findings for 502 children, but 275 of the 502 children in this study were previously diagnosed with a speech and language impairment significantly biasing the results. And, although the results are reported for a sample of 502 children the measures were only obtained for 33% of the sample and multiple imputation was conducted to complete the dataset. The limitations of these studies restrict their generalizability to the larger population. There are however, other studies showing a correlation between earlier and later reading achievement (e.g., Butler et al., 1985; Morris, Bloodgood, & Perney, 2003; Share et al., 1984), but there have been questions about the usefulness of regression analyses to provide empirical support for a *Matthew Effect* in reading (Bast & Reitsma, 1997; Phillips et al., 2002).

Highlighting the lack of clear guidelines for the empirical investigation of the *cumulative model* of reading development (*Matthew Effect*), Bast and Reitsma (1997) suggest that two assumptions must be considered in order to provide appropriate empirical support. First, there must be evidence of increasing individual variation in reading development characterized by a stable rank ordering of individuals and an increase of performance differences across time. Second, this increasing variation in reading achievement must be caused by developmentally limited, reciprocal causal relationships between reading and other cognitive skills, attitudes or behaviors. Regression analyses can only provide empirical evidence of stable rank ordering and does not allow investigation of the relationships that may lead to this outcome.

In an attempt to provide the empirical validation they found lacking, Bast and Reitsma (1998) conducted a study of 235 Dutch children, which provided some limited support for the *Matthew Effect*. A reciprocal causal relationship between reading development and vocabulary development was found. Word recognition skills measured in first grade were associated with more positive attitudes toward reading. Children with more positive attitudes toward reading and a good word recognition level tended to read more frequently during leisure time. The frequency of reading outside of school was associated with the level of reading growth of students at the end of second grade. However this pattern of interrelationships did not lead to the increasing individual differences for reading comprehension predicted by the *Matthew Effect*. Although a *Matthew Effect* (i.e., stable rank order with increasing individual differences) was found for word recognition no such effect was found for other reading related skills. Also, individual differences at first grade did not predict differences in second or third grade indicating that factors that determine initial skill level do not necessarily also determine the continued progress of students in reading.

However a replication study with a very similar sample of approximately 500 students from a stratified sample of Dutch schools (Aarnouste et al., 2001) found no *Matthew Effect* for any reading skill. They followed students' progress in decoding efficiency, reading comprehension and vocabulary from the end of first grade to the end of sixth grade. The results indicated that students who started with less skill actually made more overall progress in all three skill areas than did students with average or high beginning skills. The progress of the low performers greatly exceeded the progress of the other two groups from fall to spring, showing the group of poor readers clearly benefits the most from instruction. A number of other studies have also not supported this relationship between early reading skills and later achievement trajectories consistent with the *Matthew Effect* model (McCoach et al., 2006; Phillips et al., 2002; Scarborough, 1998; Shaywitz et al., 1995: Spira, Bracken, & Fischel, 2005)

A study of a heterogeneous sample of 414 children followed from kindergarten thru sixth grade showed no fan-spread effect for reading development. In fact, children with poorer reading ability in kindergarten showed greater improvement over the course of the study relative to children with better reading ability (Shaywitz et al., 1995). Another study of 64 students tracked from the end of second grade until the end of eighth grade showed that forty-two percent of children identified with a significant delay in reading ability at the end of second grade (1.5 SD below the mean reading score) had improved sufficiently by the end of eighth grade to no longer be considered reading disabled (Scarborough, 1998). A Canadian study of a homogenous sample of 187 students from first to sixth grade showed students who began first grade as poor readers had a .53 probability of becoming an average reader by sixth grade. Further in second grade the results showed a convergence of scores in the average range with a number of below average readers improving and a large percentage of above-average readers dropping into the average

category (Phillips et al., 2002). A study followed 288 children from kindergarten through the end of fourth grade. Half of the sample scored within the average range in reading at the end of first grade. Although the other 146 children scored in the lowest 30th percentile in reading at the end of first grade, a full 30% of these children were within the average range in reading skill by the end of fourth grade. Further, reading achievement at the end of first grade (.42) was only a moderate indicator of reading level at the end of fourth grade (Spira, Bracken, & Fischel, 2005). A more recent study of 8,089 students within 657 schools showed a high correlation among four reading assessments from the beginning of kindergarten until the end of first grade. This finding indicates a high stability over time in the rank order of students in terms of their relative reading skills, but initial status was negatively correlated with reading skill growth in both kindergarten and first grade. Children who entered school with less reading skills experienced more growth than students with higher initial skills. Further, children who made slower growth in kindergarten made greater growth in first grade. Children who entered kindergarten with the lowest skills did not completely close the gap by the end of first grade. It is unclear whether these children would continue to close the gap if the study had been extended (McCoach et al., 2006).

While finding similar accelerated growth for students who began as poor readers, a study conducted in Helsinki, Finland measuring the relationship between self-concept and the growth in reading skills across first grade for 105 students also found three different trajectories. One group of 24 students who had poor entry reading skills and a low self-concept exhibited a positive trend for self-concept and a negative trend for reading skills. The second group of 37 students who began school with a high level of reading skills and a high self-concept experienced a positive trend for self-concept and a negative trend for reading skills. The final group of 44 students who began school with poor entry reading skills, but a high self-concept

showed a positive trend for reading skills and self-concept (Aunola et al., 2002). Another study of 196 Finnish children followed from the beginning of preschool until the end of first grade provided evidence of a cumulative trajectory of reading development in preschool but a compensatory trajectory in first grade, with the poorer readers making greater progress than their more skilled peers. Their findings also indicated that the skills related to reading growth changed from preschool to first grade. While phonological awareness was associated with better reading skills measured at the beginning of preschool, the growth of reading skills in preschool was predicted by letter knowledge and number sense and negatively related to listening comprehension. However, the growth of reading skills in first grade was predicted by listening comprehension and negatively associated with phonological awareness and number sense. Further a cluster analysis of growth trajectories found three distinct trajectories of reading development: a group of 71 who began school with proficient skills and continued to make significant progress; a group of 113 who began with poor skills but who made rapid progress during first grade and a final group of 11 who began with poor skills and continued to struggle throughout the study (Leppanen et al., 2004).

Finally, using cluster analysis a study of 90 children from six elementary classes in 4 schools in Finland revealed three groups of readers: poor readers (poor word reading/poor comprehension), technical readers (good word reading/poor comprehension) and competent readers (good word reading/good comprehension). Only 31% of the students, all from the competent reader group, showed stability in reading skill across all measurement occasions. The remaining 69% showed a number of different developmental trajectories across time, only 3% showing the consistent regression, which would be predicted by the *Matthew Effect* (Lerkkanen et al., 2004). Although the majority of the studies supporting a compensatory development of

reading have been conducted in languages with a more transparent orthography (1) than English, a recent study comparing the results of similar analyses using samples of both English speaking and Finnish speaking students also found support for a compensatory model of reading development for English speaking students (Parrila et al., 2005).

There is clearly substantial diversity in the findings of research examining the reading trajectories of children entering school with poor reading skills. While this inconsistency could be the result of sample selection, the choice of measures used or limitations in the methodology, as argued by Parrila and colleagues (2005) and Bast and Reitsma (1997), it is also possible these differences could be the result of some unmeasured sample characteristic moderating the relationship between instruction and achievement. There is obviously less convergence in research concerning the presence of a *Matthew Effect* for children who enter school with lower initial reading skills. Clearly some research has found that students who enter school with poor reading skills manage to benefit from classroom instruction, while others struggle and continue to fall behind. More recent research seems to indicate that there are many different trajectories of reading development. This research needs to be replicated for American school children and it is important to determine whether and if so, how the reading development of children low-SES families differs from that of their peers from higher SES families. Further, if differences are found it is essential to ascertain what factors are related to these differences in order to design and implement the most effective interventions to address deficits in reading development for this population. Early intervention to address the discrepancy in early reading skill is certainly

1 In transparent orthographies, the mappings from letters to sounds are consistent. In more opaque orthographies, like English, the same grapheme or graphemes may represent different phonemes in different words (and vice-versa). For example in English, "ove" represents different phonemes in the words, *cove, love*, and *move*. For more information see Joshi and Aaron (2006).

important, but it may not be sufficient to completely ameliorate the differences often found in the reading development of children from low-SES families.

SES and Behavior Problems

One such factor may be behavior problems. The same demographic factors related to lower early reading skills are also associated with increased problem behaviors, which may hinder the effectiveness of classroom instruction (Carr, Taylor, & Robinson, 1991; DuPaul et al., 2004; Gunter & Coutinho, 1997; Hamre & Pianta, 2001; Kochenderfer & Ladd, 1996; Lynch & Cicchetti, 1997). The survey of 2,000 children drawn from the 1993 NHES (Zill et al., 1995), which showed that children from low-SES families enter kindergarten with lower early reading skills, also showed that many of these same children have significantly higher levels of problem behavior at school entry. For instance children of mothers with less than a high school diploma are more likely to be restless and fidgety (43% compared to 27%), to have a short attention span (38% compared to 21%) and to have temper tantrums (36% compared to 21%) than their peers with mothers with at least a high school diploma. The same differences are also found between children from poor and non-poor families: restlessness (36% compared to 26%), short attention span (32% compared to 20%), and temper tantrums (28% compared to 21%). This relationship between factors leading to low early reading skills and behavior problems is also found in the NCES (2000) study. Children from poor families were less likely to show prosocial behavior (60% compared to 69%), and more likely to show antisocial behavior (15% compared to 10%), and to be inattentive (47% compared to 32%) than their peers from non-poor families. Further these children showed less task persistence (59% compared to 73%) and less eagerness to learn (62% to 76%) when compared to their peers.

Reading Achievement and Behavior Problems

Behavior problems have been variously defined as inattention, hyperactivity, impulsivity, aggression, defiance, disruptive behavior, lack of self-regulation, task avoidance, delinquency, externalizing behavior or socioemotional impairment. These behaviors are also associated with the psychiatric diagnoses of Attention-Deficit-Hyperactivity Disorder (ADHD), Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) and eligibility for special education as Emotional Behavior Disordered (also known as Emotionally Impaired). Regardless of how they have been defined, behavior problems have consistently been associated with lower reading achievement (Arnold, Goldston, Walsh, Reboussin, Daniel, Hickman et al., 2005; Hinshaw, 1992; McGee, Share, Moffitt, Williams & Silva, 1988; Reid, Gonzalez, Nordness, Trout & Epstein, 2004; Trout, Nordness, Pierce, Epstein, 2003) with anywhere from 50% to 85% of children with reading difficulties also being described as having behavior problems (Frick, Kamphaus, Lahey, Loeber, Christ, Hart, & Tannebaum, 1991; Greenbaum, Dedrick, Freidman, Kutash, Brown, Lardieri et al. 1996; Nelson et al., 2004). Horn and Packard (1985) conducted a meta-analysis of 58 studies that reported correlations between behavior problems in kindergarten or first grade and reading achievement later in elementary school, which indicated that the average correlation between behavior problems and later reading achievement was .48 (inattention = .63; externalizing = .45; internalizing = .59 and social skills = .44). In fact, inattention was more highly correlated with later reading achievement than either language ability (.52) or IQ (.53). The results of another meta-analysis of 26 studies showed that children with behavior problems had significantly lower reading achievement than their peers with an average effect size of -.61 (Reid, Gonzalez, Nordness, Trout, & Epstein, 2004). Wentzel (1993) showed that aggressive and non-compliant behavior in sixth and seventh grade was negatively

correlated with grade point average (-.55), scores on a standardized achievement test (-.35) and with academic behavior (e.g., interest in schoolwork, independent learning and concern with evaluation; -.49). Another study indicated that attention problems (-.38), delinquent behavior (-.31) and aggressive behavior (-.28) were all negatively correlated with reading achievement for adolescents between the ages of 11 and 17 (Barriga, Doran, Newell, Morrison, Barbetti & Robbins, 2002). And Velting and Whitehurst (1997) found that hyperactivity and inattention were negatively related to reading achievement in first grade (-.28) for a group of children from low-SES families. Numerous other studies have linked early behavior problems to continuing academic difficulties and eventual school dropout (Alexander & Entwisle, 1988; Birch & Ladd, 1997; Entwisle & Hayduk, 1988; Kochenderfer & Ladd, 1996; Lynch & Cicchetti, 1997; Pianta, Sternberg & Rollins, 1995).

While the relationship between behavior problems and academic achievement has been well documented (Hinshaw, 1992; McGee et al. 1988; Reid et al., 2004; Trout et al., 2003), the exact nature of the relationship has remained unclear. There are currently four accepted causal models to explain the nature of this relationship (for a review see Dionne, 2005; Hinshaw, 1992; Mandel, 1997; Spira & Fischel, 2005). The first causal model suggests that underachievement and behavior problems are not causally related, but rather some common, unmeasured developmental antecedent may cause both academic underachievement and behavior problems, and the two may have no direct effect on each other. Several developmental antecedent explanations have been offered: auditory comprehension (Benner, Beaudoin, Kinder, & Mooney, 2005); Attention-Deficit-Hyperactivity Disorder (ADHD; Clark, Prior, Kinsella, 2002; Saudino & Plomin, 2007); a common underlying genetic factor (Willcutt & Pennington, 2000); or a common underlying environmental factor (Hinshaw, 1992; Trzesniewski, Moffitt, Taylor,

Maughan, & Caspi, 2006). The second causal model suggests that underachievement leads to behavior problems. A history of academic failure may lead to frustration, low self-esteem, and negative attitudes toward learning leading toward task-avoidant and acting out behaviors (Arnold, 1997; Fleming, Harachi, Cortes, Abbott, & Catalano, 2004; McGee & Share, 1988; McIntosh, Horner, Chard, Boland, & Good, 2006). The third causal model suggests that behavior problems lead to underachievement. Off-task and disruptive behaviors decrease the student's ability to attend to and benefit from instruction (Dally, 2006; Deater-Deckard, Mullineaux, Petrill, Thompson, 2009; Rabiner, Coie, & the Conduct Problems Prevention Research Group, 2000; Torgesen, Alexander, Wagner, Rashotte, Voeller, & Conway, 2001). The fourth and final causal model suggests that a reciprocal relationship exists between reading and behavior problems. In this model, regardless of the primacy of either causal factor, academic failure is expected to lead to increasing academic disengagement thus exacerbating future academic and behavior difficulties (McGee, Prior, Williams, Smart & Sanson, 2002; Onatsu-Arvilommi & Nurmi, 2000; Rowe & Rowe, 1992; Stipek & Miles, 2008; Trzesniewski et al., 2006).

The above studies provide evidence both supporting and contradicting each of the four proposed causal models. The multitude of studies examining this relationship have used samples of varying ages and backgrounds, widely divergent definitions of behavior problems and academic achievement and a variety of methodological approaches (Hinshaw, 1992; Spira & Fischel, 2005) making it quite likely that all of these models are correct to some degree for specific populations. Disentangling the association between reading difficulties and behavior problems is often complicated by the complex, multicausal nature of these frequently comorbid difficulties, and providing conclusive evidence in support of only one causal model is often problematic (Hinshaw, 1992). With that in mind the goal of this study is not to invalidate any of

the above causal models explaining the relationship between academic achievement and behavior problems, but rather to develop a better understanding of the reading development of children from low-SES backgrounds by examining the role of behavior problems in that development. There is evidence that early behavior problems that predate school entry or that occur before the child has experienced a history of learning failure are associated with slower growth in reading skills (Deater-Deckard et al., 2009; Rabiner, Coie et al., 2000; Smart et al., 2001). There is also evidence that children with behavior problems have more difficulty effectively engaging in classroom instruction (Baker, Clark, Maier, & Viger, 2008; DuPaul & Stoner, 1994; Hamre & Pianta, 2001; Mantzicopoulos, 2005; Rothbart & Bates, 1998) and often do not benefit from evidence-based reading interventions (Al Otaiba & Fuchs, 2002; Nelson, Benner, & Gonzalez, 2003; Rabiner, Malone et al., 2004; Torgeson, Wagner, Rashotte, Rose, Conway, & Garvan, 1999). This is not to say that the comorbid behavior problems of children from low-SES families are the cause of their reading difficulties, but it certainly points to the need for a closer examination of this relationship.

Many children from low-SES families enter school with increased behavior problems (NCES, 2000; Zill et al., 1995) and as mentioned previously there is evidence that behavior problems are related to slower reading development. The exact nature of this relationship is unclear, but active engagement during classroom instruction is critically important for academic success, particularly in the area of reading (McGee & Share, 1988; Rowe & Rowe, 1992; Warner-Rogers, Taylor, Taylor & Sandberg, 2000). Children with higher parent ratings of effortful control (measuring attention focusing, inhibitory control, low intensity pleasure and perceptual sensitivity) showed greater growth in reading skills (.20) than children who were rated lower in effortful control (Deater-Deckard, Mullineaux, Petrill, & Thompson, 2009). Behavior

problems can lead to downward deflections in achievement across time (Jimerson, Egeland, & Teo, 1999) and a lack of behavior problems is associated with improvement in reading after encountering difficulties in first grade (Spira, Bracken, & Fischel, 2005). A Finnish study indicated that children in preschool who were rated as less task-oriented, more ego-defensive and more socially dependent were more likely to be poor readers at the end of second grade (Poskiparta, Niemi, Lepola, Ahtola, & Laine, 2003). An Australian study demonstrated the persistence of reading difficulties from second to sixth was significantly related to early behavior problems (Smart, Prior, Sanson, & Oberklaid, 2001). Rabiner, Coie and colleagues (2000) demonstrated that inattention measured in early Kindergarten was negatively associated with reading achievement in later Kindergarten (-.29) and first grade (-.29) when controlling for IQ and earlier reading skills. Additionally, teacher ratings of attention in second grade were associated with fifth grade reading (-.10). There was some evidence of a reciprocal relationship with Kindergarten reading being negatively associated with first grade ratings of inattention (-.18). However, when additional analyses were conducted to determine the nature of the causal relationship between reading and inattention, they only found a significant causal pathway between inattention and reading achievement with inattention associated with decreases in reading achievement from -.52 to -.86. Yet there is also evidence of a reciprocal relationship. A Finnish study (Onatsu-Arvilommi & Nurmi, 2000) showed that high levels of task-avoidant behavior measured before school entry predicted lower levels of reading skills across first grade, both from Time 1 to Time 2 (-.24) and from Time 2 to Time 3 (-.19). In turn, a low level of reading skills at school entry predicted a high level of task-avoidant behavior from Time 1 to Time 2 (-.18), but not from Time 2 to Time 3 (-.07). Another Finnish study indicated that children with lower reading skills had higher rates of externalizing and internalizing problems

across preschool and first grade. Additionally both externalizing and internalizing behavior were related to substantially lower levels of reading performance at the end of first grade (Halonen, Aunola, Ahonen, & Nurmi, 2006). Stipek and Miles (2008) demonstrated that aggression had a negative effect on achievement through reductions in task engagement associated with heightened teacher conflict related to the student's heightened level of aggression, but they also found that lower achievement showed a weak association with increased aggression. Finally, another American study (Trzesniewski et al., 2006) found that earlier behavior problems were associated with lower levels of reading achievement at age 7, but they also found that early reading skills were associated with a higher rate of behavior problems between ages 5 and 7. Clearly, the presence of early behavior problems is associated with slower reading development, which may in turn create a reciprocal relationship between reading development and behavior problems, with continued academic failure leading to increased behavior problems.

Behavior problems often emerge before school entry and can be associated with later academic achievement. Arnold (1997) demonstrated the correlation between disruptive behavior and early academic skills was -.37 at age 3 and grew to -.84 by age 6. Students who exhibit early behavior problems often lack the necessary skills to meet the academic and behavioral demands of the typical classroom (DuPaul & Stoner, 1994, Rothbart & Bates, 1998). Early behavior problems are strongly associated with self-regulation difficulties (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; Eisenberg et al., 2000), which means the individual has difficulty focusing or shifting attention, demonstrating persistence on tasks, activating or inhibiting behavior, and responding adaptively to novel situations (Rothbart & Bates, 1998). These deficits in self-regulation have a profound impact on the classroom behavior of these students. Rather than appropriately engaging in academic tasks, they are typically involved in other disruptive

non-academic behavior (e.g., noncompliance, aggression, inattention, impulsivity, hyperactivity, arguing, and rule breaking; Abikoff et al., 2002; Junod et al., 2006; Waller, 2006). These difficulties preclude the active involvement in classroom tasks that facilitate learning for these students.

Students who exhibit early behavior problems typically have lower rates of academic engagement (DuPaul et al., 2004). This is unfortunate because student engagement is one of the best predictors of academic achievement (Fredericks, Blumenfeld, & Paris, 2004; Greenwood, Horton, & Utley, 2002). In one study, 44% of elementary students and 75% of middle school students who reported higher levels of engagement had higher levels of academic achievement (Klem & Connell, 2004). Students who are academically engaged are better able to benefit from classroom instruction and have higher rates of time on task (Blair et al., 2004; Karweit, 1989). Further, engaged students are afforded additional opportunities to participate in academic tasks (DiPerna, Volpe, & Elliot, 2002) and have more supportive relationships with teachers (Good & Brophy, 1994). These factors consistently predict higher achievement (Gest, Welsh, & Domitrovich, 2005; Leach & Dolan, 1985). Conversely, lack of engagement is associated with a number of negative outcomes such as higher disciplinary rates, absenteeism, and school dropout (Croninger & Lee, 2001; Finn, 1989; Finn & Rock, 1997).

Further children with behavior problems often develop negative, conflictual relationships with teachers, which further hinders their academic performance (Birch & Ladd, 1997; Ladd & Burgess, 1999; Pianta, Steinberg, & Rollins, 1995). The social interactions of these children tend to be abrasive and uncooperative (Dishion et al., 1995; Patterson et al., 1992). Further, they typically exhibit more inappropriate, disruptive behavior and are less likely to comply with teacher requests (DeMartini-Scully, Bray, & Kehle, 2000). Teachers find interacting with these

students to be aversive (Carey, 1998; Gunter & Coutinho, 1997) and respond to them with less support and more punishment than other children (Brophy & Evertson, 1981; Little & Hudson, 1998). The majority of the interactions these students have with teachers are negative or neutral (Jack et al., 1996). These students rarely receive praise for appropriate behavior (Shores et al., 1993), and teachers are more likely to respond to their inappropriate behavior with aversive consequences (Wehby et al., 1993). Van Acker, Grant and Henry (1996) showed that students with behavior problems received little attention for appropriate behavior whereas they often received reprimands for inappropriate behavior. Brendgen and colleagues (2006) demonstrated that 15% of the students in their study, primarily boys who displayed antisocial and inattentive behavior, experienced psychological abuse from the teacher in the form of verbal attacks on the student's character or ability (e.g., name calling, yelling, or public ridicule) or as acts of neglect (e.g., ignoring). In a recent publication Jenson and colleagues (2004) described classrooms as a "sea of negativity" for students with behavior problems.

The relationship that students form with teachers is an important source of stress or support within the classroom environment and can have a significant influence on the students' school performance. Students who have a close relationship with their teacher, characterized by warmth, affection, and open communication, have higher rates of classroom participation, school liking, cooperation in the classroom and self-directed behavior. In contrast, students who have more conflictual relationships with their teacher, marked by a pattern of discordant relationships through negative interactions and cognitions, have lower rates of these positive classroom behaviors but higher rates of attention problems, classroom misconduct, aggression, school avoidance, and disciplinary issues (Birch & Ladd, 1997; Ladd & Burgess, 1999; Ladd & Burgess, 2001; Mantzicopoulos, 2005; Murray & Murray, 2004; Pianta and Steinberg, 1992;

Pianta, Steinberg, & Rollins, 1995). Also a student's ability to gain academic assistance through appropriate classroom interactions is strongly related to the student's emotional security with the teacher (Lynch & Cicchetti, 1997; Pallas et al., 1987; Pianta, 1992; Pianta & Nimetz, 1991) so students with more negative teacher-student relationships are less likely to be able to effectively use the teacher as a source of academic support (Newman, 1990; Newman & Schwager, 1993).

Teachers are also likely to modify their interactions with students with disruptive behavior problems, influencing the quality and quantity of instruction received by these students (Carr, Taylor, & Robinson, 1991; Good & Brophy, 1994; Gunter & Coutinho, 1997; Shores, Gunter, & Jack, 1993; Walker et al., 1998; Wehby et al., 1998). In 1991, Carr and colleagues conducted a small study examining teacher interactions with four problem students (students with a history of disruptive behavior problems) compared to their interactions with four more average students with no history of disruptive behavior. They found that teachers tend to alter their method of teaching when interacting with children perceived to have disruptive behavior problems. Teachers had a median number of 377 (range of 295 to 506) intervals of instructional behavior for average students compared to a median number of 226 (range of 69 to 323) intervals of instructional behavior for problem students. Teachers presented a median number of 147 (range 88 to 205) task commands to average students compared to a median number of 61 (range of 0 to 115) task commands to problem students. The findings also demonstrated that the content of instruction offered by the teachers differed for problem students when compared to average students. Teachers presented all eight possible tasks to average students but only 2 out of 11 teachers presented all eight tasks to the problem student; in fact only 16.9% of the total instruction offered to problem students would be considered challenging (Carr, Taylor, & Robinson, 1991). The findings cannot be considered conclusive because of the small sample size.

However these findings do suggest that teachers alter their interactions with students with disruptive behavior problems in significant ways.

Students who enter school with behavior problems are at a distinct disadvantage. They lack the necessary self-regulatory skills to effectively engage in classroom instruction; they often have more negative, less supportive relationships with teachers and they can receive lower quality instruction. It is quite possible the persistence of reading difficulties for children from low-SES families is related to the strong association between reading difficulties, behavior problems and disadvantaged circumstances. These children who enter with much lower skills and are therefore in much greater need for quality instruction may be less able to benefit from the instruction received (Clark, Baker, Grant, 2007; Gettinger, 1985; Gettinger & Seibert, 2002). A study evaluating the effectiveness of three instructional approaches for improving the reading skills of young children with weak phonological skills found that 24% of the children did not show significant improvement even using the most effective instructional approaches. Further analyses to identify specific individual factors that predicted response to the reading interventions indicated the most consistently important variables were rapid naming, home background and classroom behavior ratings (Torgeson et al., 1999). In a review of similar research studies Al Otaiba and Fuchs (2002) found that anywhere from 8% to 80% of children who were at risk for reading difficulties did not benefit from generally effective reading interventions. Attention was listed among the factors related to non-response in 7 out of 9 of the studies reviewed. A meta-analysis of 30 studies (Nelson, Benner, & Gonzalez, 2003) identifying learner characteristics that influence the treatment effectiveness of early literacy interventions supported these earlier findings. This meta-analysis revealed that the presence of behavior problems was moderately correlated (standardized effect size = .46) with the failure of these

interventions. Further the strength of this relationship was second only to rhyming (.53) and rapid naming (.51) making behavior problems a stronger predictor of persistent reading difficulties than phonological awareness (.42), alphabetic principle (.35), memory (.31) and IQ (.26). Finally, a study by Rabiner, Malone and colleagues (2004) confirmed a relationship between the persistence of reading difficulties and behavior problems. Children from disadvantaged backgrounds were provided a phonics-based, mastery-oriented reading intervention designed to promote the skills of students with low school readiness. The impact of the tutoring on reading achievement was greatest for children with low externalizing behavior problems. For children whose behavior problems approached clinically significant levels, the impact of tutoring on reading achievement was minimal. The reading achievement for students who were poor early readers with comorbid behavior problems was significantly worse than any other groups (students with behavior problems and no reading difficulties and students with reading difficulties but without behavior problems) even for students receiving a reading intervention.

These findings may highlight the need to learn more about the relationship between low-SES and slower reading development. Most of the current focus on addressing the deficits in reading proficiency for this population is related to a belief in a *Matthew Effect,* for example the federally supported reading intervention programs, *Reading First* and *Early Reading First.* However, if behavior problems are associated with slower reading development and if the presence of behavior problems is associated with the lower effectiveness of evidence-based literacy interventions, as many of the studies discussed above seem to suggest, then early reading intervention alone may not be sufficient to ameliorate the reading deficits commonly observed among children from low-SES families. Early evaluations of these federally funded programs

may also point to the need for more information about the relationship between low-SES, behavior and reading development. Although the *Reading First Impact Study: Interim Report* (Gamse, Bloom, Kemple, & Jacob, 2008) indicated significant increases in instructional time spent on the five essential components of reading instruction, it failed to show any increases in reading achievement. While there may be many reasons for these findings, it is interesting to note that the average academically engaged time in the observed classrooms was only 46.9% for the first graders and 49.7% for the second graders, which is considerably lower than what would be expected. Prior research indicates that the typical level of task engagement in general education classrooms ranges from 75% to 85% (Rich & Ross, 1989; Walker & Severson, 1990). Children may link this lower task engagement to the higher rate of behavior problems experienced from low-SES backgrounds. The substantial evidence indicating the detrimental influence of behavior problems on the effectiveness of instruction, especially considering the influence of comorbid behavior problems on reading development, underscores the critical need for a better understanding of the environmental factors related to both the reading development and the behavioral adjustment of children from low-SES families.

Summary and Hypotheses:

Reading development is a critical skill for participation in American society, yet children from low-SES families have historically had significantly lower reading achievement when compared with their peers (Bowey, 1995; Lonigan et al., 1998; Lee, Grigg & Donahue, 2007; Molfese, Modglin, & Molfese, 2003; Whitehurst, 1997). Concerns over these achievement deficits have led to an increased focus on providing early intervention to improve the early reading skills of these children, with the expectation that this approach would considerably

reduce the number of children with reading difficulties (Burns, Griffin, & Snow, 1999; Entwisle & Alexander, 1993; McCardle, Scarborough, & Catts, 2001; Shonkoff & Phillips, 2000; Snow, Burns & Griffin, 1998; Storch & Whitehurst, 2002; Torgeson, 2002). These recommendations are based upon the belief in a *Matthew Effect* for reading, in which the lower early reading skills of children from low-SES families at school entry is expected to create a cumulative disadvantage in reading achievement over time. However, there has only been limited support for a *Matthew Effect* in reading (Aram, 2005; Cunningham & Stanovich, 1997; Juel, 1988; Durham et al., 2007) and several of these studies have significant limitations. Other research has supported a *compensatory model* of reading development in which the children, who enter school with lower skills, actually show the greatest rate of growth and may follow multiple trajectories of reading development (Aarnouste et al., 2001; Aunola et al., 2002; Leppanen et al., 2004; Lerkkanen et al., 2004; Parrilla et al., 2005; Phillips et al., 2002; Shaywitz et al., 1995; Spira, Bracken & Fischel, 2005). The increased focus on providing early intervention to increase the early reading skills of children from low-SES families makes sense but the focus on addressing deficits in early reading skills may be too narrow. It is also important to consider other factors that may be influencing reading development

> **Hypothesis 1:** Children will follow multiple trajectories of reading development. Some children from low-SES families, who enter school with lower initial reading skills, may follow a cumulative trajectory of reading development, consistent with the *Matthew Effect.* However, it is expected that the majority of these children will follow a cumulative trajectory of reading development through kindergarten, but show a compensatory developmental trajectory in later grades.

Yet merely identifying the reading trajectories of children from low-SES families is insufficient to support the creation of effective interventions for these children, because this narrow focus on reading development ignores the larger context of development within a low-SES family. Children from low-SES families are also more likely to enter school with increased behavior problems (NCES, 2000; Zill et al., 1995) and these comorbid behavior problems are likely to decrease the effectiveness of classroom instruction in reading and specific interventions for reading deficits (Al Otaiba & Fuchs, 2002; Barriga et al, 2002: Deater-Deckard et al., 2009; Rabiner et al., 2004; Reid et al., 2004; Spira, Bracken & Fischel, 2005; Torgeson et al., 1999; Velting & Whitehurst, 1997).

Hypothesis 2: The presence of comorbid behavior difficulties is expected to be associated with distinct reading trajectories for children from low-SES families.

1) Children who enter school with low early reading skills, but no comorbid behavior problems are expected to show a *compensatory trajectory* of reading development.

2) Children who enter school with average early reading skills, but a comorbid behavior problem are expected to show a slower rate of growth.

3) Children who enter school with both low early reading skills and behavior problems are expected to show the slowest growth in reading and may follow a *cumulative trajectory*.

4) Children who show decreases in behavior problems after school entry are also likely to see a concomitant improvement in reading achievement; conversely the

later emergence of behavior problems is expected to be associated with declines in reading growth trajectories.

CHAPTER 3

METHOD

Participants

The sample for this study was drawn from the Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K). This study, developed under the sponsorship of the United States Department of Education National Center for Education Statistics (NCES), is following a nationally representative cohort of children from kindergarten into high school. It provides a comprehensive picture of children's early family, neighborhood, and school experiences over time. During the fall of the 1998-99 school year, the base year of data collection, a national probability sample of 21,260 children was recruited from 1,277 kindergarten classrooms in about 800 public and 200 private schools. They were assessed at entry to kindergarten and in the spring of their kindergarten year. Two more waves of data were collected in the fall and spring of the 1999-2000 school year when most, but not all, of the base year children were in first grade. The fall-first grade data collection was limited to a 30 percent sub-sample of schools, but the spring-first grade data collection contained the full sample. A fifth wave of data was collected in the spring of the 2001-02 school year and a sixth wave of data was collected in the spring of the 2003-2004 school year when most of the sampled children were in third grade and fifth grade respectively. A sub-sample of 17,565 children was retained in the longitudinal kindergarten to fifth grade sample.

Given the nature of longitudinal data collection, there is a large amount of missing data for the outcome measures (8,696 children missing IRT scores and 10,306 children missing teacher ratings of behavioral adjustment for at least one of five assessment data points). To determine the nature of the missing data a series of comparisons were ran on the outcome measures and various demographic variables. The students who were missing data had

significantly lower reading scores (see Table 1) and higher teacher rated behavior problems (see Table 2) across all time points. These children were also more likely to come from families with lower socioeconomic status and have parents with less education (see Table 3). Additionally, proportionally more single parent, non-English speaking and minority families were excluded. The nature of the missing data precluded conducting techniques (e.g., multiple imputation, hot deck imputation, etc.) to replace the missing data (Little & Rubin, 1987). It is also important to note that because the students that were retained for further analysis were significantly different in many respects from those that were excluded because of missing data, the resulting analytic sample is not representative of American school children. The final sample to be used in this study consists of 6,698 children (see Table 4 for demographic information).

Measures

Child Outcomes

Reading Achievement. One-on-one, untimed direct child assessments, taking between 50 to 96 minutes, were administered using both hard-copy instruments and computer-assisted personal interviewing (CAPI). Prior to each assessment period, assessors (anywhere from 102 to 343 in number depending on the assessment period) and field supervisors (anywhere from 39 to 112 in number) were trained through 8 hours of home study focused on study design, field procedures and computer keyboard skills followed by several in-person training sessions. These in-person training sessions included an overview of study activities to date, interactive lectures based on the direct child assessments and the parent interview, practice parent interviews in pairs using role-play scripts, practice direct child assessments using role-play scripts, direct child assessment pre-certification exercises on each form of the direct child assessments, training on appropriate use of standardized procedures, techniques for parent refusal avoidance, and

strategies for building rapport with children. All assessors and field supervisors were required to complete a two-step certification process before data collection began to ensure all direct child assessments were completed in a standardized manner. The first step of the certification process was the completion of written exercises on each level form of each of the assessment domains. Assessors completed written exercises following an interactive lecture and individual practice with each form of an assessment domain. Each exercise required the trainees to score an assortment of possible responses to certain assessment items from the level form that was most recently discussed. Assessors who did not achieve a passing score were asked to attend an additional training session to review the items and then retook the same exercises they had previously failed. In the second stage of the certification process the assessors were observed conducting a direct child assessment with children brought on site to the training session. Trainers rated the assessors on skills such as rapport with the child, avoidance of coaching or use of inappropriate probing, following proper administration procedures, and pacing. While the assessor administered the assessment, an observer certified on the assessment simultaneously coded the child's answers to pre-selected open-ended questions. After the assessment was completed, the answers recorded by the assessor were compared with those recorded by the observer. Discrepancies in any of the recorded answers were included in the assessor's overall score on a certification form. Assessors who scored 85 percent or above were certified qualified to administer the child assessments; those who failed to reach this standard were re-certified following remedial training (Tourangeau et al., 2006).

The field staff was organized into work areas, with each data collection team consisting of one field supervisor and two or more assessors. Continuous quality assurance procedures were employed during all data collection activities, but with a particular focus on the assessments.

Field supervisors conducted two on-site observations of the child assessments for each assessor. During these observations the assessor was evaluated on the rapport building skills, the compliance with appropriate standardization procedures and the scoring of protocols. Feedback was provided to the assessors on the strengths and weaknesses of their performance and, when necessary, remedial training was provided in areas of weakness. The field supervisor, as a part of the child assessment observations, completed "validation items," which were at least one item that both the observer and the assessor scored. The items that were scored by both the assessor and observer had open-ended responses that called for interpretation on the part of the assessor to determine whether a child's response was correct. A measure of interrater reliability was obtained by comparing the extent to which assessors and observers agreed on the scoring of these "validation items." The interrater reliability for these "validation items" was fairly high with the lowest being .96.

Prior to direct child assessment during kindergarten and first grade, a language-screening assessment, the *Oral Language Development Scale (OLDS;* Duncan & De Avila, 1998) was administered to those children identified from their school records (or by their teacher if no school records were available) as coming from a language minority background (meaning that their primary home language was not English). This screening test was used to determine the child's proficiency in the English language. Children who passed the language screener received the full English direct assessment battery. Children who did not pass an established cut score on the language screener received a reduced version of the assessment battery, which did not include a reading assessment. These students are not included in the analyses because they did not have reading data available for the first assessment.

Reading assessments were individually administered at all five time points (i.e. fall & spring kindergarten, fall & spring of first grade, spring of third and fifth grade). A team of elementary education specialists developed the pool of test items. Test items were reviewed by elementary school curriculum and content area specialists for appropriateness of content and difficulty, and for relevance to the test framework. In addition, items were reviewed for issues related to sensitivity to minority concerns. Items that passed these content, construct, and sensitivity screenings were field tested before being administered to the participants. The validity of the content in the ECLS-K item pools was established by comparing the results of the ECLS-K with scores on the *Woodcock-McGrew-Werder Mini-Battery of Achievement* (MBA; Woodcock, McGrew, & Werder, 1994) that was also administered during the field test. The reliability between the MBA and the reading assessments were between .73 and .77 (no further information was provided regarding field test procedures or sample sizes). At each assessment period new items were chosen to extend the longitudinal scales and there were grade-appropriate changes in content and format. For example, in the kindergarten and first-grade reading assessment, children read short sentences. By fifth grade, the new passages were more complex and more text was presented on a single page than had been the case in the third-grade reading assessment.

A two-stage assessment approach was used; children's responses from an 18-25 item routing test were used to select the appropriate difficulty level of the second stage form. The kindergarten and first grade reading assessment contained five proficiency levels reflecting a progression of skills and knowledge: 1) identifying upper- and lower-case letters of the alphabet by name; 2) associating letters with sounds at the beginning of words; 3) associating letters with sounds at the end of words; 4) recognizing common "sight" words; and 5) reading words in

context. The third-grade reading assessment also included five proficiency levels: two retained from the kindergarten and first-grade assessments, recognizing common "sight words" and reading words in context; plus three new levels 1) making inferences using cues that were directly stated with key words in text (literal inference); 2) identifying clues used to make inferences (extrapolation), and using personal background knowledge combined with cues in a sentence to understand use of homonyms; and 3) demonstrating understanding of author's craft and making connections between a problem in the narrative and similar life problems (evaluation). The fifth-grade reading assessment included three items from the third-grade assessment: making inferences using cues that were directly stated with key words in text (literal inference); identifying clues used to make inferences (extrapolation), and using personal background knowledge combined with cues in a sentence to understand use of homonyms; and demonstrating understanding of author's craft and making connections between a problem in the narrative and similar life problems (evaluation) in addition to comprehension of biographical and expository text (evaluating non-fiction).

Children's performances on the reading assessments were calculated in a variety of ways; number-right scores, Item Response Theory (IRT) scores, standardized t-scores, and criterion-referenced proficiency scores are provided. For the purposes of this study, the IRT scores and criterion-referenced proficiency scores will be used to measure children's progress in reading. Number-right scores are counts of the raw number of items a child answered correctly. However, due to the nature of the assessment methodology these scores are not comparable across grade levels, making it difficult to make direct comparisons between the grade-levels. Standardized t-scores are transformations of the IRT theta (ability) estimates, rescaled to a mean of 50 and standard deviation of 10 using cross-sectional sample weights for each wave of data. These

scores provide a norm-referenced measurement of achievement relative to the population as a whole and cannot be used to represent mastery of a particular set of skills. In contrast, IRT scores use the overall pattern of right and wrong responses and the characteristics of each item to estimate a child's ability. IRT scores represent estimates of the number of items students would have answered correctly at each point in time if they had taken all of the 186 questions in all of the first- and second-stage reading forms administered. IRT scoring makes it possible to measure the longitudinal gain in achievement over time, even though the assessments that are administered are not identical at each point. The common items present in the routing test and in overlapping second-stage forms allow the scores to be placed on the same scale, even as the two-stage design adapts to children's growth over time. Although IRT scale scores are useful in identifying cross-sectional differences among subgroups in overall achievement level, and may be used as longitudinal measures of overall growth, the gains made at different points on the scale have qualitatively different interpretations. For example, children who made gains in recognizing letters and letter sounds are learning very different skills than those who are making the jump from reading words to reading sentences, although the gains in number of scale score points may be the same. To allow for group comparison in growth for each specific skill area secondary analyses will be performed on proficiency probability scores. These scores are criterion-referenced measures of proficiency in specific skills derived from the overall IRT model. They are useful as longitudinal measures of change because they show not only the extent of gains but also where on the achievement scale the gains are taking place. Thus, they can provide information on differences in skills being learned by different groups, as well as the relationships with processes, both in and out of school, that correlate with learning specific skills. The proficiency level at which the largest change is taking place is likely to be different for

children with different initial status, background, and school setting. Changes in proficiency probabilities over time may be used to identify different developmental profiles of children from low SES families and may lead to a better understanding of the reading development of children with behavior problems.

The IRT scores were re-estimated in the longitudinal dataset using a process of vertical equating; the kindergarten and first-grade responses were pooled with the third- and fifth-grade data to stabilize the longitudinal estimates and the maximum values of the scale scores were extended to include the more difficult items administered in the fifth-grade assessments. The scale scores for each round of reading assessments were defined based on performance on all tasks administered up to and including the fifth grade assessments allowing for the calculation of meaningful estimates of gains over time. The IRT scale scores on the reading assessments range from 0 to 186, the means and standard deviations are reported by grade level in Table 5. The proficiency probability scores on the reading assessment range from 0 to 1, the means and standard deviations are reported by grade and skill level in Table 6. The most appropriate estimate of the reliability of the reading assessment is the reliability of the overall IRT ability estimate, theta. This number is based on the variance of repeated estimates of theta, and applies to all of the scores derived from the theta estimate, namely, the IRT scale scores, T-scores, and proficiency probabilities. The reliability measured by estimates of theta was acceptable at all assessment points (ranging from .91 in the fall of kindergarten to .96 in the spring of first grade).

Teacher Rating of Behavior Problems. Both teachers and parents provided rating of the child's behavioral adjustment using the Social Rating Scale (SRS), a measure adapted by the ECLS-K from the *Social Skills Rating Scale (SSRS;* Gresham & Elliot, 1990). Only the teacher ratings of behavioral adjustment are used in this study. Parent ratings and teacher ratings of

behavioral adjustment often capture very different types of behavior and there is often low inter-rater agreement between the two reports (Achenbach, McConaughy, & Howell, 1987; Johnston & Murray, 2003; McDermott, 1993). Because the focus of this study is the influence of behavior problems on reading development rather than the more global development of behavioral adjustment it makes sense to focus exclusively on ratings of the child's behavior in the classroom. Children's behavior in the classroom is more likely to directly influence reading development than the children's behavior at home or in the community.

Teachers rated individual student's behavioral adjustment as part of a larger self-administered questionnaire that was collected at every wave of data collection. Teachers used a frequency scale (items rated from 1 (never) to 4 (very often) or N/O for no opportunity to observe behavior) to report how often students exhibited certain social skills and behaviors. Five scales were developed based on the teachers' responses; three of the scales capture positive aspects of children's behavior (*approaches to learning, self-control,* & *interpersonal skills*) and two scales represent problem behaviors (*externalizing problem behaviors* & *internalizing problem behaviors*). The scale score is the mean rating on the items included in the scale and scores were only computed if the student was rated on at least two-thirds of the items in that scale. The scales are as follows:

> *Approaches to Learning* scale measured behaviors that affect the ease with which children can benefit from the learning environment. It included six items measuring the child's attentiveness, task persistence, eagerness to learn, learning independence, flexibility and organization. This item was reverse coded so that higher numbers represent lower behavioral adjustment.

Self Control scale included four items that indicate the child's ability to control behavior by respecting the property rights of others, controlling temper, accepting peer ideas for group activities and responding appropriately to pressure from peers. This number was reverse coded so that higher numbers represent lower behavioral adjustment.

Interpersonal Skills scale has five items that rate the child's skill in forming and maintaining friendships; getting along with people who are different; comforting or helping other children; expressing feelings, ideas, and opinions in positive ways; and showing sensitivity to the feelings of others. This number was reverse coded so that higher numbers represent lower behavioral adjustment.

Externalizing Problem Behaviors scale has five items that rate the frequency of acting out behaviors such as arguing, fighting, getting angry, acting impulsively, and disturbing ongoing activities. Higher numbers on this scale represent lower behavioral adjustment.

Internalizing Problem Behaviors scale has four items that ask about the apparent presence of anxiety, loneliness, low self-esteem and sadness. Higher numbers on this scale represent lower behavioral adjustment.

The ranges, means, standard deviations and split-half reliabilities for each scale are presented by assessment period in Table 7. The scales were totaled to produce a single number representing overall behavioral adjustment, with higher numbers representing a higher teacher rating of behavior problems.

Family Measures.

Parents or guardians, who resided with the sample child, answered questions using computer assisted telephone interviewing (CATI) or computer assisted personal interviewing if the parents did not have a phone. Interviews lasted approximately 44 minutes and included approximately 330 questions covering children's school experiences, childcare, family characteristics, home environment, parenting behavior and household income. The parent interview was conducted primarily in English, but provisions were made to interview parents who spoke other languages. The questionnaire was translated into Spanish, Chinese, Lakota, and Hmong languages; bilingual interviewers were trained to conduct the parent interview in the parent's primary language. The child's mother was the respondent in 81 percent of the cases and the child's father in 8 percent. Other adults completed the parent interview in 11 percent of the cases (typically grandparents of the sample child). Information from the parent interview was used to derive the information necessary to determine socioeconomic status.

Socioeconomic Status. Two primary approaches were used to measure socioeconomic status. The family's SES was measured using a composite variable computed at the household level that was derived by the U.S. Department of Education, which is derived from a logarithm of five variables measuring family income, mother's education, father's education, mother's occupational prestige, and father's occupational prestige (see Tourangeau, Nord, Lê, Pollack, & Atkins-Burnett, 2006 for details). This composite has been computed for each year of data collection and is provided as both a continuous variable and a categorical variable. The continuous variable ranges from -4.75 to 2.75 with the higher values representing higher SES, mean = .16, SD = .77. The SES composite is the average of up to five measures, each of which was standardized to have a mean of 0 and a standard deviation of 1, hence the negative values.

For ease of interpretation this scale was converted to a continuous positive scale by adding 4.84 to each value of the original SES continuous scale, mean = 5.00, SD = .77. A categorical variable representing the quintile for the value of the SES continuous variable (see Table 4 for the percentages) was also used to indicate SES and ranges from 1 (representing the lowest SES category) to 5 (representing the highest SES category).

During the parent interview information was gathered about the family income as well as the current occupation and the highest educational level achieved by both parents. Information about the family income was collected in the spring of each assessment year. It ranged from 0 to a million dollars with only 200 people having more than $200,000 and 880 having less than $10,000; the median income was $45,000 ($25^{th}$ quartile = $24,000, 75^{th} quartile = $70,000) and the mean was $55,618 with a standard deviation of 57,616. Approximately 2,000 families (or 16.7% of the initial kindergarten sample) were below the 1998 Federal poverty threshold. Parents' occupation was recoded to reflect the average of the 1989 General Social Survey (GSS; Nakao & Treas, 1992) prestige score. This 22-position scale ranks occupations according to their relative prestige (see Tourangeau et al, 2006 for a description of the aggregated categories that were used for coding occupation in the ECLS-K). Information is provided for each parent separately; this scale ranges from 29.6 to 75.5, with higher codes representing more prestigious occupations (see Table 8 for the frequency of occupations found in the initial kindergarten sample). The highest level of education is provided individually for each parent and as a composite indicating the highest educational level achieved for any parent or guardian currently residing with the child (see Table 4).

Data Analysis

Initially, a split-plot ANOVA was completed to determine if there were mean differences across levels of SES, consistent with previous research, on IRT reading scores and teacher behavior ratings. After this analysis, the hypotheses were tested.

The first hypothesis predicted that there would be multiple trajectories of reading development and that although some children from low-SES backgrounds would follow a cumulative trajectory of reading development, the majority would follow a compensatory trajectory. Bast and Reitsma (1997) argue that evidence for a cumulative model must consist of stable rank ordering and increasing individual differences in reading achievement over time. Two analytical models have been proposed to provide this evidence (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002; Bast & Reitsma, 1997,1998). The first analytical model, the simplex model, is particularly well suited to longitudinal series in which there is occasion-to-occasion transmission, that is to say that the observation at time 2 depends on the observation at time 1, and in turn the observation at time 3 depends on the observation at time 2, and so forth. Simplex modeling (Jöreskog, 1979) is a special case of structural equation modeling, in which a factor or construct is estimated across several measurements by using only one indicator variable for each measurement. The advantage of a simplex model is that it allows for other sources of variance than those responsible for initial performance differences to be incorporated into the model. This model represents the expectation that different factors affect the inter-individual variance at different times. The second analytical model, latent growth curve modeling (Muthén & Khoo, 1998), allows for the analysis of associations between initial level and growth over time. Within this model, two latent factors, level and shape, represent dimensions of individual differences in growth over time. These common factors are used to describe the values of the status and growth

of individuals on a trait at all occasions. Using this type of analysis allows the examination of the association between the initial level and the growth in reading skills across time. Since both models represent different components of the reading trajectory, both models were used to test the first research hypothesis.

To examine the stability and variance of reading performance from kindergarten through fifth grade, a simplex model with the continuous SES composite as a covariate (see Figure 1) was estimated to represent the relationship between reading development at subsequent time points. A cumulative model of the reading development of children from low-SES backgrounds would be represented by a significant relationship between low-SES and lower entry scores, high stability in reading skills at each time point and increasing variance in assessment points over time. This finding would provide evidence that the lower entry skills of children from low-SES backgrounds is predictive of slower growth in reading development over time in comparison with their more advantaged peers. A compensatory model of the reading development of children from low-SES backgrounds would be represented by decreasing variance in reading skills across time despite evidence demonstrating the lower entry skills of children from low-SES backgrounds.

A latent growth curve model with the continuous SES composite as a covariate was estimated to explore the association between the level of entry reading skill and the growth of those skills (i.e. developmental trend) over the five measurement occasions (see Figure 2), however the fit indices that this model did not fit the data well. Considering previous research concerning the nature of reading growth across time, with growth in reading skills being different within each time frame (Bast & Reitsma, 1998; Leppanen, 2004), it was decided that a piecewise growth model would better fit the data. A piecewise growth model is a special case of

general growth curve modeling, which allows for the separate estimation of growth trajectories at different phases of development (Li et al., 2001; Muthén & Muthén, 1998). Using this type of analysis not only allowed the examination of the association between the initial level and the growth in reading skills at different developmental periods differently but it also allowed the association between the separate growth components to be examined separately. A piecewise growth curve model with the continuous SES composite as a covariate was estimated to explore the association between the level of entry reading skill and the growth of those skills (i.e. developmental trend) over the five measurement occasions, from the beginning to the end of kindergarten, from the end of kindergarten to the end of first grade, from the end of first grade to the end of third grade and from the end of third grade to the end of fifth grade (see Figure 3). It was expected that SES would be positively associated with initial scores; children from low-SES backgrounds should enter school with much lower reading ability on average than their more advantaged peers. A cumulative model of the reading development of children from low-SES backgrounds would be represented by a significant positive relationship between the level and slope component of the model, with lower early reading skills (level) predicting slower growth. A compensatory model of the reading development of these children would be represented by a significant negative relationship between the level and slope component of the model, indicating that children with lower entry skills grow faster to compensate for their slower start.

The second hypothesis predicted that the socioemotional development of children from low-SES families would be associated with their reading development. Several analyses were conducted to test this hypothesis. To examine possible multi-construct associations between reading development and teacher rated behavior, a multi-construct simplex model was estimated with SES as a covariate. First, a simplex model for behavior model with the continuous SES

composite as a covariate (Figure 4) was estimated without any relationship to reading development and then a multivariate simplex model was estimated by adding statistically significant cross-construct paths between reading and behavior to the model (Figure 5). It was expected that low SES would predict both lower initial reading skills and higher ratings of behavior problems. Further, it was expected that higher ratings of behavior problems should be associated with lower reading achievement over time.

To further explore the relationship between the reading development and teacher ratings of behavior across time, a multivariate piecewise growth curve model was estimated. This analysis allows the examination of possible multi-construct associations between the level and shape components of the IRT reading scores and the teacher rating of behavior. To conduct this analysis, a univariate latent growth curve model for behavior model with the continuous SES composite as a covariate was estimated without any relationship to reading development (see Figure 6), however the fit indices that this model did not fit the data well. Considering that reading growth showed a different rate of growth within each time frame, it was decided that a piecewise growth model would better fit the data. So a piecewise growth model for behavior with the continuous SES composite as a covariate was estimated without any relationship to reading development (see Figure 7). It was expected that children from low-SES families would have significantly higher ratings of behavior problems at school entry (level) and would show more stable or increasing ratings of behavior problems over time (shape) when compared to their more advantaged peers. Once the univariate analysis for behavior ratings was completed, the multivariate piecewise growth curve analysis was conducted with the continuous SES composite as a covariate (Figure 8). It was expected that there would be a significant relationship between the level and shape components of behavior ratings and the shape component of reading

development with higher ratings of behavior problems predicting lower reading achievement even when controlling for entry levels of behavior and reading skill.

To determine the number and types of reading trajectories found in this sample, a clustering-by-cases analysis for longitudinal data (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002; Bergman, Eklund, & Magnusson, 1991; Bergman & Magnusson, 1997) was completed. To carry out this analysis, a piecewise growth curve analysis was carried out. Standardized scores for the latent level and shape components of reading achievement were computed based on the results from the piecewise growth curve analysis. These new variables were used as the criteria variables to group students into homogenous subgroups using analysis of clustering by cases. The methodological process outlined by Aunola and colleagues (2002) and recommended by Bergman and Magnusson (1991) was used to analyze clustering by cases. First a hierarchical cluster analysis was conducted, selecting the squared Euclidian distance as a similarity measure and using Ward's (1963) methods to form initial clusters without restricting their number. This analysis provided a dendrogram based on the distance of the clusters. This dendrogram was inspected to determine the number of meaningful clusters in the sample. To verify the final solution, alternate solutions of different numbers of clusters were examined in terms of conceptual clarity and the number of students in each cluster. The appropriate number of clusters was determined and then the final clusters were formed using SPSS quick cluster analysis. This quick cluster procedure selects initial cluster centers according to MacQueen's k-means clustering methods. After this, the algorithm assigns each case to the nearest cluster center. Several analyses were conducted until the solution stabilized, in these additional analyses the earlier solutions were stored and used as initial centers in the next run. It was expected that several reading trajectories would be found.

An examination of the group differences at the different measurement points was conducted for the clusters identified based on their initial reading skill and growth trajectories. Since IRT scale scores, which were used to derive groups, are good at measuring overall growth but not in determining the specific area of growth (see discussion in Measures section), the proficiency probability scores were used to allow for a descriptive group comparison in growth for each specific skill area. Finally, a statistical comparison of differences in SES and behavior ratings between the clusters was completed using a Kendall's tau-c analysis.

CHAPTER 4

RESULTS

The results of the analyses are presented in several steps. First, the results of the analyses to determine if there were mean differences across levels of SES, consistent with previous research, on IRT reading scores and teacher behavior ratings are presented. Second, hypotheses regarding the two research questions of the present study are tested. Finally, the number and types of reading trajectories found in this sample through the use of a clustering-by-cases analysis is presented with a discussion of the relationship between the different trajectories of reading development and two independent variables, teacher rating of behavior and SES.

A split-plot ANOVA was conducted using time as the within factor and categorical SES as the between factor. The reading scores of children from lower SES families were lower than their peers from higher SES families, $F(4, 5219) = 18.67$, $p < .001$, *Eta squared* = .04 and there was a significant SES by time interaction $F(4, 5219) = 10.12$, $p < .001$, *Eta squared* = .02. A trend analysis suggests that there was both a linear and quadratic trend for time and a linear trend for SES. Post hoc comparisons using the Tukey HSD test indicated that the mean IRT scores (see Table 9 for means and standard deviations) were different between the lowest SES quintile and all other SES quintiles except the fourth SES quintile, $p < .01$ for each comparison. The only other group that showed a statistically significant difference from the other SES quintiles was the highest SES group, which had IRT scores that were significantly higher than all but the second SES quintile, $p < .01$ for each comparison. There was not a difference between the IRT scores of the remaining SES quintiles. The behavior ratings of children from lower SES families indicated a higher rate of behavior problems than their peers from higher SES families, $F(4, 5219) = 4.94$, $p =$

.001, *Eta Squared* = .002, however there was no significant interaction between time and SES $F(4, 5219) = 1.20$, $p = .26$. A trend analysis suggests a linear and quadratic trend for time and a linear and cubic trend for SES. Post hoc comparisons using the Tukey HSD test indicated that the mean behavior ratings (see Table 10 for means and standard deviations) were only significantly different between the first SES quintile and the fifth SES quintile, $p < .001$, there were no other differences in behavior ratings between the other SES quintiles.

Simplex Model for Reading

The first hypothesis predicted that some children from low-SES families, who entered school with lower initial reading skills, might follow a cumulative trajectory of reading development, consistent with the *Matthew Effect.* However, it was expected that the majority of these children would follow a cumulative trajectory of reading development through kindergarten, but show a compensatory developmental trajectory in later grades. Two analytical models have been proposed to provide evidence of a cumulative developmental trajectory, the simplex model and the latent growth curve model (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002; Bast & Reitsma, 1997, 1998). The simplex model (see Figure 1) allows an examination of the stability and variance of reading performance across five measurement occasions. In this model, the latent skill variables consisted of one indicator, the observed reading skill variable (the IRT reading score) for that measurement occasion. The residual variances of the observed reading skill variables were constrained to be equal across time to identify the model. The fit indices indicated a good fit (Chi-Square = 98.5, df = 5, $p < .001$; CFI = .996; TLI = .99; RMSEA = .058, 90% Confidence Interval .049 .to 069; SRMR = .01 and Hoelter's Index = 618). Inspection of

modification indices suggested that estimating the covariance between the residuals of the latent reading construct at Time 1 and Time 5 (standardized estimate = .10, $t = 5.83$, $p < .001$), between Time 3 and Time 5 (standardized estimate = .14, $t = 7.69$, $p < .001$), and between Time 2 and Time 4 (standardized estimate = -.05, $t = -2.44$, $p = .02$) would improve the fit of the model. After the simplex model was specified this way, the path between SES and Reading at Time 2 was no longer statistically significant, so it was removed from the model. After these model changes, the fit of the model was excellent (Chi-Square = 27.4, df = 3; CFI = 1.0; TLI = 1.0; RMSEA = .038, 90% Confidence Interval .026 to .052; SRMR = .005 and Hoelter's Index = 1,567). The results are presented in Table 11.

The results indicated high stability in reading skill development with at least 50% of the reading skill development at any time point being explained by the development in reading skill at the previous time point. As might be expected given that the time between assessments was so short relative to other adjacent time points, the strongest relationship between reading at adjacent time points was between reading at the beginning of kindergarten and the end of kindergarten (R-squared = .79). The lowest stability between reading skills at adjacent points was between the end of first grade and the end of third grade (R-squared = .46), which, although a weaker relationship, is still relatively stable.

In addition, the results showed that the variance of the latent reading skill constructs (Table 11) showed increasing variance from the beginning of kindergarten until the end of third grade (86.43 at the beginning of kindergarten to 508.59 at the end of third grade). There was a slight decrease in variance from the end of third grade until the end of fifth grade (from 508.59 to 412.77). The evidence of stable rank order and increasing variance from the beginning of

kindergarten until the end of third grade suggests the presence of a cumulative growth trajectory for this time segment (Bast & Reitsma, 1997). However, the slight decrease in variance from the end of third grade to the end of fifth grade suggests a more compensatory trajectory for this time segment.

There was a moderate relationship between socioeconomic status and initial reading skill (standardized estimate .37, $t = 30.09$, $p < .001$) and a small, but statistically significant relationship between SES and reading skill development at all the remaining time points except the end of kindergarten. These results show that children from lower SES families are more likely to enter kindergarten with lower reading skills and that SES continues to be negatively associated with reading development across time, though to a lesser degree.

The residual variances were all statistically significant indicating that there were other factors associated with reading skills at each point than those contained in this model. However, because the reading skills at the previous time point explained a considerable amount of variance in the reading skills at the adjacent time points, the residual variances are relatively small except for the residual variance at the first time point. This finding shows that SES explains only a small portion of the variation in initial reading skill. This model suggests the presence of both compensatory and cumulative trends in the growth of the measured reading skills across time. This model suggests that reading performance was stable across elementary school with children who entered school with lower IRT reading scores remaining behind their peers in reading skills across elementary school. Additionally, there was increasing variance in reading scores from the beginning of kindergarten suggesting that there was a widening gap between the students with the highest IRT reading scores and those with the lowest scores. However, there were also

indications that the relative stability of reading scores decreased across elementary school and the gap in reading performance appeared to narrow somewhat between the end of third and the end of fifth grade.

Growth Curve Analysis for Reading

The first hypothesis predicted that some children from low-SES families, who entered school with lower initial reading skills, might follow a cumulative trajectory of reading development, consistent with the *Matthew Effect.* However, it was expected that the majority of these children would follow a cumulative trajectory of reading development through kindergarten, but show a compensatory developmental trajectory in later grades. The latent growth curve model (Muthén & Khoo, 1998), allows for the analysis of associations between initial level and growth over time. Within this model, two latent factors, level and shape, represent dimensions of individual differences in growth over time. These common factors are used to describe the values of the status and growth of individuals on a trait at all occasions. A latent growth curve analysis with the continuous SES composite as a covariate (see Figure 2) was conducted to examine the association between initial reading level and growth in reading skills over time. In this model, two latent factors, level and shape, represent dimensions of individual differences in growth over time. All loadings for the first factor, initial status, are fixed at 1. For the second factor, change over time (overall change; shape parameter), the first loading is fixed at 0 and the last loading is fixed at 1. The intermediate loadings of the shape factor are free parameters. To institute the assumption of measurement invariance across measurement occasions, the error variances of the five measurement occasions are constrained to be equal over time. The fit indices indicated a poor fit

(Chi-Square = 7092, df = 14, $p < .001$; CFI = .69; TLI = .67; RMSEA = .303, 90% Confidence Interval .297 .to .309; SRMR = .39 and Hoelter's Index =19).

Because the nature of reading growth is expected to be different within each time frame (Bast & Reitsma, 1998; Leppanen, 2004), it was determined that a piecewise growth model may better reflect the reading growth across time. A piecewise growth model is a special case of general growth curve modeling which allows for unique growth trajectories at different phases of development (Li et al., 2001; Muthén & Muthén, 1998). This model (see Figure 3) consisted of four components: one initial status factor (level) and three shape-growth factors: 1) a linear growth factor from the beginning of kindergarten to the end of first grade (Growth I); 2) a linear growth factor from the end of first grade to end of third grade (Growth II); and 3) a linear growth factor from the end of third grade to the end of fifth grade (Growth III). The level factor consisted of the five observed reading skill variables (Time 1 thru Time 5) with each of the loadings fixed at 1. To measure Growth I the loadings of the observed reading skill variables were set to 0, 1, 3, 3, 3, respectively. To measure Growth II the loadings of the observed reading skill variables were set to 0, 0, 1, 4, 4, respectively. To measure Growth III the loadings of the observed reading skill variables were set to 3, 3, 3, 6, 9, respectively. The fit indices indicated an excellent fit (Chi-Square = 7.38, df = 2, $p = .03$; CFI = 1.0; TLI = 1.0; RMSEA =.022, 90% Confidence Interval .007 .to 04; SRMR = .005 and Hoelter's Index = 4,462). The results are presented in Table 12.

The intercepts for the latent shape factors (Table 12) were positive and significant for all three growth periods, indicating steady growth in reading skills across all time periods. The greatest rate of growth was found from the beginning of kindergarten until the end of first grade, with a mean growth rate of 8.57 (se = .35) in the latent reading skill variable, followed closely by

the growth rate from the end of third grade to the end of fifth grade with a mean growth rate of 8.17 (se = .24). The slowest rate of growth in the latent reading skill variable was between the end of first grade to the end of third grade with a mean growth rate of 4.46 (se = .45). There was also considerable variance in the Level component (148.36) and the variances of two of the growth components (Growth I, 15.14 and Growth II, 13.17) indicating that there were considerable interindividual differences in the initial reading skills (Level) and the growth in reading skills from the beginning of kindergarten to the end of third grade. The variance in the third growth component was considerably smaller (1.05) indicating there were considerably less interindividual differences in the growth of reading skills during the period from the end of third to the end of fifth grade.

The covariance between latent Level and Growth I was positive and statistically significant (standardized coefficient = .34, $t = 8.29$, $p < .001$), the covariance between latent Level and Growth II was not statistically significant (standardized coefficient = .11, $t = 1.85$, $p = .06$) and the covariance between latent Level and Growth III was negative and statistically significant (standardized coefficient = -.72, $t = -35.23$, $p < .001$). The results also show that covariance between the shape factor for Growth I and the shape factor for Growth II is negative and statistically significant (standardized coefficient = -.25, $t = -8.67$, $p < .001$). The covariance between the shape factors for Growth I and Growth III is also negative and statistically significant (standardized coefficient = -.34, $t = -2.91$, $p = .004$) as is the case for the covariance between the shape factors for Growth II and Growth III (standardized coefficient = -.43, $t = -4.29$, $p < .001$). These results indicate higher initial reading skills are associated with greater growth during the kindergarten year, but they have no significant association with growth in the

measured reading skills from the end of first to the end of third grade. The most interesting finding is that higher initial reading skills are associated with significantly slower growth during the period from the end of third grade to the end of fifth grade. This finding suggests that at least some children entering school with lower entry skills, who follow a cumulative developmental trajectory through kindergarten, are beginning to close the gap with their peers and following a more compensatory trajectory from the end of first grade to the end of fifth grade.

The results also showed that SES had a positive and statistically significant association with the latent level factor (standardized coefficient = .34, $t = 17.05$, $p < .001$), the shape factor for Growth I (standardized coefficient = .16, $t = 9.71$, $p < .001$) and the shape factor for Growth II (standardized coefficient = .23, $t = 9.28$, $p < .001$). However, SES had a negative and statistically significant relationship with the shape factor for Growth III (standardized coefficient = -.18, $t = -3.38$, $p = .001$). This finding suggests that higher SES is associated with higher entry level reading skills and higher rates of growth in reading skill from the beginning of kindergarten until the end of the third grade. The negative and significant association between SES and reading development from the end of third grade to the end of fifth grade suggests that children from lower SES families are experiencing compensatory growth during this period.

The residual variances of Level (146.21, $t = 11.91$, $p < .001$) and the variances of the three growth components (Growth I, 20.93, $t = 23.90$, $p < .001$; Growth II, 19.69, $t = 8.22$, $p < .001$; Growth III, 2.52, $t = 2.12$, $p = .03$) were all statistically significant, indicating that there was a significant amount of variance in the initial entry skills and the growth in skills from the beginning of kindergarten that remain unexplained by this model. Again this model suggests the presence of both compensatory and cumulative trends in the growth of the measured reading skills across

time. There was a statistically significant positive association between level and the development of reading skills from the beginning of kindergarten to the end of first grade suggesting that children who enter school with lower IRT reading skills are experiencing slower growth in reading skills during this time when compared to their peers who enter school with higher IRT reading scores. However, there was no relationship between level and the growth in reading from the end of kindergarten to the end of third grade and a significant negative association between level and growth in reading from third to fifth grade suggesting that those children who entered school with lower skills experienced a period of compensatory growth in reading skills. Further, there were statistically significant negative associations between the growth slopes, suggesting that individuals who experienced rapid growth during one period of time showed slower growth during the subsequent time period.

Simplex Model for Reading and Behavior

The second hypothesis predicted that the socioemotional development of children from low-SES families is associated with their reading development. Several analyses were conducted to test this hypothesis. To examine possible multi-construct associations between reading skill and behavior adjustment trajectories across time, a multivariate simplex model was constructed with SES as a covariate. To construct such a model it was necessary to first create a simplex model for behavior (Figure 6). This model was estimated without any relationship to reading development to examine the stability and variance of behavioral ratings across the five measurement occasions. In this model, the latent skill variables consisted of one indicator, the observed behavior rating variable for that measurement occasion. The residual variances of the

observed behavior rating variables were constrained to be equal across time for model identification. The fit indices indicated a good fit (Chi-Square = 58.55, df = 5; CFI = .95; TLI = .86; RMSEA = .04, 90% Confidence Interval .034 .to 055; SRMR = .01 and Hoelter's Index =1,039). Inspection of modification indices suggested that estimating the covariance between the residuals of the latent behavior construct at Time 1 and Time 5 (standardized estimate .17, t = 3.65, $p < .001$) and between Time 1 and Time 4 (standardized estimate .25, t = 5.32, $p < .001$) would improve the fit of the model. After these specifications, the path between SES and Behavior at Time 2 and the path between SES and Time 4 were no longer statistically significant, so they were removed from the model. After these model changes, the fit of the model improved (Chi-Square = 30.65, df = 5; CFI = .98; TLI = .93; RMSEA = .031, 90% Confidence Interval .021 .to 041; SRMR =.016; Hoelter Index = 1,984). The results are presented in Table 13.

The results indicated high stability in behavior ratings from Time 1 to Time 2 (R-squared= .53), but less so between other time points (R-squared from 10.9 to 20.3), although all pathways were statistically significant. Additionally the results showed that the variance of the behavior ratings increased quite dramatically from Time 1 to Time 2, decreased from Time 2 to Time 3 and remained fairly stable from Time 3 to Time 5. Socioeconomic status showed a small but statistically significant relationship with behavior ratings at the beginning of kindergarten and at the end of first and third grade. These results show that children from lower SES families are somewhat more likely to demonstrate more behavior problems than their peers from higher SES families. The residual variances were all moderate to large and statistically significant (see Table 13), indicating that there are other factors associated with the behavior ratings at each point than those contained in this model. This finding shows that SES explains only a small percentage of

the variance in the behavior ratings at each time point.

A multivariate simplex model was conducted to determine if there were multi-construct associations between the latent variables of reading and behavior across the five time points. Simplex models for reading and behavior (see Figures 1 and 4) without any relationships between them were estimated separately (results presented in Table 11 and 13), and then the latent behavior variables were regressed on the latent reading variables (see Figure 5). The fit indices indicated a good fit (Chi-Square = 243.98, df = 29; CFI = .99; TLI = .98; RMSEA = .037, 90% Confidence Interval .033 .to 041; SRMR = .031 and Hoelter's Index = 958). The results are presented in Table 14.

There were only slight changes in the parameter estimates from the separate simplex models for reading and behavior and the multivariate simplex model. SES continued to have a small but statistically significant association with both reading and behavior. There was a positive and statistically significant association between behavior and reading but it was extremely small (the largest relationship was found between the behavior rating at the end of first grade and the reading score at the end of third grade of .12, while the remaining associations were even smaller from .03 to .04). These results indicate that higher rates of behavior problems were related to less proficient reading, but the small size of this coefficient suggests that this relationship has little practical significance. Earlier reading proficiency still remains the best predictor of reading proficiency at later grades and SES has a stronger association with reading scores than behavior ratings at all time points with the exception of the end of kindergarten. Further, there were only slight decreases in the residual variances of the reading scores at the four time points with the addition of behavior ratings to the model, indicating that regressing the latent behavior variables

on the latent reading variables did little to increase the explanatory power of the model. The results of these analyses do not appear to support the hypothesis that behavior problems have a strong association with the reading development of children from low-SES families.

Growth Curve Model For Reading and Behavior

To further examine the hypothesis that the socioemotional development of children from low-SES families is associated with their reading development, a multivariate latent growth curve model was estimated. This model allowed for the examination of the multi-construct associations between the level and shape components of the reading skill and behavioral rating variables. To conduct this analysis, it was necessary to first create a univariate latent growth for behavior ratings (see Figure 6). This model was conducted to examine the association between the initial behavior rating level and change in behavior ratings over time, without any relationship to reading development. Within this model, two latent factors, level and shape, represent dimensions of individual differences in change over time. All loadings for the first factor, initial status, are fixed at 1. For the second factor, change over time (overall change; shape parameter), the first loading is fixed at 0 and the last loading is fixed at 1. The intermediate loadings of the shape factor are free parameters. To institute the assumption of measurement invariance across measurement occasions, the error variances of the five measurement occasions are constrained to be equal over time. The fit indices indicated a poor fit (Chi-Square = 210.84, df = 14; CFI = .82; TLI = .81; RMSEA = .051, 90% Confidence Interval .045 to .057; SRMR = .12 and Hoelter's Index =617).

Because the nature of the behavior ratings is also likely to be different within each time frame and to be consistent with the model estimated for reading growth, a piecewise growth curve

model was constructed for the behavior ratings at the five time points (Figure 7).This model consisted of four components: one initial status factor (Level) and three shape-growth factors: 1) a linear growth factor from the beginning of kindergarten to the end of kindergarten (Growth I); 2) a linear growth factor from the end of first grade to the end of third grade (Growth II); and 3) a linear growth factor from the end of third grade to the end of fifth grade (Growth III). The level factor consisted of the five observed behavior rating variables (Time 1 thru Time 5) with each of the loadings fixed at 1. To measure Growth I the loadings of the observed reading skill variables were set to 0, -1, 1, 1, 1, respectively. To measure Growth II the loadings of the observed reading skill variables were set to 0, 0, 1, 2, 2, respectively. To measure Growth III the loadings of the observed reading skill variables were set to 1, 1, 1, 2, 3, respectively. The fit indices indicated an excellent fit (Chi-Square = 8.35, df = 2; CFI = .99; TLI = .96; RMSEA = .024, 90% Confidence Interval .009 to 042; SRMR = .007 and Hoelter's Index =3,942). The results are presented in Table 15.

The intercepts for the latent shape factors (Table 15) were statistically non-significant for all three growth periods indicating there was no changes in behavior ratings across the measurement period. The variance of Level (.56) and the variance of the first growth component (Growth I; .15) were statistically significant indicating that there were interindividual differences in the initial behavior ratings (Level) and the first growth component. The variance for the second and third growth components (Growth II, .02 and Growth III, .01) were extremely small indicating that there was little interindividual difference in behavior ratings at these time points. The residual variances of Level (1.14, $t = 7.091$, $p < .001$) and Growth I (.40, $t = 2.41$, $p = .02$) were statistically significant, indicating that there was a significant amount of variance in the

initial entry behavior ratings and the change in behavior ratings across kindergarten that remain unexplained by this model.

The covariance between latent Level and Growth I (standardized coefficient = -.56, t = -3.82, $p < .001$) and latent Level and Growth III (standardized coefficient = -.55, t = -3.34, $p < .001$) were negative and statistically significant. However, the covariance between latent Level and Growth II was not statistically significant. There was also no statistically significant association between any of latent growth factors. These findings indicate that children who are entering school with higher levels of behavior problems are showing improvements in behavior during the kindergarten year and between the end of third grade to the end of fifth grade. There was also a positive and statistically significant association between SES and the latent level factor of behavior ratings (standardized coefficient = .13, t = 4.18, $p < .001$), but no statistically significant association between SES and any of the growth factors. So although children from low-SES families are more likely to exhibit behavior problems upon school entry, the frequency of behavior problems changes over time does not appear to be related to SES.

A multivariate piecewise growth curve (Figure 8) was conducted to determine if there would be multi-construct associations between the level and shape components of the reading and behavior variables. To examine this potential relationship, the piecewise growth curve models for reading and behavior (see Figures 3 and 7) were first estimated separately without any relationships between them (results presented in Table 12 and 15), and then covariances between the latent level and shape components of the reading and behavior ratings were estimated. The fit indices indicated an excellent fit (Chi-Square = 26.71, df = 13, p = .03; CFI = 1.0; TLI = 1.0; RMSEA = .014, 90% Confidence Interval .006 .to 021; SRMR = .005 and Hoelter's Index =

4,598). The results are presented in Table 16.

Again, there were only slight changes in the parameter estimates from the separate piecewise growth curve models for reading and behavior and the multivariate piecewise growth curve model. The results also showed that the covariance between the latent Level factor for reading skill and the latent Level factor for behavior was positive and significant (standardized coefficient = .10, $t = 2.38$, $p = .02$). There was also a positive and significant association between the latent Level factor for behavior and the first growth shape for reading (standardized coefficient = .16, $t = 4.15$, $p < .001$) and between the latent Level factor for reading and the first growth shape for behavior (standardized coefficient = .16, $t = 2.20$, $p = .03$), There were no other significant associations between the latent Level factors for behavior ratings and reading scores and any of the other growth shapes for either behavior or reading. The associations between any of the growth factors for reading scores and behavior ratings were non-significant. Further, there were no decreases in the residual variances of the level and growth components for the reading scores with the addition of behavior ratings to the model, indicating that this addition did little to increase the explanatory power of the model.

Clustering by Cases Analyses

To determine the number and types of reading trajectories a clustering-by-cases analysis for longitudinal data (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002; Bergman, Eklund, & Magnusson, 1991; Bergman & Magnusson, 1997) was completed. To carry out this analysis, the standardized scores for the latent level and three latent growth components of reading skills piecewise growth curve analysis for reading were used as the criteria variables to group pupils

into homogenous subgroups using analysis of clustering by cases. The methodological process outlined by Aunola and colleagues (2002) and recommended by Bergman and Magnusson (1991) was used to analyze clustering by cases. Initially, a hierarchical cluster analysis was conducted, selecting the squared Euclidian distance as a similarity measure and using Ward's (1963) methods to form initial clusters without restricting their number. Hierarchical cluster analysis is most appropriate for small sample sizes of 100 to 200. So to use this approach to determine the number of meaningful clusters in a considerably larger sample, 20 random samples of 200 were extracted from the larger dataset. Hierarchical cluster analyses were conducted on these samples to determine the number of meaningful clusters for each of these smaller samples. These analyses provided a dendrogram based on the distance of the clusters. The dendrogram was inspected to determine the number of meaningful clusters in each smaller sample. To verify these solutions, the solutions of different numbers of clusters in terms of conceptual clarity and the number of students in each cluster were examined. An examination of the separate cluster solutions suggested that there were six meaningful clusters represented in this data sample. This information was used to form the final clusters using SPSS quick cluster analysis. This quick cluster procedure selects initial cluster centers according to MacQueen's k-means clustering methods. After this, the algorithm assigns each case to the nearest cluster center. Several analyses are conducted until the solution stabilizes, in these additional analyses the earlier solutions are stored and used as initial centers in the next run.

The clustering-by-cases analysis indicated that there were six meaningful clusters represented in the data (see Figure 9). Cluster 1 consisted of 35 children (less than 1% of the sample). These children entered school with the highest reading skills (IRT reading score = 98.27)

and continued to remain the strongest readers at all measurement occasions. These children showed little growth (change in mean IRT scores = 9.95) across the kindergarten year, moderate but steady growth from the end of kindergarten to the end of third grade (change in mean IRT scores was 24.24 from end of kindergarten to end of first grade and 26.39 from the end of first to the end of third grade) and reduced growth from the end of third to the end of fifth grade (change in mean IRT scores = 12.43). These children entered kindergarten with a number of proficient reading skills. According to the proficiency scores (see Table 17) these children demonstrated mastery of the letter recognition, beginning and ending sounds and sight word components of the reading assessment upon their entry into kindergarten. Most of their growth in reading skills from the end of kindergarten to the end of fifth grade was in the higher order skills related to comprehension such as literal inference, extrapolation, evaluation and evaluating non-fiction. By the end of fifth grade, the children in this cluster have demonstrated mastery in almost all areas of proficiency except for evaluation (.88) and evaluating non-fiction (.57).

Cluster 2 consisted of 64 children (1.2% of the sample). These children enter school with the second highest reading skills (IRT reading score = 68.02) and continue to remain among the strongest readers at all measurement occasions. The children in this cluster show the fastest growth of all clusters across the kindergarten year (change in mean IRT scores = 22.77), moderate but steady growth from the end of kindergarten to the end of third grade (change in mean IRT scores was 28.96 from end of kindergarten to end of first grade and 29.07 from the end of first to the end of third grade) and reduced growth from the end of third to the end of fifth grade (change in mean IRT scores = 13.97). Although these children enter school with IRT reading scores 30 points behind the first cluster by the end of fifth grade their IRT scores are only 8.5 points

behind this cluster's fifth grade IRT score, indicating that the gap in reading skills between the two groups is closing. The children in this cluster entered kindergarten with a number of proficient reading skills. According to the proficiency scores (see Table 17) these children demonstrated mastery of the letter recognition, beginning and ending sounds and sight word components of the reading assessment upon their entry into kindergarten. Children in this cluster show much lower proficiency in understanding words in context and literal inference than children in the first cluster (.44 compared to .88 for words in context and .07 compared to .46 for literal inference). Most of their growth in reading skills from the end of kindergarten to the end of fifth grade is also in the higher order skills related to comprehension such as literal inference, extrapolation, evaluation and evaluating non-fiction. However, children in this cluster show slower growth in these areas and demonstrate mastery on these proficiency scores later in their reading developmental trajectory when compared to the first cluster. By the end of fifth grade, the children in this cluster have demonstrated mastery in almost all areas of proficiency except for evaluation (.76) and evaluating non-fiction (.33), but again children in this cluster are showing less proficient skills in these areas than their peers in the first cluster (.88 and .57 respectively).

Cluster 3 consisted of 384 children (7% of the sample). These children enter school with reading skills (mean IRT Reading score = 46.15) over 20 points behind the children in Cluster 2 (mean IRT reading score = 68.02) but by the end of fifth grade these children's mean IRT reading score (164.20) has surpassed their peers in Cluster 2 (mean IRT reading score = 162.79) and their mean IRT reading score is only 7 points behind their peers in Cluster 1 (mean IRT reading score = 171.28). These children show the second fastest growth (change in mean IRT score is 22.77) across the kindergarten year, moderate but rapid growth from the end of kindergarten to the end

of third grade (change in mean IRT score from end of kindergarten to end of first grade is 41.23 and change in mean IRT score from the end of first to the end of third grade is 49.43) and reduced growth from the end of third to the end of fifth grade (change in mean IRT score is 14.37). When compared to Cluster 1 and Cluster 2, these children enter kindergarten with much less proficient reading skills. According to the proficiency scores (see Table 17) these children only demonstrate mastery of the letter recognition and beginning sounds components of the reading assessment upon their entry into kindergarten. Children in this cluster show lower proficiency in recognizing ending sounds (.80 compared to 1.0 for Cluster 1 and .98 for Cluster 2); recognizing sight words (.21 compared to 1.0 for Cluster 1 and .87 for Cluster 2) and understanding words in context (.05 compared to .88 for Cluster 1 and .44 for Cluster 2). Although the children in this cluster demonstrate delayed growth in literal inference, extrapolation, evaluation and evaluating non-fiction when compared to children in Cluster 2, by the end of fifth grade they have reached a comparable level in these areas to children in Cluster 2.

Cluster 4 consisted of 1184 children (21.6% of the sample). These children enter school with reading skills (mean IRT Reading score = 36.71) less than 10 points behind the children in Cluster 3 (mean IRT reading score = 46.15) and they follow a parallel growth trajectory with their peers in Cluster 3, remaining 7 points behind in their IRT scores at the end of fifth grade. These children show slow growth (change in mean IRT score = 12.20) in their mean IRT score across the kindergarten year, but rapid growth from the end of kindergarten to the end of third grade (change in mean IRT score from end of kindergarten to end of first grade is 41.23 and 49.43 from the end of first to the end of third grade) and reduced growth from the end of third to the end of fifth grade (change in mean IRT score is 17.29). These children enter kindergarten with

much less proficient reading skills. According to the proficiency scores (see Table 17) these children only demonstrate mastery of the letter recognition component of the reading assessment upon their entry into kindergarten. Children in this cluster show lower proficiency in recognizing beginning sounds (.71 compared to .95 for Cluster 3); recognizing ending sounds (.41 compared to .80 for Cluster 3) and recognizing sight words (.02 compared to .21 for Cluster 2). In spite of their rapid growth in mean IRT score from the end of kindergarten until the end of third grade, these children continue to lag behind their peers in the first three clusters, in their proficiency in evaluation and evaluating non-fiction.

Cluster 5 consisted of 2200 children (40.1% of the sample). These children enter school with considerably lower reading skills (mean IRT Reading score = 28.80) than the other clusters. Even though they show rapid growth from the end of kindergarten to the end of third grade (change in mean IRT scores is 89.45) this cluster of children is the first to fall further behind their peers, although only slightly (1.85 points lower at the end of fifth than at the end of first). These children show slow growth (change in mean IRT score = 11.67) in their mean IRT score across the kindergarten year, but rapid growth from the end of kindergarten to the end of third grade (change in mean IRT score from end of kindergarten to end of first grade is 32.74 and 56.71 from the end of first to the end of third grade) and reduced growth from the end of third to the end of fifth grade (change in mean IRT score = 17.18). These children enter kindergarten with much less proficient reading skills than the other clusters. According to the proficiency scores (see Table 17) these children do not demonstrate mastery of any of the proficiency components upon their entry into kindergarten. Children in this cluster show lower proficiency in letter recognition (.81 compared to .98 for Cluster 4); recognizing beginning sounds (.25 compared to .71 for Cluster 4)

and recognizing ending sounds (.08 compared to .41 for Cluster 4). By the end of third grade these children have caught up to their peers in the remaining clusters in all the basic reading proficiencies measured (letter recognition, beginning and ending sounds, sight words and words in context), however they continue to lag behind their peers in their proficiency in extrapolation, evaluation and evaluating non-fiction.

Cluster 6 consisted of 1687 children (30.7l% of the sample). These children enter school with lowest reading skills of all the clusters (mean IRT Reading score = 22.78) and though there is only small difference between the entry skills of Cluster 5 and Cluster 6 (difference in initial mean IRT scores is 5.42) by the end of fifth grade this difference has grown to a difference of more than 22 points. These children show the slowest growth of any cluster (change in mean IRT scores = 9.82) in their mean IRT score across the kindergarten year, and moderate growth from the end of kindergarten to the end of first grade (change in mean IRT score = 24.18). The children in this cluster show their largest growth from the end of first grade to the end of third grade (change in mean IRT scores = 42.35) and they show the greatest growth of any cluster from the end of third to the end of fifth grade (change in mean IRT score = 25.86). However, these children continue to remain behind their peers in a number of skills. These children enter kindergarten with the least proficient reading skills of any cluster. According to the proficiency scores (see Table 17) these children enter school with very low reading skills. Children in this cluster show lower proficiency in letter recognition (.39 compared to .81 for Cluster 5); recognizing beginning sounds (.05 compared to .25 for Cluster 5) and recognizing ending sounds (.01 compared to .05 for Cluster 5). These children reach mastery level in their proficiency of the letter recognition component of the reading skill test by the end of kindergarten, but it takes them until the end of

third grade before they reach mastery level proficiency in the recognizing sight words and reading words in context components of the reading skill test. The children in this cluster also show substantial deficits in literal inference, extrapolation, evaluation and evaluating non-fiction components of the reading test in comparison to their peers in the other clusters.

Cluster membership by categorical SES and behavior

Differences in cluster membership by categorical SES and behavior ratings were evaluated using Kendall's tau-c. The continuous behavior ratings variables were averaged across the five time points and then recoded into a categorical variable by dividing the scores into quartiles. The lowest quartile included children with behavior ratings from10.27 to 14.18, the second quartile ranged from 14.19 to 14.92, the third quartile from 14.93 to 15.64 and the highest quartile from 15.65 to 18.06. Kendall's tau-c is a measure of ordinal association and is calculated as the excess of concordant over discordant pairs multiplied by a term representing an adjustment for the size of the table. The value of Kendall's tau-c varies from -1 to 1, with 1 or -1 indicating a perfect relationship and 0 indicating no relationship. Cluster membership was significantly associated with categorical SES, Kendall's tau-c (20) = .30, $p < .001$ and categorical behavior ratings, Kendall's tau-c (15) = .12, $p < .001$. To determine how these factors were jointly related to cluster membership, first a nested table was created looking at the association between cluster membership and categorical SES by behavior ratings. This analysis indicated that there were some slight differences in the relationship between the categorical SES variable and cluster membership by behavior ratings. Kendall's tau-c ranged from .33 for those children with the highest ratings of behavior problems to .26 for those children with the lowest ratings of behavior problems.

However all relationships remained significant with a *p*-value of less than .001. A second nested table was created looking at the association between cluster membership and behavior ratings by categorical SES. This analysis also indicated that there were some slight differences in the relationship between behavior ratings and cluster membership by categorical SES. Kendall's tau-c ranged from .11 for those children from the families within the first quintile of SES to .05 for those children living in families within the fifth quintile of SES. However all relationships remained significant with a *p*-values ranging from less than .001 to .03.

CHAPTER 5

DISCUSSION

Consistent with previous research (Lee, Grigg, & Donahue, 2007; Lonigan, Burgess, Anthony, & Barker, 1998; Molfese, Modglin, & Molfese, 2003; Whitehurst, 1997), children from low-SES families were on average behind their peers in reading development at all measured time points. Children from the lowest SES quintile families entered school with lower reading skills than their peers from higher SES families; they were on average 2.7 to 10.2 points behind their peers from higher SES families at school entry. This difference grew across the grade levels to as much as a 10.6 to 30.5 point difference at the end of third grade. The significance of these numbers is unclear seeing that these IRT scores are not easily comparable to school-based skill assessment, but children from the lowest SES quintile were behind their peers in all the reading subskills measures within this study. Also consistent with previous research (NCES, 2000; Zill et al., 1995), children from lower SES families were on average more likely to exhibit a higher rate of behavior problems at school entry but this difference was considerably smaller and did tend to narrow across elementary school.

Reading Developmental Trajectories

There is a mix of research findings regarding the nature of the reading development of children who enter school with lower initial reading skills (Aarnouste et al., 2001; Cunningham & Stanovich, 1997; Juel, 1988; Phillips et al., 2002), with results showing both cumulative and compensatory trajectories for reading development. However, some of this previous research has shown that children who enter school with lower initial reading skills typically follow a cumulative trajectory of reading development through kindergarten, but show a compensatory

developmental trajectory in later grades (Aarnouste et al., 2001; Aunola et al., 2002; Leppanen et al., 2004; Lerkkanen et al., 2004; McCoach et al., 2006; Parrila et al., 2005). The findings of this study are consistent with the findings of this earlier research. According to Bast and Reitsma (1997) evidence of cumulative trajectory consists of three components of developmental change: the stability of interindividual differences across time, increases in interindividual variance across time and the association between initial skill level and its growth across time. The results of this study indicated a high stability in reading scores (an association of .79) between the beginning and end of kindergarten with an increasing variance (from 86.43 to 163.70) showing a fan spread effect expected from cumulative development. There was also a positive association between initial reading level and the growth in reading skill across the kindergarten year, indicating that children who enter kindergarten with higher letter recognition, better phonemic awareness, and a greater knowledge of sight words show the fastest growth in IRT reading scores across kindergarten. However, consistent with earlier research (Aarnouste et al., 2001; Aunola et al., 2002; Leppanen et al., 2004; Lerkkanen et al., 2004; McCoach et al., 2006; Parrila et al., 2005), there was evidence of a compensatory developmental trajectory in later grades. There was no evidence of a relationship between initial level of reading skills and the growth of reading skills from the end of first to the end of third grade and a significant negative association between initial level of reading and the growth in reading skill from the end of third grade to the end of fifth grade, indicating that children who entered school with lower proficiency in the previously mentioned reading related skills on average experienced greater growth in their IRT reading scores during this period of time. Further, growth in reading development from the beginning to the end of kindergarten is significantly negatively associated with growth in reading skills from the end of kindergarten to end of fifth grade, indicating that even though children

with higher initial reading skills are experiencing a period of more rapid growth across kindergarten they are showing slower growth than their peers with lower initial reading skills from the end of kindergarten to the end of fifth grade.

These findings call into question the assertion that reading skill at school entry exclusively shapes the future of reading development, and that the gap between weak and strong reading achievement widens over the elementary years, becoming increasingly difficult to close. It is true there was a fairly high stability in reading skill, suggesting that relative position in achievement remained stable across elementary school and that children who entered school with more proficient reading skills on average remained more proficient than their less skilled peers. The relationships between reading scores at adjacent time points ranged from.79 between the beginning and the end of kindergarten to .46 between third grade and fifth grade. However, while there was a strong likelihood that children who entered kindergarten with less reading proficiency would end kindergarten behind their more proficient peers, this likelihood was substantially reduced by fifth grade. It appears as if some of these children with lower reading skills at school entry were able to make substantial gains, closing the initial gap between them and their more proficient peers. This finding was further supported by data showing that although there was a relationship between initial reading proficiency and growth across kindergarten, there was no relationship between initial proficiency and growth from first to third grade. Even more importantly the data suggest that children who were less proficient at school entry are actually experiencing faster growth in reading skill from third to fifth. This finding would seem to cast doubt on the assertion that closing the gap in reading proficiency after third grade is extremely difficult. While this is only one study and further replication is necessary, the results do raise doubts about the presence of a *Matthew Effect* for children entering school with

lower reading proficiency. These results are consistent with earlier research (Aarnouste et al., 2001; Aunola et al., 2002; Leppanen et al., 2004; Lerkkanen et al., 2004; McCoach et al., 2006; Parrila et al., 2005) suggesting that these children follow multiple trajectories and these trajectories may be a mix of both cumulative and compensatory growth.

Reading development and SES

It was hypothesized that the majority of children from low-SES families, who are more likely to enter school with lower initial reading skills (Aram, 2005; Bowey, 1995; Christian, Morrison, & Bryant, 1998; Hood, Conlan, & Andrews, 2008; Korat, Klein, & Segal-Drori, 2006; Spira, Bracken, & Fischel, 2005; Walker, Greenwood, Hart & Carta, 1994; Zill, Collins, West, & Hausken, 1995), would follow a cumulative trajectory of reading development through kindergarten, but show a more compensatory developmental trajectory in later grades. As expected, on average children from lower SES families in this sample did enter school with lower initial reading skills as evidenced by lower letter recognition, phonemic awareness, knowledge of sight words and reading words in context. However, there was only a moderate relationship between SES and initial reading skills (.37 in the univariate simplex model and .34 in the univariate piecewise growth curve model) suggesting that other factors not measured in the models are associated with lower initial reading skills upon entry to kindergarten. This moderate relationship may be the result of using a global measure of SES rather than looking at more proximal indicators of reading skill development that are frequently associated with low-SES. Low-SES has been associated with home language environment, parental support, cognitive ability, parental expectations and family instability which have all been related to lower reading skills (Eamon, 2002; Gershoff et al., 2007; Votruba-Drzal, 2006), but the relationship between

SES and these factors are is not perfect. There is considerable variation in the types of academic and emotional support that low-SES families are able to provide their children. It may be wise in future studies to identify specific factors that underlie this relationship between SES and reading skill development, especially considering that these factors are often more likely to be addressed by effective interventions. It is usually very difficult to change the family income, parental occupational status or parental education level to any great degree, but there are a number of proven interventions that have been shown to improve parental emotional support and to increase the quality of the home language environment (Justice & Ezell, 2000; Nicholson, Berthelsen, Williams, & Abad, 2010; Van der Heyden, Snyder, Broussard, & Ramsdell, 2008; Webster-Stratton & Herman, 2008)

As expected low-SES was associated with lower IRT scores upon school entry, however this study provided mixed results concerning the pattern of reading development for children from low-SES families. There was a continued significant association between SES and the development of reading skills even after controlling for initial reading skills at school entry. Although the association was small, on average children from higher SES families received higher IRT reading scores at each point excepting the end of kindergarten when no significant association was found. Further, higher SES was associated with faster growth in IRT reading scores from the beginning of kindergarten to the end of third grade. However, the results did suggest that children from low-SES families are experiencing a period of faster growth in reading scores than their peers from higher SES families from the end of third grade to the end of fifth grade. These findings seem to suggest that many children from low-SES families may still experience slower growth in reading skills independently of their lower reading scores at school entry. Further although there was some support for a compensatory growth in reading scores

from the end of third grade to the end of fifth grade for children from lower SES families, on average this rate of growth was insufficient to overcome the gap in skills that widened from the beginning of first grade to the end of third grade.

The nature of this study did not allow the long-term value of early reading intervention to be evaluated, seeing that this data was not included in the study. It may have been that early intervention may have boosted the reading skills of lower SES children allowing a higher percentage of them to close the gap between their more proficient peers. However, the findings suggesting an association between low-SES and the slower development of reading skills across elementary school, even when controlling for initial reading proficiency, highlights the necessity for an even deeper exploration into the relationship between low-SES and reading development. Early intervention is clearly an important first step in addressing the deficits in reading skills experienced by many children from low-SES families, but these findings suggest it may not be enough. It is important to delve deeper into the achievement of students from low-SES families to determine what other factors, other than SES and early achievement, are influencing the reading development of children from low-SES families. There are many potential explanations for this slower reading development that were not explored within this study such as school effects, summer effects, and the emotional aspects of schooling and school-based relationships among others.

Other factors to be considered

Previous journalistic work and numerous research studies have consistently shown that there are substantial differences in the quality of low-SES schools when compared to higher SES schools. Jonathan Kozol (1991) provides a poignant description of some of the harsh conditions

faced by students in low-SES schools in his book, *Savage Inequalities, Children in America's Schools.* He describes low-SES schools awash in sewage, lacking qualified teachers and adequate school-related supplies and providing substantially inferior educational opportunities. While it is almost certain that the schools he describes are not typical of most low-SES schools, previous research does provide evidence to indicate that low-SES schools are on average deficient when compared to their higher SES counterparts. Classic work by Jean Anyon (1981) discusses the divergent manner in which knowledge is defined in schools across the SES spectrum. She found that knowledge was conceptualized as "fragmented facts," "practical," "mechanical," and "procedural" in nature in low-SES schools in comparison to higher SES schools, which treated knowledge as more "conceptual" and more open to discovery, reason and/or logic. Anyon (1981) found that these divergent conceptualizations of knowledge led to differences in curriculum, differences that could arguably lead to differences in academic growth across the years of schooling.

More recent research in this area supports the contention that low-SES schools are often inferior to their higher SES counterparts. Previous research has shown that low-SES schools on average have smaller libraries (Guice, Allington, Johnston, Baker, & Michaelson, 1994) and fewer and older computers than higher SES schools (Becker & Sterling, 1987). Haycock (2000) found that children in high poverty schools were less likely to be taught by teachers who are fully certified and who themselves perform less well on external assessment. Tabors and Snow (2001) found that on average teachers of students in low-SES schools have lower expectations of their students and Barone (2002) discovered that teachers in low-SES schools typically use more narrow instructional strategies when teaching reading. They tended to use less extended text in their instruction, rather choosing to focus the majority of the instruction on letter recognition and

the sounds of the letters. This finding was consistent with earlier work completed by Duke in 2000, which compared the print environment and experiences offered in low- and high-SES schools.

While there was a wide diversity in the types of literacy experiences offered in low-SES first grade classrooms, Duke (2000) found substantial differences in the experiences offered in low-SES classrooms in comparison to high-SES classrooms. On average, low-SES classrooms contained fewer literacy materials and made less use of the materials that they did possess. First, students in low-SES classrooms encountered less environmental print and experienced fewer references to that print. Further it was found that the references that were given in low-SES classrooms were typically less integrated with print resources and the topic of study in the class at the time. For example, Duke (2000) describes one high-SES classroom in which many pieces of environmental classroom print related to the topic of horses were displayed, including poems about horses (some written by students), a large display of horse jokes, a list of the types of horses, a class-composed informational text about horses, and student-made labels on various horse-related items, and accompanying this environmental print there were a large number of books about horses. While Duke (2000) does not indicate if this horse-related literacy material was integrated with classroom instruction on horses, it is quite likely that this was the case. This same rich literacy environment found in this high-SES classroom was rarely found in low-SES classrooms observed in this study. In addition, on average low-SES classroom libraries contained fewer magazines and books than higher-SES classrooms, with as much as a 40 percent mean difference between the two settings. This number is even more alarming considering that low-SES schools often had three to four more students in their classrooms than did higher SES schools. Duke (2000) also found that children in low-SES schools often had fewer opportunities

to access their classroom libraries and in general the proportion of the library displayed was much less in low-SES schools when compared to higher SES schools. She also found that the available print was less integrated into classroom instruction. Finally, Duke (2000) found substantial differences in student agency with print between low- and high-SES schools. Students in low-SES schools had fewer choices in their assigned reading material, had less choice in the types of written activities they engaged in and a much narrower audience available for their written activities. Duke (2000) contends that this less rich literacy environment in low-SES schools may be related to the slower growth in reading skills for low-SES students.

Other research has shown that the make-up of the student population of the school is also associated with the academic achievement of low-SES students. The aggregated or mean school SES has been shown to be independently associated with student achievement beyond that of individual student backgrounds, with schools with a higher percentage of children from low-SES families having lower average scores on standardized tests than their higher-SES counterparts (Kahlenberg, 2001; Rumberger & Palardy, 2005; Sirin, 2005; Willms, 1999). In some cases the correlation between school SES and student achievement has been found to be even stronger than the association with individual SES and student achievement (Sirin, 2005). Logan and Petscher (2010) have furthered this research using latent profile analysis to show that not only the proportion of students from low-SES families, but also the proportion of minority students and the proportion of English Language Learners (ELL) are associated with poorer academic performance. Their analyses found four clusters that they called the "Low-Risk" group, the "Average-Risk" group, the "Poverty-Risk" group and the "Language-Risk" group. Their findings showed that there were differences in the initial scores on the *Dynamic indicators of basic early literacy (DIBELS) oral reading fluency (ORF)* (5th edition; Good, Kaminski, Smith, Laimon, &

Dill, 2001) by group membership at first, second and third grades. Further they found differences in growth rates in words correct per minute (WCPM) as measured by the *DIBELS ORF* between the four groups with the "Poverty-Risk" group and the "Language-Risk" group in all three grades showing slower growth. This finding was affirmed by Borman and Dowling (2010), who found that the racial/ethnic and social class composition of a student's school was 1.75 times more important than the student's individual SES or minority status when predicting educational achievement.

Additionally the nature of this study also did not provide the opportunity to control for "summer effects," or the educational disadvantage experienced by children from lower SES families when compared to their peers from higher SES families over the summer months. On average low-SES parents are less likely to provide the same level of educational enrichment in the home environment as their higher SES counterparts. The same disadvantages experienced by children from low-SES families that are often associated with their lower reading skills upon school entry are also often associated with a greater decline of reading skills over the summer months. A number of studies have shown that children from lower SES families experience a greater decline in reading skills over the summer when compared to their peers from higher SES families (Alexander, Entwisle, & Olson, 2007; Cooper, Nye, Charlton, Lindsay, & Greathouse, 1996; Downey, von Hippel, Broh, 2004; McCoach et al., 2006; Ready, 2010). In fact, while children from low-SES families typically experience declines in reading skills, children from higher SES families often seem to continue to develop new skills or to strengthen their already existing skills (Alexander, Entwisle, & Olson, 2007; Cooper et al., 1996; McCoach et al., 2006; Ready, 2010). Downey and colleagues (2004) found that children from higher SES families experienced a relative gain of .07 points per month in kindergarten and .05 points per month in

first grade on a measure of reading skills (letter recognition, phonemic awareness and sight word recognition) in comparison to their peers from lower SES families, but the relative gain increased to .16 points per month during the summer months. Further the negative effects of this "summer effect" seem to increase with increases in the students' grade level and the complexity of the academic material (Alexander, Entwisle & Olson, 2007; Cooper et al., 1996). While the findings of this study do suggest that children from low-SES families are making slower growth in reading skills during elementary school, it is impossible to determine how much of this widening of the gap is occurring during the summer months. If the gap between the reading skills of low- and higher SES families is occurring during the summer months, this may be an area that would benefit from targeted intervention for these children.

Finally, the emotional aspects of schooling and school-based relationships cannot be ignored and were not included in this study. There is an emerging consensus that the emotional aspects of the classroom are predictive of academic achievement above and beyond the nature and quality of the instructional practices provided (Bransford, Brown, & Cocking, 1999; Cameron et al., 2005; Curby, Rimm-Kaufman, & Ponitz, 2009; Eccles & Gootman, 2002; Hamre & Pianta, 2007). Teachers' sensitivity and emotional support have been found to be associated with achievement gains for first-graders (Hamre & Pianta, 2005). Further students who have more supportive teachers are much more likely to demonstrate behaviors that support learning (e.g., motivation, self-regulation, engagement and autonomy) and that are frequently associated with higher academic achievement (Crosnoe, Johnson, & Elder, 2004; Greenberg, Weissberg, O'Brien, Zins, Fredericks, Resnick, et al., 2003; Gregory & Weinstein, 2004; Pianta,LaParo, Payne, Cox, & Bradley, 2002; Rimm-Kaufman et al., 2005; Roeser, Eccles, & Sameroff, 2000; Wentzel, 2002; Zins, Bloodworth, Weissberg, & Walberg, 2004). In more recent research, Pianta

and colleagues (Pianta, Belsky, Vandergrift, Houts, & Morrison, 2008) found that the warmth of teacher-child interactions, as well as the adults' skill in detecting and responding to the students' individual needs, was a consistent predictor of reading growth from first to third grade. This is especially relevant to the findings in this study seeing that Kirby and colleagues (Curby, Rimm-Kauffman & Ponitz, 2009) found that the students with low initial skills benefited even more from classrooms with a high level of emotional support than did their higher achieving peers. Finally, Hauser-Cram and colleagues (Hauser-Cram, Durand, & Warfield, 2007) showed that children's early attitudes toward school predicted fifth-grade literacy skills even when controlling for initial skills prior to school entry. It seems as if children who initially hold more ambivalent or negative attitudes toward school also experience slower growth in achievement across the elementary school years. Although it is important to recognize that other factors than initial reading skills may be associated with the reading development of children from low-SES families, it is significantly more important to determine what these other factors may be and how their interaction may influence the development of reading across elementary school as well as the effectiveness of intervention for these students.

Clustering-by-Cases analysis

Consistent with expectations, there were multiple trajectories of reading development; the clustering-by-cases analysis suggested the presence of six different reading development trajectories. There was a mix of cumulative, compensatory and parallel trajectories. Approximately 8% of this sample of children demonstrated a compensatory trajectory and although beginning school with IRT scores that were 30 to 50 points behind their peers with the most proficient reading skills at school entry, they were able to close the gap and in some cases

surpass these peers by fifth grade. The majority of the sample (approximately 60%) follows a somewhat parallel trajectory, maintaining their relative position in the hierarchy of reading skill development. However, despite following a largely parallel course these students do narrow the gap in reading skills with their highest achieving peers. There is an approximately 70 point difference in IRT scores at school entry between the highest scoring cluster and the next to lowest scoring cluster compared to only approximately 25 points difference at the end of fifth grade. The most concerning findings were the approximately 30% of the sample that appear to follow a cumulative trajectory. This group of students enters school with the lowest IRT reading scores of any group and shows the slowest growth in reading scores through elementary school. Further, although their IRT scores are only approximately 5 points behind the majority of their peers in the next highest group at school entry by the end of fifth grade the gap has widened to 22 points and they continue to remain 46 points behind their highest scoring peers.

These findings further raise questions regarding the strong assertion that reading skill at school entry exclusively shapes the future of reading development, and that the gap between weak and strong reading achievement widens over the elementary years, becoming increasingly difficult to close. The data gathered in this study seem to suggest otherwise. The majority of the children in this sample (approximately 60%) followed a more parallel trajectory. Although these students did not catch up with their more proficient peers, they did appear to close the gap in reading proficiency across their years in elementary school. Only 30% of the sample appears to follow the more compensatory trajectory consistent with a *Matthew Effect.* Further, the results do seem to call into question the assertion that intervention after third grade is unlikely to provide any substantial benefits. Even though it was insufficient to close the gap with their

higher achieving peers and the improvement that was seen was in primarily in basic reading skills (i.e., beginning and ending sounds, sight words and words in context) rather than more higher order skills (i.e., literal inference, extrapolation, evaluation and evaluating non-fiction), this group of children following this more cumulative trajectory experienced a period of more rapid growth after third grade. Although these findings do cast doubt on the validity of the *Matthew Effect* model, they do not necessarily negate the benefit of early, intensive intervention. The nature of this study precludes determining the relative benefit of early intervention and its ability to alter later reading trajectories, however it is still unclear if an intensive early intervention alone would be sufficient to meet the needs of these students, especially those following the more cumulative trajectory of reading development.

Cluster membership relationship with SES and behavior

The limited nature of this study precludes substantial knowledge about the characteristics of these clusters; however, the analyses that were conducted suggest that cluster membership is associated with both SES and the level of teacher rated behavior problems. Children from low-SES families were significantly more likely to follow a cumulative trajectory of reading development and were predominantly grouped in the clusters with the slowest reading growth (58% of the 1st SES quintile and 35% of the 2nd quintile were in the 6th cluster and 32% and 42% respectively were in the 5th cluster). There was also a relationship between a higher rate of teacher rated behavior problems and cluster membership, with the children with a higher rate of behavior problems being overrepresented in the lowest reading group (35% of the children in the 6th cluster were identified as having the highest rate of behavior problems compared to only 22%

of children with the lowest rate of behavior problems). However, it should be noted this relationship was not as strong as the relationship between SES and reading cluster. Yet it was interesting to note that the relationship between behavior ratings and reading cluster was stronger for children from the lower SES quintiles in comparison to children from the highest SES quintiles. This finding suggests that a higher rate of behavior problems may be more related to slower growth in reading skills for those children from the lowest SES families than for their more advantaged peers. This finding makes sense in light of research that has shown a relationship between multiple risk factors and poorer academic performance (Deater-Deckard, Dodge, Bates, & Pettit, 1998; Greenberg, Speltz, DeKlyen, & Jones, 2001; Jones, Forehand, Brody, & Armistead, 2002; Rutter, 1979; Sameroff, 2000; Williams, Anderson, McGee, & Silva, 1990) and seeing that many of these children enter school significantly behind their peers in reading proficiency.

Although many of the findings of this study suggest that the *Matthew Effect* model may not be representative of the majority of students, the data does show that children from lower SES families are more likely to follow a cumulative trajectory of reading development. Almost 60% of children from families in the lowest quintile of SES and 35% of the children from families in the second lowest quintile of SES were in the sixth cluster and followed a cumulative trajectory. Further 32% of children from families in the lowest SES quintile and 58% of children from the second lowest quintile were in the fifth cluster, and although following a somewhat parallel trajectory, they remained the furthest behind their peers, showed the slowest growth for a group with a parallel trajectory and experienced much of their growth in basic reading skills. These findings indicate that 90 % of children from families in the lowest SES quintile and 77% of

children from families in the second lowest SES quintile were in the lowest two reading clusters, trajectories of reading development, which left them well behind their higher achieving peers. This finding was inconsistent with expectations and is highly intriguing. Many of the children from other socioeconomic backgrounds who entered school with lower initial reading skills followed a relatively parallel trajectory of development and were able to close the gap in reading skills, at least to some degree. A small number of these children even demonstrated a compensatory trajectory, closing the gap in reading proficiency between themselves and their higher achieving peers. These findings would seem to suggest that something more than lower initial reading skills are related to the slower growth in reading development for these children from lower SES families.

This finding is highly pertinent because the two federal initiatives, *Early Reading First* and *Reading First,* have been derived from a belief in a *Matthew Effect.* These programs have been initiated to address this widening gap in the reading development of children from the lowest SES families and their more proficient peers by providing early, intensive reading interventions in an attempt to close the gap in reading proficiency early. It is the expectation that closing this gap early will positively influence long-term development and ameliorate the widening gap in reading proficiency between children from the lowest SES families and their higher achieving peers. Although these programs have not been in place long enough to truly evaluate their relative effectiveness, several cautions need to be raised. First, the findings of this study seem to indicate that children from low-SES families still experience slower growth even when controlling for their initial skills. There may be many reasons for this slower growth, some of which have been discussed above, poorer schools, summer effects, other family factors to name a few. These findings may suggest that early reading intervention alone may not be

sufficient to address the needs of these children. Further previous research has found that students with weak oral language skills and impoverished home environments are less likely to benefit from early literacy instruction (Al Otaiba et al., 2008; Al Otaiba & Fuchs, 2002; Lonigan, 2003; Torgeson, 2000; Torgeson et al., 1999). While it is unclear if this lower effectiveness is related to some facet of the reading instruction or some other unmeasured correlate of these factors, it does highlight the need for a deeper, more thorough understanding of the relationship between reading development and low-SES. Finally, although the findings of this study regarding the relationship between behavior ratings and reading development were much weaker than expected, there was a small relationship found between behavior rating and cluster membership. Students who followed a more cumulative trajectory of reading development were more likely to be rated as having a higher rate of behavior problems than their peers who followed a more parallel or compensatory trajectory. Additionally, the data suggest that this relationship was stronger for children from lower SES families.

Reading development and behavior

It was also hypothesized that behavior problems would be associated with the slower reading development of children from low-SES families. Previous research has shown that children from low-SES families are more likely to have behavior problems in school (NCES, 2000; Zill et al., 1995) and that these behavior problems may be associated with slower development of reading skills (Arnold et al., 2005; Hinshaw, 1992; McGee et al., 1988; Reid et al., 2004; Trout et al., 2003). The findings of this study do suggest a relationship between low-SES and a higher rate of behavior problems, but the association, although statistically significant, was small. In the univariate simplex model a significant association was only found between

SES and three time points (beginning of kindergarten, .12; end of first grade, .12; and the end of fifth grade, .09) and there was only a significant relationship between SES and the initial level of behavior problems. These results suggest that children from lower SES families are somewhat more likely to demonstrate behavior problems than their peers from higher SES families, but the findings of this study provided little support for a relationship between a higher rate of behavior problems and the slower reading development of children from low-SES families. The addition of behavior ratings to the univariate models of reading development did very little to add explanatory power to the model. Further, while there were a few statistically significant relationships found between a higher rate of teacher rated behavior problems and slower reading development, these relationships were small and unlikely to offer much practical significance. According to the findings of this study, earlier reading proficiency still remains the best predictor of reading proficiency at later grades and SES has a stronger association with reading scores than behavior ratings at all time points with the exception of the end of kindergarten.

Although the findings of this study do not support the hypothesis that a higher rate of behavior problems are associated with the slower reading development of children from low-SES families, it is quite possible that this relationship exists. Previous research has shown that a higher rate of behavior problems is associated with lower reading achievement (Arnold et al., 2005; Hinshaw, 1992; McGee et al., 1988; Reid et al., 2004; Trout et al., 2003) and that a higher rate of behavior problems in kindergarten and first grade is associated with slower reading growth across the remainder of elementary school (Horn & Packard, 1985; Rabiner et al., 2000; Reid et al., 2004; Velting & Whitehurst, 1997). Further, children with a higher rate of behavior problems are more likely to have lower academic engagement (Abikoff et al., 2002; DuPaul et

al., 2004; Junod et al., 2006; Waller, 2006), more conflictual relationships with teachers (Birch & Ladd, 1997; Brendgen et al., 2006; DeMartini-Scully, Bray, & Kehle, 2000; Dishion et al., 1995; Ladd & Burgess, 1999; Shores et al., 1993) and less academic support than their peers with better classroom behavior (Carr, Taylor, & Robinson, 1991; Good & Brophy, 1994; Gunter & Coutinho, 1997; Shores, Gunter, & Jack, 1993; Walker et al., 1998; Wehby et al., 1998). These factors should conceivably be associated with lower academic achievement for these children (Dally, 2006; Deater-Deckard et al., 2009; DiPerna, Volpe, & Elliot, 2005; McGee & Share, 1988; Rabiner, Coie et al., 2000; Velting & Whitehurst, 1997; Warner-Rogers et al., 2000; Wentzel, 1993). Finally, a number of studies have demonstrated that children with behavior problems are less likely to benefit from effective reading interventions (Nelson, Benner, & Gonzalez, 2003; Otaiba & Fuchs, 2002; Rabiner et al., 2004: Torgeson et al., 1999). Considering the findings of previous research, it is quite likely that the lack of findings supporting a relationship between higher behavior problems and slower reading development is more the result of the way in which behavior was measured in this study, rather than a lack of such a relationship. Behavioral ratings were gathered from teachers at each time point using an adaptation of the *Social Skills Rating Scale (SSRS;* Gresham & Elliot, 1990). This behavior measure provided a global rating of the teacher's perception of the student's approach to learning, self-control, interpersonal skills, externalizing problem behaviors and internalizing problem behaviors. While this measure did provide some information about the student's overall behavior it may not have been sensitive enough to capture the types and frequencies of behavior that may be related to the slower development of reading skills. Additionally, the long span of time between ratings of behavior may have obscured the subtle changes in weekly behavior that could have been associated with changes in reading growth. However, it could be that a more

sensitive measure would not have yielded substantially different findings. As mentioned earlier the relationship between behavior and reading is still somewhat uncertain with several different relationships being found (Dionne, 2005; Hinshaw, 1992; Mandel, 1997; Spira & Fischel, 2005). Clearly additional research is needed to clarify this question further.

Limitations of this Study

While this study adds to the current knowledge base about the reading development of children from low-SES families, it also has a number of limitations. First, this study is considering SES as a composite variable. While the use of a composite measurement of SES represents SES better than any single construct alone with each construct predicting unique variance in children's developmental outcomes (Bradley & Corwyn, 2002; Conger & Donnellan, 2007), it does not allow for the consideration of the more proximal effects of SES on the student's development (see Luthar & Zigler, 1991; McLloyd, 1998; Sameroff, Seifer, Baldwin, & Baldwin, 1993 for a more detailed discussion). The findings of this study suggest that children from low-SES families are more likely to enter school with fewer reading skills than their peers from higher SES families and are more likely to experience slower growth of reading skills across elementary school. However, other studies have shown that the proximal factors associated with lower SES, such as quality of emotional support, level of cognitive stimulation, and the experience of material hardship, largely mediate the relationship between SES and these associated outcomes (Eamon, 2002; Gershoff et al., 2007; Votruba-Drzal, 2006). Further, these more proximal processes are easier to address with effective intervention through parent education or the provision of cognitively supporting enrichment activities for the children, than family income, job status and parental education level.

Second, the nature of the measurement of classroom behavior may not have been sensitive enough to detect any relationship between behavior and reading development. Behavioral ratings were gathered from teachers at each time point using an adaptation of the *Social Skills Rating Scale (SSRS;* Gresham & Elliot, 1990). This behavior measure provided a global rating of the teacher's perception of the student's approach to learning, self-control, interpersonal skills, externalizing problem behaviors and internalizing problem behaviors. While this measure did provide some information about the student's overall behavior it relied on the teachers' overall impression of the student and may not have captured the types and frequencies of behavior that may be related to the slower development of reading skills. Additionally, the long span of time between ratings of behavior may have obscured the subtle changes in weekly behavior that could have been associated with changes in reading growth. Finally, the children from the most disadvantaged circumstances, and likely the highest rates of severe behavior problems,were underrepresented in this study.

Third, this study did not consider the classroom or the school effects on children's development. Another study looking at this sample of data (McCoach et al. 2006) found that most of the variance between schools could be explained by the differences in the catchment area that the school drew their children from. The growth rate of academic skills was comparable across schools, but schools in advantaged areas tended to draw larger populations of advantaged children who entered school with higher academic scores, making the school appear to be of a higher quality. However, these school and classroom effects may be significant, previous research has shown that approximately 10%-30% of the variance in student achievement lies between schools and another 12%-20% of variance in student achievement lies between classrooms within schools (Kyriakides, Campbell, & Gagatsis, 2000; Raudenbush & Byrk, 2002;

Rowan, Correnti, & Miller, 2002). As discussed above, previous research has also shown that the nature of schools and literacy instruction in classrooms can be substantially different (Barone, 2002; Borman & Dowling, 2010; Duke, 2000; Haycock, 2000; Logan & Petscher, 2010; Sirin, 2005; Tabors & Snow, 2001) and these differences may be related to the findings of this study.

Fourth, the nature of the data precludes the measurement of "summer effects." Previous studies (Alexander, Entwisle, & Olson, 2007; Cooper, Nye, Charlton, Lindsay, & Greathouse, 1996; Downey, von Hippel, & Broh, 2004; McCoach et al., 2006) have indicated that children from low-SES suffer greater skill loss over the summer break than their peers from higher SES families. It appears that the children from the lowest SES families are entering school behind their peers in reading skills and then remaining significantly behind them in reading skills across elementary school. However, the design of the study precludes the partitioning of the growth in IRT reading scores during school from the growth or decline of reading skills across the summer months, when most children are away from school. For many children this "summer effect" may be the difference between closing the gap in IRT reading scores with their more skilled peers and remaining significantly behind them. For the children from the lowest SES families, the summer may be a critical period that may provide an opportunity for the implementation of intensive interventions to address the widening gap in IRT reading scores across the elementary school years.

Finally, the significant amount of missing data limits the generalizability of this study, especially considering the disproportionate amount of data missing from those children from extremely disadvantaged families. While it is impossible to be sure, it is highly likely that these children from the most disadvantaged families would show the slowest growth in reading development across elementary school and is likely to be a group in the greatest need of effective

interventions. On average these families are more likely to experience a greater number of risk factors associated with slower academic growth (Deater-Deckard, Dodge, Bates, & Pettit, 1998; Greenberg, Speltz, DeKlyen, & Jones, 2001; Jones, Forehand, Brody, & Armistead, 2002; Rutter, 1979; Sameroff, 2000; Williams, Anderson, McGee, & Silva, 1990). Additionally, these more disadvantaged families are more likely than higher SES families to experience high levels of family instability, which often leads to frequent school absences and a higher than average number of school transfers (Ackerman, Brown, D'Erama, & Izard, 2002; Capaldi & Patterson, 1991; Eckenrode, Rowe, Laird, & Braithwaite, 1995; Seccombe, 2000; Seltzer, 2000; White & Rogers, 2000). These transitions and absences are likely to further inhibit these children's academic development (Ready, 2010).

Implications of findings for practice and future research

The implications of this study for practice are restricted because of the inherent limitations of the study and because of the narrow focus of the research questions; however, this study should serve as a foundation for future research. First, this study supported earlier research indicating a relationship between low-SES and lower reading skills at school entry, but the moderate relationship did suggest that there were other unmeasured factors associated with these lower initial reading skills. Other studies have found that more proximal factors that are often associated with lower SES mediate this relationship (Eamon, 2002; Gershoff et al., 2007; Votruba-Drzal, 2006) and these factors are more likely to respond to effective intervention.

Second, there were mixed findings regarding the types of reading developmental trajectories that children from low-SES families followed. A large percentage of children from low-SES families followed a cumulative trajectory of reading development, entering school with

the lowest IRT reading scores and showing a much slower growth rate than their peers from higher SES families. However, not all children who entered with the lowest initial IRT reading scores demonstrated this slower growth rate and some were able to catch up or surpass their peers who began school with more proficient reading skills. It would be beneficial to take a closer look at the factors other than SES and behavior ratings that were associated with membership in the lowest reading cluster to determine if there were specific factors that were associated with either a more cumulative or compensatory trajectory for children from low-SES families. It may also be informative to determine if there is an overlap between the different trajectories found in this study and the different reading profiles found by earlier research (Pierce, Katzir, Wolf & Noam, 2007; Riddle-Buly & Valencia, 2002; Valencia & Riddle-Buly, 2004). Further, even when controlling for initial IRT reading scores, lower SES was associated with slower reading growth across elementary school. However, the nature of this study precluded a separate analysis of school and classroom effects and the separation of growth during periods when students were receiving instruction in school and the growth or decline occurring during the summer months. Future research will need to be designed to control for school and classroom effects and the "summer effects" in reading growth across elementary school. Finally, this study provided little support regarding the association between higher rates of behavior problems and slower reading development for children from low-SES families. However there is reason to believe this relationship may exist and may be stronger than the findings of this study suggest. Future studies should attempt to collect more detailed data about behavior during reading instruction, including data gathered through regular classroom observations.

APPENDICES

APPENDIX A

TABLES

Table 1. *Comparison of Reading IRT Scores by Grade Level for Included and Excluded Samples.*

	Included Sample Mean (SD)	Excluded Sample Mean (SD)	Independent Samples *t*-test (df)
Fall Kindergarten	30.4 (*10.0*)	24.9 (*14.0*)	-29.0 (15818), $p < .001$**
Spring Kindergarten	42.3 (*13.4*)	36.8 (*17.4*)	-23.1 (16548), $p < .001$**
Fall First-grade	50.0 (*17.3*)	43.6 (*20.9*)	-12.0 (4710), $p < .001$**
Spring First-grade	74.8 (*21.3*)	67.1 (*26.0*)	-20.9 (16018), $p < .001$**
Spring Third-grade	122.4 (*23.3*)	112.1 (*30.4*)	-23.0 (14048), $p < .001$**
Spring Fifth-grade	143.1 (*21.3*)	133.4 (*27.1*)	-21.1 ((8271), $p < .001$**

Table 2. *Comparison of Teacher-Rated SRS Scores by Assessment Period for Included and Excluded Samples.*

Fall Kindergarten	Included Sample Mean (SD)	Excluded Sample Mean (SD)	Independent Samples *t*-test (df)
Approaches to Learning	2.7 (*.84*)	2.7 (*.78*)	-4.30 (13839), $p < .001$**
Self-Control	2.7 (*.87)*	2.7 (*.81*)	0.15 (13482), $p = .88$
Interpersonal	2.7 (*.80*)	2.6 (*.75*)	-2.26 (13493), $p = .02$*
Externalizing Behavior	1.6 (*.59*)	1.7 (*.65*)	10.14 (15046), $p < .001$**
Internalizing Behavior	1.5 (*.50*)	1.6 (*.53*)	7.64 (14624), $p < .001$**
Spring Kindergarten			
Approaches to Learning	2.7 (*.95*)	2.6 (*.88*)	-2.10 (13643), $p =. 04$*
Self-Control	2.6 (*.96*)	2.6 (*.90*)	0.98 (13714), $p = .33$
Interpersonal	2.6 (*.92*)	2.6 (*.86*)	1.50 (13621), $p = .14$
Externalizing Behavior	1.6 (*.60*)	1.7 (*.66*)	9.64 (15193), $p < .001$**
Internalizing Behavior	1.5 (*.48*)	1.6 (*.53*)	9.20 (15022), $p < .001$**
Spring First-Grade			
Approaches to Learning	2.7 (*.90*)	2.6 (*.85*)	-4.53 (14013), $p < .001$**
Self-Control	2.6 (*.93*)	2.7 (*.87*)	1.61 (13848), $p = .25$
Interpersonal	2.6 (*.90*)	2.6 (*.85*)	0.69 (13818), $p = .50$
Externalizing Behavior	1.6 (*.61*)	1.7 (*.66*)	8.86 (14680), $p < .001$**
Internalizing Behavior	1.6 (*.49*)	1.6 (*.53*)	7.65 (14585), $p < .001$**

Table 2 (cont'd)

Spring Third-Grade	Included Sample Mean (SD)	Excluded Sample Mean (SD)	Independent Samples *t*-test (df)
Approaches to Learning	2.7 (*.87*)	2.7 (*.84*)	-3.60 (10923), $p < .001$**
Self-Control	2.7 (*.93*)	2.6 (*.90*)	-0.72 (10791), $p = .47$
Interpersonal	2.6 (*.88*)	2.6 (*.86*)	-0.55 (10703), $p =$. 58
Externalizing Behavior	1.7 (*.59*)	1.7 (*.62*)	4.68 (10291), $p < .001$**
Internalizing Behavior	1.6 (*.51*)	1.7 (*.56*)	6.57 (10023), $p < .001$**
Spring Fifth-Grade			
Approaches to Learning	2.7 (*.88*)	2.7 (*.84*)	-1.20 (9018), $p = .24$
Self-Control	2.7 (*.94*)	2.7 (*.91*)	0.49 (8769), $p = .62$
Interpersonal	2.6 (*.87*)	2.7 (*.82*)	0.82 (8749), $p = .41$
Externalizing Behavior	1.6 (*.56*)	1.7 (*.61*)	4.14 (8053), $p < .001$**
Internalizing Behavior	1.6 (*.53*)	1.7 (*.55*)	4.40 (8191), $p < .001$**

Table 3. *Sociodemographic Information Comparison Between Excluded and Included Samples.*

Characteristic	Included Sample	Excluded Sample	Chi square (df)
Total	6,698	10,867	
Child Gender			20.6 (2), $p < .001$**
Male	3,309 (49.4%)	5,676 (52.2%)	
Female	3,389 (50.6%)	5,180 (47.7%)	
Child race/ethnicity			660 (8), $p < .001$**
White, Non-Hispanic	4,534 (67.7%)	5,357 (49.3%)	
African American	701 (10.5%)	1,793 (16.5%)	
Hispanic	752 (11.3%)	2,310 (21.3%)	
Asian/Pacific Islander	407 (2.9%)	909 (8.4%)	
Native American	113 (1.7%)	203 (1.9%)	
More than one race	187 (2.8%)	261 (2.4%)	
Unknown	4 (.1%)	34 (.3%)	
Highest parent level of education			446 (8), $p < .001$**
Less than high school	316 (4.7%)	1,323 (12.2%)	
High school graduate	1,534 (22.9%)	2,779 (25.6%)	
Vocational/technical	358 (5.3%)	586 (5.4%)	
Some college	1,861 (27.8%)	2,615 (24.1%)	
College graduate	1,600 (23.9%)	1,849 (17%)	
Masters	563 (8.4%)	640 (5.9%)	
Ph.D./Professional	364 (5.4%)	394 (3.6%)	
Unknown	102 (1.5%)	681 (6.3%)	
Family Type			161 (4), $p < .001$**
Dual Parent	5,282 (78.9%)	6,285 (57.8%)	
Single Parent	1,092 (16.3%)	2,120 (19.5%)	
Other	93 (1.4%)	192 (1.8%)	
Unknown	231 (3.4%)	2,270 (20.9%)	
Home Language			496 (2), $p < .001$**
English	6,143 (91.7%)	8,240 (75.8%)	
Non-English	446 (6.7%)	1,848 (17%)	
Unknown	109 (1.6%)	779 (7.2%)	
Socioeconomic Status			470 (4), $p < .001$**
First Quintile	709 (10.6%)	2,330 (21.4%)	
Second Quintile	1,213 (18.1%)	1,990 (18.3%)	
Third Quintile	1,371 (20.5%)	1,975 (18.2%)	
Fourth Quintile	1,550 (23.1%)	1,945 (17.9%)	
Fifth Quintile	1,753 (26.2%)	1,946 (17.9%)	
Unknown	102 (1.5%)	681 (6.3%)	

Table 4. *Sociodemographic Information for Final Sample Used in this Study.*

Characteristic	Total	Sector	
		Public	Private
Total	6,698	5,138 (76.7%)	1,560 (23.3%)
Region			
Northeast	1,336 (19.9%)	1,012 (19.7%)	324 (20.8%)
Midwest	1,968 (29.4%)	1,396 (27.2%)	572 (36.7%)
South	2,105 (31.4%)	1,795 (34.9%)	310 (19.9%)
West	1,289 (19.2%)	935 (18.2%)	354 (22.7%)
Type of locale			
Large & Mid-size city	2,211 (33%)	1,377 (26.8%)	834 (53.5%)
Suburbs & Large Town	2,592 (38.7%)	2,103 (40.9%)	489 (31.3%)
Small Town & Rural	1,895 (28.3%)	1,658 (32.3%)	237 (15.2%)
Child race/ethnicity			
White, Non-Hispanic	4,534 (67.7%)	3,356 (65.3%)	1,178 (75.5%)
African American	701 (10.5%)	639 (12.4%)	62 (4%)
Hispanic	752 (11.3%)	585 (11.4%)	167 (10.7%)
Asian/Pacific Islander	407 (2.9%)	312 (6.1%)	95 (6.1%)
Native American	113 (1.7%)	99 (1.9%)	14 (.9%)
More than one race	187 (2.8%)	145 (2.8%)	42 (2.7%)
Child Gender			
Male	3,309 (49.4%)	2,537 (49.4%)	772 (49.5%)
Female	3,389 (50.6%)	2,601 (50.6%)	788 (50.5%)
Highest parent level of education			
Less than high school	316 (4.7%)	307 (5.9%)	9 (.6%)
High school graduate	1,534 (22.9%)	1,378 (26.8%)	156 (10%)
Vocational/technical	358 (5.3%)	300 (5.8%)	58 (3.7%)
Some college	1,861 (27.8%)	1,464 (28.5%)	397 (25.4%)
College graduate	1,600 (23.9%)	1,062 (20.7%)	538 (34.5%)
Masters	563 (8.4%)	353 (6.9%)	210 (13.5%)
Ph.D./Professional	364 (5.4%)	193 (3.8%)	171 (11%)
Unknown	102 (1.5%)	81 (1.6%)	21 (1.3%)
Socioeconomic Status			
First Quintile	709 (10.6%)	690 (13.4%)	19 (1.2%)
Second Quintile	1,213 (18.1%)	1,077 (21%)	136 (8.7%)
Third Quintile	1,371 (20.5%)	1,107 (21.5%)	264 (16.9%)
Fourth Quintile	1,550 (23.1%)	1,114 (21.7%)	436 (27.9%)
Fifth Quintile	1,753 (26.2%)	1,069 (20.8%)	684 (43.8%)
Unknown	102 (1.5%)	81 (1.6%)	21 (1.3%)

Table 5. *Means and Standard Deviations for Reading Assessments by Grade Level.*

	Mean	Standard Deviation
Fall Kindergarten	30.4	10.0
Spring Kindergarten	42.3	13.4
Fall First-grade	50.0	17.3
Spring First-grade	74.8	21.3
Spring Third-grade	122.4	23.3
Spring Fifth-grade	143.1	21.3

Table 6. *Means and Standard Deviations for Proficiency Probabilities by Grade and Skill Level.*

Fall Kindergarten	Mean	Standard Deviation
Letter Recognition	.73	.31
Beginning Sounds	.34	.33
Ending Sounds	.19	.27
Sight Words	.03	.13
Words in Context	.02	.08
Literal Inference	.00	.04
Extrapolation	.00	.01
Evaluation	.00	.01
Evaluating Non-fiction	.00	.00
Spring Kindergarten		
Letter Recognition	.95	.12
Beginning Sounds	.75	.29
Ending Sounds	.56	.33
Sight Words	.17	.27
Words in Context	.07	.16
Literal Inference	.01	.07
Extrapolation	.00	.02
Evaluation	.00	.02
Evaluating Non-Fiction	.00	.00
Fall First-Grade		
Letter Recognition	.98	.24
Beginning Sounds	.87	.30
Ending Sounds	.73	.35
Sight Words	.32	.40
Words in Context	.14	.32
Literal Inference	.03	.24
Extrapolation	.00	.21
Evaluation	.00	.21
Evaluating Non-Fiction	.00	.20

Table 6 (Cont'd)

Spring First-Grade	Mean	Standard Deviation
Letter Recognition	1.0	.02
Beginning Sounds	.99	.07
Ending Sounds	.96	.12
Sight Words	.82	.27
Words in Context	.52	.31
Literal Inference	.19	.24
Extrapolation	.04	.12
Evaluation	.04	.06
Evaluating Non-fiction	.00	.00
Spring Third-Grade		
Letter Recognition	1.0	.00
Beginning Sounds	1.0	.00
Ending Sounds	1.0	.01
Sight Words	.98	.04
Words in Context	.94	.12
Literal Inference	.75	.26
Extrapolation	.50	.37
Evaluation	.28	.21
Evaluating Non-Fiction	.01	.05
Spring Fifth-Grade		
Letter Recognition	1.0	.00
Beginning Sounds	1.0	.00
Ending Sounds	1.0	.00
Sight Words	1.0	.01
Words in Context	.98	.05
Literal Inference	.91	.15
Extrapolation	.79	.30
Evaluation	.50	.26
Evaluating Non-Fiction	.09	.20

Table 7. *Means and Standard Deviations for Teacher-rated SRS by Assessment Period.*

Fall Kindergarten	Mean	Standard Deviation	Split half Reliability
Approaches to Learning	2.7	.84	.89
Self-Control	2.7	.87	.79
Interpersonal	2.7	.80	.89
Externalizing Behavior	1.6	.59	.90
Internalizing Behavior	1.5	.50	.80
Spring Kindergarten			
Approaches to Learning	2.7	.95	.89
Self-Control	2.6	.96	.80
Interpersonal	2.6	.92	.89
Externalizing Behavior	1.6	.60	.90
Internalizing Behavior	1.5	.48	.78
Spring First-Grade			
Approaches to Learning	2.7	.90	(NR)
Self-Control	2.6	.93	(NR)
Interpersonal	2.6	.90	(NR)
Externalizing Behavior	1.6	.61	(NR)
Internalizing Behavior	1.6	.49	(NR)
Spring Third-Grade			
Approaches to Learning	2.7	.87	.91
Self-Control	2.7	.93	.79
Interpersonal	2.6	.88	.89
Externalizing Behavior	1.7	.59	.89
Internalizing Behavior	1.6	.51	.76
Spring Fifth-Grade			
Approaches to Learning	2.7	.88	.91
Self-Control	2.7	.94	.79
Interpersonal	2.6	.87	.88
Externalizing Behavior	1.6	.56	.89
Internalizing Behavior	1.6	.53	.77

Table 8. *GSS Occupational Codes by Parent for Initial Kindergarten Sample.*

GSS Code	Occupation	Father	Mother
29.6	Handler, Equip, Cleaner, Helpers, Labor	199 (1.5%)	93 (.7%)
33.42	Production Working Occupation	920 (6.8%)	486 (3.6%)
34.95	Service Occupations	861 (6.3%)	1,909 (14%)
35.63	Agriculture, Forestry, Fishing Occupations	339 (2.5%)	44 (.3%)
35.78	Marketing & Sales Occupation	852 (6.3%)	901 (6.6%)
35.92	Transportation, Material Moving	696 (5.1%)	106 (.8%)
37.67	Precision Production Occupation	269 (2.0%)	53 (.4%)
38.18	Administrative Support, Including Clerk	531 (3.9%)	2,297 (16.9%)
39.18	Mechanics & Repairs	798 (5.9%)	22 (.2%)
39.2	Construction & Extractive Occupations	1,076 (7.9%)	24 (.2%)
48.69	Technologists, Except Health	380 (2.8%)	171 (1.3%)
52.54	Writers, Artists, Entertainers, Athletes	112 (.8%)	171 (1.3%)
53.5	Executive, Admin, Managerial Occupation	1,607 (11.8%)	1,063 (7.8%)
57.83	Health Technologists & Technicians	60 (.4%)	252 (1.9%)
59	Social Scientist/Workers, Lawyers	217 (1.6%)	176 (1.3%)
61.56	Registered Nurses, Pharmacists	75 (.6%)	448 (3.3%)
62.87	Natural Scientists & Mathematicians	129 (.9%)	52 (.4%)
63.43	Teacher, except Postsecondary	142 (1.0%)	575 (4.2%)
64.89	Engineers, Surveyors, & Architects	354 (2.6%)	39 (.3%)
72.1	Teachers, College; Postsecondary Counselors; Librarians	101 (.7%)	112 (.8%)
75.5	Physicians, Dentists, Veterinarians	235 (1.7%)	85 (.6%)

Table 9. *Reading IRT Scores by SES Quintile & Measurement Point*

Beg. of K		
	SES Quintile	Mean (SD)
	1st	24.85 (5.46)
	2nd	27.53 (8.50)
	3rd	29.56 (8.80)
	4th	31.55 (11.81)
	5th	35.09 (10.14)
End of K		
	1st	35.74 (9.75)
	2nd	38.76 (11.72)
	3rd	41.24 (12.13)
	4th	43.95(12.34)
	5th	47.60 (15.24)
1st Grade		
	1st	62.35 (17.20)
	2nd	68.87 (18.93)
	3rd	72.70 (18.82)
	4th	78.11 (20.08)
	5th	83.88 (22.03)
3rd Grade		
	1st	104.10 (23.18)
	2nd	114.73 (22.84)
	3rd	120.85 (22.13)
	4th	127.01 (20.35)
	5th	134.64 (19.26)
5th Grade		
	1st	126.96 (22.36)
	2nd	135.78 (21.52)
	3rd	142.03 (19.35)
	4th	147.41 (17.53)
	5th	154.42 (16.26)

Table 10. *Behavior Ratings by SES Quintile & Measurement Point*

Beg. of K		
	SES Quintile	Mean (SD)
	1st	14.65 (1.95)
	2nd	14.95 (2.01)
	3rd	15.02 (1.95)
	4th	15.03 (1.93)
	5th	15.11 (2.03)
End of K		
	1st	14.43 (2.03)
	2nd	14.64 (2.10)
	3rd	14.77 (2.11)
	4th	14.88 (2.11)
	5th	14.77 (2.12)
1st Grade		
	1st	14.44 (2.14)
	2nd	14.68 (2.00)
	3rd	14.80 (2.01)
	4th	14.94 (2.14)
	5th	15.01 (2.17)
4th Grade		
	1st	14.39 (2.10)
	2nd	14.73 (2.03)
	3rd	14.63 (2.11)
	4th	14.91 (2.13)
	5th	14.89 (2.13)
5th Grade		
	1st	14.38 (1.99)
	2nd	14.69 (2.03)
	3rd	14.68 (2.09)
	4th	14.84 (2.15)
	5th	15.00 (2.23)

Table 11. *Univariate Simplex Model for Reading with SES.*

Parameter Estimates	*Unstandardized*	*Standardized*
Read T2 → Read T1	1.21** (.02)	.89** (.01)
Read T3 → Read T2	1.21** (.02)	.76** (.01)
Read T4 → Read T3	.74** (.01)	.68** (.01)
Read T5 → Read T4	.69**(.01)	.77** (.01)
Read T1 → SES	4.85** (.18)	.37** (.01)
Read T2 → SES	n.s. (dropped from model)	n.s. (dropped from model)
Read T3 → SES	2.74** (.27)	.10** (.01)
Read T4 → SES	5.36** (.32)	.17** (.01)
Read T5 → SES	2.79** (.24)	.10** (.01)
Variance (Latent Read T1)	86.43	1.0
Variance (Latent Read T2)	163.70	1.0
Variance (Latent Read T3)	428.55	1.0
Variance (Latent Read T4)	508.59	1.0
Variance (Latent Read T5)	412.77	1.0
Residuals (Read T1 with Read T5)	9.71** (1.69)	.10** (.02)
Residuals (Read T2 with Read T4)	-4.46* (1.82)	-.05* (.02)
Residuals (Read T3 with Read T5)	18.06** (2.42)	.14** (.02)
Residual for Latent Read T1	80.50** (1.97)	.87** (.01)
Residual for Latent Read T2	35.18** (2.69)	.21** (.02)
Residual for Latent Read T3	163.31** (4.18)	.37** (.01)
Residual for Latent Read T4	232.48** (4.99)	.45** (.01)
Residual for Latent Read T5	109.69** (2.94)	.26** (.01)

Table 12. *Univariate Piecewise Growth Curve Model for Reading with SES.*

Parameter Estimates	*Unstandardized*	*Standardized*
Level with Read Growth I	18.54** (1.67)	.34** (.04)
Level with Read Growth II	5.87 (3.56)	.11 (.06)
Level with Read Growth III	-13.75** (3.68)	-.72** (.02)
Read Growth I with Read Growth II	-5.07**(.83)	-.25** (03)
Read Growth I with Read Growth III	-2.44** (.43)	-.34* (.12)
Read Growth II with Read Growth III	-3.03** (1.13)	-.43** (.10)
Level → SES	6.05** (.31)	.34** (.02)
Read Growth I → SES	1.04** (.11)	.16** (.02)
Read Growth II → SES	1.44** (.14)	.23** (.03)
Read Growth III → SES	-.39** (.07)	-.18** (.05)
Intercept (Level)	-9.29** (1.00)	-.72** (.08)
Intercept (Read Growth I)	8.57** (.35)	1.85** (.09)
Intercept (Read Growth II)	4.46** (.45)	.98** (.12)
Intercept (Read Growth III)	8.17** (.24)	5.60** (1.16)
Residual for Read T1	3.43* (1.40)	.03* (.01)
Residual for Read T2	33.62** (1.34)	.19** (.01)
Residual for Read T3	72.22** (4.53)	.16** (.01)
Residual for Read T4	64.86** (9.40)	.12** (.02)
Residual for Read T5	67.71** (16.90)	.16** (.04)
Residual for Level	146.21** (12.27)	.88** (.01)
Residual for Read Growth I	20.93** (.88)	.97** (.01)
Residual for Read Growth II	19.69** (2.40)	.95** (.01)
Residual for Read Growth III	2.52* (1.19)	.97** (.02)

Table 13. *Univariate Simplex Model for Behavior with SES.*

Parameter Estimates	*Unstandardized*	*Standardized*
Beh T2 → Beh T1	1.07** (.11)	.73** (.03)
Beh T3 → Beh T2	.24** (.03)	.33** (.03)
Beh T4 → Beh T3	.44** (.06)	.42** (.05)
Beh T5 → Beh T4	.46**(.06)	.45** (.05)
Beh T1 → SES	.17** (.03)	.12** (.02)
Beh T2 → SES	n.s. (dropped from model)	n.s. (dropped from model)
Beh T3 → SES	.19** (.04)	.12** (.02)
Beh T4 → SES	n.s. (dropped from model)	n.s. (dropped from model)
Beh T5 → SES	.14** (.06)	.09** (.02)
Variance (Latent Beh T1)	.54	1.0
Variance (Latent Beh T2)	1.41	1.0
Variance (Latent Beh T3)	.47	1.0
Variance (Latent Beh T4)	.56	1.0
Variance (Latent Beh T5)	.55	1.0
Residuals (Beh T1 with Beh T5)	.19** (.06)	.17** (.05)
Residuals (Beh T1 with Beh T4)	.27** (.06)	.25* (.05)
Residual for Latent Beh T1	2.77** (.13)	.71** (.03)
Residual for Latent Beh T2	2.08** (.12)	.46** (.02)
Residual for Latent Beh T3	3.17** (.14)	.71** (.03)
Residual for Latent Beh T4	3.09** (.13)	.69** (.03)
Residual for Latent Beh T5	3.07** (.14)	.68** (.03)

Table 14. *Multivariate Simplex Model for Reading and Behavior with SES.*

Parameter Estimates	*Unstandardized*	*Standardized*
Read T2 → Read T1	1.10** (.01)	.83** (.00)
Read T3 → Read T2	1.14** (.02)	.72** (.01)
Read T4 → Read T3	.71** (.01)	.65** (.01)
Read T5 → Read T4	.68**(.01)	.75** (.01)
Beh T2 → Beh T1	1.10** (.10)	.74** (.03)
Beh T3 → Beh T2	.25** (.03)	.35** (.03)
Beh T4 → Beh T3	.49** (.07)	.46** (.05)
Beh T5 → Beh T4	.47** (.05)	.47** (.05)
Read T2 → Beh T1	.57** (.15)	.04** (.01)
Read T3 → Beh T2	.35* (.16)	.03* (.01)
Read T4 → Beh T3	2.47** (.41)	.12** (.02)
Read T5 → Beh T4	.75** (.22)	.04** (.01)
Read T1 → SES	4.89** (.18)	.36** (.01)
Read T2 → SES	n.s. (dropped from model)	n.s. (dropped from model)
Read T3 → SES	3.12** (.27)	.11** (.01)
Read T4 → SES	5.11** (.33)	.16** (.01)
Read T5 → SES	2.89** (.23)	.10** (.01)
Beh T1 → SES	.17** (.03)	.12** (.02)
Beh T2 → SES	n.s. (dropped from model)	n.s. (dropped from model)
Beh T3 → SES	.19** (.04)	.12** (.02)
Beh T4 → SES	n.s. (dropped from model)	n.s. (dropped from model)
Beh T5 → SES	.14** (.04)	.08** (.02)
Variance (Latent Read T1)	100.61	1.0
Variance (Latent Read T2)	178.67	1.0
Variance (Latent Read T3)	444.95	1.0
Variance (Latent Read T4)	524.97	1.0
Variance (Latent Read T5)	429.09	1.0
Variance (Latent Beh T1)	.50	1.0
Variance (Latent Beh T2)	1.35	1.0
Variance (Latent Beh T3)	.45	1.0
Variance (Latent Beh T4)	.57	1.0
Variance (Latent Beh T5)	.52	1.0

Table 14. (cont'd.)

Parameter Estimates	*Unstandardized*	*Standardized*
Residual (Read T1 with Read T5)	9.37** (1.62)	.09** (.02)
Residual (Read T2 with Read T4)	-3.79* (1.74)	-.03* (.02)
Residual (Read T3 with Read T5)	19.09** (2.33)	.13** (.02)
Residual (Beh T1 with Beh T5)	.17** (.05)	.17** (.05)
Residual (Beh T1 with Beh T4)	.26** (.06)	.25** (.05)
Residual for Latent Read T1	88.77** (1.72)	.87** (.01)
Residual for Latent Read T2	54.57** (1.12)	.30** (.01)
Residual for Latent Read T3	182.80** (3.55)	.41** (.01)
Residual for Latent Read T4	238.53** (4.88)	.46** (.01)
Residual for Latent Read T5	122.06** (2.42)	.29** (.01)
Residual for Latent Beh T1	2.81** (.12)	.73** (.03)
Residual for Latent Beh T2	2.15** (.12)	.48** (.03)
Residual for Latent Beh T3	3.26** (.14)	.73**(.03)
Residual for Latent Beh T4	3.10** (.12)	.69** (.02)
Residual for Latent Beh T5	3.12** (.13)	.69** (.02)

Table 15. *Univariate Piecewise Growth Curve Model for Behavior with SES.*

Parameter Estimates	*Unstandardized*	*Standardized*
Level with Beh Growth I	-.38** (.10)	-.56** (.14)
Level with Beh Growth II	.08 *n.s.* (.13)	.22 *n.s.* (.34)
Level with Beh Growth III	-.20 *n.s.* (.15)	-.55** (.16)
Beh Growth I with Beh Growth II	-.04 *n.s.* (.16)	-.16 *n.s.* (.54)
Beh Growth I with Beh Growth III	-.01 *n.s.* (.09)	-.05 *n.s.* (.44)
Beh Growth II with Beh Growth III	-.05 *n.s.* (.16)	-.40 *n.s.* (.73)
Level → SES	.19** (.04)	.13** (.03)
Beh Growth I → SES	.06 *n.s.* (.04)	.07 *n.s.* (.05)
Beh Growth II → SES	-.06 *n.s.* (.05)	-.12 *n.s.* (.16)
Beh Growth III → SES	.02 *n.s.* (.05)	.05 *n.s.* (.09)
Intercept (Level)	14.25** (.14)	13.25** (.94)
Intercept (Beh Growth I)	-.01 *n.s.* (.13)	-.02 *n.s.* (.20)
Intercept (Beh Growth II)	-.08 *n.s.* (.18)	-.22 *n.s.* (.54)
Intercept (Beh Growth III)	.03 *n.s.* (.14)	.09 *n.s.* (.40)
Residual for Beh T1	3.07** (.10)	.78** (.02)
Residual for Beh T2	2.44** (.20)	.55** (.04)
Residual for Beh T3	3.83** (.11)	.86** (.02)
Residual for Beh T4	3.77** (.11)	.84** (.02)
Residual for Beh T5	3.81** (.21)	.84** (.04)
Residual for Level	1.14** (.16)	.98** (.01)
Residual for Beh Growth I	.40* (.17)	1.0** (.01)
Residual for Beh Growth II	.13 *n.s.* (.24)	.99** (.04)
Residual for Beh Growth III	.12 *n.s.* (.17)	1.0** (.01)

Table 16. *Multivariate Growth Curve Model for Reading and Behavior with SES.*

Parameter Estimates	*Unstandardized*	*Standardized*
Read Level with Read Growth I	18.59** (1.67)	.34** (.04)
Read Level with Read Growth II	5.89 *n.s.* (3.56)	.11** (.06)
Read Level with Read Growth III	-13.36** (3.66)	-.72** (.02)
Beh Level with Beh Growth I	-.37** (.10)	-.56** (.15)
Beh Level with Beh Growth II	.07 *n.s.* (.13)	.17 *n.s.* (.31)
Beh Level with Beh Growth III	-.18 *n.s.* (.15)	-.53** (.18)
Read Growth I with Read Growth II	-5.11** (.82)	-.25** (.03)
Read Growth I with Read Growth III	-2.43** (.43)	-.34* (.12)
Read Growth II with Read Growth III	-3.05* (1.13)	-.44** (.10)
Beh Growth I with Beh Growth II	-.04 *n.s.* (.16)	-.16 *n.s.* (.52)
Beh Growth I with Beh Growth III	-.01 *n.s.* (.09)	-.05 *n.s.* (.48)
Beh Growth II with Beh Growth III	-.05 *n.s.* (.16)	-.40 *n.s.* (.75)
Read Level → SES	6.05** (.31)	.35** (.02)
Read Growth I → SES	1.04** (.11)	.16** (.02)
Read Growth II → SES	1.44** (.14)	.23** (.03)
Read Growth III → SES	-.39** (.07)	-.18** (.06)
Beh Level → SES	.19** (.04)	.13** (.03)
Beh Growth I → SES	.06 *n.s.* (.04)	.07 *n.s.* (.05)
Beh Growth II → SES	-.06 *n.s.* (.05)	-.11 *n.s.* (.14)
Beh Growth III → SES	.02 *n.s.* (.04)	.05 *n.s.* (.10)
Read Level with Beh Level	1.27 * (.53)	.10* (.04)
Read Level with Beh Growth I	1.16* (.47)	.16* (.07)
Read Level with Beh Growth II	-1.19 *n.s.* (.65)	-.26 *n.s.* (.27)
Read Level with Beh Growth III	.37 *n.s.* (.50)	.10 *n.s.* (.15)
Beh Level with Read Growth I	.79** (.19)	.16** (.04)
Beh Level with Read Growth II	.40 *n.s.* (.23)	.09 *n.s.* (.05)
Beh Level with Read Growth III	-.19 *n.s.* (.13)	-.12 *n.s.* (.08)
Read Growth I with Beh Growth I	.27 *n.s.* (.17)	.10 *n.s.* (.06)
Read Growth II with Beh Growth I	.13 *n.s.* (.21)	.05 *n.s.* (.08)
Read Growth III with Beh Growth I	-.15 *n.s.* (.11)	-.16 *n.s.* (.13)
Read Growth I with Beh Growth II	.02 *n.s.* (.23)	.01 *n.s.* (.13)
Read Growth II with Beh Growth II	.14 *n.s.* (.29)	.08 *n.s.* (.19)
Read Growth III with Beh Growth II	.04 *n.s.* (.16)	.06 *n.s.* (.28)
Read Growth I with Beh Growth III	-.27 *n.s.* (.18)	-.18 *n.s.* (.18)
Read Growth II with Beh Growth III	-.01 *n.s.* (.23)	-.01 *n.s.* (.15)
Read Growth III with Beh Growth III	.04 *n.s.* (.12)	.08 *n.s.* (.26)

Table 16. (cont'd)

Parameter Estimates	*Unstandardized*	*Standardized*
Intercept (Read Level)	-9.29** (1.0)	-.72** (.08)
Intercept (Read Growth I)	8.57** (.35)	1.85** (.09)
Intercept (Read Growth II)	4.46** (.45)	.97** (.12)
Intercept (Read Growth III)	8.17** (.24)	5.19** (1.24)
Intercept (Beh Level)	14.25** (.14)	13.38** (.96)
Intercept (Beh Growth I)	-.01 *n.s.* (.13)	-.02 *n.s.* (.20)
Intercept (Beh Growth II)	-.08 *n.s.* (.18)	-.20 *n.s.* (.50)
Intercept (Beh Growth III)	.03 *n.s.* (.14)	.09 *n.s.* (.43)
Residual for Read T1	3.58* (1.40)	.04* (.01)
Residual for Read T2	33.48** (1.34)	.18** (.01)
Residual for Read T3	72.78** (4.50)	.16** (.01)
Residual for Read T4	63.51** (9.25)	.12** (.02)
Residual for Read T5	70.17** (16.67)	.16** (.04)
Residual for Read Level	144.86** (12.20)	.88** (.01)
Residual for Read Growth I	20.87** (.87)	.97** (.01)
Residual for Read Growth II	19.93** (2.38)	.95** (.01)
Residual for Read Growth III	2.40* (1.19)	.97** (.02)
Residual for Beh T1	3.05** (.10)	.78** (.02)
Residual for Beh T2	2.46** (.20)	.55** (.04)
Residual for Beh T3	3.84** (.11)	.86** (.02)
Residual for Beh T4	3.76** (.11)	.84** (.02)
Residual for Beh T5	3.84** (.21)	.85** (.04)
Residual for Beh Level	1.12** (.16)	.98** (.01)
Residual for Beh Growth I	.39* (.17)	1.0** (.01)
Residual for Beh Growth II	.14 *n.s.* (.24)	.99** (.03)
Residual for Beh Growth III	.11 *n.s.* (.17)	1.0** (.01)

Table 17. *Comparison of IRT Reading Scores and Proficiency Scores by Cluster.*

Cluster 1										
Time Point	IRT Score	Letter Recog	Beg Sounds	End Sounds	Sight Words	Words in Context	Literal Inferen	Extrap	Eval	Eval Non-Fiction
Beg K	98.27 (11.99)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.88 (.01)	.46 (.03)	.08 (.02)	.08 (.01)	.00 (.00)
End K	108.22 (13.83)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.93 (.01)	.63 (.03)	.20 (.03)	.13 (.01)	.00 (.00)
First	132.46 (14.94)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.98 (.00)	.88 (.02)	.66 (.05)	.35 (.03)	.01 (.00)
Third	158.85 (12.3)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.99 (.00)	.97 (.00)	.71 (.03)	.19 (.05)
Fifth	171.28 (9.08)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.88 (.02)	.57 (.06)
Cluster 2										
Time Point	IRT Score	Letter Recog	Beg Sounds	End Sounds	Sight Words	Words in Context	Literal Inferen	Extrap	Eval	Eval Non-Fiction
Beg K	68.02 (8.26)	1.0 (.00)	1.0 (.00)	.98 (.00)	.87 (.01)	.44 (.02)	.07 (.01)	.00 (.00)	.01 (.00)	.00 (.00)
End K	90.79 (13.70)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.99 (.00)	.80 (.01)	.36 (.03)	.05 (.01)	.06 (.01)	.00 (.00)
First	119.75 (13.20)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.96 (.00)	.77 (.02)	.41 (.03)	.22 (.02)	.01 (.00)
Third	148.82 (14.08)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.99 (.00)	.96 (.01)	.90 (.02)	.56 (.03)	.07 (.02)
Fifth	162.79 (13.06)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.99 (.01)	.97 (.01)	.76 (.02)	.33 (.04)

Table 17. (cont'd)

Cluster 3										
Time Point	IRT Score	Letter Recog	Beg Sounds	End Sounds	Sight Words	Words in Context	Literal Inferen	Extrap	Eval	Eval Non-Fiction
Beg K	46.15 (4.07)	1.0 (.00)	.95 (.00)	.80 (.00)	.21 (.01)	.05 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)
End K	65.98 (12.18)	1.0 (.00)	.99 (.00)	.97 (.00)	.76 (.01)	.39 (.01)	.08 (.01)	.00 (.00)	.01 (.00)	.00 (.00)
First	110.49 (14.40)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.93 (.00)	.65 (.01)	.24 (.01)	.15 (.00)	.00 (.00)
Third	149.83 (13.11)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.99 (.00)	.97 (.00)	.92 (.01)	.58 (.01)	.06 (.00)
Fifth	164.20 (11.54)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.99 (.00)	.98 (.00)	.78 (.01)	.33 (.02)
Cluster 4										
Time Point	IRT Score	Letter Recog	Beg Sounds	End Sounds	Sight Words	Words in Context	Literal Inferen	Extrap	Eval	Eval Non-Fiction
Beg K	36.71 (3.52)	.98 (.00)	.71 (.01)	.41 (.01)	.02 (.01)	.01 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)
End K	48.91 (6.37)	1.0 (.00)	.96 (.00)	.84 (.00)	.31 (.00)	.10 (.00)	.01 (.00)	.00 (.00)	.00 (.00)	.00 (.00)
First	90.14 (13.89)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.98 (.00)	.79 (.00)	.34 (.01)	.05 (.01)	.01 (.00)	.00 (.00)
Third	139.57 (13.48)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.99 (.00)	.93 (.00)	.80 (.01)	.43 (.01)	.02 (.00)
Fifth	156.86 (13.18)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.98 (.00)	.96 (.00)	.68 (.01)	.16 (.01)

Table 17. (cont'd)

Cluster 5										
Time Point	IRT Score	Letter Recog	Beg Sounds	End Sounds	Sight Words	Words in Context	Literal Inferen	Extrap	Eval	Eval Non-Fiction
Beg K	28.80 (3.18)	.81 (.00)	.25 (.00)	.08 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)
End K	40.47 (5.50)	.99 (.00)	.82 (.00)	.58 (.01)	.09 (.00)	.03 (.01)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)
First	73.21 (12.00)	1.0 (.00)	1.0 (.00)	.99 (.00)	.89 (.00)	.53 (.01)	.13 (.00)	.01 (.00)	.02 (.00)	.00 (.00)
Third	129.92 (15.04)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.97 (.00)	.84 (.00)	.56 (.01)	.29 (.00)	.00 (.00)
Fifth	147.10 (15.84)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.99 (.00)	.95 (.00)	.87 (.00)	.54 (.00)	.07 (.00)
Cluster 6										
Time Point	IRT Score	Letter Recog	Beg Sounds	End Sounds	Sight Words	Words in Context	Literal Inferen	Extrap	Eval	Eval Fiction
Beg K	22.78 (3.02)	.39 (.01)	.05 (.00)	.01 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)
End K	32.60 (5.69)	.88 (.00)	.48 (.01)	.24 (.01)	.02 (.00)	.01 (.01)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)
First	56.78 (11.23)	1.0 (.00)	.96 (.00)	.89 (.00)	.58 (.01)	.23 (.00)	.03 (.00)	.00 (.00)	.01 (.00)	.00 (.00)
Third	99.13 (16.55)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.98 (.00)	.85 (.00)	.49 (.01)	.13 (.00)	.10 (.00)	.00 (.00)
Fifth	124.99 (19.17)	1.0 (.00)	1.0 (.00)	1.0 (.00)	1.0 (.00)	.96 (.00)	.80 (.01)	.54 (.01)	.29 (.00)	.01 (.00)

APPENDIX B

FIGURES

Figure 1. *Univariate Simplex Model for Reading Development.*

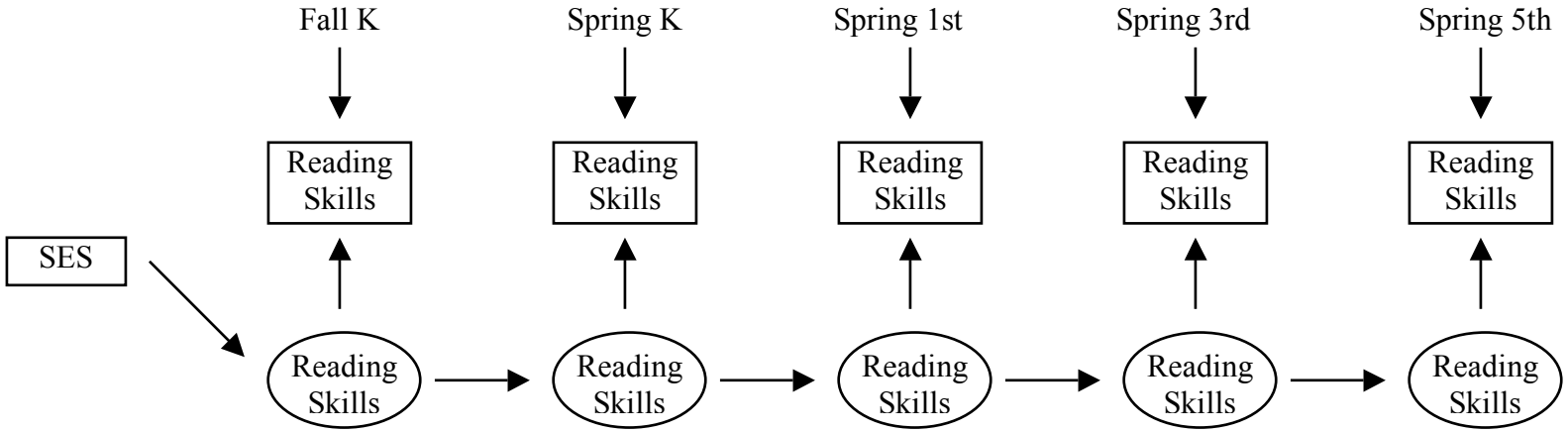


Figure 2. *Univariate Latent Growth Curve Model for Reading Development.*

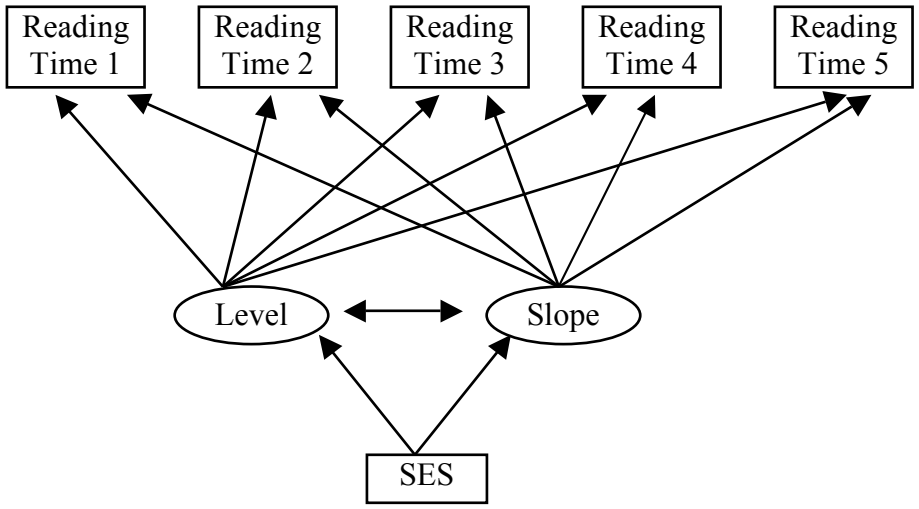


Figure 3. *Univariate Piecewise Growth Curve Model for Reading Development.*

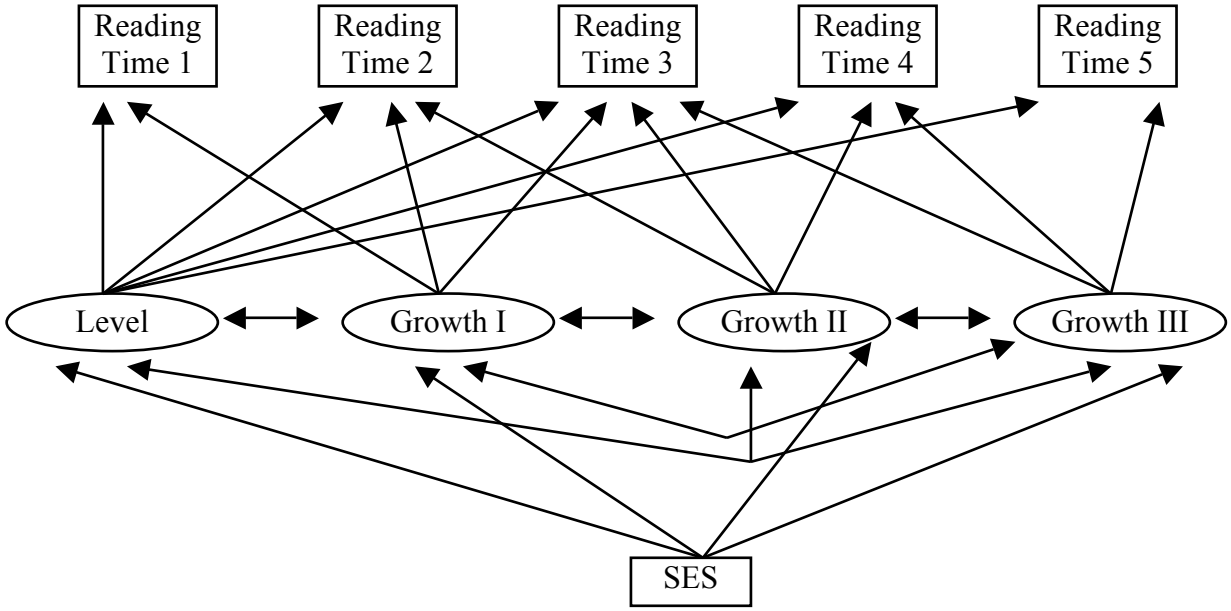


Figure 4. *Univariate Simplex Model for Behavior Ratings.*

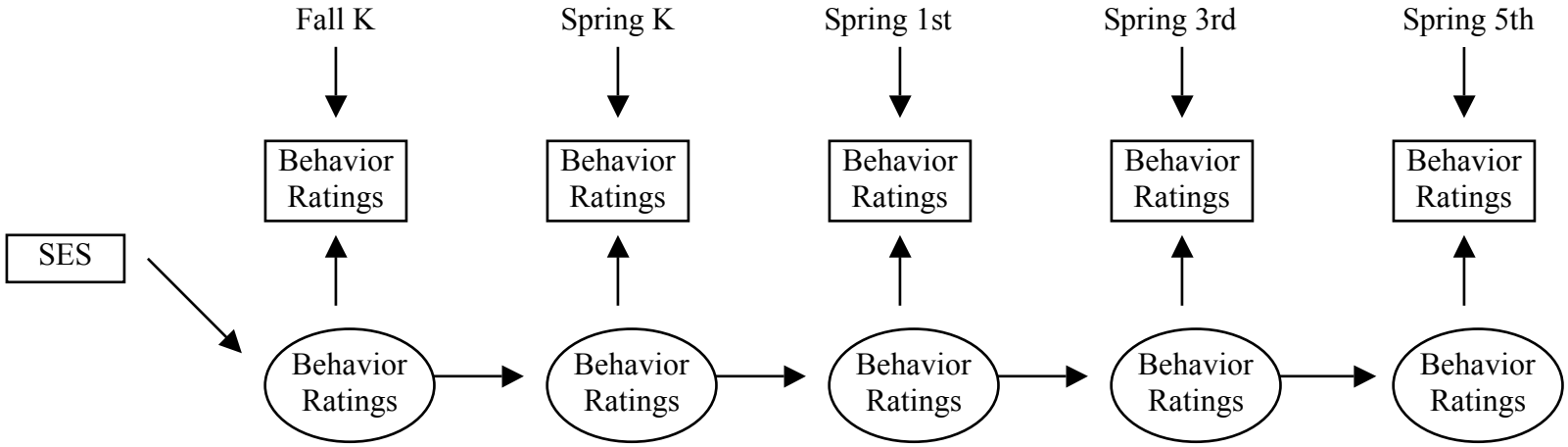


Figure 5. *Multivariate Simplex Model for Reading and Behavior.*

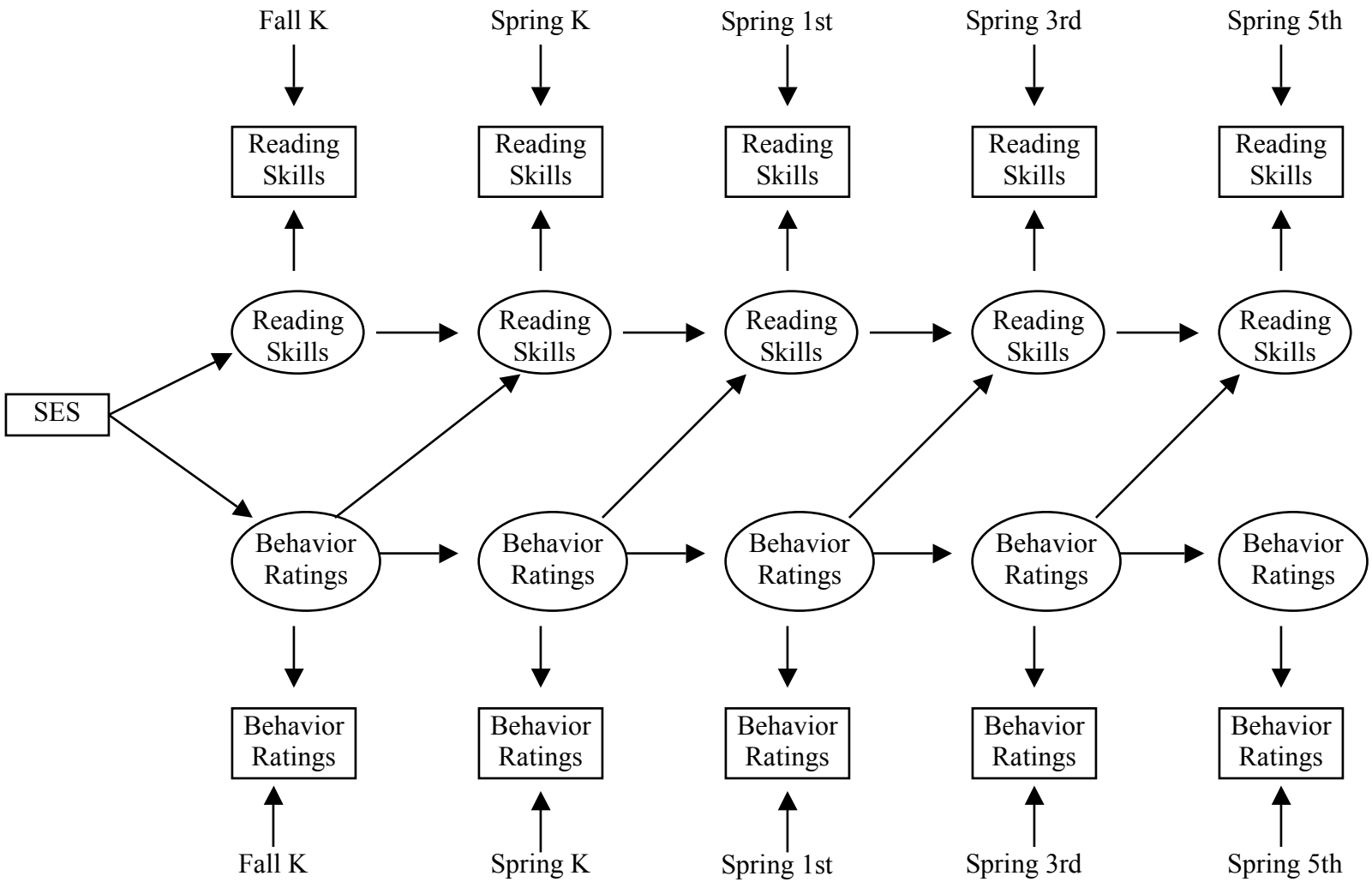


Figure 6. *Univariate Latent Growth Curve Model for Behavior Ratings.*

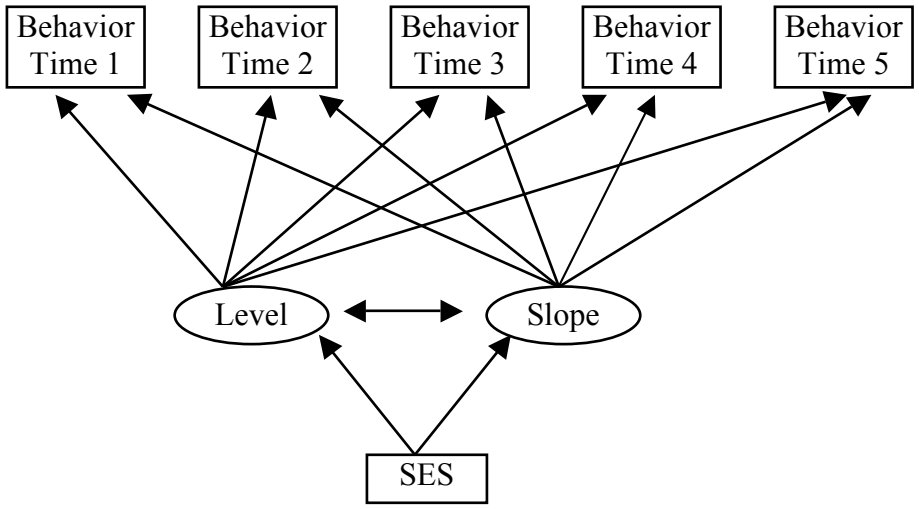


Figure 7. *Univariate Piecewise Growth Curve Model for Behavior Ratings.*

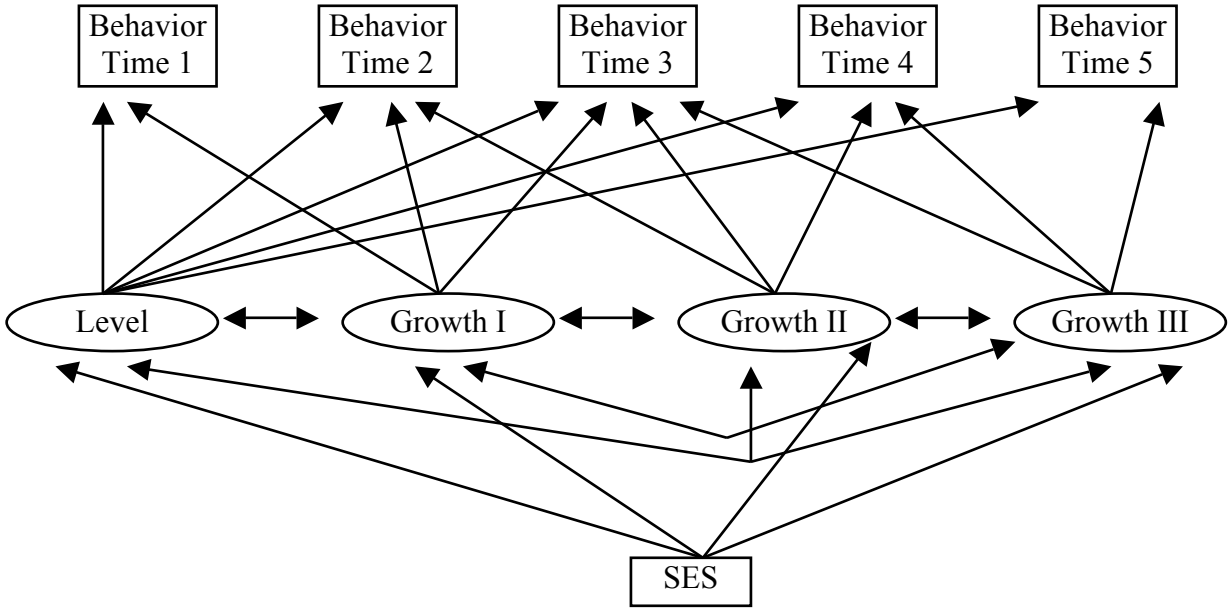


Figure 8. *Multivariate Piecewise Growth Curve Model for Reading & Behavior.*

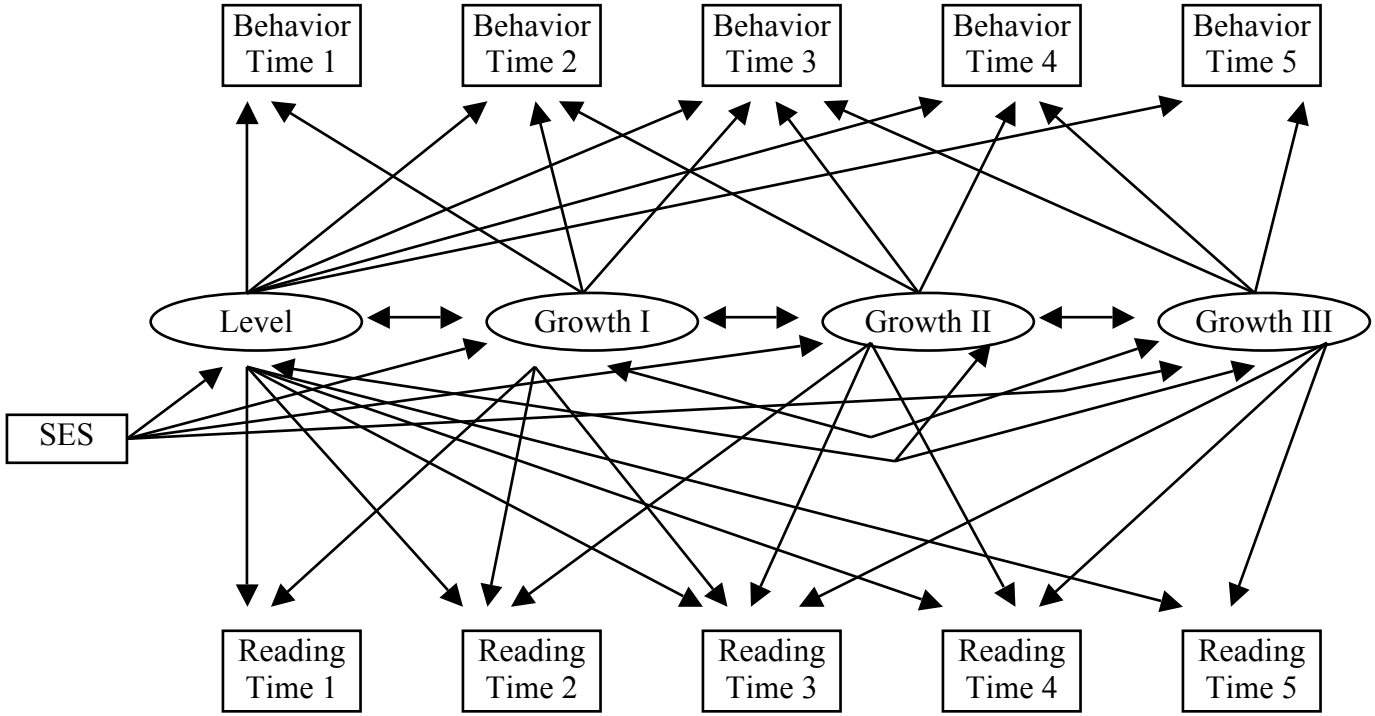
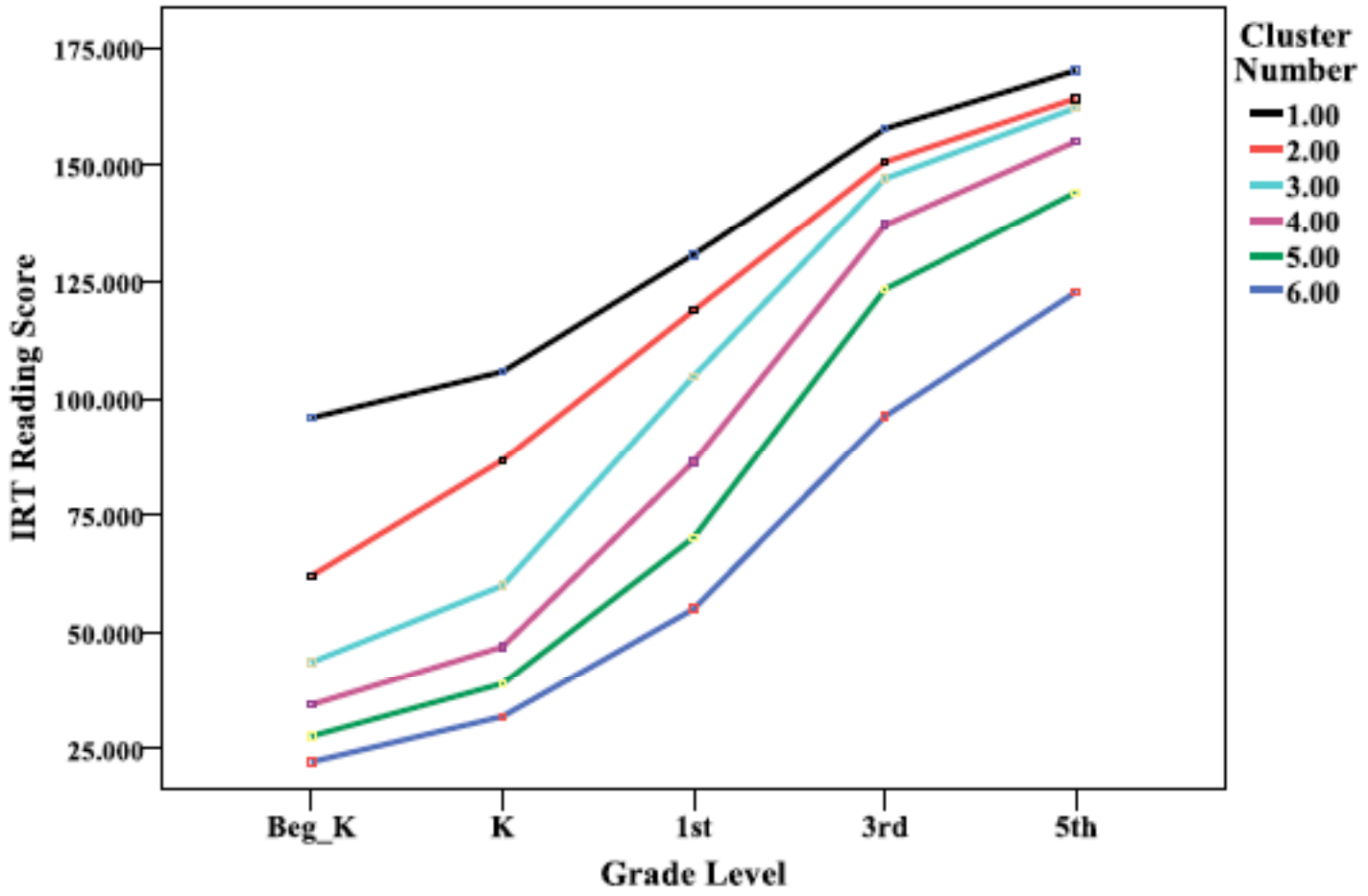


Figure 9. *Comparison of Reading Trajectories by Clusters.*



* For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation.

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