NEIGHBORHOOD EFFECTS ON BEHAVIORAL AND EDUCATIONAL TRAJECTORIES OF U.S. CHILDREN AND ADOLESCENTS

By

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ABSTRACT

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Neighborhood Effects on Behavioral and Educational Trajectories of U.S. Children and Adolescents

Thesis directed by Associate Professor Elisabeth Root

Behavioral and academic outcomes have been explored in relation to neighborhood contexts, but most research conducted on this population ignores time, space, and the multiple ecologies to which children belong. The vast majority of studies rely on cross-sectional data and limited conceptualizations of residential neighborhoods, which only characterize children's contexts at one point in time and grossly ignore other influential spatial contexts. Moreover, most studies only model home-school or home-neighborhood combinations. Given the high degree of correlation between home, school, and neighborhood characteristics, any analysis that omits one of these contexts runs the risk of overstating or misstating the effect of each. Further, few observational studies address the fact that families have agency in choosing where to live, leading to selection bias and threatening the validity of existing research on neighborhood effects. This dissertation uses nationally representative, longitudinal survey data, longitudinal propensity scores, and multiple conceptualizations of residential and school neighborhoods to address these gaps and analyze empirical and policy relevant questions about how, when, and to what degree neighborhood contexts affect child and early adolescent development. Results show that: (1) after controlling for multiple social ecologies as well as selection bias, residential and school neighborhood contexts exerted significant and direct effects on educational and behavioral outcomes, (2) both family and school contexts simultaneously mediated between

residential neighborhood contexts and reading and math scores and internalizing and externalizing behaviors, (3) for reading and math scores, the mediating effect of family and school lessened over time whereas the direct effect of neighborhood increased over time, (4) school attendance zones represented the ideal local context for examining contextual effects on childhood development, and (5) neighborhoods more strongly influence educational outcomes for children with ADHD relative to their non-impaired peers. This dissertation has important implications for future studies examining neighborhood effects on child health, well-being and development. It speaks directly to the importance and impact of social and environmental contexts. Although researchers and policymakers generally focus on the school as the critical arena in which development occurs, I argue that the focus should be on a combination of child, family, school, and neighborhood.

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CHAPTER 1

INTRODUCTION AND SIGNFICANCE

According to the U.S. Surgeon General, rougly 20% of American youth exhibit signs of one or more mental, emotional or behavioral disorders (National Research Council and Institute of Medicine, 2009). The presence of externalizing behaviors (e.g., conduct disorder, ADHD) or internalizing behaviors (e.g., depression, anxiety) during childhood and early adolescence is predictive of moderate to severe academic achievement deficits, poor health, bullying, delinquency, substance abuse, and poverty later in life (Caughy, Nettles, & O'Campo, 2008; Eccles, 1999; Humphrey, Storch, & Geffken, 2007; Leventhal & Brooks-Gunn, 2000; National Research Council and Institute of Medicine, 2009). Similarly, academic achievement in elementary school is a good predictor of high school grades, educational achievement, and social and economic success as an adult. In fact, reading and math scores in first grade are predictive of high school graduation and labor market succes in adulthood (Alexander, Entwisle, & Horsey, 1997; Entwisle, Alexander, & Olson, 2004). Although genetic factors are important, neurological development associated with mental health and educational achievement is highly sensitive to environmental factors, such as cognitive and non-cognitive stimulation, social and physical interaction, the warmth and support that children receive, and socioeconomic conditions (Brito & Noble, 2014; National Research Council and Institute of Medicine, 2000).

In studies of elementary and middle school students, low resource neighborhoods are associated with poorer emotional and psychosocial adjustment as well as decreases in math and reading scores. Disruptive behavioral disorders and academic difficulties are part of a cyclical relationship wherein each problem exacerbates the other. These issues do not occur in isolation, but rather unfold in the context of risk and protective factors, such as home, school or

neighborhood environments (Arnold et al., 1999). Neighborhoods represent a particularly important context to explore during this critical period of development as children spend a majority of their time in local surroundings (Leventhal & Brooks-Gunn, 2000). In both observational and experimental studies, children residing in disadvantaged neighborhoods exhibited higher levels of externalizing and internalizing behaviors (Chase-Lansdale & Gordon, 1996; Goering & Feins, 2003; Kohen, Dahinten, Leventhal, & McIntosh, 2008; Kupersmidt, Griesler, Derosier, Patterson, & Davis, 1995; Ludwig, Duncan, & Hirschfield, 1999; Mrug & Windle, 2009). In a study of 5-11 year olds, a 1 standard deviation increase in neighborhood disadvantage resulted in a 2% increase in the probability of meeting the clinical threshold for internalizing problems (Xue, Leventhal, Brooks-Gunn, & Earls, 2005). Similarly, there is empirical evidence to support neighborhood effects on education outcomes. Studies find that students living in high poverty neighborhoods have lower math and reading achievement, and are more than three times more likely to drop out of school than their peers in advantaged neighborhoods (Ainsworth, 2002; Catsambis & Beveridge, 2001; Eamon, 2005; Greenman, Bodovski, & Reed, 2011; Jargowsky & Komi, 2009; Klebanov, Brooks-Gunn, Chase-Landsdale, & Gordon, 1997; Kohen et al., 2008; Sastry & Pebley, 2010). In one study, researchers found that a $1,000 increase in mean neighborhood income increased years of schooling by about one tenth of a year (Datcher, 1982).

Focusing in on elementary students with ADHD, we find a group of children who are particularly susceptible to disruptive environments. Children with ADHD demonstrate significant decreases in IQ, score lower on all school subjects, have lower class rankings, perform more poorly on standardized academic achievement tests, and are more likely to repeat a grade, use remedial academic services, and be expelled or suspended (Elder, 2010; Loe &

Feldman, 2007; Scheffler et al., 2009). Research demonstrates that children with ADHD are sensitive to place, particularly disruptive or unstructured environments because those contexts tend to exacerbate underlying excessive levels of trouble concentrating, paying attention, staying organized, and remembering details (Hinshaw & Scheffler, 2014; Mulligan et al., 2013; Razani et al., 2014). Although neighborhoods represent a potentially disruptive context that children are exposed to daily, very little research has been conducted on how neighborhoods impact children with ADHD and no studies have examined how neighborhood contexts contribute to educational achievement in children with ADHD.

Behavioral and academic outcomes have been explored in relation to neighborhood contexts, but most research conducted on this population ignores time, space, and the multiple ecologies to which children belong. The vast majority of studies rely on cross-sectional data and limited conceptualizations of residential neighborhoods, which only characterize children's contexts at one point in time and grossly ignore other influential spatial contexts. Moreover, most studies only model home-school or home-neighborhood combinations. Given the high degree of correlation between home, school and neighborhood characteristics, any analysis that omits one of these contexts runs the risk of overstating or misstating the effect of each (Jargowsky & Komi, 2009). Further, few observational studies address the fact that families have agency in choosing where to live, leading to selection bias and threatening the validity of existing research on neighborhood effects. This dissertation uses nationally representative, longitudinal survey data, longitudinal propensity scores, and multiple conceptualizations of residential and school neighborhoods to address these gaps and analyze empirical and policy relevant questions about how neighborhood contexts affect child and early adolescent behavioral and educational trajectories.

THEORY

Macro-theories

To examine the impact neighborhood context on child and adolescent behavioral and educational trajectories, I take an ecologically driven approach and situate my research at the intersection of *Life Course, Ecological Systems,* and *Neighborhood and Heath* theories. According to *Life Course theory*, development is a lifelong process and experiences in childhood have long-term consequences that filter into later stages of the life course (Crosnoe & Elder, 2004; Elder, 1994; Elder, 1998). Life course provides a framework in which to examine the dynamic relationships between people, the contexts they live in, and the time in which they live. Development takes place in the context of multiple ecologies that work together to structure life chances so that advantages and disadvantages tend to cluster cross-sectionally and accumulate longitudinally (Blane, 1999). Cross-sectionally, (dis)advantage in one area of life is likely to be accompanied by similar (dis)advantage in another. A child who lives in an affluent home with attentive parents is likely to attend an affluent school with involved teachers. Similarly, (dis)advantage in one phase of the life course is likely to have been preceded by and to be followed by similar (dis)advantage in other phases of the life course. A child raised in an affluent home who attended a "good" school is likely to succeed educationally, enter into a well-paying sector of the labor market, and achieve financial security into old age (Blane, 1999).

A central premise of life course theory is that developmental processes and outcomes are shaped by the life trajectories children follow (Elder 1998; Entwisle et al., 2004). Trajectories are made up of transitions and timing between transitions represent the duration of exposure to a set of dynamic contexts. A life course perspective makes it natural to think about transitions as

turning points which may alter expected trajectories or developmental pathways. These transitions often have lifelong implications for shaping later events, experiences and transitions, especially when they take place early in life (Elder, Johnson, & Crosnoe, 2004; Elder 1998). For example, the transition to first grade is considered a timed life event critically important for children's future development because it marks the start of a life trajectory that encompasses both schooling and work careers (Entwisle et al., 2004).

In a complementary fashion, an ecological perspective argues that development is shaped by a complex web of embedded social contexts. Children and adolescents are at once members of- and exposed to- several structural and social environments. As development is a product of the interaction between child and his/her environment, understanding child development requires examination of the child, the contexts to which he/she is exposed, and the processes taking place within and between them (Bronfenbrenner, 1979). As such, E*cological Systems theory*, can be conceived as set of nested, interdependent contexts in which children dynamically and simultaneously experience different environments that work together to influence development over time (Bronfenbrenner, 1979). Social ecological models highlight the nested arrangement of family, school, and neighborhood contexts and envision child development as embedded within family processes, school settings, and neighborhood contexts. In this nested conceptualization, neighborhoods represent a blend of many simultaneously occurring individual and social contexts and processes. These processes then affect the acquisition of knowledge, norms, beliefs, behaviors, and competencies that shape healthy development (Furstenberg & Hughes, 1997).

Although life course and ecological systems theories focus on different aspects of the developmental process, they emphasize three concepts that are vital to understanding the influence of neighborhood social processes on child and adolescent behavior and educational

trajectories. First is the concept of *interconnectedness*. Children do not live their lives alone; they are interconnected with their families and communities and those relationships help to negotiate current and future developmental pathways. To that end, individual and social contexts must be examined in a comprehensive, systems analysis to avoid a "development out of context" dilemma (Bronfenbrenner, 1979; Elder 1998). Second, is the concept of *transitions*. Life course theory posits that trajectories are composed of transitions; Bronfenbrenner (1979) argues that transitions occur whenever a child's position in the ecological environment is altered as a result of a change in role, setting, or both. This concept is key to child development as role and environmental changes directly influence a range factors that affect development, e.g., how children interact with each other, parents or teachers, how they are perceived, how they experience their environments, their level of autonomy, etc. (Bronfenbrenner, 1979). Third, is the concept of *timing*. Early transitions (e.g., kindergarten to first grade) are extremely important because they affect subsequent transitions and have long term consequences that affect later development (Bronfenbrenner, 1979; Elder 1998). Moreover, the developmental impact of life events and transitions are contingent on when they occur, such that ill-timed (or non-normative) events may lead to adverse outcomes. For example, Elder (2010) found that children born in the month prior to their state's cutoff date for kindergarten eligibility – who typically become the youngest and most developmentally immature children within a grade – are diagnosed with ADHD at a significantly higher rate than their normative aged classmates.

Mid-Range Theories - Neighborhood and Health Theories

Research that provides a theoretical pathway connecting neighborhood environments to child and adolescent outcomes often classifies mechanisms into three broad categories. The first,

Neighborhood Institutional Resource Models, posit that childhood health and well-being is affected by the quality of community institutions, e.g., schools, police departments, parks, libraries, by providing safe and stimulating learning environments (Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000; Sastry & Pebley, 2010; Wilson, 1987). The presence and quality of businesses, organizations, and institutions contribute to the vitality of neighborhoods, increase informal social control, help keep crime at bay, and contribute to health and development (Small & McDermott, 2006). Access to high-quality institutions that foster positive child and adolescent development, such as schools and recreational centers, varies across neighborhoods (Dupere, Leventhal, Crosnoe, & Dion, 2010). High quality institutions provide a context where positive interactions with adults in the community, most prominently teachers and coaches or instructors, are likely to occur. Just as warm parent-child interactions are central to healthy development, these kinds of relationships are likely to be especially important as children age and spend increasingly more time away from home (Dupere et al., 2010; Eccles, 1999). Following this model, the quantity and quality of resources that affect the lives of young people, e.g, child care, education, health care facilities, are likely to be lower in neighborhoods with high levels of disadvantage. Moreover, the scarcity of resources – particularly child care – leads to competition and subsequent tensions within and between neighborhoods (Crowder & South, 2011; Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2001; Vyncke et al., 2013; Wodkte, Harding, & Elwert, 2011).

Second, ***Relative Deprivation Models*** posit that neighborhood conditions affect individuals by means of their evaluation of their own social and economic standing relative to neighbors and peers. The psychosocial distress that follows social comparisons involving inequality often lead to adverse physical, psychological, behavioral, or academic outcomes

(Crosnoe, 2009; Crowder & South, 2011; Leventhal & Brooks-Gunn, 2000; Lhila & Simon, 2010; Turley, 2002; Wilson, 1987). Youth evaluate themselves relative to those in their neighborhood, particularly their peers who are better-off than themselves, which produce psychosocial distress. The negative self-comparisons might lead to stress, anxiety, and low self-esteem which may affect health and well-being directly or in-directly through, for example, high glucose levels or poor eating habits (Lhila & Simon, 2010). Within a relative deprivation framework, child and adolescent health and well-being is a function of how youth view themselves and how others evaluate them relative to the social and economic standing of their peers (Crosnoe, 2009; Turley, 2002). As such, a social and economic mismatch between individual and neighborhood is a recipe for unhealthy or maladaptive development.

Third, ***Norms and Relationships*** is a set of models that identify parents, adult neighbors, and peers as key to healthy development. There are a number of ways in which parental relationships intervene between neighborhood influences and child and adolescent well-being: 1) parental characteristics that enhance child well-being are lower in deprived neighborhoods compared to non-deprived neighborhoods, 2) support networks available to parents might mitigate the stress associated with living in an impoverished neighborhood, which may reduce the adverse effects of parental stress on child outcomes, 3) a warm parenting style leads to emotional responsivity, support, and monitoring that translates into confident children and decreased exposure to the neighborhood environment, and 4) creation of an organized and structured home environment establishes routines and reduces the likelihood of behavior and education problems (Leventhal & Brooks-Gunn, 2000; Leventhal & Brooks-Gunn, 2001; Sampson, Morenoff, & Gannon-Rowley, 2002; Vyncke et al., 2013). Research overwhelmingly agrees that parents are crucial to mitigating or heightening the effects of exposure to

neighborhood environments (Leventhal & Brooks-Gunn, 2000; Leventhal, Dupere, & Brooks-Gunn, 2009). However, as children make strides toward adulthood and become involved in the world beyond their families, the mediating and moderating effect of parents lessen and the role of neighbors and peers increase.

Collective Socialization Models emphasize adult neighbors as responsible for reproducing socially approved behavior and mechanisms of social control. The presence of advantaged neighbors is likely to reinforce the perception that education is meaningful, steady employment is the ideal alternative to welfare, and family stability is the norm, not the exception. Conversely, residents in disadvantaged neighborhoods may be severed from social networks and institutions that provide access to job markets and mainstream culture and fail to provide role models that encourage academic or economic success (Furstenberg & Hughes, 1997; Jencks & Mayer, 1990; Sastry & Pebley, 2010; Wilson, 1987; Wodkte et al., 2011). *Contagion or Epidemic Models* focus on the attitudes and behaviors of peers as pivotal mediators of neighborhood effects. Residents within the same geographical space are likely to share similar attitudes, beliefs, and behaviors and hence adopt and adhere to common ways of doing things. It is possible that resource-poor environments will lead to diminished educational achievement because friends and peers devalue education, thus performing poorly, dropping out of high school or other deleterious outcomes are likely to spread in epidemic fashion throughout the neighborhood (Crowder & South, 2011; Furstenberg & Hughes, 1997; Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000; Wilson, 1987).

The collective efficacy and social capital mechanisms put forth by Sampson and Colleagues (2002) complement the popular works by Jencks and Mayer (1990) but place more emphasis on social ties and interactions within communities. *Collective efficacy* embodies the

notions of mutual trust and shared expectations at the neighborhood level. This concept is particularly salient to childhood health and well-being outcomes because residents without mutual trust and clear social rules are less likely to intervene on behalf of children, e.g., act as informal enforcers to keep children from engaging in risky behavior (Crowder & South, 2003; Sampson et al., 2002). Adolescents may benefit from the ability of residents to attain collectively valued goals, such as creating a safe and resourceful environment. Neighborhoods with high levels of collectively efficacy may offer youth a richer environment by keeping violence and disorder in check, and enhancing residents' capacity to attract and maintain high-quality services in the neighborhood. In contrast, children immersed in a social world where collective efficacy is low and where they witness signs of failure to attain collectively desired goals may come to believe, broadly, that efforts to change their life circumstances are futile. Research on self-efficacy demonstrates that an individual's beliefs about his or her future success affect behavior. Thus, youth residing in disadvantaged, low-resource neighborhoods may act in ways that are counterproductive to healthy development (Dupere, Leventhal, & Vitaro, 2012; Kingston, Huizinga, & Elliott, 2009; Sharkey, 2006).

Social capital represents resources - norms, trust, reciprocity, exercise of sanctions, social support, and information channels – that foster community and social participation and are realized through relationships (Bourdieu, 1986; Coleman, 1988; Kawachi & Berkman, 2000; Putnam, 2000; Sampson, Morenoff, & Earls, 1999). Within neighborhoods, these resources are derived from the level or density of social ties and frequency of social interactions. Neighborhoods high in social capital may promote healthy youth development through interactions such as the exchange of advice, material goods, or child care. These types of reciprocated exchanges lead to social support that can be drawn upon, not just by parents but by

children as they develop (Sampson et al., 1999). For youth, social capital provides integration into local institutions and relationships with non-parental adults, which allows for transmission of community-wide norms and attitudes.

The processes identified above should not be viewed as discrete or alternative mechanisms of neighborhood influence; rather, they should be viewed as complementary processes. Generally, neighborhood effects researchers simultaneously include several mechanisms when theorizing about *how* neighborhoods work to influence children and adolescents. *Social Disorganization* theory is one such theoretical perspective that combines several complementary processes into a cohesive theoretical framework. In particular, this theory posits that neighborhood level structural disadvantage gives rise to social processes among families, peers and neighbors that lead to community-level disorganization, higher rates of problem behaviors, and lower levels of educational achievement (Leventhal & Brooks-Gunn, 2000; Sampson & Groves, 1989; Sampson et al., 2002; Shaw & McKay, 1942; Wilson, 1987).

Though originally developed as an explanation for varying crime rates across urban neighborhoods, social disorganization theory identifies three specific dimensions of neighborhood structure – population heterogeneity, low economic status, and residential instability – that may be relevant to healthy childhood development (Browning & Cagney, 2003; Leventhal & Brooks-Gunn, 2000; Sampson & Groves, 1989; Sampson et al., 2002; Shaw & McKay, 1942; Wilson, 1987). First, population heterogeneity often creates neighborhoods with diverse values and cultural backgrounds, which in turn, may impede interactions and development of social ties among residents and decrease the likelihood that residents will share common values. Second, residential instability may adversely affect the formation of social networks because it takes time to develop meaningful ties from which to identify positive role

models and extract resources. Third, low economic status may contribute to the social fabric of a neighborhood by: a) influencing the quality and quantity of resources, and b) producing negative feelings due to experience of poverty, which may in turn affect the formation and development of social relationships. Thus, within a social disorganization framework, the salient structural conditions – population heterogeneity, residential instability, and low economic status – affect the ability of neighborhood residents to build formal and informal social relationships essential for: maintaining social control, creating shared trust and reciprocity, promoting prosocial norms and attitudes, monitoring and sanctioning inappropriate behavior, promoting nurturing and supporting parenting styles, and developing social bonds to conventional society (Kingston et al., 2009; Leventhal & Brooks-Gunn, 2000; Sampson & Groves, 1989; Sampson et al., 2002; Shaw & McKay, 1942; Wilson, 1987).

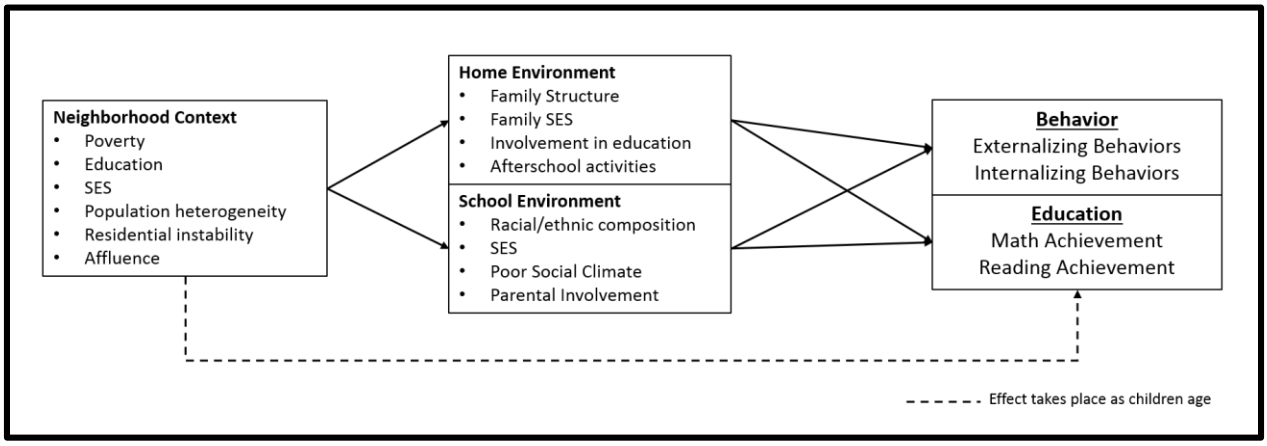
THEORETICAL FRAMEWORK

For my dissertation, I bring together life course, ecological systems, and neighborhood and health theories to examine children's social ecologies from kindergarten to 8th grade. My conceptual model (Figure 1.1) focuses on both the structural factors and social processes within neighborhood contexts that influence children's psychosocial adjustment and educational achievement directly or indirectly by affecting parents, home environments, school settings, and local institutions.

As they age, children become competent, independent, self-aware and involved in the world beyond their families. Following this progression, the relationship between neighborhood context and development increases in magnitude as children age. In early elementary school, children have little autonomy and are insulated by their parents, home, and school (Eccles,

1999), leading to neighborhood effects that are likely mediated by home and school environments. On the other hand, the biological, cognitive and social changes taking place during later elementary and middle school lead to a broadened exposure to adults and peers outside of family (Eccles, 1999). As such, neighborhoods may directly affect adolescents over time.

Figure 1.1: Conceptual Model



LITERATURE REVIEW

Association between neighborhood context and internalizing and externalizing behaviors

Empirical evidence supports the link between neighborhood context and psychosocial adjustment in children and adolescents. Several studies have shown that internalizing and externalizing behaviors vary systematically with the quality of children's neighborhoods, with these problems being more common in neighborhoods characterized by high rates of poverty, crime, single parent headed households, residential mobility, and ethnic heterogeneity (Greenberg, Lengua, Coie, & Pinderhughes, 1999; Sampson et al., 2002; Sampson, Raudenbush, & Earls, 1997). The strongest evidence exists for the adverse effect of neighborhood poverty, such that an increased number of low-SES neighbors is positively associated with greater risk of internalizing and

externalizing outcomes (Curtis et al., 2013; Leventhal & Brooks-Gunn, 2000; Leventhal et al., 2009; Sharkey & Faber, 2014). Two longitudinal studies of children and adolescents support this finding. Wheaton and Clarke (2003) concluded that early exposure to neighborhood poverty was associated with behavioral symptoms years later in a child's life. Similarly, Beyers et al. (2003) found that neighborhood poverty was associated with increased rates of externalizing problems via unsupervised time spent in the neighborhoods and less parental involvement. Both studies argue that the social processes created by neighborhood social disorganization, e.g., increased parental stress and fewer social networks, put youth at risk for externalizing behavior problems.

Neighborhood social disorganization has explicitly been linked with behavior problems in children and adolescents. In a test of neighborhood social disorganization on high-risk youth in 44 Denver neighborhoods, Kingston et al. (2009) found that social disorganization within neighborhoods increased rates of problem behavior by leading youth to expect limited future opportunities for themselves. Kingston and colleagues argue that children and adolescents living in socially disorganized environments feel a sense of hopelessness about their future and act in ways that are counterproductive to healthy development. Similarly, in a test of social disorganization theory among adolescents, Sampson and Groves (1989) demonstrate the validity of social disorganization as a theoretical framework to examine the effect of neighborhood structural factors on youth behavioral outcomes. In particular, they found that population heterogeneity and residential instability were positively related to adolescent externalizing behaviors via social networks, unsupervised youth, and the prevalence of organizational participation in the community.

Experimental and quasi-experimental studies such as the Moving-to-Opportunity (MTO) and Gautreaux Program also support the idea that neighborhood disadvantage is related to

healthy development in children and adolescents. A 5-year evaluation of MTO demonstrated that moving from dangerous, high poverty neighborhoods reduced stress and other psychological benefits for parents and children. In particular, adolescent girls who moved to low poverty neighborhoods reported less psychological distress, anxiety, and substance abuse and were less likely to be arrested than girls who remained in high poverty neighborhoods.(Kling, Liebman, & Katz, 2007; Sharkey & Sampson, 2010). Results from the Gautreaux program found that boys who moved to the suburbs were less likely to be arrested (Keels, 2008). On the other hand, boys who moved in the MTO sample were less likely to be arrested for violent crime, but they were more likely to be arrested for property crime and to engage in risky behaviors themselves (Sharkey & Sampson, 2010). The inconsistent results from MTO may be due to the fact that moving residences did not mean that youth changed their unhealthy social networks. In fact, a lot of youth moved short distances where they were able to visit their old neighborhoods, which essentially did not affect important mediating factors (Leventhal & Brooks-Gunn, 2003a; Leventhal et al., 2009).

Association between neighborhood context and Academic Achievement

During childhood and adolescence, the most consistent result from cross-sectional neighborhood effect studies is that high-SES neighbors have a positive effect on verbal ability, IQ score, cognitive skills, educational achievement, and educational attainment, over and above markers of family advantage (Dupere et al., 2010; Greenman et al., 2011; Leventhal et al., 2009; Sampson et al., 2002). For example, Brooks-Gunn et al. (1993) found that the proportion of high income residents was negatively and significantly associated with the risk of dropping out of high school. Similarly, Datcher (1982) found that a $1,000 increase in mean neighborhood income

increased years of schooling by approximately one tenth of a year. The positive influence of neighborhood affluence on academic achievement is supported by evidence from the quasi-experimental Gautreaux program. Youth who moved from highly impoverished, urban neighborhoods to the suburbs were more likely to graduate from high school, take college preparatory classes, attend college, be employed, and earn higher wages than their peers who remained in the city (Rubinowitz & Rosenbaum, 2000). No such results were found in the MTO study. However, researchers hypothesize that MTO didn't produce positive educational outcomes because, unlike Gautreaux, moving did not necessarily dictate that youth changed schools or peer groups. Thus, the study did a good job of adjusting for selection bias, but was not able to affect all of the contexts that mediate between child and neighborhood (Dupere et al., 2010; Sharkey & Sampson, 2010). Moreover, the Gautreaux and MTO studies were methodologically strong but have limitations regarding the generalizability of results obtained in the very specific context of relocation out of highly disadvantaged urban neighborhoods, rather than a more normative range of neighborhood conditions.

Focusing instead on neighborhood socioeconomic disadvantage, Sharkey and Faber (2014) conclude that the most consistent findings from longitudinal neighborhood effect studies is that the effect of neighborhood disadvantage on cognitive and academic outcomes for children and adolescents is more severe if disadvantage is persistent and experienced over generations. Taking a life course approach, Sharkey and Elwert (2011) found that exposure to neighborhood poverty over consecutive generations reduced cognitive skills by more than one half of a standard deviation. Similarly, consistent exposure to poverty over the course of childhood reduced the probably of black youth graduating high school by 20 percentage points and 10 percentage points for all other youth (Wodtke, Harding, & Elwert, 2011). In one of the few

studies that examine school and neighborhood contexts together, Owens (2010) found that different dimensions of neighborhood SES mattered for different educational outcomes. Living in high poverty neighborhoods decreased the odds of graduating from high school while high SES neighborhoods increased the odds of graduating from college.

Association between neighborhood context and Attention-Deficit/Hyperactivity Disorder

Attention-Deficit/Hyperactivity Disorder (ADHD) is a disruptive neurobehavioral disorder associated with persistent, pervasive, impairing, and developmentally excessive levels of inattention, impulsivity, and activity. Now understood as a chronic disorder, it is one of the most common and costly mental health problems in the United States. The CDC (2014) estimates that prevalence rates of school-age children range from 4-12% with excessive economic costs totaling $31.6 billion in 2000. Longitudinal studies show that academic underachievement and poor educational outcomes associated with ADHD are persistent and begin early in life.

Research demonstrates that children with ADHD are sensitive to place, particularly disruptive or unstructured environments because those contexts tend to exacerbate underlying symptomology (Hinshaw & Scheffler, 2014; Mulligan et al., 2013; Razani et al., 2014). For youth with ADHD, trends in educational achievement are significantly affected by stressful home environments and changes in school contexts/routines (Langberg et al., 2008). Behavior modification studies suggest that providing structured yet simplified home and school environments produce behavioral and educational improvement whereas changing those environments to be less structured or more complex leads to worsened behavior and educational outcomes (Langberg et al., 2008).

Neighborhoods represent a primary context for development where youth spend substantial amounts of time; they also represent a potentially disruptive context for children with ADHD. To my knowledge, there have been three published studies examining neighborhood effects on childhood ADHD. In each of these studies, the authors examined the association between perceived social support of the child's residential context and either ADHD diagnosis or severity (Butler, Kowalkowski, Jones, & Raphael, 2012; Hinojosa et al., 2012; Razani et al., 2014). Generally, they found that social support buffered or exacerbated outcomes for either the parent, e.g., neighborhood social support increased parental mental health which reduced parent-child strain, or the child, e.g., deprivation of social support was associated with increased ADHD symptomology. To my knowledge, no studies have examined how exposure to neighborhood context affects educational achievement in children with ADHD, specifically, if neighborhoods exert more influence on children with ADHD versus their non-impaired peers.

Families as a Proximal Context

The family context in early life sets the trajectory into adulthood and plays a significant role in shaping child and adolescent healthy development (Eccles, 1999; Elder 1998). Family variables play two substantial roles in neighborhood effect studies, (1) as mediators that transmit the effects of neighborhood social disorganization on children's development, and (2) as moderators that interact with neighborhood conditions and modify or buffer the effects of neighborhood conditions on childhood behavioral and educational outcomes (Earls & Carlson, 2001; Fan & Chen, 2012). Prior research finds that family SES and parenting behaviors mediate or moderate the association between neighborhood context and child and adolescent behavioral and educational outcomes (Deng et al., 2006; Dupere et al., 2010; Fan & Chen, 2012; Greenman et

al., 2011; Kohen et al., 2008; Leventhal & Brooks-Gunn, 2000; Leventhal et al., 2009; Roosa et al., 2005; Sampson et al., 2002).

Family SES is strongly related to a youth development. The social networks of poor families are often restricted to the local neighborhood. The limited geographic extent of social networks may lead children to be more sensitive to the absence of successful role models and the presence of deviant subcultures, e.g., adult neighborhoods that devalue education. Without parents or adult neighbors demonstrating the ability to be professionally and economically successful, children may develop low self-efficacy for their own future success (Jencks & Mayer, 1990; Kingston et al., 2009; Wilson, 1987; Wodtke, Elwert, & Harding, 2012). Several studies have found that families with social and economic resources can utilize social ties to buffer children from adverse neighborhood conditions or to take advantage of opportunities within and outside of the immediate neighborhood (Ananat, Francis, Gassman-Pines, & Gibson-Davis, 2011; Casciano & Massey, 2012; Jencks & Mayer, 1990; Sharkey & Faber, 2014; Wodtke et al., 2012). Parents with greater economic resources may be able to afford to send their child to better childcare, private schools, or supplementary educational programs, and travel outside of the neighborhood to secure other goods and services that facilitate effective parenting. Parents from poor families, on the other hand, often lack the ability to "buy out" of low quality institutions and are dependent on the resources within their own neighborhood (Wodtke et al., 2012).

Parenting practices vary from community to community, but neighborhoods represent a social space where parents interact with each other and reinforce collective norms about parenting behaviors. Ideas regarding the "right" parenting behaviors are embedded in the cultural discourse within a given social and spatial location. Parents from advantaged neighborhood are

often especially cohesive in shared norms regarding acceptable behavior and notions of what is to be done to raise a child properly. (Crowder & South, 2011; Furstenberg et al., 1999; Furstenberg & Hughes, 1997; Greenman et al., 2011; Kohen et al., 2008; Lareau, 2000, 2003; Sampson et al., 1999). There are a number of parenting practices related to behavioral and academic achievement that parents in high resource neighborhoods adopt. For instance, they are more likely to (1) utilize warm, consistent parenting styles, (2) actively monitor youth and ensure they interact with positive adult role models, (3) actively cultivate learning by creating opportunities inside and outside of the home and neighborhood, and (4) create structured home environments (Dupere et al., 2010; Furstenberg et al., 1999; Furstenberg & Hughes, 1997; Lareau, 2000, 2003; Leventhal et al., 2009). On the contrary, parents from disadvantaged neighborhoods often experience weaker social norms which diminish social sanctions against the use of unresponsive or harsh parenting practices and often do not have the time or resources to monitor youth behavior and provide outside developmental opportunities (Dupere et al., 2010; Molnar, Buka, Brennan, Holton, & Earls, 2003; Simons, Simons, Burt, Brody, & Curtona, 2005).

Schools as a Proximal Context

Schools are a significant social context associated with educational achievement and psychosocial adjustment in American youth. Children attending schools in disadvantaged neighborhoods may be doubly burdened by both contexts, as disadvantaged neighborhoods may create school environments with high percentages of poor and minority students, serious crime problems, low instructional expenditures, and few opportunities to enroll in advanced courses, which in turn, affect behavior and educational achievement (Crosnoe, 2009; Eamon, 2005; Jargowsky & Komi, 2009). This is, in large part, due to the fact that schools are funded by the

local tax revenues based on local property values and business activities. The local financial capital generates better infrastructure, which translates into human capital. Thus, schools in advantaged areas are often able to hire and retain highly qualified, effective teachers, and create a culture where parents expect and lobby for high quality services and become involved with school activities such as parent teacher organizations (Crosnoe, 2009; Dupere et al., 2010; Lareau, 2003; Leventhal, Dupere, & Brooks-Gunn, 2009; Owens, 2010). Thus, both the structural and social factors from the surrounding areas coalesce to create a "safety net" that promotes educational achievement and supports children's socioemotional development (Roeser & Eccles, 2014).

Social dynamics in neighborhoods might also influece youth development by weakening or strengthening local schools. In disadvantaged neighborhoods, children and adolescents seldom consistently interact with educated, employed neighbors, which may cause children to question the value of education. In this social milieu, both students and teachers become discouraged and subsequently put in less effort to create supportive school environments that foster student-teacher relationships and create norms regulating social behavior, which may lead to a downward cycle of low expectations and low achievement (Dupere et al., 2010; Kingston et al., 2009; Leventhal et al., 2009). On the other hand, high-income parents expect higher quality services for their children, closely scrutinize school personnel and exert pressures if dissatisfied, are actively involved in school activities such as parent-teacher organizations, and have the ability to tap into a wide range of social and human capital resources to benefit both the neighborhood and embedded school (Dupere et al., 2010; Lareau, 2000, 2003; Leventhal et al., 2009).

LIMITATIONS IN THE CURRENT LITERATURE

This dissertation examines the relationships among family processes, school characteristics, neighborhood context, and child and early adolescent behavioral and educational trajectories. My dissertation stands to make methodological improvements and provide novel empirical contributions to the study of longitudinal effects of neighborhood contexts on childhood development. Specifically, this research address four important limitations in neighborhood effects research for children and early adolescents.

The absence of longitudinal designs

First, it is imperative to analyze neighborhoods from a life course perspective because it is well established that factors operating early in life have implications for a range of outcomes in adulthood including health, development, well-being, and economic and social success (Diez Roux & Mair, 2010; Elder 1998; Leventhal & Brooks-Gunn, 2000; Root & Humphrey, 2014a; Sampson et al., 2002; Sharkey & Faber, 2014). Yet, most research overwhelmingly uses cross-sectional designs that assess neighborhood effects at one point in time. This is problematic because a snap-shot view renders neighborhoods static, rather than a context that evolves over time (Diez Roux & Mair, 2010; Jackson & Mare, 2007). Just as neighborhood characteristics change, families move and children are exposed to different, often more disadvantaged, contexts and with each move (Root & Humphrey, 2014b). My dissertation addresses these limitations by analyzing a nationally representative sample of U.S. children followed from kindergarten to eight grade. Moreover, I use both Decennial Census and American Community Survey data to estimate neighborhood contexts over multiple years to avoid creating static neighborhood contexts.

Examination of multiple social ecologies

Second, most research fails to account for the multiple contexts that influence youth behavior by only modeling home-school or home-neighborhood environments (Leventhal & Brooks-Gunn, 2000). Life course and ecological systems theories emphasize that interconnected is paramount to child and adolescent behavioral and educational development. That is, children exist in- and interact with- many overlapping spheres of influence and the social relationships within those spheres help to negotiate developmental pathways. Leventhal (2000) estimates that 5-10% of the variation in childhood development can be explained by neighborhood factors, while Konstantopoulos (2006) estimates that 10-20% of variation in achievement is due to school context. Given the high degree of correlation between home, school, and neighborhood characteristics, any analysis that omits one of these contexts runs the risk of misstating the effect of each. Thus, analyzing neighborhood effects on youth without simultaneously examining individual, family, and school contexts likely lead to over- or under-estimation of the relative importance of each context (Bronfenbrenner, 1979; Elder 1998; Jargowsky & Komi, 2009). Recent studies that did not control for selection, but simultaneously estimated the effect of individual, school, and neighborhood contexts on adolescent academic and smoking outcomes found that: (1) school context variables were more robust in explaining variation in outcomes than neighborhood environments, and (2) while neighborhoods significantly impacted adolescent well-being, smaller estimates of neighborhood effects were found after school context was included (Carlson & Cowen, 2015; De Clercq, Pfoertner, Elgar, Hublet, & Maes, 2014; Jargowsky & Komi, 2009; Owens, 2010). Thus, when researchers attempt to link neighborhood processes to youth outcomes without including school context, the results may be misleading and likely overestimate the magnitude of neighborhood effects. My dissertation addresses this

limitation by concurrently assessing the effect of individual characteristics with home, school, and neighborhood environments on child and early adolescent behavioral and educational trajectories.

Relevant spatial contexts for children and early adolescents

Third, a recurring issue in the neighborhood effects literature is the definition and operationalization of a "neighborhood" or relevant geographic areas. Neighborhoods can be defined in many ways, but researchers agree that the definition and scale of a neighborhood should be based on theory and evidence specific to the outcome(s) under study and the hypothesized pathways through which neighborhoods exert influence (Diez Roux & Mair, 2010; Flowerdew, Manley, & Sabel, 2008; Root, 2012; Sharkey & Faber, 2014; Spielman, Yoo, & Linkletter, 2013). Recent research urges neighborhood and health scholars to define neighborhoods as contexts that are relevant to the social and spatial environments in which children regularly engage (Sharkey & Faber, 2014). Given that youth spend a large portion of their day in school, school neighborhoods serve as a natural starting point for redefining relevant contexts. Yet, the role of school neighborhood has largely been ignored in this literature. In this dissertation, I address this gap by examining trajectories of reading and math achievement and internalizing and externalizing behaviors across residential census tracts, school census tracts, and school attendance zones.

Selection bias in longitudinal designs

Finally, experimental or non-experimental studies remain the method of choice for neighborhood effects research. However, these studies are few and far between leaving most researchers to

analyze observational studies. Selection bias is the major criticism of observational designs and represents a potential threat to the validity of most existing neighborhood effect studies (Leventhal & Brooks-Gunn, 2000; Leventhal et al., 2009; Oakes, 2004; Sampson et al., 2002). Selection bias refers to the fact that families have agency regarding the neighborhoods in which they live, and some omitted or unmeasured variable, e.g., maternal education, might account for neighborhood choice and unobserved neighborhood effects (Manski, 1993; Oakes, 2004; Tienda, 1991). Common methods of addressing selection bias include controlling for a host of background characteristics potentially related to neighborhood selection and propensity score matching. Because neighborhood characteristics are composed of family characteristics, controlling for background information does not fully overcome the selection problem. Similarly, propensity score matching methods were not designed for dealing with time-varying treatments, covariates and outcomes. Root and Humphrey (2014a) showed that selection bias could be controlled by estimating time-varying propensity scores (TVPS) as a covariate in growth models predicting neighborhood racial composition on child and adolescent general health status. My dissertation will mitigate selection bias by estimating each model with TVPS as well as survey weights to address sample design and attrition.

In neighborhood effect studies, propensity score covariate-adjustment methods mitigate selection bias by including a covariate in models that represents the likelihood that a family selected into a neighborhood type, e.g., high or low poverty, based on background characteristics. In longitudinal analyses, it is necessary to specify time-varying propensity scores because families move and neighborhood environments change, exposing children to different contexts over time. Within a growth curve framework, the main effect for TVPS represents the average difference, over time, in educational achievement or psychosocial adjustment for a one-

unit increase in the likelihood of selecting into a neighborhood (Singer & Willett, 2003). Thus, the time-varying propensity scores adjust the effect of treatment, neighborhood type, for selection bias over time.

RESEARCH QUESTIONS AND HYPOTHESES

Paper 1

Although past research has demonstrated that neighborhoods are a meaningful social context for healthy development, these studies have several limitations. First, few simultaneously account for individual-, family-, school-, and community-level characteristics that coalesce to affect educational achievement. Existing studies provide evidence that both schools and neighborhoods shape students' academic achievement, but the tendency to study these contexts in isolation has limited our understanding, and likely over-estimated the already small to moderate direct neighborhood effects. Second, few observational studies address the fact that families have agency in choosing where to live, leading to selection bias and threatening the validity of existing research on neighborhood effects. Finally, most research only asks "if" neighborhoods affect youth, rather than also assessing "how" the effects are manifested. This study addresses these limitations by examining the relationships among family processes, school context, neighborhood environments, and trajectories of youth academic achievement. Specifically, I examine the following research questions:

1. After controlling for family and school contexts as well as selection bias, do neighborhoods affect educational achievement during childhood and adolescence?

I hypothesize that the influence of neighborhood, measured as dimensions of affluence, poverty, and population heterogeneity, will be robust enough to remain significant in the

expected direction (e.g., high poverty neighborhoods will adversely affect achievement trajectories) after controlling for other influential social contexts and selection bias. However, I believe the direct effects will be minimal compared to indirect effects via family and school contexts.

2. Do family and school contexts mediate the relationship between exposure to neighborhood environments and educational achievement during elementary and middle school?

3. Does the mediating influence of family and school decrease with age?

I hypothesize that both family and school contexts will mediate the relationship between neighborhood context and both achievement outcomes, regardless of how neighborhood is characterized. As they age, children become competent, independent, self-aware and involved in the world beyond their families. Following this progression, I hypothesize that the mediating effects of family and school will decrease by 8th grade as the direct effect of neighborhood grows.

Paper 2

In this study, I advance previous research by addressing several limitations. First, to my knowledge, no research has simultaneously examined the impact of child characteristics, family context, school context, and the neighborhood environment on childhood psychosocial adjustment. Existing studies provide evidence that both schools and neighborhoods shape children's behavior, but the tendency to model family-school or family-neighborhood contexts limits our understanding of the processes affecting healthy development and most likely over-estimates direct neighborhood effects (Carlson & Cowen, 2015; De Clercq, Pfoertner, Elgar, Hublet, & Maes, 2014; Jargowsky & Komi, 2009). Second, few observational studies address the

fact that many families make choices about where to live and non-random assignment of neighborhood leads to selection bias – the biggest issue plaguing neighborhood effects research (Diez Roux & Mair, 2010; Manski, 1993; Oakes, 2004; Rosenbaum & Rubin, 1983; Tienda, 1991). Finally, in asking "how" neighborhoods impact child behaviors, most research assesses the mediating role of families or schools. By contrast, this study concurrently assess how multiple mechanisms within both the family and school environments indirectly affect youth behavioral trajectories. I address these limitations by examining the relationships among family processes, school context, neighborhood environments, and trajectories of behavior problems in elementary school children. Specifically, I examine the following research questions:

1. Do neighborhood environments affect trajectories of internalizing and externalizing behaviors during elementary school, after controlling for family and school contexts as well as selection bias?
2. What role do family and school contexts play in mediating the relationship between neighborhood context and psychosocial adjustment during elementary school?

    I hypothesize that neighborhood contexts will not directly affect internalizing or externalizing behaviors during elementary school, but rather, effects will be transmitted simultaneously through families and schools.

Paper 3

The residential census tract is the most frequently used definition of "neighborhood" in studies of childhood and early adolescent educational achievement and psychosocial adjustment. Recent research urges neighborhood and health scholars to define neighborhoods as contexts that are relevant to the social and spatial environments in which children regularly engage. Given the

focus on behavioral and academic outcomes in youth, school neighborhoods serve as a natural starting point for redefining relevant contexts. Yet, the role of school neighborhood has largely been ignored in this literature. A few city-specific studies have examined the effects of school neighborhoods on youth health and well-being using school attendance boundaries, cluster analysis, school census tracts, and school-centric buffers (Bernelius & Kauppinen, 2012; Forsyth, Wall, Larson, Story, & Neumark-Sztainer, 2012; Schwartz, 2010; Whipple, Evans, Barry, & Maxwell, 2010; Zhang, Christoffel, Mason, & Liu, 2006), but no research has used nationally representative data to demonstrate how school neighborhoods affect educational achievement and psychosocial adjustment during elementary school. In light of children's limited mobility and daily exposure to both home and school neighborhood environments, school census tracts and school attendance zones may represent valid contexts that exert influence on educational achievement and behavioral adjustment during elementary school. In paper I ask:

1. How do neighborhoods affect reading and math scores and internalizing and externalizing behaviors in elementary students across neighborhoods defined by residential census tracts, school census tracts, and school attendance zones?

I hypothesize, that:

a) Residential census tracts will have direct effects on reading and math scores, but little to no effect on internalizing and externalizing behaviors.

b) Effects for school census tracts will be similar to that of residential tracts.

c) School census tracts characterized by social disorganization will exert few direct effects on educational and behavioral outcomes.

d) Effects for school attendance zones will be attenuated relative to census tract neighborhoods, but represent a more reasonable neighborhood environment for children.

Paper 4

Research demonstrates that children with ADHD are sensitive to place, particularly disruptive or unstructured environments because those contexts tend to exacerbate underlying excessive levels of trouble concentrating, paying attention, staying organized, and remembering details (Hinshaw & Scheffler, 2014; Mulligan et al., 2013; Razani et al., 2014). For youth with ADHD, trends in educational achievement are significantly affected by stressful home environments and changes in school contexts/routines (Langberg et al., 2008). Neighborhoods represent a primary context for development where youth spend substantial amounts of time; they also represent non-familial/school environments that may exacerbate or improve educational outcomes in children with ADHD. Yet, neighborhood effects research in this area is lacking. To my knowledge, no studies have examined how neighborhood contexts contribute to educational achievement in children with ADHD. In this paper, I ask:

1. Do neighborhood environments exert more influence on reading and math scores in elementary students with ADHD versus their non-impaired peers?

I hypothesize that, because they are extremely sensitive to place, particularly disruptive environments, residential and school neighborhood environments will be more influential for youth with ADHD than their non-impaired peers.

CHAPTER 2

"Neighborhoods and academic achievement trajectories of children and adolescents: The influence of multiple social ecologies, selection bias, and family and school proximal contexts"

INTRODUCTION

Academic achievement in elementary school predicts educational and economic success in adulthood, demonstrating that early life experiences have long-term consequences and represent the start of developmental trajectories that children follow into adulthood (Alexander et al., 1997; Entwisle et al., 2004). Youth development does not occur within a vacuum. The interplay of genetic factors, environmental contexts, and social connections a person experiences throughout his or her lifetime significantly impacts the development of cognitive skills (Brito & Noble, 2014). Neurological development is highly sensitive to contextual factors within families, schools, and communities. These supportive contexts cultivate the development of academic skills through cognitive and non-cognitive stimulation, social and physical stimulation, social and physical interaction, the warmth and support that children receive, and socioeconomic conditions (Brito & Noble, 2014; National Research Council and Institute of Medicine, 2000; Potter, Mashburn, & Grissmer, 2013).

The family context in early life sets developmental trajectories into adulthood and plays a significant role in shaping healthy development. However, it is important to examine development within the multiple social-structural environments in which a child is embedded in order to truly understand the role of the family (Bronfenbrenner, 1979; Crosnoe, 2009; Diez Roux & Mair, 2010; Elder, 1998; Leventhal & Brooks-Gunn, 2000; Northridge et al., 2003; Sampson et al., 2002; Wilson, 1987). Schools and neighborhoods are thought to be two of the most important extra-familial contextual influences on student academic outcomes. The school

effects literature recognizes that schools are a major source of variation in achievement outcomes, although less than that of familial contexts, and that such variation has links to future social and economic success (Carlson & Cowen, 2015; Coleman et al., 1966; Konstantopoulos, 2006). Similarly, the most consistent result from observational neighborhood studies is that of a positive effect of neighborhood affluence and a negative effect of neighborhood disadvantage on test scores, verbal ability, IQ scores, cognitive skills, and educational attainment, over and above markers of family advantage (Dupere et al., 2010; Greenman et al., 2011; Kohen et al., 2008; Leventhal & Brooks-Gunn, 2000; Leventhal & Brooks-Gunn, 2003b; Leventhal et al., 2009; Owens, 2010; Sampson et al., 2002; Sampson et al., 2008; Sharkey & Elwert, 2011; Sharkey & Faber, 2014; Turley, 2002, 2003; Wodtke et al., 2011). The positive association between neighborhood affluence and academic achievement is supported by evidence from the quasi-experimental Gautreaux program (Rubinowitz & Rosenbaum, 2000) and the Baltimore site of the experimental Moving to Opportunity (MTO) study (Ludwig et al., 2001). While neighborhood disadvantage appears to have a stronger effect on emotional and mental well-being than educational achievement, the effect of neighborhood disadvantage on cognitive and academic outcomes for children and adolescents is severe if disadvantage is persistent and experienced over generations (Leventhal et al., 2009; Sampson et al., 2008; Sharkey & Elwert, 2011; Sharkey & Faber, 2014; Wodtke et al., 2011). The evidence linking neighborhood racial and ethnic heterogeneity to child and adolescent educational achievement is studied less often and has produced inconsistent results (Chase-Lansdale & Gordon, 1996; Halpern-Felsher et al., 1997; Leventhal & Brooks-Gunn, 2000; Leventhal et al., 2009).

Although past research has demonstrated that neighborhoods are a meaningful social context for healthy development, these studies have several limitations. First, few simultaneously

account for individual-, family-, school-, and community-level characteristics that coalesce to affect educational achievement. Existing studies provide evidence that both schools and neighborhoods shape students' academic achievement, but the tendency to study these contexts in isolation has limited our understanding, and likely over-estimated the already small to moderate direct neighborhood effects. Second, few observational studies address the fact that families have agency in choosing where to live, leading to selection bias and threatening the validity of existing research on neighborhood effects. Although methodologically strong, the Gautreaux and MTO studies have limitations regarding the generalizability of results obtained in the very specific context of relocation out of highly disadvantaged urban neighborhoods, rather than a more normative range of neighborhood conditions. Finally, most research only asks "if" neighborhoods affect youth, rather than also assessing "how" the effects are manifested. Most researchers agree that neighborhoods work indirectly through proximal contexts such as families and schools, but do not simultaneously assess how multiple mechanisms at both levels affect youth outcomes. This study addresses these limitations by examining the relationships among family processes, school context, neighborhood environments, and trajectories of youth academic achievement. Specifically, I examine the following research questions: 1) After controlling for family and school contexts as well as selection bias, do neighborhoods affect educational achievement during childhood and adolescence?, 2) Do family and school contexts mediate the relationship between exposure to neighborhood environments and educational achievement during elementary and middle school?, and 3) Does the mediating influence of family and school decrease with age? Addressing these questions may lead to a better and more rigorous understanding of how, when, and to what degree neighborhood environments affect

reading and math achievement during elementary and middle school, which is critical for informing policy and practice.

Neighborhood and Achievement: Pathways through Families and Schools

I take an ecologically driven approach to examining the impact of neighborhood contexts on child and adolescent educational trajectories by situating my research at the intersection of life course, ecological systems, and neighborhood and health theories. According to life course theory, development is a lifelong process and experiences in childhood have long-term consequences that filter into later developmental stages (Crosnoe & Elder, 2004; Elder, 1994; Elder, 1998). The life course perspective provides a framework in which to examine the dynamic relationships between people, the contexts they live in, and the time in which they live. In a complementary fashion, an ecological perspective argues that development is shaped by a complex web of embedded social contexts and that understanding child development requires examination of the child, the contexts to which he or she is exposed, and the processes taking place within and between them (Bronfenbrenner, 1979). Neighborhoods provide the physical space in which youth access resources and opportunities, but also the social spaces in which interactions with peers, family, and other adults occur (Leventhal et al., 2009). As such, researchers have identified several broad underlying mechanisms – institutional resources, collective socialization, collective efficacy, social capital, and social organization – through which students' neighborhoods could influence their achievement outcomes (Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002). Although each theoretical perspective conceptualizes the mechanisms differently, they each argue that neighborhoods are

both a physical and social space in which interactions with parents, other adults (e.g., teachers, coaches, librarians, neighbors), and peers foster healthy development.

The social and physical aspects of neighborhoods often work to influence youth development through proximal contexts such as families and schools. The family context acts as a mechanism through which neighborhoods exert influence in many ways. For example, Kohen (2008) found that low neighborhood social cohesion affected children's verbal and behavioral outcomes indirectly by impinging on parent's mental health and family functioning. Similarly, the social networks of poor families are often restricted to the local neighborhood. The limited geographic extent of social networks may lead children to be more sensitive to the absence of successful role models leading to low self-efficacy of their own future success (Jencks & Mayer, 1990; Kingston et al., 2009; Wodtke et al., 2012). Schools as a proximal context also transmit the effect of the neighborhoods in which they are located. Most notably is the financial and human capital within neighborhoods that directly translate to financial and human capital within schools. Thus, children attending schools in disadvantaged neighborhoods may be doubly burdened by both contexts, such that poor neighborhoods may create school environments with discouraged students and teachers, high teacher turn-over, low instructional expenditures, and low parental involvement in school activities (Crosnoe, 2009; Eamon, 2005; Jargowsky & Komi, 2009). Taken together, this ecologically driven approach highlights the nested arrangement of family, school, and neighborhood contexts. In this research, I argue that neighborhoods may have small direct effects on youth math and reading trajectories, but they mainly influence youth by affecting family and school contexts (Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002).

Multiple Social Ecologies and Estimation of Neighborhood Effects

Most research fails to account for the multiple contexts that influence youth development by only modeling home-school or home-neighborhood environments (Leventhal & Brooks-Gunn, 2000). Interconnectedness is paramount to child and adolescent educational trajectories; that is, children exist in- and interact with- many overlapping spheres of influence and the social relationships within those spheres help to negotiate developmental pathways (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 1998; Elder, 1998). Leventhal (2000) estimates that 5-10% of the variation in childhood development can be explained by neighborhood factors, while Konstantopoulos (2006) estimates that 10-20% of variation in achievement is due to school context. Given the high degree of correlation between home, school, and neighborhood characteristics, any analysis that omits one of these contexts runs the risk of misstating the effect of each. Thus, analyzing neighborhood effects on youth without simultaneously examining individual, family and school contexts likely lead to over- or under-estimation of the relative importance of each context (Bronfenbrenner, 1979; Carlson & Cowen, 2015; Jargowsky & Komi, 2009). Recent studies that did not control for selection, but simultaneously estimated the effect of individual, school, and neighborhood contexts on adolescent academic and smoking outcomes found that: (1) school context variables were more robust in explaining variation in outcomes than neighborhood environments, and (2) while neighborhoods significantly impacted adolescent well-being, smaller estimates of neighborhood effects were found after school context was included (Carlson & Cowen, 2015; De Clercq et al., 2014; Jargowsky & Komi, 2009; Owens, 2010). Thus, when researchers attempt to link neighborhood processes to youth outcomes without including school context, the results may be biased and overestimated.

Selection Bias and Propensity Scores

One of the major limitations of neighborhood effect studies is that they are observational and non-random assignments of neighborhood leads to selection bias (Diez Roux, 2004; Oakes, 2004). Selection bias occurs when background characteristics that are related to academic achievement are also related to the neighborhood in which families choose to live. If the selection mechanism, e.g., household socioeconomic status, is not controlled, subsequent "neighborhood effects" may be confounded and lead to difficulties in drawing causal inference (Manski, 1993; Oakes, 2004; Tienda, 1991). Propensity scores mitigate selection bias and reduce the dimensionality of covariates to more easily allow for parsimonious models (Rosenbaum & Rubin, 1983; Smith, 2011). A propensity score is the estimated probability of receiving a treatment given background covariates; in this case, the probability that a child lives in a type of neighborhood given individual and family characteristics. Common methods of addressing selection bias include controlling for background information and propensity score matching. Because neighborhood characteristics are composed of family characteristics, controlling for background information does not fully overcome the selection problem. Similarly, propensity score matching methods were not designed for dealing with time-varying treatments, covariates and outcomes. Root and Humphrey (2014a) showed that selection bias could be successfully mitigated in longitudinal designs by estimating time-varying propensity scores as covariates in growth models; I adopt their methodology for this research.

The Present Study

This study has two primary aims. First is to examine whether neighborhood context affects math and reading achievement trajectories in a nationally representative sample of U.S. children and

adolescents, after accounting for family- and school-level sociodemographic characteristics and selection into neighborhoods. I argue that the influence of neighborhood, measured as dimensions of affluence, poverty, and population heterogeneity, will be robust enough to remain significant in the expected direction (e.g., high poverty neighborhoods will adversely affect achievement trajectories) after controlling for other influential social contexts and selection bias. However, I believe the direct effects will be minimal compared to indirect effects via family and school contexts. The second aim is to understand the mechanisms mediating the relationship between neighborhood context and child achievement outcomes during a critical developmental period and whether the magnitude of those mechanisms changes as children progress into adolescence. I predict that both family and school contexts will mediate the relationship between neighborhood context and both achievement outcomes, regardless of how neighborhood is characterized. As they age, children become competent, independent, self-aware and involved in the world beyond their families. Following this progression, I hypothesize that the mediating effects of family and school will decrease by 8th grade as the direct effect of neighborhood grows.

METHODS

Data

The Early Childhood Longitudinal Study – Kindergarten Cohort (ECLS-K), sponsored by the Department of Education (National Center for Education Statistics, 2009), is a nationally representative study that followed a cohort of more than 21,400 children who entered kindergarten during the 1998-1999 school year through 8th grade. Data collection took place during the fall and spring of kindergarten (1998-1999) and 1st grade (1999-2000) and the spring

of 3rd (2002), 5th (2004) and 8th grades (2007). The ECLS-K contains longitudinal and geocoded data collected directly from children, parents, teachers, and school administrators, providing comprehensive information on education, development, and home, school, and neighborhood environments. In order to maximize the amount of longitudinal data, subsamples of children were followed if they changed schools and any child flagged to be followed a one point in time continued to be followed in subsequent data collections. Due to the multistage stratified sampling design, ECLS-K includes weights to compensate for both sampling strategy and attrition. Results of weighted analyses are generalizable to the U.S. population of kindergarten children in the 1998-1999 school year and first graders in 1999-2000. Subsequent waves are only representative of the ECLS-K cohort.

Children with IRT scale scores for math and reading from kindergarten to 8th grade as well as positive sampling weights were included in the analysis. The final analytic sample consisted of 8,630 and 8,130 students for math and reading achievement outcomes, respectively. Approximately 49% of the sample was female while 62% self-identified as non-Hispanic white, 12% non-Hispanic black, 19% Hispanic, and 7% as non-Hispanic Asian or other racial backgrounds. At entrance to kindergarten, children were 68.5 months old on average.

Measures

Math and Reading Achievement – IRT Scale Scores

Academic achievement from kindergarten to 8th grade was measured using reading and math scores calculated from item response theory (IRT) procedures. "IRT uses the pattern of right, wrong, and omitted responses to the items actually administered in an assessment and the difficulty, discriminating ability, and 'guess-ability' of each item to place each child on a

continuous ability scale" (National Center for Education Statistics, 2009, pp. 3-6). Responses across waves were pooled to stabilize longitudinal estimates; the child's response at each wave represents estimates of the number of items the child would have answered correctly at each point in time if they had taken all of the 212 questions in the reading forms and all of the 174 questions in all of the mathematics forms (See Table 2.1 for descriptive statistics).

Table 2.1. Descriptive statistics of child and family, school, and neighborhood characteristics for reading and math achievement. Weighted and pooled sample from the ECLS-K sample – kindergarten through 8th grade.

	Math Achievement					Reading Achievement				
	N	Mean	Standard Error	Min	Max	N	Mean	Standard Error	Min	Max
Achievement	40920	91.52	0.64	10.51	172.20	40190	114.24	0.71	21.07	208.90
Child and Family Characteristics										
Race and Ethnicity										
White	40820	0.62	0.02	0	1	40090	0.63	0.02	0	1
Black	40820	0.12	0.02	0	1	40090	0.12	0.02	0	1
Hispanic	40820	0.19	0.02	0	1	40090	0.18	0.02	0	1
Asian	40820	0.02	0.00	0	1	40090	0.03	0.00	0	1
Other	40820	0.05	0.01	0	1	40090	0.05	0.01	0	1
Child in good health	38630	0.85	0.01	0	1	37960	0.85	0.01	0	1
Male	40920	0.51	0.01	0	1	40190	0.51	0.01	0	1
Parents not married	39060	0.25	0.01	0	1	38350	0.25	0.01	0	1
Residential Mobility	33150	0.12	0.00	0	1	32890	0.12	0.00	0	1
Maternal Education										
LTHS	37680	0.11	0.01	0	1	36970	0.10	0.01	0	1
High school and some college	37680	0.61	0.01	0	1	36970	0.61	0.01	0	1
Bachelor's degree	37680	0.20	0.01	0	1	36970	0.21	0.01	0	1
Graduate or professional degree	37680	0.08	0.00	0	1	36970	0.08	0.00	0	1
SES	39170	0.01	0.03	-4.75	2.88	38460	0.03	0.03	-4.75	2.88
Parent Communication	38870	3.21	0.05	0	99	38170	3.22	0.05	0	99
Parental Involvement in Education	39100	0.07	0.02	-3.89	2.18	38390	0.08	0.02	-3.89	2.18
School Characteristics										
% Minority Students										
0- <25%	40250	0.52	0.03	0	1	39530	0.53	0.03	0	1
25 - <50%	40250	0.16	0.01	0	1	39530	0.17	0.01	0	1
50 - <75%	40250	0.11	0.01	0	1	39530	0.11	0.01	0	1

>=75%	40250	0.21	0.02	0	1	39530	0.20	0.02	0	1
Parents are active in school programs	34600	0.78	0.01	0	1	34130	0.78	0.01	0	1
Problem with teacher turnover	34640	0.07	0.01	0	1	34170	0.06	0.01	0	1
Neighborhood Characteristics										
Poverty	36330	0.12	0.01	0	0.77	35670	0.12	0.01	0	0.77
Median Household Income/$1000	36330	53.31	1.36	6.77	248.13	35670	53.72	1.37	6.77	248.13
Less than High School Education	36330	0.19	0.01	0	0.86	35670	0.18	0.01	0	0.86
Graduate or Professional Education	36330	0.09	0.00	0	0.67	35670	0.09	0.00	0	0.67
Diversity Index	36322	0.23	0.01	0	0.74	35660	0.23	0.01	0	0.74

Per ECLS-K guidelines, Ns are rounded to the nearest 10 to protect participants. Data are in "long" form and measured in person-years. There are N=8,630 and N=8,130 individual students for math and reading achievement, respectively. Statistics are estimated with probability weights and sandwich estimators to adjust for clustering within primary sampling units. LTHS= less than high school degree. SES= socioeconomic status.

Child and Family Level Variables

I controlled for a variety of child and family characteristics in all multivariate models based on previous studies of educational achievement and theoretical rationale; all variables except child race and or ethnicity and sex were time-varying (Dupere et al., 2010; Leventhal & Brooks-Gunn, 2000; Lloyd, Li, & Hertzman, 2010; Sampson et al., 2002; Sampson et al., 2008). Sociodemographic characteristics included child race and or ethnicity, child health status (good health vs. poor health), child sex, family structure (married vs. unmarried parents), maternal education, socioeconomic status (SES), and residential mobility (Root & Humphrey, 2014b). The SES measure is a continuous scale, constructed by the ECLS-K at each wave, combining information on household-level education, occupation, and income (National Center for Education Statistics, 2009) (See Table 2.1 for descriptive statistics).

I also included indirect and direct measures of parental involvement in the child's education. Communication with other parents was measured by asking parents "how many of your child's classmates' parents do you speak with regularly?" I also created a scale which directly measured parental involvement in education. The scale was created by summing positive responses on questions such as "attended an open house," "met the child's teacher," or "talk with child about their plan after graduating high school." Because the number of questions varied at each survey wave, the scores were standardized with a mean of 0 and a standard deviation of 1 to make the scale comparable across waves.

School Level Variables

School context was measured by time-varying principal report of the percentage of minority students, whether parents were active in school programs, and whether there was a problem with

teacher turnover. Teacher turnover was included as a means to assess the social climate within schools (See Table 2.1 for descriptive statistics). A measure of school-level SES (% of students on free or reduced lunch) was too highly correlated with the minority student measure to be included in the growth curve models, but was instead used in the parallel multiple mediator models (see below).

Neighborhood Characteristics

Neighborhoods were defined as residential census tracts – characterized by measures of affluence, poverty, and population heterogeneity – in order to directly compare this study with prior research on neighborhood effects in childhood and adolescence (Crowder & Teachman, 2004; Leventhal & Brooks-Gunn, 2003b). The ECLS-K did not provide census tract geocodes for the 5th grade; thus, my analysis of neighborhood context spans four waves of data: Kindergarten, 1st, 3rd, and 8th grades. Kindergarten, 1st, and 3rd grade (1998/1999 – 2002) geocodes were linked to the 2000 US Decennial Census. To avoid temporal mismatch between census data used to create neighborhood contexts and time of the survey completion, I derived 8th (2007) grade data from the 2005-2009 American Community Survey (ACS) 5- year estimates. Linear interpolation of census and ACS data was performed for inter-censal waves.

I created multiple, time-varying measures of neighborhood socioeconomic characteristics by first deriving the proportion of persons living below the federal poverty line (poverty), proportion of persons with less than a high school education (LTHS), proportion of persons with a graduate or professional education (graduate), and the median household income (income) in the child's census tract. Following the methodology used by the U.S. Census Bureau (1992), I also constructed a time-varying Diversity Index for each child's census tract, which represents

the likelihood that two persons, chosen at random from the same neighborhood, belong to different racial groups. This equation is:

$$V_i = (1 - \sum {p_i}^2)$$

where p_i represents the proportion of the population in each racial group for each census tract. I then transformed the raw proportions or values to tertiles such that each dimension was categorized as low, moderate, or high (e.g., low, moderate, or high poverty neighborhoods, or highly similar, moderately similar, or highly dissimilar neighborhoods). I transformed the neighborhood variables for two reasons. First, it is necessary for the "treatment" variable, neighborhood, to be in logistic form (in this case multinomial) to support the propensity score methodology (Rosenbaum & Rubin, 1983). Second, I was interested in examining the tail end of the distributions, "low" or "high," because the presence of poor or affluent (or similar or dissimilar) neighbors have differential associations with child and adolescent outcomes (Leventhal et al., 2009). Neighborhood measures were created for each child's census tract at each wave of the study using Decennial Census and ACS data to provide time-varying, temporally matched measures (See Table 2.1 for descriptive statistics).

Analytic Strategy

Time-varying Propensity Scores (TVPS)

I used multinomial logistic regression models to create propensity scores for each child for each type of neighborhood (poverty, LTHS, graduate, income, diversity) at each wave of the survey. In each model, I regressed neighborhood type (reference set as "moderate") on family characteristics from the same wave; besides child race/ethnicity and residential mobility, background characteristics included in the propensity score equations were not duplicated in

growth curve models (see Appendix A for a list of variables). The predicted probability from each model represents the propensity score, or the likelihood that a family selected into their neighborhood type based on background characteristics. Because children moved over the course of the survey, time-varying propensity scores are needed to mitigate selection bias at each wave (Root & Humphrey, 2014a; Root & Humphrey, 2014b).

Multilevel Growth Curve Models

I first examined the distribution of math and reading scores and child, family, school, and neighborhood covariates. Multivariate analyses use growth curve models for continuous outcomes to predict trajectories for reading and math achievement by analyzing time points (Level 1) nested within individual children (Level 2). Thus, the child's grade is the Level 1 unit, and child is Level 2 (Singer & Willett, 2003). There were not enough students per residential census tract to estimate a 3-level model in which youth were also nested within neighborhood contexts.

I first compared linear and quadratic functions of grade at Level 1. For math scores, the linear model was the best fit, suggesting that scores changed uniformly over time. For reading scores, the quadratic model was the best fit, suggesting that scores increased as children progressed but eventually leveled off. To test the effect of controlling for selection into neighborhoods and exposure to multiple ecologies, subsequent models iteratively controlled for neighborhood context, TVPS, family-, and then school-level measures. Models were estimated using *xtmixed* in Stata 12 (StataCorp, 2011) with probability weights and a sandwich estimator of standard errors, which adjusts for clustering within the primary sampling unit. I assigned one

unique variance parameter per random effect and assumed the covariance parameters were zero. The basic model specification is:

$$Y_{ij} = \pi_{0i} + \pi_{1i}GRADE_{ij} + \pi_{2ni}W_i + \varepsilon_{ij}$$

$$\text{where: } \pi_{0i} = \gamma_{00} + \gamma_{0n}X_i + \xi_{0i}$$

$$\pi_{1i} = \gamma_{10} + \gamma_{1n}Z_i + \xi_{1i}$$

Y_{ij} shows the level-1 model which includes $GRADE$ (centered at kindergarten) as the trajectory of educational achievement across students and W as a matrix of time-varying predictors of educational achievement. π_{0i} and π_{0i} are the level-2 models which show how the initial status and trajectory are modified over time. X_i and Z_i are matrices of time-invariant variables that modify the intercept and slope over time, respectively. I use the Bayesian information criterion (BIC) and the Akaike information criteria (AIC) to assess model fit and improvement across nested models.

Parallel Multiple Mediator Models

Parallel multiple mediator models allow researchers to model multiple mechanisms simultaneously in a single integrated model – arguably a more realistic approach to developmental research (Hayes, 2013; Krull & MacKinnon, 2001; Selig & Preacher, 2009). For each neighborhood context that remained a significant predictor for achievement outcomes in the final growth curve models, I simultaneously tested for mediation at the family level (SES, family structure, and parental involvement in education) and the school level (SES and whether parents were actively engaged in school programs). I then estimated the same models centered at 8th grade to test whether the mediating effect of family and school contexts diminished over time. Formally testing for multiple mediational effects in hierarchical growth models is completed in

three steps. First, associations between neighborhood context and mediators and mediators and outcomes were evaluated in ordinary least squares regression models (Baron & Kenny, 1986; Hayes, 2013; Krull & MacKinnon, 2001). I estimated the OLS models using continuous neighborhood variables rather than multinomial variables because of the numerous computation and interpretation problems associated with mediation analysis of categorical variables (MacKinnon & Cox, 2012). Second, for each outcome a series of models introducing the mediators one by one were tested for each neighborhood context. Third, for each outcome and neighborhood context, I estimated a final model including all mediators that were individually significant. All models included the full battery of controls. For all models, Sobel tests of mediation (Sobel, 1982) were performed to determine statistical significance of the mediated effect (calculated as the product of coefficients). The Sobel equation is:

$$Z = \frac{a * b}{\sqrt{(b^2 * s_a^2 + a^2 * s_b^2)}}$$

where a and b are the coefficients for the association between neighborhood context and mediator and mediator and outcome, respectfully. s_a and s_b are the associated standard errors.

RESULTS

Descriptive Analysis

Table 2.1 summarizes the main descriptive findings for all variables showing weighted means and standard errors. On average, children were in good health (M=0.85; SE= 0.01), only 25% lived in a household in which parents were not married (SE=0.01), 12% moved at least once, and 61% of mothers had a high school diploma with some college experience (SE=0.01). Of the schools students attended, roughly 50% were comprised of less than 25% minority students (math M=0.52; SE=0.03; reading M=0.53; SE=0.03), 78% of schools had a culture of actively

engaged parents (SE=0.01), and less than 10% had problems with teacher turnover (math M=0.07; SE=0.01; reading M=0.06; SE=0.01). On average within neighborhoods, 12% of residents lived below the federal poverty line (SE=0.01), the median household income was about $53,000 (math M=$53,310; SE=$1,360; reading M=$53,720; SE=$1,370), fewer than 20% of residents had less than a high school diploma (math M=0.19; SE=0.01; reading M=0.18; SE=0.01), 9% had a graduate or professional education (SE=0.01), and the likelihood that two residents chosen at random from the same neighborhood were of different races was 0.23 (SE=0.01).

After controlling for family and school contexts as well as selection bias, do neighborhoods affect educational achievement during childhood and adolescence?

Table 2.2 displays the final growth curve models, which control for individual, family, school, and neighborhood contexts, as well as time-varying propensity scores to address selection bias (see Appendices B and C for nested models with contexts iteratively added). Due to convergence or over-fitting issues, I was unable to interact grade by neighborhood to examine neighborhood effects on trajectories of educational achievement. Thus, coefficients represent effects at either kindergarten or 8th grade, as noted. These final models indicated that individual and family characteristics were the main drivers of variation in both achievement outcomes, followed by school then neighborhood contexts. School effects were stronger for math while neighborhood effects were stronger for reading achievement. Final models demonstrated that relative to moderate levels, neighborhoods high in poverty (*b*=-1.25; *SE*=-0.31), high in residents with less than a high school education (*b*=-1.35; *SE*=-0.54), low in residents with graduate education (*b*=-0.94; *SE*=-0.40), and low income levels (*b*=-0.97; *SE*=-0.32) adversely affected kindergarten

math scores. Significant and positive effects on reading trajectories were demonstrated in children who resided in neighborhoods in which residents were highly educated (*b*=1.03; *SE*=-0.47). Similarly, fully saturated models showed that neighborhoods with low income levels (*b*=-1.95; *SE*=-0.37), low in residents with a graduate education (*b*=-1.11; *SE*=-0.30), high poverty levels (*b*=-2.43; *SE*=-0.49), and high levels of residents with less than a high school education (*b*=-3.06; *SE*-0.44) negatively affected reading achievement in kindergarten. Significant and positive effects on reading scores were demonstrated in children who resided in neighborhoods in which residents were highly educated (*b*=0.82; *SE*=-0.29) and few people had low education levels (*b*=1.13; *SE*=-0.44). There was no significant neighborhood effects for diverse neighborhoods for either achievement outcome. I conducted sensitivity analyses for neighborhoods characterized by composite measures (socioeconomic advantage, socioeconomic disadvantage, racial and ethnic diversity) and substantive conclusions did not change. Sensitivity analysis for testing moderation between neighborhood and child SES and neighborhood and child race and or ethnicity resulted in worse model fit, therefore no neighborhood interactions were included in the final models.

Because I was unable to examine how neighborhoods affect trajectories, I re-estimated models centered at 8th grade (not shown) to explore whether direct neighborhood effects increased or decreased over time. For both reading and math, the associations between neighborhood environment and outcome was stronger at 8th grade compared to kindergarten. For example, in kindergarten, living in tracts with high levels of residents with less than a high school education (LTHS) was associated with a 3.06 point reduction in reading scores; at 8th grade, living in high LTHS tracts resulted in a 3.44 point reduction in reading scores.

Table 2.2. Final growth curve models examining the relationship between neighborhood context and math and reading achievement among children and early adolescents in the ECLS-K sample, net of family and school variables and time-varying propensity scores.

	Math Achievement – Final Models				Reading Achievement – Final Models			
	Poverty	**Income**	**LTHS**	**Graduate**	**Poverty**	**Income**	**LTHS**	**Graduate**
	b	**b**	**b**	**b**	**b**	**b**	**b**	**b**
	se	**se**	**se**	**se**	**se**	**se**	**se**	**se**
Fixed Effects								
Initial status	37.56***	37.86***	36.43***	36.78***	16.43***	16.67***	16.70***	16.43***
	-0.99	-1.09	-1.21	-1.11	-2.16	-2.03	-1.88	-1.90
Grade	26.74***	26.71***	26.77***	26.73***	70.95***	70.92***	70.92***	70.90***
	-0.21	-0.21	-0.21	-0.20	-0.79	-0.81	-0.79	-0.83
Grade^2					-8.17***	-8.17***	-8.16***	-8.16***
					-0.15	-0.15	-0.15	-0.16
Race (ref=white)								
Black	-12.22***	-12.38***	-12.28***	-12.47***	-10.02***	-10.41***	-10.21***	-10.68***
	-1.21	-1.15	-0.99	-1.13	-0.89	-0.90	-0.85	-0.90
Hispanic	-3.09*	-3.25**	-3.05*	-3.09*	-4.22***	-4.60***	-4.08***	-4.40***
	-1.21	-1.19	-1.21	-1.21	-0.92	-0.91	-0.98	-0.94
Asian	2.66**	2.55**	2.51**	2.50*	3.54**	3.30**	3.50**	3.41**
	-0.97	-0.98	-0.97	-0.98	-1.12	-1.16	-1.16	-1.19
Other	-4.74†	-4.79†	-4.84†	-4.86†	-4.082*	-4.18*	-4.36*	-4.43*
	-2.58	-2.52	-2.54	-2.55	-1.97	-2.03	-2.05	-2.07
Child in good health	1.29***	1.30***	1.29***	1.30***	3.07***	3.07***	3.06***	3.08***
	-0.31	-0.30	-0.31	-0.30	-0.49	-0.46	-0.45	-0.45
Male	3.19***	3.18***	3.19***	3.15***	-4.61***	-4.65***	-4.63***	-4.66***
	-0.49	-0.48	-0.48	-0.48	-0.56	-0.55	-0.56	-0.56
Parents not married	-2.34***	-2.34***	-2.36***	-2.40***	-1.46*	-1.48*	-1.51*	-1.59*

	-0.52	-0.52	-0.54	-0.53	-0.74	-0.74	-0.74	-0.74
Residential Mobility	-3.75***	-3.75***	-3.81***	-3.80***	0.72**	0.72*	0.60*	0.68*
	-0.46	-0.44	-0.42	-0.45	-0.27	-0.29	-0.28	-0.27
Maternal Education (ref=High School or Some College)								
Less than high school	-5.24***	-5.28***	-5.24***	-5.36***	-8.32***	-8.42***	-8.27***	-8.57***
	-0.46	-0.46	-0.48	-0.45	-0.67	-0.61	-0.63	-0.64
Bachelor's degree	2.81***	2.83***	2.78***	2.68***	3.45***	3.52***	3.38***	3.31***
	-0.32	-0.32	-0.33	-0.33	-0.68	-0.72	-0.71	-0.68
Graduate or professional degree	3.65***	3.63***	3.51***	3.44***	5.57***	5.51***	5.35***	5.21***
	-0.46	-0.46	-0.46	-0.48	-0.80	-0.82	-0.81	-0.76
SES (continuous measure)	6.19***	6.23***	6.18***	6.11***	6.32***	6.45***	6.29***	6.35***
	-0.26	-0.24	-0.32	-0.31	-0.59	-0.55	-0.49	-0.55
Parent Communication	-0.01	-0.01	-0.01	-0.01	0.07*	0.07*	0.07**	0.07*
	-0.02	-0.02	-0.02	-0.02	-0.03	-0.03	-0.03	-0.03
Parental Involvement in Education	0.27	0.27	0.27†	0.28†	0.24†	0.23†	0.24†	0.26†
	-0.17	-0.17	-0.16	-0.16	-0.14	-0.13	-0.13	-0.14
School Characteristics								
% Minority Students (ref=0-<25%)								
25 - <50%	-0.89	-0.94	-0.88	-0.97	0.15	-0.00	0.21	-0.03
	-0.77	-0.74	-0.71	-0.73	-0.42	-0.41	-0.43	-0.43
50 - <75%	-0.90	-1.05	-0.96	-1.03	-0.33	-0.71	-0.31	-0.70
	-0.69	-0.69	-0.66	-0.67	-0.57	-0.58	-0.56	-0.63
>=75%	-0.09	-0.30	-0.14	-0.34	-3.05**	-3.52***	-2.95**	-3.68***
	-0.67	-0.59	-0.52	-0.60	-1.03	-0.99	-0.98	-1.05
Parents are active in school programs	3.18***	3.20***	3.14***	3.14***	1.09†	1.14†	1.03	1.09†
	-0.22	-0.22	-0.20	-0.21	-0.58	-0.61	-0.63	-0.60
Problem with teacher turnover	0.28	0.29	0.33	0.36	-1.07	-1.06	-0.95	-0.96
	-0.83	-0.82	-0.83	-0.82	-0.75	-0.76	-0.75	-0.75
Neighborhood Characteristics								
Time-Varying Propensity Score	1.69*	1.36*	4.41***	3.56***	2.11**	2.66***	2.69**	2.30*

	-0.68	-0.59	-0.65	-0.79	-0.82	-0.60	-0.82	-0.91
Neighborhood Tertiles (ref= Moderate)								
Low	0.46	-0.97**	0.39	-0.94*	1.66†	-1.95***	1.13**	-1.11***
	-0.53	-0.32	-0.31	-0.40	-0.91	-0.37	-0.44	-0.30
High	-1.25***	0.24	-1.35*	1.03*	-2.43***	0.75†	-3.06***	1.88***
	-0.31	-0.69	-0.54	-0.47	-0.49	-0.39	-0.44	-0.46
Random Effects								
Intercept	14.96***	14.99***	14.97***	14.97***	17.32***	17.37***	17.35***	17.33***
	0.15	0.21	0.21	0.21	0.27	0.26	0.25	0.25
Slope	2.50***	2.49***	2.50***	2.50***	2.97***	2.96***	2.92***	2.96***
	0.21	0.15	0.16	0.15	0.29	0.29	0.30	0.29
AIC	23023671	23024851	23018914	23021123	23603953.8	23607744	23603003	23607577
BIC	23023875	23025055	23019118	23021327	23604165	23607955	23603214	23607788

N=8,630 students for math achievement; 8,130 students for reading achievement. Per ECLS-K guidelines, all N's are rounded to the nearest 10 to protect student privacy. These are the final growth curve models, which include the full battery of family-, school-, and neighborhood-level measures. Each model is estimated with probability weights and sandwich estimators. LTHS= less than high school degree. SES= socioeconomic status. AIC= Akaike information criterion. BIC= Bayesian information criterion.

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Do family and school contexts mediate the relationship between exposure to neighborhood environments and educational achievement during elementary and middle school? Does the mediating influence of families and school decrease over time, as the direct effect of neighborhood increases?

Math Achievement

The left panel of Table 2.3 presents the results of the final parallel process mediation models for math achievement. Mediation analyses were conducted for neighborhoods characterized by the proportion of persons living below the federal poverty line (poverty), proportion of persons with less than a high school education (LTHS), proportion of persons with a graduate or professional education (graduate), and the median household income (income) because those contexts remained significant in the final growth curve models. In addition, I conducted these analyses with models centered at 8th grade to test whether the mediating effects of family and school diminished over time. Following the individual mediation tests, family SES, family structure, and parental involvement in education (significant only in kindergarten) were identified as family-level mediators; school-level mediators included SES and whether parents were active in school programs. For each neighborhood context, family SES was most important in explaining the relationship between exposure to neighborhood and math achievement. Parents active in school programs, family structure, and school SES mediated the relationship to lesser degrees. The linear association between less than high school neighborhoods and math scores became insignificant when all mediators were included in the analysis, indicating that family and school variables fully meditated the relationship. On the other hand, the relationship between neighborhood poverty and math achievement was only partially mediated by home and school contexts. In kindergarten, family and school contexts accounted for about 2/3 of the association

between neighborhoods and math achievement; at 8th grade, family and school contexts explained roughly 1/3 and 1/2 of the association for poverty and graduate neighborhoods, respectively. The diminished associations between neighborhood contexts and math scores indicate that the mediating effects of family and school contexts decreased while the direct effects of neighborhoods increased between kindergarten and 8th grade.

Reading Achievement

The right panel of Table 2.3 presents the results of the final parallel multiple mediation models for reading achievement. Mediation analyses were conducted for poverty, income, LTHS, and graduate neighborhoods because those contexts remained significant in the fully saturated growth curve models. In addition, I conducted these analyses with models centered at 8th grade to test whether the mediating effects of family and school diminished over time. Across each neighborhood context, the individual mediation models indicated that school-level variables were not significant mediators, leaving only family-level variables to explain how neighborhood influences manifest to affect reading achievement in children and adolescents. For poverty, income, and graduate neighborhoods, family SES, family structure and parental involvement in education were significant mediators. Analyses indicated that parental involvement in education was the most influential mediator between reading achievement and LTHS neighborhoods. It is important to note that in all models, the linear association between neighborhood and reading scores remained significant indicating that family-level variables only partially mediated the association. Generally, family and school contexts accounted for approximately 1/3 of the association in kindergarten, and at 8th grade they accounted for about 1/4 of the association. Interestingly, at 8th grade, family structure (living in a home with married versus unmarried

parents) no longer remained a significant mediator between any neighborhood context and reading achievement. The diminished associations between neighborhood contexts and math scores indicate that the mediating effects of family contexts decreased while the direct effects of neighborhoods increased between kindergarten and 8th grade.

Table 2.3. Final parallel process mediation models examining family- and school-level mechanisms between neighborhood context and math and reading achievement in the ECLS-K sample.

	Math Achievement – Final Parallel Process Mediation Models						Reading Achievement – Final Parallel Process Mediation Models							
	Poverty K	**Poverty 8th**	**LTHS K**	**LTHS 8th**	**Graduate K**	**Graduate 8th**	**Poverty K**	**Poverty 8th**	**Income K**	**Income 8th**	**LTHS K**	**LTHS 8th**	**Graduate K**	**Graduate 8th**
Family-Level Mediators														
Socioeconomic Status														
B	-0.15 ***	-0.18 ***	-0.17 ***	-0.20 ***	0.16 ***	0.19 ***	-0.17 ***		79 **	50.70 ***	-0.18 ***	-0.21 ***	0.00 ***	0.00 ***
SE	0.00	0.02	0.02	0.02	0.02	0.02	0.01		21	2.11	0.01	0.01	0.01	0.01
Family Structure														
B	-0.05 ***	-0.04 **	-0.03 ***	-0.02 **	0.01 ***	0.01 **	-0.03 *		10 *	2.94	-0.01 **	-0.01	0.00 *	0.00
SE	0.01	0.02	0.01	0.01	0.00	0.00	0.01		10	2.44	0.01	0.01	0.00	0.00
Parent Involvement in Education														
B	0.00		-0.10		-0.00		-0.00 ***	**	41 **	0.15 *	0.23 ***	0.13 **	0.00 ***	0.00 **
SE	0.00		0.09		0.00		0.00	0.00	0.08	0.07	0.04	0.04	0.00	0.00
School-Level Mediators														
SES														
B	0.00 †	0.00 †	0.00 *	0.00 *	0.00 †	0.00								
SE	0.00	0.00	0.00	0.00	0.00	0.00								
Parents Active in School Programs														
B	-0.07 ***	-0.06 ***	-0.05 ***	-0.05 ***	0.06 ***	0.06 ***						-0.01		
SE	0.01	0.01	0.01	0.01	0.00	0.01						0.01		
Proportion of association explained by mediators	0.64	0.34	0.87	0.91	0.63	0.46	0.28	0.26	0.31	0.26	0.37	0.39	0.36	0.29

Mediators included in the final models were selected based on results of the individual mediation analyses. Each model is estimated with probability weights and sandwich estimators. LTHS= less than high school education

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

DISCUSSION

This study examined neighborhood effects on children's math and reading achievement between kindergarten and 8th grade, after controlling for family and school contexts and selection bias. It also examined the mechanisms underlying the association and how neighborhood effects manifested over time. Taking an ecologically driven approach (Bronfenbrenner, 1979; Elder, 1998), I proposed that neighborhoods – characterized by measures of affluence, poverty, and population heterogeneity – would significantly affect math and reading achievement trajectories, albeit with small direct effects, after accounting for multiple social ecologies and selection into neighborhoods. In addition, I hypothesized that family SES, family structure, parental involvement in education, school SES, and school culture of active parenting would mediate the relationship between neighborhood context and achievement outcomes, and the influence of the proximal contexts would lessen as children progressed into adolescence. Results from growth curve models generally supported these hypotheses across outcomes and neighborhoods characterized by measures of poverty and affluence. Results from parallel multiple mediator models indicated that both family and school contexts were mediators for math achievement, but only the family context mediated the relationship between neighborhood and reading achievement trajectories. Moreover, I found that the influence of family and school contexts decreased over time for both outcomes, and by 8th grade, family structure was no longer a mechanism through which neighborhoods exerted influence on reading scores.

Although the results were generally consistent for both outcomes, the results for math achievement were generally weaker, suggesting that the strength of association between neighborhood and achievement may vary as a function of the specific outcome considered (Dupere et al., 2010; Lloyd et al., 2010). A possible reason for this difference could involve how

math and reading skills are acquired. While the acquisition of math skills tend to be acquired in formal institutional settings (e.g., schools, classrooms), reading skills tend to be those acquired not only in schools and classrooms, but also at home and across neighborhood environments (e.g., public libraries). Therefore, it may be the case that neighborhoods exert a stronger influence on reading scores because the acquisition of reading skills involves more collective efforts from parents, teachers, family members, neighbors, and community members than math skills (Lloyd et al., 2010). Taking a "village" view, I find direct links between family, school, and neighborhood resources and reading achievement in youth. According to the U.S. Department of Education (1996), there is a substantial relationship between parent involvement in school programs and elementary reading comprehension. Where parent involvement is low, the average classroom reading score is 46% below the national average. Where parent involvement is high, classrooms score 28% above the national average. Similarly, the availability of local public libraries and community reading programs have been associated with children's literacy, vocabulary, and reading comprehension growth, but children in disadvantaged areas may have low quality or limited access to those resources (Entwisle, Alexander, & Olson, 1997). Social disorganization theory, a theoretical perspective which combines several complementary neighborhood theories, argues that the economic status of neighborhoods may contribute to the social fabric of a neighborhood by limiting social interactions and relationships, influencing the quality and quantity of resources, decreasing the learning opportunities for children, and affecting the availability of positive adult role models (Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002). Thus, if youth reading skills are partly dependent on collective efforts, then I would expect that living in high poverty, low income, and less educated neighborhoods would adversely affect reading achievement, which my study found to be true.

Previous research has demonstrated that child characteristics, family, and school contexts are more influential than neighborhoods and estimating neighborhood effects without the inclusion of the child's school context introduces bias and over-estimates the small to moderate direct neighborhood effects (Carlson & Cowen, 2015; Cook, Herman, Phillips, & Settersten, 2002; De Clercq et al., 2014; Jargowsky & Komi, 2009; Owens, 2010). My findings are in line with prior research (Carlson & Cowen, 2015; Cook et al., 2002; De Clercq et al., 2014; Jargowsky & Komi, 2009), in that child characteristics, family contexts, and the schools that students attend had a greater impact on achievement outcomes than did the neighborhoods in which children lived. However, I also found that neighborhoods have a small direct and independent effect on student achievement after controlling for multiple social ecologies and examining potential mediation. My analyses revealed significant variation across neighborhoods with respect to their estimated contributions to test scores. To my knowledge, previous research combining multiple social ecologies, have not, in my opinion, adequately addressed selection bias. The studies cited above made efforts to control for background characteristics, which does not fully overcome the selection or "reflection" problem (Diez Roux, 2004; Manski, 1993; Oakes, 2004). By using a comprehensive longitudinal dataset, including time-varying propensity scores (Root & Humphrey, 2014a), and controlling multiple social ecologies, I believe I have adequately mitigated selection bias, the biggest issue plaguing neighborhood studies, and made a significant contribution to the neighborhood effects and child development literature.

Beyond observing an association between neighborhood context and youth academic achievement trajectories, net of family, school, and selection bias, this study's other major contribution has been examining the potential mediating role of family and school proximal contexts. Substantial theoretical work has identified that family and school contexts are

mediators that transmit the effects of neighborhood environments on youth development (Earls & Carlson, 2001; Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002), but empirical work testing these mechanisms is lacking. Previous studies have focused on one mechanism at a time, an unrealistic view of how development unfolds, leading to an incomplete understanding of the processes at play. In contrast, this study simultaneously tested for mediation at the family level (SES, family structure, and parental involvement in education) and the school level (SES and whether parents were actively engaged in school programs). I also tested mediation in both kindergarten and 8th grade to examine how the influence of the underlying mechanisms changed over time. In regards to math achievement, my study demonstrated that both family and school contexts mediated the association between neighborhood and math scores; by 8th grade, the mediating influence diminished. The mediation analysis for reading achievement is particularly interesting as neither of the school context variables had mediating roles in either elementary or middle school. The insignificant mediating effect of school context on reading achievement may be due, again, to the fact that math achievement is heavily influenced by the quality of institutional resources, whereas reading skills are gained in a more holistic manner.

Both the growth curve and mediation analyses revealed that the school is a significant social context associated with math achievement. Because math skills are so heavily influenced by institutions, children attending schools in disadvantaged neighborhoods may be doubly burdened by both contexts, as disadvantaged neighborhoods may create school environments with high percentages of poor and minority students, serious crime problems, low instructional expenditures, and few opportunities to enroll in advanced courses (Crosnoe, 2009; Eamon, 2005; Jargowsky & Komi, 2009). This is partly due to the financial and human capital resources within

neighborhoods. Schools are, in large part, funded by the local tax revenues based on local property values and business activities. Neighborhood-level financial capital generates better infrastructure, which translates into human capital. Thus, schools in advantaged areas are often able to hire and retain highly qualified, effective teachers, and create a culture where parents expect and lobby for high quality services, and engage parents to become involved with school activities such as parent-teacher organizations (Crosnoe, 2009; Dupere et al., 2010; Lareau, 2003; Leventhal et al., 2009; Owens, 2010).

For both math and reading scores, family SES exerted the most influence. One possible explanation is that parents with greater economic resources may be able to afford to send their child to better childcare, private schools, or supplementary educational programs, and travel outside of the neighborhood to secure other goods and services that facilitate healthy development and educational achievement. Parents from poor families, on the other hand, often lack the ability to "buy out" of low quality institutions and are dependent on the resources within their own neighborhood (Wodtke et al., 2012). Similarly, more affluent parents often engage in "concerted cultivation" (Lareau, 2003) – the deliberate efforts to facilitate children's social and cognitive development through enrolling children in multiple leisure-time activities, consistently intervening and advocating on their child's behalf at school, and crafting stimulating and structured home environments – which lead to skills and attitudes preferred and rewarded in institutional settings (Lareau, 2003; Potter & Roksa, 2013). Although the family context is important, by 8th grade the influence of the family mediators decreased and family structure no longer mediated the neighborhood-reading achievement relationship. This indicates that as children progress into adolescence, other social contexts than the family become important for achievement, which is generally supported by developmental researchers who argue that by

middle school, adolescents are regularly exposed to adults and peers outside of the family, are given more freedom and responsibilities, spend less time under the supervision of their parents, and come increasingly under the influence of peers, neighbors, and teachers (Eccles, 1999). Although researchers and policymakers generally focus on the school as the critical arena in which development occurs, I argue that the focus should be on a combination of child, family, school, and neighborhood but the focus should shift over time. In light of these findings, it may be that policymakers focus on improving the social and structural components of family and school contexts in early childhood and elementary school. However, in middle and high school, policy should focus on adolescents, peers, and non-familial environments in which youth can learn about themselves and their worlds, and can discover opportunities for carving their own versions of success (Eccles, 1999).

Limitations

This study has several limitations. First, I defined neighborhoods as residential census tracts despite the call to use other spatial contexts that are relevant for child and adolescent development (e.g., school attendance zones) (Sharkey & Faber, 2014). However, census tracts as neighborhood proxies allow for direct comparison to previous research examining neighborhood effects on children and adolescents. Second, theoretical and empirical research indicates that parent-child interaction, parental warmth, discipline style, and stimulating home environments are key mediators between the neighborhood and achievement relationship (Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002). The ECLS-K either did not include these measures in their survey forms, or they were inconsistent across waves such that no useable measure could be extracted. Thus, it is likely that I was unable to fully understand the processes at play. Third,

both reading and math outcomes used in this study were scaled to the 8th grade. Thus, these measures were only available for children who remained in the survey through 8th grade. However, I limited bias as much as possible by estimating models with survey weights that compensated for attrition. Another limitation is that the results are only generalizable to the U.S. population of kindergarten children in the 1998-1999 school year and first graders in 1999-2000; subsequent waves are only representative of the ECLS-K cohort. While this is important to consider when interpreting results, I also point out that the ECLS-K surveyed a large and diverse population of children, which is a strength of the dataset and my analyses.

Despite these limitations, my findings have important implications for future neighborhood research and policy. They point to the small, yet robust direct impact neighborhoods have on academic achievement during a critical developmental period and suggest that future research should simultaneously tackle the "selection" problem and assess multiple social contexts. Further it suggests that efforts to improve educational achievement and mitigate educational inequality need to span multiple contexts. Policies or practices that exclusively focus on the family, school, or neighborhood may generate some benefits, but will likely fall short by addressing only part of the equation.

The largest comprehensive program that simultaneously addresses family-, school-, and community-level contexts is the Harlem Children's Zone (HCZ). It is a place-based initiative created to address all of the problems that poor children in central Harlem, NY face – housing, schools, crime, community, etc. – through a conveyer belt of services from birth to college. The program is based on the assumption that one must improve both neighborhoods and schools to affect student achievement. This holistic approach has led to large and significant increases in math performance, marginal performance in reading achievement, and a 14.1% increase in the

likelihood that participating children enroll in college (Dobbie & Fryer, 2011). This program has been so successful at improving the lives of poor children and their families that President Obama launched the “Promise Neighborhoods” program, which aims to fund HCZ-like programs in 20 cities across the country.

CHAPTER 3

"Neighborhood effects on psychosocial adjustment during elementary school"

INTRODUCTION

According to the U.S. Surgeon General, roughly 20% of American youth exhibit signs of one or more mental, emotional or behavioral disorders (U.S. Department of Health and Human Services, 1999). The presence of externalizing behaviors (e.g., acting out, conduct disorder, ADHD) or internalizing behaviors (e.g., depression, anxiety) during childhood and adolescence is predictive of moderate to severe academic achievement deficits, poor health, bullying, delinquency, substance abuse, and poverty later in life (Caughy et al., 2008; Eccles, 1999; Humphrey et al., 2007; Leventhal & Brooks-Gunn, 2000; National Research Council and Institute of Medicine, 2009). Increasing evidence from experimental and non-experimental research has described that children residing in low SES, racially diverse, and residentially unstable neighborhoods exhibit higher levels of internalizing and externalizing behaviors, above and beyond genetic predisposition, individual characteristics, and family or school contexts (Aneshensel & Sucoff, 1996; Butler et al., 2012; Curtis et al., 2013; Deng et al., 2006; Fowler et al., 2014; Goldner, 2009; Kohen et al., 2008; Leventhal & Brooks-Gunn, 2000; Mrug & Windle, 2009; Pachter et al., 2006; Plybon & Kliewer, 2001; Roosa et al., 2005; Sampson et al., 2002; Sucoff et al., 1999). As they age, children become competent, independent, self-aware and involved in the world beyond their families. As such, most researchers agree that neighborhoods may directly affect adolescents and adults, but impact children indirectly through proximal contexts, such as families, schools, and peers (Leventhal & Brooks-Gunn, 2000).

Neighborhoods represent both a spatial and social context important for the development of internalizing and externalizing behaviors as children spend a majority of time in their local

surroundings and the social and structural aspects of neighborhoods affect proximal contexts, such as families and schools (Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002). Neighborhood social disorganization theory posits that neighborhood level structural disadvantage – low economic status, residential instability, population heterogeneity – gives rise to social processes among families, peers, and neighbors that lead to community-level disorganization and subsequent problem behavior among youth (Sampson & Groves, 1989; Sampson et al., 2002; Shaw & McKay, 1942; Wilson, 1987). Two longitudinal studies of children and adolescents support these assertions. Wheaton and Clarke (2003) concluded that early exposure to neighborhood poverty was associated with behavioral symptoms years later in a child's life. Similarly, Beyers et al. (2003) found that neighborhood poverty was associated with increased rates of externalizing problems via unsupervised time spent in the neighborhoods. Both studies argue that the social processes created by neighborhood social disorganization, e.g., increased parental stress, less adult supervision, fewer social networks, put youth at risk for behavior problems.

In this study, I advance previous research by addressing several limitations. First, to my knowledge, no research has simultaneously examined the impact of child characteristics, family context, school context, and the neighborhood environment on childhood psychosocial adjustment. Existing studies provide evidence that both schools and neighborhoods shape children's behavior, but the tendency to model family-school or family-neighborhood contexts limits our understanding of the processes affecting healthy development and most likely over-estimates direct neighborhood effects (Carlson & Cowen, 2015; De Clercq et al., 2014; Jargowsky & Komi, 2009). Second, few observational studies address the fact that many families make choices about where to live and non-random assignment of neighborhood leads to selection

bias – the biggest issue plaguing neighborhood effects research (Diez Roux & Mair, 2010; Manski, 1993; Oakes, 2004; Rosenbaum & Rubin, 1983; Tienda, 1991). Finally, in asking "how" neighborhoods impact child behaviors, most research assesses the mediating role of families or schools. By contrast, in this study I concurrently assess how multiple mechanisms within both the family and school environments indirectly affect youth behavioral trajectories. I address these limitations by examining the relationships among family processes, school context, neighborhood environments, and trajectories of behavior problems in elementary school children. Specifically, I examine the following research questions: 1) Do neighborhood environments affect trajectories of internalizing and externalizing behaviors during elementary school, after controlling for family and school contexts as well as selection bias?, and 2) What role do family and school contexts play in mediating the relationship between neighborhood context and psychosocial adjustment during elementary school? I argue that neighborhood contexts will not directly affect internalizing or externalizing behaviors during elementary school, but rather, effects will be transmitted simultaneously through families and schools. Addressing these questions may lead to a better and more rigorous understanding of how neighborhood environments affect internalizing and externalizing behaviors during elementary school, which is critical for improving child psychosocial health and informing policy and practice.

METHODS

Data

The Early Childhood Longitudinal Study – Kindergarten Cohort (ECLS-K), sponsored by the Department of Education (National Center for Educational Statistics, 2006), is a nationally

representative study that followed a cohort of more than 21,400 children who entered kindergarten during the 1998-1999 school year through 8th grade. Data collection took place during the fall and spring of kindergarten (1998-1999) and 1st grade (1999-2000) and the spring of 3rd (2002), 5th (2004), and 8th grades (2007). The ECLS-K contains longitudinal and geocoded data collected directly from children, parents, teachers, and school administrators, providing comprehensive information on education, development, and home, school, and neighborhood environments. In order to maximize the amount of longitudinal data, subsamples of children were followed if they changed schools and any child flagged to be followed a one point in time continued to be followed in subsequent data collections. In a longitudinal sample, attrition due to non-response and eligibility change is expected. During the first four waves (kindergarten through 5th grade), the ECLS-K had a 40% attrition rate. However, the ECLS-K included weights to compensate for both sampling strategy and attrition; all analyses in this study are weighted appropriately. Results of weighted analyses are generalizable to the U.S. population of kindergarten children in the 1998-1999 school year and first graders in 1999-2000. Subsequent waves are only representative of the ECLS-K cohort.

Children with behavior measures for at least two time points and positive sampling weights were included in the analysis. The final analytic sample consisted of 16,080 and 16,160 students for internalizing and externalizing behaviors, respectfully. Approximately 49% of the sample was female while, 60% self-identified as non-Hispanic white, 14% non-Hispanic black, 18% Hispanic, and 7% as non-Hispanic Asian or other racial backgrounds. At entrance to kindergarten, the average age was 68.5 months.

Measures

Internalizing and Externalizing Behaviors

Internalizing and externalizing behaviors are measured using subscales of the Teacher Social Rating Scale for fall and spring kindergarten and spring of 1st, 3rd, and 5th grades. The five to six items of the Externalizing Problem Behaviors scale measured acting out behaviors (e.g., arguing, fighting, showing anger, acting impulsively, disturbing the classroom's ongoing activities). The four items on the Internalizing Problem Behavior measured negative affective states such as anxiety, loneliness, sadness and low self-esteem. The ECLS-K scored each scale as the average of the underlying items. The National Center for Educational Statistics (2006) reports adequate split-half reliability ranges of 0.76 to 0.89 for the Externalizing and Internalizing Problem Behavior scales. Exploratory and confirmatory factor analyses confirmed the full scale's structure. Scale scores were standardized with mean of 0 and standard deviation of 1.

Child and Family Level Variables

I controlled for a variety of child and family characteristics in all multivariate models based on previous studies of psychosocial adjustment and theoretical rationale; all variables except child race and or ethnicity and sex was time-varying (Curtis et al., 2013; Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002). Sociodemographic characteristics included child race and or ethnicity, child health status (good health vs. poor health), child sex, child age, family structure (married vs. unmarried parents), maternal education, socioeconomic status (SES), and residential mobility (Root & Humphrey, 2014b). The SES measure is a continuous scale, constructed by the ECLS-K at each wave, combining information on household-level education, occupation, and income (National Center for Education Statistics, 2006) (See Table 3.1 for descriptive statistics). I also included a measure of the child's organized after school activities (OASA), by summing

the number of activities the child participated in: dance lessons, athletic activities, recreational activities, music lessons, art classes, performing arts programs. This measure was included for two reasons: 1) participation in organized activities creates structured routines and increases time youth are monitored by adults, often leading to fewer externalizing behaviors (Furstenberg et al., 1999; Mrug & Windle, 2009; Sampson et al., 2002), and 2) participation in organized activities builds self-esteem, which may reduce internalizing behaviors (Eccles, 1999; Eccles et al., 1996; Eccles, Lord, & Midgley, 1991).

Table 3.1. Descriptive statistics of child and family, school, and neighborhood characteristics for internalizing and externalizing behaviors. Weighted and pooled sample from the ECLS-K sample – kindergarten through 5th grade.

	Internalizing Behaviors					Externalizing Behaviors				
	N	Mean	Standard Error	Min	Max	N	Mean	Standard Error	Min	Max
Psychosocial Adjustment	52130	0.01	0.01	-1.171	4.67	52480	0.018	0.01	-1.14	4.06
Child and Family Characteristics										
Race and Ethnicity										
White	51970	0.60	0.02	0	1	52320	0.60	0.02	0	1
Black	51970	0.14	0.02	0	1	52320	0.14	0.02	0	1
Hispanic	51970	0.18	0.02	0	1	52320	0.18	0.02	0	1
Other	51970	0.07	0.01	0	1	52320	0.07	0.01	0	1
Child in good health	47590	0.84	0.00	0	1	47900	0.84	0.00	0	1
Male	52130	0.51	0.00	0	1	52480	0.51	0.00	0	1
Age (months)	50460	95.34	0.214	51.13	156.67	50790	95.40	0.21	51.13	156.67
Married parents	49570	0.72	0.01	0	1	49880	0.72	0.01	0	1
Maternal Education										
LTHS	46460	0.12	0.01	0	1	46750	0.12	0.01	0	1
High school and some college	46460	0.63	0.01	0	1	46750	0.63	0.01	0	1
Bachelor's degree	46460	0.18	0.01	0	1	46750	0.18	0.0	0	1
Graduate or professional degree	46460	0.07	0.00	0	1	46750	0.07	0.00	0	1
SES	49810	-0.02	0.02	-4.75	2.88	50130	-0.02	0.02	-4.75	2.88
Residential Mobility	34600	0.12	0.00	0	1	34860	0.12	0.00	0	1
School Characteristics										
% Minority Students										
0- <25%	51290	0.51	0.03	0	1	51640	0.51	0.03	0	1
25 - <50%	51290	0.17	0.01	0	1	51640	0.17	0.01	0	1
50 - <75%	51290	0.11	0.01	0	1	51640	0.11	0.01	0	1
>=75%	51290	0.21	0.02	0	1	51640	0.21	0.02	0	1
Parents are active in school programs	43230	0.80	0.01	0	1	43530	0.80	0.01	0	1

Neighborhood Characteristics	N	Mean	Median	Min	Max	N	Mean	Median	Min	Max
Poverty	42460	0.13	0.10	0	0.72	42730	0.13	0.10	0	0.72
Female Headed Household	42420	0.25	0.10	0	0.81	42690	0.25	0.10	0	0.81
Residential Instability	42460	0.63	0.57	0	0.93	42730	0.63	0.57	0	0.93
Black	42450	0.15	0.05	0	1.00	42720	0.16	0.05	0	1.00
Diversity Index	42450	0.24	0.20	0	0.74	42720	0.24	0.20	0.	0.74
Affluence	43220	0.23	0.18	0	0.87	43510	0.23	0.18	0	0.87

Per ECLS-K guidelines, Ns are rounded to the nearest 10 to protect participants. Data are in "long" form and measured in person-years. There are N=16,080 and N=16,160 individual students for internalizing and externalizing behaviors, respectively. Statistics are estimated with probability weights and sandwich estimators to adjust for clustering within primary sampling units. LTHS= less than high school degree. SES= socioeconomic status.

School Level Variables

School context was measured by time-varying principal report of the percentage of minority students, school SES, whether parents were active in school programs, and the degree of "stressful social climates" within schools. School socioeconomic status was operationalized as the percent of students on free or reduced lunch. The stressful social climate measure was created by summing positive responses to whether: children bring weapons to school, children or teachers are threatened by force on the way to or from school, children or teachers are attacked or physically involved in fights, school employed security guards, school installed metal detectors, and school exit doors remain locked during the day (See Table 3.1 for descriptive statistics).

Neighborhood Characteristics

Neighborhoods were defined as residential census tracts characterized by measures of social disorganization – low economic status, residential instability, and population heterogeneity – in order to directly compare this study with prior research on neighborhood effects in childhood (Crowder & Teachman, 2004; Leventhal & Brooks-Gunn, 2000; Leventhal & Brooks-Gunn, 2003b; Sampson et al., 2002). In addition to the traditional neighborhood measures associated with social disorganization theory, I also characterized communities by affluence as affluence exerts unique protect effects on child development (Browning & Cagney, 2003; Furstenberg et al., 1999). I linked geocodes to the 2000 U.S. Decennial census and created multiple, time-varying measures of neighborhood social disorganization. For each census tract, I created measures of low SES, affluence, residential instability, and population heterogeneity. Low economic status was measured by the proportion of residents living below the federal poverty

line and the proportion of female headed households (FHHH). Affluence was measured by the proportion of residents with at least a four-year degree. Residential instability was measured by the proportion of residents that moved in the prior 5-years. In addition to the proportion of non-Hispanic blacks, I also constructed a time-varying Diversity Index (Meyer & McIntosh, 1992) for each child's census tract as measures of population heterogeneity. The Diversity Index represents the likelihood that two persons, chosen at random from the same neighborhood, belong to different racial groups. This equation is:

$$V_i = (1 - \sum {p_i}^2)$$

where p_i represents the proportion of the population in each racial group for each census tract. I then transformed the raw proportion or index value into binary values by cutting the variable above or below the median (Table 3.1). Thus, each of the six social disorganization dimensions were categorized as low or high. I transformed the neighborhood variables because it is necessary for the "treatment" variable, neighborhood, to be in binary form to support the propensity score methodology (Rosenbaum & Rubin, 1983).

Teacher-reported internalizing and externalizing behaviors were only measured in kindergarten, 1st, 3rd, and 5th grades. As such, our analysis of neighborhood effects spans only the elementary school years (1998/1999-2004). The ECLS-K did not provide geocoded residential locations in the 5th grade; therefore the only children who did have neighborhood data available for the 5th grade wave were those who remained in the same household since kindergarten – approximately 83% of the sample.

Analytic Strategy

Time-varying Propensity Scores (TVPS)

I used logistic regression models to create propensity scores for each child for each dimension of neighborhood social disorganization (low economic status, affluence, residential instability, population heterogeneity) at each wave of the survey. In each model, I regressed neighborhood type (reference set as "low" – see Table 3.1 for cutoffs based on median values) on family characteristics from the same wave; besides child race/ethnicity and residential mobility, background characteristics included in the propensity score equations were not duplicated in growth curve models (see Appendix A for a list of variables). The predicted probability from each model represents the propensity score, or the likelihood that a family selected into their neighborhood type based on background characteristics. Because children moved over the course of the survey, time-varying propensity scores are needed to mitigate selection bias at each wave (Root & Humphrey, 2014; Root & Humphrey, 2014b).

Multilevel Growth Curve Models

I examined the distribution of internalizing and externalizing behaviors and child, family, school, and neighborhood covariates. Multivariate analyses use growth curve models for continuous outcomes to predict trajectories for internalizing and externalizing behaviors by analyzing time points (Level 1) nested within individual children (Level 2). Thus, the child's grade is the Level 1 unit, and child is Level 2 (Singer & Willett, 2003). There were not enough students per residential census tract to estimate a 3-level model in which youth were also nested within neighborhood contexts.

I compared linear and quadratic functions of grade at Level 1. For both internalizing and externalizing behaviors, the linear model was the best fit, suggesting that scores changed uniformly over time. To test the effect of controlling for selection into neighborhoods and

exposure to multiple ecologies, subsequent models iteratively controlled for neighborhood, TVPS, family-, and then school-level measures. Models were estimated using *xtmixed* in Stata 12 (StataCorp, 2011) with probability weights and a sandwich estimator of standard errors, which adjusts for clustering within the primary sampling unit. I assigned one unique variance parameter per random effect and assumed the covariance parameters were zero. The basic model specification is:

$$Y_{ij} = \pi_{0i} + \pi_{1i}GRADE_{ij} + \pi_{2ni}W_i + \varepsilon_{ij}$$

$$\text{where: } \pi_{0i} = \gamma_{00} + \gamma_{0n}X_i + \xi_{0i}$$

$$\pi_{1i} = \gamma_{10} + \gamma_{1n}Z_i + \xi_{1i}$$

Y_{ij} shows the level-1 model which includes $GRADE$ (centered at kindergarten) as the trajectory of psychosocial adjustment across students and W as a matrix of time-varying predictors of internalizing and externalizing behaviors. π_{0i} and π_{0i} are the level-2 models which show how the initial status and trajectory are modified over time. X_i and Z_i are matrices of time-invariant variables that modify the intercept and slope over time, respectively. I use the Bayesian information criterion (BIC) and the Akaike information criteria (AIC) to assess model fit and improvement across nested models.

Parallel Multiple Mediator Models

Parallel multiple mediator models allow researchers to model multiple mechanisms simultaneously in a single integrated model – a more realistic approach to developmental research (Hayes, 2013; Krull & MacKinnon, 2001; Selig & Preacher, 2009). Generally, researchers do not assess indirect pathways in the absence of direct effects (Baron & Kenny, 1986); however, a direct effect is not a necessary prerequisite for testing indirect effects if strong

enough links exist between the initial and mediating variables and mediating and outcome variables (Hayes, 2009; Hurd, Stoddard, & Zimmerman, 2013; Shrout & Bolger, 2002). For each neighborhood context, I simultaneously tested for mediation at the family level (SES, family structure, and organized after school activities) and the school level (school SES and stressful social climate). Formally testing for multiple mediational effects in hierarchical growth models is completed in three steps. First, associations between neighborhood context and mediators and mediators and outcomes were evaluated in ordinary least squares regression models (Baron & Kenny, 1986; Hayes, 2013; Krull & MacKinnon, 2001). I estimated the OLS models using continuous neighborhood variables rather than logistic variables because of the numerous computation and interpretation problems associated with mediation analysis of categorical variables (MacKinnon & Cox, 2012). Second, for each outcome a series of models introducing the mediators one by one were tested for each neighborhood context. Third, for each outcome and neighborhood context, I estimated a final model including all mediators that were individually significant. All models included the full battery of controls. For all models, Sobel tests of mediation (Sobel, 1982) were performed to determine statistical significance of the mediated effect (calculated as the product of coefficients). The Sobel equation is:

$$Z = \frac{a * b}{\sqrt{(b^2 * s_a^2 + a^2 * s_b^2)}}$$

where a and b are the coefficients for the association between neighborhood context and mediator and mediator and outcome, respectfully. s_a and s_b are the associated standard errors.

RESULTS

Descriptive Analysis

Table 3.1 summarizes the main descriptive findings for all variables. On average, children were in good health (M=0.85; SE= 0.00), 72% lived in a household with married parents (SE=0.01), 63% of mothers had a high school diploma with some college experience (SE=0.01), and 12% of children moved during elementary school. Of the schools students attended, roughly 51% had less than 25% minority students (SE=0.03), 21% were composed of 75% or more minority students (SE=0.02), and 80% of schools had a culture of actively engaged parents (SE=0.01). On average within neighborhoods, 13% of residents lived below the federal poverty line (SE=0.00), 25% were comprised of female headed households (SE=0.00), 37% of residents moved in the previous 5 years (SE=0.00), about 15% of residents were non-Hispanic black (internalizing M=0.15; SE=0.01; externalizing M=0.16; SE=0.01), the likelihood that two residents chosen at random from the same neighborhood were of different racial groups was 0.24 (SE=0.01), and 23% of communities were comprised of affluent neighbors (SE=0.01).

Growth Curve Models

Table 3.2 displays the final growth curve models for neighborhoods high in female headed household (FHHH) and residential instability (instability) – the only contexts with significant direct effects. Table 3.2 also distinguishes between modeling with and without residential mobility as a covariate, the significance of which is discussed below. However, I consider the models including residential mobility as "final" based on theoretical rationale and reductions AIC/BIC values. These models are interpreted in the following sections. Due to convergence or over-fitting issues, I was unable to interact grade by neighborhood to examine neighborhood effects on trajectories of internalizing behaviors. Thus, coefficients represent effects at kindergarten.

Table 3.2. Growth curve models examining the relationship between neighborhood context and psychosocial adjustment among elementary school children in the ECLS-K sample. Models adjust for family and school contexts, the influece of residential mobility, and time-varying propensity scores.

	Internalizing Behaviors				Externalizing Behaviors			
	No Mobility		Mobility		No Mobility		Mobility	
	FHHH	Instability	FHHH	Instability	FHHH	Instability	FHHH	Instability
	b	b	b	b	b	b	b	b
	se	se	se	se	se	se	se	se
Fixed Effects								
Initial status	0.4572***	0.5017***	0.4330***	0.5351***	0.042	0.0446	-0.1042	-0.0552
	-0.1091	-0.1146	-0.1022	-0.1009	-0.0813	-0.1001	-0.1017	-0.1121
Grade	0.0727**	0.0713**	0.0964**	0.0954**	0.1005***	0.0993***	0.0780**	0.0775**
	-0.0246	-0.0246	-0.0311	-0.0308	-0.0198	-0.0195	-0.0259	-0.0252
Child/Family Characteristics								
Race (ref=white)								
Black	-0.0737*	-0.0539	-0.1070***	-0.0792**	0.3126***	0.3403***	0.3458***	0.3717***
	-0.0373	-0.0365	-0.0299	-0.0256	-0.0531	-0.0492	-0.0568	-0.0525
Hispanic	-0.0568**	-0.0467**	-0.1165***	-0.0998***	-0.0691	-0.0609	-0.0641	-0.05
	-0.0181	-0.0169	-0.0291	-0.028	-0.0509	-0.0464	-0.0585	-0.054
Other	-0.0571*	-0.0503†	-0.1225***	-0.1125**	-0.1081*	-0.1025*	-0.1199*	-0.1099*
	-0.0269	-0.0275	-0.0349	-0.0355	-0.0448	-0.043	-0.0557	-0.0533
Child in good health	-0.1399***	-0.1489***	-0.1531***	-0.1646***	-0.0196	-0.0272	-0.0087	-0.0206
	-0.0144	-0.0145	-0.0259	-0.0256	-0.0181	-0.018	-0.0221	-0.0227
Male	0.0654***	0.0645***	0.0716***	0.0706***	0.4175***	0.4167***	0.4127***	0.4119***
	-0.0148	-0.0151	-0.0138	-0.0137	-0.0169	-0.0174	-0.0144	-0.0145
Child's age (months)	-0.0032**	-0.0031**	-0.0038**	-0.0037**	-0.0036***	-0.0035***	-0.0026*	-0.0025*
	-0.001	-0.001	-0.0012	-0.0011	-0.0009	-0.0009	-0.0011	-0.001
Parents married	-0.2013***	-0.2181***	-0.1916***	-0.2124***	-0.1513***	-0.1651***	-0.1390***	-0.1583***
	-0.0197	-0.0208	-0.0205	-0.0211	-0.0213	-0.0181	-0.0222	-0.0183
Maternal Education (ref=LTHS)								

High school and some college	-0.0486	-0.0496	-0.0556**	-0.0544*	0.01	0.0081	0.0275	0.0292
	-0.0345	-0.0353	-0.0216	-0.0215	-0.0233	-0.0222	-0.0341	-0.0337
Bachelor's degree	-0.0834†	-0.0872†	-0.0671*	-0.0648*	-0.0325	-0.0395	-0.0269	-0.0242
	-0.0491	-0.0509	-0.0331	-0.0329	-0.0373	-0.036	-0.0368	-0.0368
Graduate or professional degree	-0.0538	-0.0461	-0.0507	-0.0334	-0.038	-0.0347	-0.0293	-0.0101
	-0.0509	-0.0519	-0.0359	-0.0358	-0.0322	-0.0319	-0.0381	-0.0392
SES (continuous measure)	-0.0660***	-0.0956***	-0.0879***	-0.1263***	-0.0432***	-0.0712***	-0.0665***	-0.1087***
	-0.0176	-0.0177	-0.0157	-0.016	-0.0129	-0.0164	-0.0189	-0.0228
Residential Mobility			0.0810***	0.0859***			0.0048	0.0041
			-0.018	-0.0197			-0.0268	-0.0251
School Characteristics								
% Minority Students (ref=0-<25%)								
25 - <50%	-0.0026	0.0091	0.0077	0.0248	-0.0263	-0.0195	-0.0563***	-0.0453**
	-0.023	-0.0257	-0.0349	-0.0364	-0.0179	-0.0174	-0.0138	-0.0155
50 - <75%	-0.0826*	-0.0593*	-0.0544	-0.0201	-0.0701**	-0.0524*	-0.03	-0.0075
	-0.0323	-0.0277	-0.0363	-0.0353	-0.0238	-0.0235	-0.0288	-0.0251
>=75%	-0.1026**	-0.0711*	-0.1018***	-0.0582*	-0.0535†	-0.0252	-0.0869**	-0.0569†
	-0.036	-0.0286	-0.0241	-0.025	-0.0279	-0.0233	-0.0291	-0.0313
Parents are active in school programs	-0.016	-0.0205	0.0113	0.0049	-0.0202	-0.0248	-0.0072	-0.0114
	-0.0179	-0.0175	-0.0236	-0.0226	-0.0177	-0.0171	-0.0281	-0.0264
Neighborhood Characteristics	**FHHH**	**Instability**	**FHHH**	**Instability**	**FHHH**	**Instability**	**FHHH**	**Instability**
Time-Varying Propensity Score	0.1995***	0.0958	0.2106***	0.006	0.1964**	0.1612	0.2646***	0.1457
	-0.0403	-0.0603	-0.0449	-0.0702	-0.0605	-0.1127	-0.0636	-0.1354
High Neighborhood (Ref=Low)	0.0272	0.0315**	0.0438*	0.0324†	0.0511**	0.0618***	0.0215	0.0290†
	-0.0255	-0.0107	-0.0212	-0.0182	-0.0178	-0.0182	-0.0145	-0.0165
Random Effects								
Intercept	0.2387***	0.2403***	0.2455**	0.2476***	0.4627***	0.4636***	0.4537***	0.4556**
Slope					0.0000***	0.0000***	0.0000***	0.0000***
AIC	16798542	16804123	10364933	10370083	15740267	15744020	9879131	9884720
BIC	16798717	16804298	10365106	10370256	15740451	15744203	9879312	9884901

N=16,080 students for internalizing behaviors; 16,160 students for externalizing behaviors. Per ECLS-K guidelines, Ns are rounded to the nearest 10 to protect participants. Each model is estimated with probability weights and sandwich estimators to adjust for clustering within primary sampling units. LTHS= less than high school degree. SES= socioeconomic status. AIC= Akaike information criterion. BIC= Bayesian information criterion.
† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Internalizing Behaviors

Final models indicated that individual and family characteristics followed by attending a high minority school were the main drivers of variation in initial internalizing behaviors. Family structure exerted the largest effect on internalizing behaviors such that a living in a two parent household reduced psychosocial distress by about 1/5th of a standard deviation (see Table 3.2). Being black, Hispanic, or other race – relative to white, having higher SES, and attending a high minority school reduced internalizing behaviors by 1/10th of a standard deviation. Across nested models that iteratively controlled for individual and family, then school characteristics, neighborhood direct effects were small (Appendices D & E). Living in neighborhoods with a high proportion of female headed households (FHHH), remained the only significant association with internalizing behaviors (b=0.04; SE=-0.02); neighborhoods with high residential instability remained marginally significant (b=0.03; SE=-0.02).

Externalizing Behaviors

Similar to internalizing behaviors, individual and family-level factors explained most of the variation in externalizing behaviors, but to much higher degrees (Table 3.2). Being black and male, relative to white, increased behaviors by 1/3rd of a standard deviation. Robustness checks indicated that child/teacher racial incongruence was responsible for about 0.13 standard deviations in teacher reported externalizing behaviors for black children, while no significant disparities were found for white children. Living with married parents, having higher SES, and attending a high minority school reduced behaviors by about 1/10th of a standard deviation. Before controlling for school factors (Appendices D & E), the direct effects for FHHH and instability neighborhoods were positive and significant. However, after including measures of

school context, residential instability was reduced to marginal significance (*b*=0.03; *SE*=-0.02) and FHHH was no longer statistically significant.

The role of residential mobility

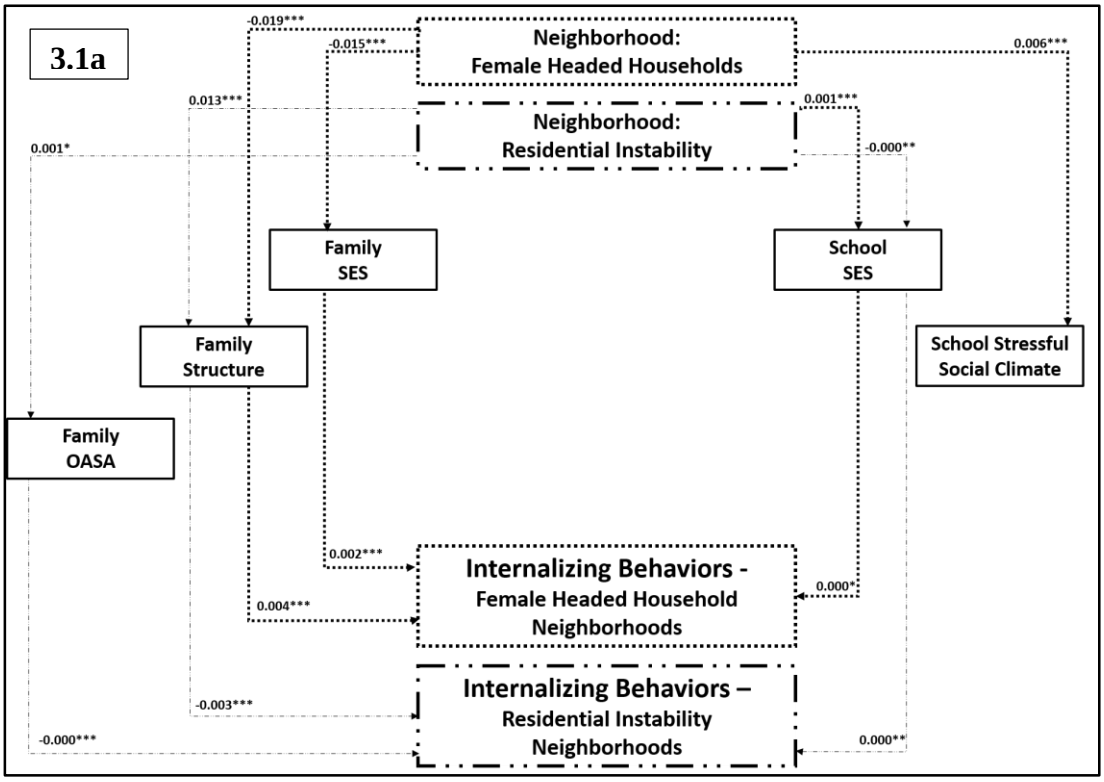
Although explicitly examining residential mobility was not part of my research agenda for this paper, the interesting, and I argue important, differences in results are worth exploring (Table 3.2). For internalizing behaviors, the addition of residential mobility reversed the significance of FHHH and instability neighborhoods, such that FHHH became significant and instability became marginally significant. In addition, moving was associated with an increase of about $1/10^{th}$ of a standard deviation in psychosocial distress. Residential mobility had the opposite effect on externalizing behaviors. Before the inclusion of the mobility variable, both FHHH and instability contexts were significant and positive. After controlling for mobility, FHHH became insignificant, instability became marginally significant, and the coefficients were reduced to about 1/3 of the previous size. Sensitivity analyses examining interactions between child mobility and neighborhood context were insignificant and did not improve model fit.

Parallel Multiple Mediator Models

Figures 3.1a and 3.1b show coefficients and significance levels for paths between neighborhood FHHH and instability, family and school contexts, and internalizing and externalizing behaviors, respectively. Figure 3.1a demonstrates that across neighborhood contexts, family SES, family structure, and school SES were significant mediators for FHHH neighborhoods; family structure, organized after school activities (OASA), and school SES were significant mediators of residentially unstable neighborhoods. Across both neighborhood contexts, family structure

(living with married vs. unmarried parents) exerted the most influence on internalizing behaviors. It is important to note that the linear association between neighborhood FHHH and internalizing behaviors became insignificant when all mediators were included in the analysis, indicating that family SES, family structure, and school SES fully mediated the relationship. On the other hand, the linear relationship between instability neighborhoods and internalizing behaviors remained significant, indicating that family structure, organized after school activities, and school SES were only partially responsible for its effect on internalizing behaviors.

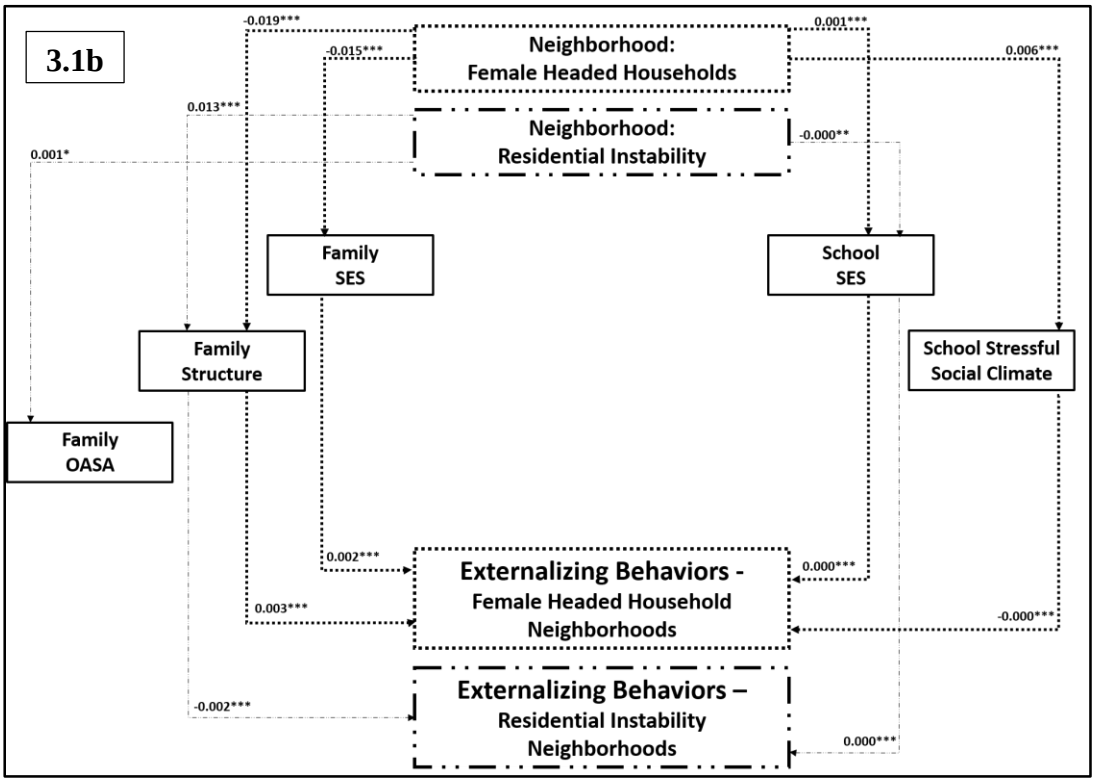
Figure 3.1a Multilevel path analysis. The effect of neighborhoods (female headed households and residential instability) on internalizing behaviors mediated through family and school contexts.



† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Figure 3.1b shows that family SES, family structure, school SES, and stressful social climates at school mediated the relationship between FHHH neighborhoods and externalizing behaviors. Only family structure and school SES mediated between instability neighborhoods and externalizing behaviors. Similar to internalizing behaviors, family structure was the most influential mediator. The linear association between FHHH neighborhood and externalizing behaviors was insignificant after inclusion of all mediators, indicating that the relationship could be fully explained by family SES, family structure, school SES, and stressful social climates at school. The linear association between instability neighborhoods and externalizing behaviors was marginally significant, indicating that family structure and school SES only partially explained the relationship.

Figure 3.1b Multilevel path analysis. The effect of neighborhoods (female headed households and residential instability) on externalizing behaviors mediated through family and school contexts.



† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

DISCUSSION

This study examined neighborhood effects on internalizing and externalizing behaviors during elementary school, after controlling for family and school contexts and selection bias. It also examined how neighborhood effects were mediated through families and schools simultaneously. Taking an ecologically driven approach, I proposed that social disorganization within neighborhoods – operationalized as measures of low economic status, affluence, residential instability, and population heterogeneity – would not directly affect psychosocial adjustment trajectories after accounting for multiple social ecologies and selection into neighborhoods. In addition, I hypothesized that neighborhood context worked indirectly via family SES, family structure, organized after school activities, school SES, and stressful social climates within schools. Results from growth curve models partially supported these hypotheses in that neighborhoods with high proportions of poverty, black residents, racial diversity, and affluence did not directly affect behaviors; neighborhoods with high proportions of female headed households and residential instability produced significant or marginally significant direct effects. Unfortunately, convergence and over fitting issues did not allow me to examine neighborhood effects on trajectories, only initial status in kindergarten. Results from parallel multiple mediator models indicated that family and school contexts simultaneously mediated between outcomes and neighborhood contexts.

Several studies have shown that psychosocial adjustment varies systematically with the quality of children's neighborhoods, with these problems being more common in neighborhoods characterized by high rates of poverty, crime, single parent headed households, residential mobility, and ethnic heterogeneity (Greenberg, Lengua, Coie, & Pinderhughes, 1999; Sampson et al., 2002; Sampson, Raudenbush, & Earls, 1997). Similar to previous research that only

controlled for the family context (Beyers et al., 2003; Curtis et al., 2013; Deng et al., 2006; Hurd et al., 2013; Kohen et al., 2008; Mrug & Windle, 2009; Roosa et al., 2005), I have shown that as early as kindergarten, neighborhoods with a greater proportion of female headed households and high residential instability directly impacted internalizing and externalizing behaviors after adjusting for families, schools, and selection bias, with effects sizes ranging from 0.02 to 0.04 standard deviations. Although those findings were contrary to my hypothesis, when I measured neighborhood context using other indicators, e.g., poverty and racial diversity, I found no direct effects. I suggest that in neighborhoods characterized by female headed households and high residential turnover, children and their families often experience less stability in their friendships, social networks, and reciprocal exchange (aspects that families and schools have little control over), which may directly contribute to psychosocial adjustment problems (Mrug & Windle, 2009; Sampson et al., 1999). However, in neighborhoods characterized by poverty, affluence, and racial heterogeneity, family and school characteristics may be able to overcome the structural aspects of neighborhoods that impact youth behavior, e.g., higher SES families may be able to send their child to quality after-school care that instill behavioral norms valued in formal institutions.

Importantly, this investigation adds to the expanding research that demonstrates the adverse effects of moving on child well-being (Anderson, Leventhal, & Dupere, 2014; Busacker & Kasehagen, 2012; Jelleyman & Spencer, 2008). Although I was not explicitly examining the effect of mobility on child behaviors, I found that residential mobility increased internalizing behaviors by $1/10^{th}$ of a standard deviation and either reversed the significance or reduced the effect size of direct neighborhood effects. Residentially mobile youth, compared with their stable peers, may have experienced anxiety and depressive symptoms because moving may compound

the challenges of other transitions including social and structural changes within the neighborhood, family changes, school changes, and shifting peer groups (Anderson, Leventhal, & Dupere, 2014; Root & Humphrey, 2014; Simmons, Burgeson, Carlton-Ford, & Blyth, 1987). Research also demonstrates that mobility indirectly affects youth behaviors via family and school contexts. Moving may come with changes in family interactions (e.g., competition for parental resources and availability), family structure (e.g., marital status), family processes (e.g., stress may affect parent conflict), and family SES (e.g., moving for employment), which in turn, may lead to unfavorable child outcomes (Anderson et al., 2014; Conger & Donnellan, 2007). School quality is another potential pathway linking residential mobility and children's outcomes. Mobile students in new schools must develop relationships with peers and teachers, a formidable and not always successful task, and adjust to new school expectations and climate, critical to teachers' evaluations of students' behavior (Anderson et al., 2014; Eccles & Roeser, 2011).

The family context in early life sets developmental trajectories into adulthood and plays a significant role in shaping socioemotional well-being. For both internalizing and externalizing behaviors, family structure was the most influential mediator among family and school contexts. Neighborhood contexts may exacerbate stress in single parent households, leading to emotional problems, parental conflict and unsupportive parenting processes that are associated with youth behavior problems (Anderson et al., 2014; Leventhal & Brooks-Gunn, 2000; Leventhal et al., 2009). Similarly, children in households with married parents may be exposed to more adult supervision within the home rather than relying on neighborhood resources. By contrast, parents from unmarried households may need to rely on adult neighbors to supervise their children, leaving youth to navigate potentially heterogeneous subcultures with conflicting views on appropriate behaviors and skills that facilitate success in formal institutions (Lareau, 2003;

Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002). Children raised in families with different economic resources likely respond differently to the neighborhood in which they live. Resource-rich parents may be able to "buy out" of the potential harmful effects of neighborhoods by, for example, sending their children to high-quality childcare outside of the neighborhood; resource-poor parents are likely more dependent on the resources within the neighborhood (Beyers et al., 2003; Jencks & Mayer, 1990; Kingston et al., 2009; Wilson, 1987; Wodtke et al., 2012). Notably, I found that participation in organized after school activities (OASA) did not transmit neighborhood effects for externalizing behaviors. This is particularly surprising as OASA translates to additional adult supervision for children rather than spending time in unsupervised play groups that may promote or reward non-normative behaviors. The negative relationship between a community's ability to control peer groups and problem behavior is a central tenet behind neighborhood social disorganization theory, especially for adolescents (Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002). Perhaps the young age of this sample (kindergarten through 5th grade) does not allow for unsupervised time at home or in the community, rendering these activities valuable only for the positive effects on internalizing behaviors.

Both the growth curve and mediation analyses revealed that the school is a significant social context associated with internalizing and externalizing behaviors in elementary school. The neighborhood-school relationship may be partly explained by the financial and human capital resources within neighborhoods, which often directly translate into the financial and human capital resources within schools (Crosnoe, 2009; Eamon, 2005; Jargowsky & Komi, 2009; Leventhal et al., 2009; Owens, 2010). Higher SES schools are able to attract and retain effective, qualified teachers and promote parent involvement in school activities; both positive

factors promote socioemotional well-being by establishing a "safety net" of concerned adults that support children's development (Roeser & Eccles, 2014). Social dynamics within neighborhoods might also influence youth behavior by weakening or strengthening local schools. In socially disorganized neighborhoods, youth often have less adult supervision, particularly after school, which may lead children to act inconsistently with institutional norms regarding appropriate behavior (Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002). This may explain why I found that children attending schools with more than 25% minority students had fewer reported internalizing and externalizing behavior problems. Higher minority schools are generally of lower socioeconomic status, which may translate into a culture of non-normative youth behavior. Thus, if poor behavior is the norm within schools, then we would expect to see fewer teacher reports of internalizing and externalizing behaviors as children are judged relative to their peers (Baker, Grant, & Morlock, 2008; Kellam, Ling, Merisca, Brown, & Ialongo, 1998; Mrug & Windle, 2009). Similarly, social climates within schools (SSC) represent a composite of both neighborhood and school conditions, and have been associated with student behavioral problems (Jayalekshmi & Raja, 2011). In our study, SSC did not mediate between neighborhood context and internalizing disorders. It is likely that students in highly stressful schools exhibit more anxiety and depressive symptoms, so that teachers have a higher baseline with which to judge against, leading to fewer teacher reports of internalizing behavior.

Along the same lines, I found evidence of teacher racial bias on reports of black children's externalizing behaviors. Although racial and ethnic minorities are less likely to report or be reported for psychosocial well-being issues (Samaan, 2000), there is empirical evidence to suggest that student-teacher incongruence – whether it be socioeconomic, race, ethnicity, or upbringing – leads to teacher bias in a range of academic and non-academic outcomes (Keiley,

Bates, Dodge, & Pettit, 2000; Martinez, Stecher, & Borko, 2009). Previous studies have found that race incongruent teachers – teachers and students do not share the same racial or ethnic background – are likely to give worse assessments on externalizing behaviors for African American students (Bates & Glick, 2013; Downey & Pribesh, 2004). Sensitivity analyses revealed that black students with white teachers were rated 0.13 standard deviations higher in externalizing behaviors than black students with black teachers; no such relationship existed for white students. Given that 87-91% of teachers in the sample were white, I believe that student-teacher racial incongruence may be driving some of the observed variation in externalizing behaviors during elementary school.

Limitations

This study has several limitations. I defined neighborhoods as residential census tracts despite the call to use other spatial contexts that are relevant for child and adolescent development (e.g., school attendance zones) (Sharkey & Faber, 2014). However, census tracts as neighborhood proxies allow for direct comparison to previous research examining neighborhood effects on trajectories of internalizing and externalizing behaviors during elementary school. In addition, the ECLS-K recognized the potential for teacher bias on ratings; therefore, ratings were also provided by parents/caregivers. Although significant discrepancies exist between teacher and parent ratings, the ECLS-K recommends the teacher completed scales because the teacher-completed scale was determined to be more statistically reliable, and the scales ask the rater to judge the students relative to same-age peers, which parents may not have access to (NCES, 2001). Another limitation is the age group used in this analysis. Previous research indicates that, generally, adolescence marks the time for the development of anxiety and depressive

symptomology. As this sample ranges from approximately 5-10 years old, I may be testing the association between neighborhood and internalizing behaviors a bit early. Following that logic, it may be that the symptomology I am modeling is more severe in nature and represents a more "at risk" group of children.

Despite these limitations, my findings have important implications for future neighborhood research and policy and speak directly to the importance and impact of social and environmental contexts. Children with behavior problems are more likely to experience academic failure, more likely to drop out of school, more likely to become involved in delinquent behavior as adolescents, and less likely to become productive members of society once they reach adulthood (U.S. Public Health Service, 2000). I have identified both direct and indirect family, school, and neighborhood contexts that simultaneously affect internalizing and externalizing behaviors during a critical developmental stage. Moreover my inclusive modeling approach allows for better and more rigorous examinations of neighborhood effects and suggests that researchers should simultaneously examine multiple social contexts and attempt to mitigate selection bias. Future research should further examine how residential mobility affects change in families, schools, peers, neighborhoods, and subsequent psychosocial adjustment. Along the same lines, future research should examine the depths of teacher bias on cognitive and non-cognitive outcomes due to the strong influence teachers have on future student success. Taken together, policies or practices that exclusively focus on the family, school, or neighborhood may be able to improve psychosocial adjustment, but will likely fall short by addressing only part of the equation.

For example, the Moving to Opportunity (MTO) study improved maternal mental and physical health and the mental health of female youth, but there were no long-term

improvements for participating males (Leventhal & Brooks-Gunn, 2003a; Ludwig et al., 2001). This is partly due to the fact that while neighborhood contexts improved, school quality did not drastically change. On the other hand, the Harlem Children's Zone, a comprehensive place-based initiative to improve the social environments in- and out-of school, demonstrated that a holistic approach to addressing child health and well-being was able to reduce mental and physical health inequalities for both male and female children and adolescents.

CHAPTER 4

"An examination of the impact of school neighborhoods on educational achievement and psychosocial adjustment during elementary school"

INTRODUCTION

A recurring issue in the neighborhood effects literature is the definition and operationalization of a "neighborhood" or relevant geographic areas. Neighborhoods can be defined in many ways, but researchers agree that the definition and scale of a neighborhood should be based on theory and evidence specific to the outcome(s) under study and the hypothesized pathways through which neighborhoods exert influence (Diez Roux & Mair, 2010; Flowerdew et al., 2008; Root, 2012; Sharkey & Faber, 2014). However, neighborhood analyses often takes place in the presence of data constraints and as a result, researchers often use administrative units such as census tracts to define neighborhood boundaries. Yet, the use of administrative boundaries may not be arbitrary for children as they have limited mobility and independence, and are often constrained to the spaces surrounding them (Leventhal & Brooks-Gunn, 2003b; Northridge et al., 2003; Sharkey & Faber, 2014).

The residential census tract is the most frequently used definition of "neighborhood" in neighborhood effect studies during childhood. Considered as a whole, the body of research conducted at the level of the residential census tract demonstrates that characteristics of the neighborhood's population, e.g., poverty, appear to be consistently linked with children's academic or developmental trajectories (Leventhal & Brooks-Gunn, 2000; Sastry & Pebley, 2010; Sharkey & Faber, 2014). Yet, residential neighborhoods are only a subset of the potentially relevant contextual influences on children. As such, recent research urges neighborhood and health scholars to define neighborhoods as contexts that are relevant to the

social and spatial environments in which children regularly engage (Sharkey & Faber, 2014). Given that youth spend a large portion of their day in school, school neighborhoods serve as a natural starting point for redefining relevant contexts. Yet, the role of school neighborhoods have largely been ignored in this literature. A few city-specific studies have examined the effects of school neighborhoods on youth health and well-being using school attendance boundaries, cluster analysis, school census tracts, and school-centric buffers (Bernelius & Kauppinen, 2012; Forsyth, Wall, Larson, Story, & Neumark-Sztainer, 2012; Schwartz, 2010; Whipple, Evans, Barry, & Maxwell, 2010; Zhang, Christoffel, Mason, & Liu, 2006), but no research has used nationally representative data to demonstrate how school neighborhoods affect educational achievement and psychosocial adjustment during elementary school.

In light of children's limited mobility and daily exposure to both home and school neighborhood environments, school census tracts and school attendance zones may represent valid contexts that exert influence on educational achievement and behavioral adjustment during elementary school. However, which "scale" is most appropriate for defining neighborhood contexts? That is, is a school attendance zone a more reasonable neighborhood than that of the census tract where the school is located, or vice-versa? Using simulated cities, Spielman, Yoo, and Linkletter (2013) found that neighborhood effects were strongly influenced by the definition of neighborhood – neighborhoods that were "too small" overestimated neighborhood effects on behaviors whereas neighborhoods that were "too big" underestimated neighborhood effects. Thus, researchers often conduct parallel analyses at different scales and compare neighborhood effect estimates (Flowerdew et al., 2008; Galster, 2008; Root, 2012). The challenge, then, is to find a balance between the modifiable areal unit problem (correlations between outcomes and context are often stronger at smaller spatial scales) or spatial diffusion (characteristics tend to

cluster spatially and become more heterogeneous in larger areas) and theoretical rationale about *why* and *how* neighborhoods exert influence within each scale.

My previous work examining neighborhood effects on math and reading achievement and internalizing and externalizing behaviors of U.S. children and early adolescents, made some methodological improvements over past research by modeling multiple social ecologies, time-varying propensity scores, and examining multiple mediation processes. However, I only examined direct neighborhood effects using residential census tracts rather than also exploring the effects of other relevant contexts, such as school neighborhoods. In this study, I take the next step by examining direct effects on reading and math achievement and internalizing and externalizing behaviors across neighborhoods defined by residential census tracts, school census tracts, and school attendance zones. Further, I characterize the contexts using several single variable socio-demographic measures (proportion of residents living below the federal poverty line, proportion of female headed households, proportion of residents with less than a high school education, and proportion of affluent residents) as well as a measure of social disorganization that have been previously linked to educational and behavioral outcomes in elementary school children. I hypothesize, that: (1) similar to my previous work and other neighborhood effect studies, residential census tracts will have direct effects on reading and math scores, but little to no effect on internalizing and externalizing behaviors, (2) effects for school census tracts will be similar to that of residential tracts, (3) school census tracts characterized by social disorganization will exert few direct effects on educational and behavioral outcomes, and (4) effects for school attendance zones will be attenuated relative to census tract neighborhoods, but represent a more reasonable neighborhood environment for children.

METHODS

Data

The Early Childhood Longitudinal Study – Kindergarten Cohort (ECLS-K), sponsored by the Department of Education (National Center for Education Statistics, 2006), is a nationally representative study that followed a cohort of more than 21,400 children who entered kindergarten during the 1998-1999 school year through 8th grade. Data collection took place during the fall and spring of kindergarten (1998-1999) and 1st grade (1999-2000) and the spring of 3rd (2002), 5th (2004), and 8th (2007) grades. The ECLS-K employed a multistage probability sample design. In the base year the primary sampling units (PSUs) were geographic areas consisting of counties or groups of counties. From these PSUs, approximately 24 children were randomly sampled from each of the 1,277 selected schools, both public and private. In order to maximize the amount of longitudinal data, subsamples of children were followed if they changed schools and any child flagged to be followed at one point in time continued to be followed in subsequent data collections. In a longitudinal sample, attrition due to non-response and eligibility change is expected. During the first four waves (kindergarten through 5th grade), the ECLS-K had a 40% attrition rate. However, the ECLS-K included weights to compensate for both sampling strategy and attrition; all analyses in this study are weighted appropriately. Results of weighted analyses are generalizable to the U.S. population of kindergarten children in the 1998-1999 school year and first graders in 1999-2000. Subsequent waves are only representative of the ECLS-K cohort.

The ECLS-K contains longitudinal and geocoded data collected directly from children, parents, teachers, and school administrators, providing comprehensive information on education, development, and home, school, and neighborhood environments. The ECLS-K did not provide

census tract geocodes for the 5th grade; thus, 5th grade geographic information was only available for children who did not move in elementary school (83% of the sample). Kindergarten, 1st, and 3rd grade geocodes were linked to the 2000 US Decennial Census; 5th grade geocodes were linked to the 2005-2009 American Community Survey (ACS) 5- year estimates.

Outcomes

Academic achievement from kindergarten to 5th grade was measured using reading (N=9,790) and math (N=9,810) scores calculated from item response theory (IRT) procedures. "IRT uses the pattern of right, wrong, and omitted responses to the items actually administered in an assessment and the difficulty, discriminating ability, and 'guess-ability' of each item to place each child on a continuous ability scale" (National Center for Education Statistics, 2006, p. 3-5). Responses across waves were pooled to stabilize longitudinal estimates; the child's response at each wave represents estimates of the number of items the child would have answered correctly at each point in time if they had taken all of the 186 questions in the reading forms and all of the 153 questions in all of the mathematics forms (National Center for Education Statistics, 2006). Scores were standardized with a mean of 50 and a standard deviation of 10 (Appendix F).

Internalizing (N=16,080) and externalizing (N=16,160) behaviors were measured using subscales of the Teacher Social Rating Scale for fall and spring kindergarten and spring of 1st, 3rd, and 5th grades. The five to six items of the Externalizing Problem Behaviors scale measured acting out behaviors (e.g., arguing, fighting, showing anger, acting impulsively, disturbing the classroom's ongoing activities). The four items on the Internalizing Problem Behavior measured negative affective states such as anxiety, loneliness, sadness and low self-esteem. The ECLS-K scored each scale as the average of the underlying. The ECLS-K scored each scale as the average

of the underlying items. The National Center for Educational Statistics (2006) reports adequate split-half reliability ranges of 0.76 to 0.89 for the Externalizing and Internalizing Problem Behavior scales. Exploratory and confirmatory factor analyses confirmed the full scale's structure. Scale scores were standardized with mean of 0 and standard deviation of 1 (Appendix F).

Child-, Family-, and School-level Controls

I controlled for child and family time-invariant measures including child race/ethnicity and child sex, as well as time-varying controls including child health status, child age, family structure, maternal education, socioeconomic status (SES), residential mobility, and direct and indirect measures of parental involvement in the child's education. School context was measured by time-varying principal report of the percentage of minority students, whether parents were active in school programs, and whether there was a problem with teacher turnover (See Appendix F for descriptive analysis).

Neighborhood Construction and Characterization – Residential Tracts, School Tracts, School Attendance Zones

Time-varying neighborhood contexts were defined using residential census tracts, school census tracts, and school attendance zones. Census tract neighborhoods were defined using the tract in which the child lived and the tract in which the school was located. Official school attendance zones (SAZs) were not available on a national scale for the years this study took place. Therefore, I created SAZs by aggregating the school tract and each residential tract associated with that school.

Residential tracts, school tracts, and SAZs were characterized using four time-varying sociodemographic attributes commonly found in neighborhood effect studies during childhood (Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002: proportion of residents living below the federal poverty line, proportion of female headed households, proportion of residents with less than a high school education, and proportion of affluent residents - those with at least 4-year degrees. I then transformed the raw proportions or index values into binary values by cutting the variable above or below the median (Table 4.1). I transformed the neighborhood variables because it is necessary for the "treatment" variable, neighborhood, to be in binary form to support the propensity score methodology (Rosenbaum & Rubin, 1983).

Table 4.1. Descriptive Analysis of Neighborhood Contexts: Residential Tracts, School Tracts, School Attendance Zones

	Residential Tracts, School Tracts, School Attendance Zones						
	Median	**Mean**	**SD**	**Min**	**Max**		**N (Tracts & SAZs)**
Residential Tracts							
Poverty	0.09	0.13	0.11	0.00	0.77	K	4740
Female Headed Households	0.13	0.24	0.23	0.00	1.00	1st	5110
Less than High School Education	0.16	0.20	0.15	0.00	0.86	3rd	5007
Affluence	0.19	0.24	0.17	0.00	0.90	5th	NA
School Tracts							
Poverty	0.10	0.14	0.12	0.00	0.77	K	1434
Female Headed Households	0.13	0.25	0.24	0.00	1.00	1st	1434
Less than High School Education	0.17	0.20	0.15	0.00	0.82	3rd	1434
Affluence	0.19	0.24	0.17	0.00	0.88	5th	1434
School Attendance Zones							
Poverty	0.10	0.13	0.10	0.00	0.77	K	1952
Female Headed Households	0.11	0.20	0.19	0.00	1.00	1st	2083
Less than High School Education	0.18	0.20	0.13	0.00	0.82	3rd	3022
Affluence	0.20	0.24	0.15	0.00	0.88	5th	2391

NA = not available. Census tracts were not provided for the 5th grade wave.

Neighborhood Construction and Characterization – Cluster Analysis

I performed a *k*-means cluster analysis for each wave to identify school census tracts with similar profiles in terms of neighborhood social disorganization. Four variables were used to define social disorganization in this analysis: a diversity index, a socioeconomic deprivation index, a measure of residential stability, and the proportion of renter occupied housing (see Appendix G for scale/variable descriptions). First, I used *k*-means as the clustering algorithm with Euclidean distance as the distance measure to generate clusters for school census tracts (Li & Chuang, 2009; Van Hulst et al., 2012; Warner, Swisher, Chavez, & Kuhl, 2011). The preliminary number of clusters was obtained by the visual examination of the dendrogram obtained with hierarchical cluster analysis using Ward's method (Aldenderfer & Blashfield, 1984; Milligan & Cooper, 1987; Punj & Stweart, 1983), an inverse scree plot, and silhouette differences between clusters. Based on these considerations, a 5-cluster solution was chosen. In addition, I randomly sampled half of the school tracts and performed the cluster analysis procedures again. This cross-validation step confirmed the 5-cluster solution. Application of the cluster analysis methodology resulted in neighborhoods wherein school tracts that were comparable across levels of social disorganization (1=low; 5= high) were grouped together even though they are not necessarily geographically adjacent (Li & Chuang, 2009; Warner et al., 2011) (Table 4.2).

Table 4.2. Descriptive Analysis of Neighborhood Contexts: School Census Tracts Characterized by Social Disorganization via *K*-means Cluster Analysis

	School Social Disorganization							
	Socioeconomic Disadvantage Index		Diversity Index		Residential Stability Quintiles		Proportion Renter Occupied	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Low	-0.62	0.22	0.16	0.15	2.98	1.16	0.09	0.04
Low-Moderate	-0.35	0.35	0.17	0.16	2.52	1.14	0.21	0.04
Moderate	-0.05	0.41	0.23	0.17	1.79	1.12	0.34	0.04
Moderate-High	0.44	0.6	0.31	0.18	1.28	1.07	0.49	0.05
High	0.98	0.86	0.35	0.19	1.04	1.28	0.73	0.12
ANOVA	***		***		***		***	

Lower values on the diversity index = less disadvantage; Higher residential stability values = more stability within the neighborhood. ANOVA = Analysis of Variance.

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Analytic Strategy

Time-varying Propensity Scores (TVPS)

For census tract and school attendance zone neighborhoods I used logistic regression models to create propensity scores for each child for each characterization of neighborhood at each wave of the survey. In each model, I regressed neighborhood type (reference set as "low") on family characteristics from the same wave; besides child race/ethnicity and residential mobility, background characteristics included in the propensity score equations were not duplicated in growth curve models (see Appendix A for a list of variables). The predicted probability from each model represents the propensity score, or the likelihood that a family selected into their neighborhood type based on background characteristics. For neighborhoods created using the *k*-means cluster analysis, I used multinomial logistic regression with the reference set as "high social disorganization." Because children moved over the course of the survey, time-varying propensity scores are needed to mitigate selection bias at each wave (Root & Humphrey, 2014a; Root & Humphrey, 2014b).

Multilevel Growth Curve Models

The multivariate analyses use growth curve models for continuous outcomes to predict trajectories of reading and math achievement and internalizing and externalizing behaviors by analyzing time points (Level 1) nested within individual children (Level 2). Thus, the child's grade is the Level 1 unit, and child is Level 2 (Singer & Willett, 2003). Models included information on the child, family, school, and neighborhood characteristics as well as time-varying propensity scores. Because there were not enough students per residential census tract to

estimate 3-level models, I did not estimate 3-level models for any of the school tracts or school attendance zones for the sake of comparability.

I first compared linear and quadratic functions of grade at Level 1. For math scores, as well as internalizing and externalizing behaviors, the linear model was the best fit, suggesting that scores changed uniformly over time. For reading scores, the quadratic model was the best fit, suggesting that scores increased as children progressed but eventually leveled off. Models were estimated using *xtmixed* in Stata 12 (StataCorp, 2011) with child-, family-, and school-level controls as well as probability weights and a sandwich estimator of standard errors, which adjusts for clustering within the primary sampling unit. I assigned one unique variance parameter per random effect and assumed the covariance parameters were zero. The basic model specification is:

$$Y_{ij} = \pi_{0i} + \pi_{1i} GRADE_{ij} + \pi_{2ni} W_i + \varepsilon_{ij}$$

where: $\pi_{0i} = \gamma_{00} + \gamma_{0n} X_i + \xi_{0i}$

$$\pi_{1i} = \gamma_{10} + \gamma_{1n} Z_i + \xi_{1i}$$

Y_{ij} shows the level-1 model which includes $GRADE$ (centered at kindergarten) as the trajectory of educational achievement across students and *W* as a matrix of time-varying predictors of educational achievement. π_{0i} and π_{0i} are the level-2 models which show how the initial status and trajectory are modified over time. X_i and Z_i are matrices of time-invariant variables that modify the intercept and slope over time, respectively. I use the Bayesian information criterion (BIC) and the Akaike information criteria (AIC) to assess model fit.

RESULTS

Descriptive Analysis – Residential Tracts, School Tracts, School Attendance Zones, Cluster Analysis

Table 4.1 presents a descriptive analysis of census tract and school attendance zone (SAZ) neighborhoods. They were similar across characterizations, e.g., the cutoff for defining low/high poverty neighborhoods is 0.09, 0.10, and 0.10 across residential tracts, school tracts, and school attendance zones, respectively. Table 4.2 presents a descriptive analysis of a cluster analysis on school census tracts. Variables used in the cluster analysis varied as expected among social disorganization tracts. That is, "low" social disorganization tracts were characterized by the lowest levels of socioeconomic deprivation, population diversity, and proportion of renter occupied housing, and the highest levels of residential stability. "High" social disorganization tracts had the highest levels of deprivation, diversity, and renter occupied housing, and the lowest levels of residential stability. An Analysis of Variance (ANOVA) comparing the levels of social disorganization indicated that they differed significantly on all four variables included in the *k*-means cluster analysis.

Growth Curve Models

Table 4.3 presents coefficients from the final growth curve models estimating neighborhood effects on educational achievement and psychosocial adjustment from kindergarten to 5th grade, after applying time-varying propensity scores and controlling for family characteristics and school context. Due to convergence or over-fitting issues, I was unable to interact grade by neighborhood to examine neighborhood effects on educational or psychosocial trajectories. Thus, coefficients represent neighborhood effects during kindergarten. Overall, residential tracts, school tracts, and SAZs showed similar associations with initial reading and math scores while

all neighborhood contexts showed little or no association with either internalizing or externalizing behaviors.

Table 4.3. Coefficients from final growth curve models estimating neighborhood effects on educational achievement and psychosocial adjustment from kindergarten to 5th grade, net of family characteristics, school context, and time-varying propensity scores.

	Educational Achievement[a]		Psychosocial Adjustment[b]	
	Reading	**Math**	**Externalizing**	**Internalizing**
	Mean = 50; SD = 10		Mean = 0; SD = 1	
Residential – Tract (ref=low)				
Poverty	-0.47**	-0.34***	0.01	-0.02
Female Headed Households	0.11	-0.06	-0.01	0.00
Less than High School Education	-0.33**	-0.33***	0.02	-0.02
Affluence	0.62***	0.96***	-0.04	0.01
School – Tract (ref=low)				
Poverty	-0.51***	-0.64**	0.02	-0.05*
Female Headed Households	0.04	0.02	0.03**	-0.02†
Less than High School Education	-0.52***	-0.48**	-0.01	-0.07**
Affluence	0.85***	0.75***	0.00	0.04*
School – Attendance Zone (ref=low)				
Poverty	-0.25*	-0.26**	0.03	0.01
Female Headed Households	0.06	-0.00	-0.02	-0.01
Less than High School Education	-0.59***	-0.28	0.03†	0.01
Affluence	0.70**	0.58***	0.01	0.05**
School Tract – Cluster Analysis: Social Disorganization (ref=high)				
Low	0.45	1.16*	-0.06†	-0.01
Low-Moderate	0.84*	1.34**	-0.02	0.02
Moderate	0.24	0.44	-0.04	-0.02
Moderate-High	0.08	0.11	-0.02	-0.06†

[a]N=9,810 students for math achievement; N=9,790 students for reading achievement. These are the final growth curve models, which include controls for: child's race/ethnicity, health status, sex, parental marital status, maternal education, family SES, parent communication with other parents, level of involvement with child's education, residential mobility, school minority levels, culture of active parenting within schools, problems with teacher turnover in schools, and time-varying propensity scores to mitigate selection bias. Each model is estimated with probability weights and sandwich estimators.

[b]N=16,080 students for internalizing behaviors; 16,160 students for externalizing behaviors These are the final growth curve models, which include controls for: child's race/ethnicity, health status, sex, age, parental marital status, maternal education, family SES, residential mobility, school minority levels, culture of active parenting within schools, and time-varying propensity scores to mitigate selection bias. Each model is estimated with probability weights and sandwich estimators.

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Residential census tracts characterized by high poverty, low levels of education, and high affluence were significantly associated with reading and math achievement scores. Absolute effect sizes for differences in the initial status of reading and math scores ranged from 0.33 to 0.96 standard deviations (Table 4.3), with affluent neighborhoods exerting the strongest effect. School tracts characterized by high poverty, low levels of education, and high affluence were associated with medium to large absolute effect sizes on reading and math achievement, 0.51 to 0.85 standard deviations. School attendance zones showed similar, but attenuated effects for reading achievement (absolute effect sizes range from 0.25 to 0.70), and only SAZs characterized by poverty and affluence were significantly associated with math scores. Social disorganization census tracts created using the cluster analysis methods (school census tracts), showed that, relative to neighborhoods characterized by high social disorganization, low and low-moderate tracts were associated with reading and math scores with effect sizes ranging from 0.84 to 1.34.

DISCUSSION

Using nationally representative data that followed children from kindergarten to 5th grade, this study examined the influence of neighborhoods on reading and math achievement and internalizing and externalizing behaviors across neighborhoods defined by residential census tracts, school census tracts, and school attendance zone neighborhoods. Moreover, within the neighborhood definitions, I examined effects across a number of sociodemographic characterizations previously linked to childhood educational and behavioral outcomes. I hypothesized, that: (1) similar to my previous work and other neighborhood effect studies, residential census tracts would have direct effects on reading and math scores, but little to no

effect on internalizing and externalizing behaviors, (2) effects for school census tracts would be similar to that of residential tracts, (3) school census tracts characterized by social disorganization would exert few direct effects on educational and behavioral outcomes, and (4) effects for school attendance zones would be attenuated relative to census tract neighborhoods, but would represent a more reasonable neighborhood environment for children. Results from growth curve models generally supported these hypotheses. Since time-varying propensity scores were used to control for selection into neighborhoods, I do not believe these effects are due to selection bias.

As expected, residential census tracts were significantly associated with reading and math scores, but not internalizing and externalizing behaviors. For instance, children living in affluent tracts scored 0.96 standard deviations higher on kindergarten math scores relative to children living in tracts with low affluence. This effect translates into an almost 10 point difference in math scores for kindergarten children. Ample evidence suggests early disparities generally do not converge, but rather widen leading to greater educational disparities in adolescence and adulthood (Entwisle, Alexander, & Olson, 2005), which speaks directly to the importance and impact of social and environmental contexts. Similarly, school census tracts supported my hypotheses and demonstrated comparable patterns and effects sizes. The similarity between residential and school tracts may be due to the fact that 32% of kindergartners lived in the same tract as the school they attended. A correlation analysis (not shown) confirmed a correlation of 0.99 ($p<0.001$) between school and residential neighborhood contexts. Further, elementary schools are often "neighborhood" schools that draw from the immediate surrounding areas (Whipple et al., 2010). In light of this, I believe residential and school census tracts, while conceptually different, may actually be so similar that it is reasonable to interchange them when

examining contextual influences on health, development, and well-being of elementary school children.

I also used school census tracts in a k-means cluster analysis to create tracts with similar profiles in terms of neighborhood social disorganization. I hypothesized that school census tracts characterized by social disorganization would exert few direct effects on educational and behavioral outcomes. As expected, there were no significant direct effects for internalizing and externalizing behaviors. Interestingly, low and low-moderate (relative to high) social disorganization tracts exerted greater positive influence on math scores than on reading scores. In chapter 2, I showed that neighborhood effects, measured by single-variable sociodemographic characteristics, exerted greater influence on reading scores than math. I argued that this was due to differences in how reading and math are learned – reading is learned holistically whereas math learning is often confined to institutional settings (Dupere et al., 2010; Lloyd et al., 2010). Here, I find the opposite is true. I believe this may be due to the nature of social disorganization and the neighborhood-school link. Neighborhood social disorganization theory posits that neighborhood level structural disadvantage – low economic status, residential instability, population heterogeneity – gives rise to social processes among families, peers, and neighbors that lead to community-level disorganization that permeates to affect health, well-being, development, crime, delinquency, etc. (Sampson & Groves, 1989; Sampson et al., 2002; Shaw & McKay, 1942; Wilson, 1987). Social dynamics in neighborhoods influence youth development by weakening or strengthening local schools. In disadvantaged neighborhoods, children and adolescents seldom consistently interact with educated, employed neighbors, which may cause children to question the value of education. In this social milieu, both students and teachers become discouraged and subsequently put in less effort to create supportive school environments

that foster student-teacher relationships and create norms regulating social behavior, which may lead to a downward cycle of low expectations and low achievement (Dupere et al., 2010; Kingston et al., 2009; Leventhal et al., 2009). Thus, I believe that school neighborhoods with low levels of social disorganization contribute to schools by creating strong institutional values regarding the importance of education, which may translate into higher math scores.

One of the major criticisms of neighborhood effects research is the lack of theoretical mechanisms linking neighborhood context to child well-being outcomes (Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002; Sharkey & Faber, 2014). That is, "how" do neighborhoods exert influence? There has been significant theoretical and empirical progress in this area, particularly with the use of structural equation modeling, parallel multiple mediator models, and analysis of longitudinal data (Dupere et al., 2010; Jencks & Mayer, 1990; Kohen et al., 2008; Leventhal & Brooks-Gunn, 2000). Part of the challenge of this area of research is the use of the term "neighborhood." This term muddies the water, so to speak, by carrying connotations of a sense of community, indicates that interactions with neighbors regularly occur and influence well-being, and have clearly defined physical and social boundaries (Diez Roux & Mair, 2010; Sharkey & Faber, 2014). I think, for children this age (kindergarten through 5th grade), who have limited autonomy, the area around the home or school in which they regularly engage represents a theoretically strong environment for capturing how context impacts educational and developmental outcomes. For instance, schools are, in large part, funded by the local tax revenues based on local property values and business activities. The local financial capital generates better infrastructure, which translates into human capital. Thus, schools in advantaged areas are often able to hire and retain highly qualified, effective teachers, and create a culture where parents expect and lobby for high quality services and become involved with school

activities such as parent-teacher organizations (Crosnoe, 2009; Dupere et al., 2010; Lareau, 2003; Leventhal et al., 2009; Owens, 2010). Thus, the structural factors from the surrounding areas create a "safety net" that promotes educational achievement and supports children's socioemotional development (Roeser & Eccles, 2014).

In addition to residential and school census tracts, I examined the association between school attendance zones and educational and behavioral outcomes during elementary school. I hypothesized that effects for school attendance zones would be attenuated relative to census tract neighborhoods, but would represent a more reasonable neighborhood environment for children. My results support this hypothesis. I argue that elementary SAZs represent the ideal local context for children as they: (1) simultaneously represent the area around the home and the school that children are exposed to each day, (2) are often larger than a census tract, but not so big that they overshadow the limited mobility of children this age, and (3) may provide a more accurate depiction of children's exposure to or interaction with their environments than traditional contexts defined via administrative boundaries (Dobbie & Fryer, 2011; Jones & Pebley, 2014; Schwartz, 2010; Sharkey & Faber, 2014; Villaneuva et al., 2012). If census tracts are good proxies for "neighborhoods" then we would expect to find that effects for SAZs are slightly attenuated because of processes of diffusion. Areas of similar sociodemographic characteristics tend to cluster together spatially vis-a-vie Tobler's first law of geography, "everything is related to everything else, but near things are more related than distant things" (Tobler, 1970, p. 236). Thus, within SAZs, the further away you move from the core area around the home or school, contextual environments should become more heterogeneous and exert less influence over child development (Crowder & South, 2011; Downey, 2006). My study found this to be true, and

theoretically and empirically support the use of school attendance zones as important environments to consider for impacting child development, particularly educational achievement.

Theoretically, school attendance zones may also represent children's activity spaces – geographic units which combine the child's home area as well as other places he or she routinely visits (Jones & Pebley, 2014; Villaneuva et al., 2012). Activity spaces for children have received very little attention since the 1980's, partially due to the strict privacy regulations for children, but are resurging due to the theoretical utility and advancements in geographic technology. However, creating activity spaces are methodologically time-consuming and often require subjects to wear GPS units, keep travel diaries, or both. In light of these data limitations, school attendance zones represent a plausible and time-efficient alternative to activity spaces. Previously, official school attendance zones were often unavailable to researchers without considerable time and effort in obtaining them. The National Historic Geographic Information System (NHGIS) now hosts national school catchment areas available through the School Attendance Boundary Information System (SABINS) (The College of William and Mary and the Minnesota Population Center, 2011) for the 2009, 2010, and 2011 academic school years, which line up with the new and geocoded kindergarten and 1st grade waves of the ECLS-K:2011 surveys. Unfortunately, the funding for SABINS was not renewed and no future national-level school catchment areas will be collected.

There is no single correct scale to measure "neighborhood", but scale affects both the inferences we make about neighborhood effects as well as the theoretical underpinnings linking context to outcome (Galster, 2008). Flowerdew and Colleagues (2008) compared existing neighborhood boundaries to five realistically defined pseudo areas, and found that results vary depending on "where you draw the lines." They argue that researchers need to think of

"effective" neighborhoods and experiment with different scales and aggregations. Both census tracts and school attendance zones may represent "effective" neighborhoods for children. Yet, census tracts may represent neighborhoods that are "too small" and lead to overestimation of neighborhood effects. On the other hand, school attendance zones may be "too big" and lead to underestimation of neighborhood effects (Spielman et al., 2013). As such, I believe school attendance zones yield more conservative estimates of neighborhood effects and represent theoretically sound neighborhoods for children.

LIMITATIONS

This study has several limitations. First, I estimated elementary school attendance boundaries using census tracts for each school and sampled child rather than official catchment areas. Thus, it is possible that I underestimated the size of SAZs. However, each school sampled roughly 24 children and catchment areas for elementary schools are generally small and confined to the surrounding areas (Whipple et al., 2010). Moreover, I created SAZs that are time-varying in order to keep up with constantly change official attendance boundaries (Coulton & Korbin, 2007). Second, residential tracts, school tracts, and school attendance zones were characterized in crude ways via low/high sociodemographic characteristics, which may mask a lot of variation. However, identifying more nuanced thresholds is difficult at a national scale, and I believe this research demonstrates the validity of contextual boundaries rather than the cutoffs used to characterize them. Third, both reading and math outcomes used in this study were scaled to the 5^{th} grade. Thus, these measures were only available for children who remained in the survey through elementary school. However, I limited bias as much as possible by estimating models with survey weights that compensated for attrition. Another limitation is that the results are only

generalizable to the U.S. population of kindergarten children in the 1998-1999 school year and first graders in 1999-2000; subsequent waves are only representative of the ECLS-K cohort. While this is important to consider when interpreting results, I also point out that the ECLS-K surveyed a large and diverse population of children, which is a strength of the dataset and my analyses.

CONCLUSION

Despite these limitations, my findings have important implications for future neighborhood research and policy and speak directly to the importance and impact of social and environmental contexts. This paper contributes to the growing literature on contextual influences on childhood health, well-being, and development during a critical stage of the life course. By using an inclusive growth curve modeling approach that simultaneously controlled for time-varying family and child characteristics, school context, and propensity scores to mitigate selection bias, I demonstrated the utility of residential census tracts, school census tracts, and school attendance zones as neighborhood proxies for elementary school children. As stated above, the funding for SABINS has been cut and no future national-level school catchment areas will be collected. I believe these findings could be used to urge funding agencies, primarily NSF, AERA, and Spencer, to renew funding for the collection and processing of school attendance zone data. Moreover, these results could be used to help community advocates and policy-makers determine effective "neighborhood boundaries" for comprehensive policies, e.g., Harlem Children's Zone, in light of limited funding.

CHAPTER 5

"Neighborhood effects on educational achievement of elementary school children: The impact of ADHD"

INTRODUCTION

Attention Deficit/Hyperactivity Disorder (ADHD) is a disruptive neurobehavioral disorder associated with persistent, pervasive, impairing, and developmentally excessive levels of inattention, impulsivity, and activity (Loe & Feldman, 2007). Now understood as a chronic disorder, it is one of the most common and costly mental health problems in the United States. The CDC (2014) estimates that prevalence rates of school-age children range from 4-12% with excessive economic costs totaling $31.6 billion in 2000. Longitudinal studies show that academic underachievement and poor educational outcomes associated with ADHD are persistent and begin early in life. Compared to matched normal controls, children with ADHD demonstrate significant decreases in IQ, score lower on all school subjects, have lower class rankings, perform more poorly on standardized academic achievement tests, and are more likely to repeat a grade, use remedial academic services, and be expelled or suspended (Loe & Feldman, 2007).

Twin, family, and adoption studies support a genetic component to ADHD with heritability estimated at 76% (Mulligan et al., 2013). Yet, non-genetic factors such as low birth weight, prenatal tobacco exposure, socioeconomic conditions, stressful family environments, and unstructured school routines are associated with ADHD diagnosis and severity (Hinojosa et al., 2012; Hinshaw & Scheffler, 2014; Johnston & Marsh, 2001; Kemper, 2012; Razani et al., 2014). Research demonstrates that children with ADHD are sensitive to place, particularly disruptive or unstructured environments because those contexts tend to exacerbate underlying excessive levels of trouble concentrating, paying attention, staying organized, and remembering details (Hinshaw

& Scheffler, 2014; Mulligan et al., 2013; Razani et al., 2014). For youth with ADHD, trends in educational achievement are significantly affected by stressful home environments and changes in school contexts/routines (Langberg et al., 2008). Behavior modification studies suggest that providing structured yet simplified home and school environments produce behavioral and educational improvement whereas changing those environments to be less structured or more complex leads to worsened behavior and educational outcomes (Langberg et al., 2008).

Neighborhoods represent a primary context for development where youth spend substantial amounts of time; they also represent non-familial/school environments that may exacerbate or improve educational outcomes in children with ADHD. Yet, neighborhood effects research in this area is lacking. To my knowledge, no studies have examined how neighborhood contexts contribute to educational achievement in children with ADHD. My previous work (chapter 2, chapter 4) demonstrated that residential and school contexts are associated with both direct and indirect influences on reading and math scores during elementary and middle school, net of family and school environments. In this study, I use nationally representative data, growth curve models, longitudinal propensity scores, and residential and school neighborhoods to examine whether neighborhoods exert more influence on reading and math scores in elementary students with ADHD versus those without. I hypothesize that, because youth with ADHD are extremely sensitive to place, particularly disruptive environments, residential and school neighborhood environments will be more influential for youth with ADHD than their non-impaired peers.

METHODS

Data

The Early Childhood Longitudinal Study – Kindergarten Cohort (ECLS-K), sponsored by the Department of Education (National Center for Education Statistics, 2006), is a nationally representative study that followed a cohort of more than 21,400 children who entered kindergarten during the 1998-1999 school year through 8th grade. Data collection took place during the fall and spring of kindergarten (1998-1999) and 1st grade (1999-2000) and the spring of 3rd (2002), and 5th (2004), and 8th (2007) grades. The ECLS-K employed a multistage probability sample design. In the base year the primary sampling units (PSUs) were geographic areas consisting of counties or groups of counties. From these PSUs, approximately 24 children were randomly sampled from each of the 1,277 schools, both public and private. In order to maximize the amount of longitudinal data, subsamples of children were followed if they changed schools and any child flagged to be followed at one point in time continued to be followed in subsequent data collections. In a longitudinal sample, attrition due to non-response and eligibility change is expected. During the first four waves (kindergarten through 5th grade), the ECLS-K had a 40% attrition rate. However, the ECLS-K included weights to compensate for both sampling strategy and attrition; all analyses in this study are weighted appropriately. Results of weighted analyses are generalizable to the U.S. population of kindergarten children in the 1998-1999 school year and first graders in 1999-2000. Subsequent waves are only representative of the ECLS-K cohort.

The ECLS-K contains longitudinal and geocoded data collected directly from children, parents, teachers, and school administrators, providing comprehensive information on education, development, and home, school, and neighborhood environments. The ECLS-K did not provide census tract geocodes for the 5th grade; thus, 5th grade geographic information was only available for children who did not move in elementary school (83% of the sample). Kindergarten, 1st, and

3rd grade geocodes were linked to the 2000 US Decennial Census; 5th grade geocodes were linked to the 2005-2009 American Community Survey (ACS) 5- year estimates.

Measures

Math and Reading Achievement – IRT Scale Scores

Academic achievement from kindergarten to 5th grade was measured using reading (N=9,790) and math (N=9,810) scores calculated from item response theory (IRT) procedures. "IRT uses the pattern of right, wrong, and omitted responses to the items actually administered in an assessment and the difficulty, discriminating ability, and 'guess-ability' of each item to place each child on a continuous ability scale" (National Center for Education Statistics, 2006, p. 3-5). Responses across waves were pooled to stabilize longitudinal estimates; the child's response at each wave represents estimates of the number of items the child would have answered correctly at each point in time if they had taken all of the 186 questions in the reading forms and all of the 153 questions in all of the mathematics forms. Scores were standardized with a mean of 50 and a standard deviation of 10 (Table 5.1).

Table 5.1. Descriptive statistics of child, family and school characteristics for reading and math achievement – Combined and stratified by ADHD diagnosis. Weighted and pooled sample from the ECLS-K sample – kindergarten through 5th grade.

	Combined			ADHD			No ADHD			
	N	Mean	SE	N	Mean	SE	N	Mean	SE	ANOVA
Math Achievement	40700	49.79	0.24	1200	45.53	0.49	37870	50.23	0.27	***
Reading Achievement	41580	49.84	0.27	1200	45.38	0.45	35060	50.18	0.24	***
Child and Family Characteristics										
Child diagnosed with ADHD	54890	0.03	0.00							
Race and Ethnicity										
White	60110	0.58	0.02	1720	0.71	0.02	53020	0.60	0.02	***
Black	60110	0.15	0.02	1720	0.12	0.02	53020	0.14	0.02	*
Hispanic	60110	0.19	0.02	1720	0.10	0.01	53020	0.19	0.02	***
Other	60110	0.08	0.01	1720	0.07	0.01	53020	0.07	0.01	
Child in good health	54770	0.83	0.00	1720	0.77	0.01	53050	0.84	0.00	***
Male	60300	0.52	0.00	1720	0.76	0.02	53170	0.51	0.00	***
Parents married	57030	0.71	0.01	1720	0.64	0.02	53100	0.71	0.01	***
Residential Mobility	41350	0.14	0.00	1480	0.17	0.01	36520	0.16	0.00	
Maternal Education										
Less than high school education	53410	0.13	0.01	1500	0.12	0.01	49440	0.13	0.01	
High school and some college	53410	0.63	0.01	1500	0.66	0.02	49440	0.62	0.01	**
Bachelor's degree	53410	0.18	0.01	1500	0.16	0.01	49440	0.18	0.01	*
Graduate or professional degree	53410	0.07	0.00	1500	0.06	0.01	49440	0.07	0.00	
SES	57440	-0.03	0.02	1720	-0.13	0.03	53170	-0.02	0.02	***
Parent Communication	56720	2.61	0.05	1710	1.97	0.11	52820	2.66	0.05	***
Parental Involvement in Education	57090	-0.01	0.02	1720	-0.08	0.04	53170	0.03	0.02	***
School Characteristics										
% Minority Students										
0- <25%	57660	0.49	0.03	1610	0.53	0.03	50870	0.50	0.03	*
25 - <50%	57660	0.17	0.01	1610	0.19	0.02	50870	0.17	0.01	**
50 - <75%	57660	0.12	0.01	1610	0.14	0.02	50870	0.11	0.01	***

>=75%	57660	0.23	0.02	1610	0.14	0.02	50870	0.22	0.02	***
Parents are active in school programs	46460	0.79	0.01	1340	0.80	0.01	41200	0.80	0.01	
Problem with teacher turnover	46490	0.07	0.01	1340	0.06	0.01	41240	0.07	0.01	†

Per ECLS-K guidelines, Ns are rounded to the nearest 10 to protect participants. Data are in "long" form and measured in person-years. There are N=9,810 and N=9,790 individual students for math and reading achievement, respectively. N=630 children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). Statistics are estimated with probability weights and sandwich estimators to adjust for clustering within primary sampling units. Analysis of Variance (ANOVA) tests whether means are significantly different between ADHD and non-ADHD youth.

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Child and Family Level Variables

I controlled for a variety of child and family characteristics in all multivariate models based on previous studies of educational achievement and theoretical rationale – all measures except child race/ethnicity and sex were time-varying (Dupere et al., 2010; Leventhal & Brooks-Gunn, 2000; Lloyd et al., 2010; Sampson et al., 2002; Sampson et al., 2008). Sociodemographic characteristics included child race and/or ethnicity, child health status (good health vs. poor health), child sex, family structure (married vs. unmarried parents), maternal education, socioeconomic status (SES), and residential mobility (Root & Humphrey, 2014b). The SES measure is a continuous scale, constructed by the ECLS-K at each wave, combining information on household-level education, occupation, and income. A binary measure of ADHD diagnosis was constructed based on parent responses at each wave regarding whether a child was ever diagnosed with ADD, ADHD, or hyperactivity (National Center for Education Statistics, 2006).

I also included indirect and direct measures of parental involvement in the child's education. Communication with other parents was measured by asking parents "how many of your child's classmates' parents do you speak with regularly?" I also created a scale which directly measured parental involvement in education. The scale was created by summing positive responses on questions such as "attended an open house" or "met the child's teacher." Because the number of questions varied at each survey wave, the scores were standardized with a mean of 0 and standard deviation of 1 to make the scale comparable across waves (Table 5.1).

School Level Variables

School context was measured by time-varying principal report of the percentage of minority students, whether parents were active in school programs, and whether there was a problem with

teacher turnover. Teacher turnover was included as a means to assess the social climate within schools (Table 5.1).

Neighborhood Construction– Residential Tracts, School Tracts, School Attendance Zones

Time-varying neighborhood contexts were defined using residential census tracts, school census tracts, and school attendance zones. Census tract neighborhoods were defined using the tract in which the child lived and the tract in which the school was located. Official school attendance zones (SAZs) were not available on a national scale for the years this study took place. Therefore, I created SAZs by aggregating the school tract and each residential tract associated with that school.

Neighborhood Characterization - Residential Tracts, School Tracts, School Attendance Zones, and Perceived Disorder of the School Neighborhood

Residential tracts, school tracts, and SAZs were characterized using four time-varying sociodemographic attributes commonly found in neighborhood effect studies during childhood (Leventhal & Brooks-Gunn, 2000; Meyer & McIntosh, 1992; Sampson et al., 2002): proportion of residents living below the federal poverty line, proportion of residents with less than a high school education, proportion of affluent residents - those with at least 4-year degrees, and a diversity index. The diversity index represents the likelihood that two persons, chosen at random from the same neighborhood, belong to different racial groups. This equation is:

$$V_i = (1 - \sum {p_i}^2)$$

Where p_i represents the proportion of the population in each racial group for each census tract. I then transformed the raw proportions or index values into binary values by cutting the variable

above or below the median (Table 5.2). I transformed the neighborhood variables because it is necessary for the "treatment" variable, neighborhood, to be in binary form to support the propensity score methodology (Rosenbaum & Rubin, 1983).

The ECLS-K also provides a time-varying measure of perceived disorder of the "school neighborhood." At each wave of the survey, school principals were asked to rate (on a scale of 1-3) "how much of a problem are the following *in the neighborhood where the school is located*?": a) tensions based on racial, ethnic, or religious differences, b) garbage, litter, or broken glass in the street or road, on the sidewalks, or in yards, c) selling or using drugs or excessive drinking in public, d) gangs, e) heavy traffic, f) violent crimes like drive-by shootings, g) vacant houses and buildings, and h) crime in the neighborhood. I summed each principal's response to create a score of perceived disorder then standardized across each wave with a mean of 0 and standard deviation of 1.

Table 5.2. Descriptive analysis of residential and school neighborhoods – Combined and stratified by ADHD diagnosis. Weighted and pooled sample from the ECLS-K sample – kindergarten through 5th grade.

	Pooled			ADHD			No ADHD					
	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	ANOVA		N (Tracts & SAZs)
Residential Tract												
Poverty	0.09	0.13	0.11	0.09	0.12	0.10	0.09	0.12	0.11	*	K	4740
Less than High School Education	0.16	0.20	0.15	0.16	0.18	0.12	0.16	0.20	0.15	***	1st	5110
Affluence	0.19	0.24	0.17	0.19	0.24	0.17	0.19	0.24	0.17		3rd	5007
Diversity	0.09	0.13	0.11	0.16	0.21	0.17	0.16	0.22	0.18		5th	NA
School Tracts												
Poverty	0.10	0.14	0.12	0.10	0.13	0.10	0.10	0.13	0.11		K	1434
Less than High School Education	0.17	0.20	0.15	0.16	0.18	0.12	0.17	0.20	0.15	***	1st	1434
Affluence	0.19	0.24	0.17	0.19	0.24	0.17	0.18	0.24	0.17		3rd	1434
Diversity	0.17	0.23	0.18	0.17	0.21	0.17	0.17	0.22	0.18		5th	1434
School Attendance Zones												
Poverty	0.10	0.13	0.10	0.10	0.12	0.08	0.10	0.13	0.09	*	K	1952
Less than High School Education	0.18	0.20	0.13	0.16	0.18	0.10	0.17	0.20	0.12	***	1st	2083
Affluence	0.20	0.24	0.15	0.20	0.24	0.15	0.20	0.24	0.15		3rd	3022
Diversity	0.23	0.26	0.19	0.20	0.24	0.17	0.21	0.25	0.18		5th	2391
Perceived Disorder of the "School Neighborhood"												
Principal's opinion	0.00	1.30	1.63	0.00	1.14	1.54	0.00	1.27	1.63	*		

Per ECLS-K guidelines, Ns are rounded to the nearest 10 to protect participants. Data are in "long" form and measured in person-years. There are N=9,810 and N=9,790 individual students for math and reading achievement, respectively. N=630 children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). Med=Median. NA = not available. Census tracts were not provided for the 5th grade wave. Statistics are estimated with probability weights and sandwich estimators to adjust for clustering within primary sampling units. Analysis of Variance (ANOVA) tests whether means are significantly different between ADHD and non-ADHD youth.

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Analytic Strategy

Time-varying Propensity Scores (TVPS)

For residential tracts, school tracts, and school attendance zones, I used logistic regression models to create propensity scores for each child for each characterization of neighborhood at each wave of the survey. In each model, I regressed neighborhood type (reference set as "low" – see median values in Table 5.2) on family characteristics from the same wave; the predicted probability from each model represents the propensity score, or the likelihood that a family selected into their neighborhood type based on background characteristics. Because children moved over the course of the survey, time-varying propensity scores are needed to mitigate selection bias at each wave (Root & Humphrey, 2014a; Root & Humphrey, 2014b).

Multilevel Growth Curve Models

The multivariate analyses use growth curve models for continuous outcomes to predict trajectories of reading and math achievement by analyzing time points (Level 1) nested within individual children (Level 2). Thus, the child's grade is the Level 1 unit, and child is Level 2 (Singer & Willett, 2003). Models included information on the child, family, school, and neighborhood characteristics as well as time-varying propensity scores. Because there were not enough students per residential census tract to estimate 3-level models, I did not estimate 3-level models for any of the school tracts or school attendance zones for the sake of comparability.

I first compared linear and quadratic functions of grade at Level 1. For math scores, the linear model was the best fit, suggesting that scores changed uniformly over time. For reading scores, the quadratic model was the best fit, suggesting that scores increased as children progressed but eventually leveled off. Models were estimated using *xtmixed* in Stata 12

(StataCorp, 2011) with child-, family-, and school-level controls as well as probability weights and a sandwich estimator of standard errors, which adjusts for clustering within the primary sampling unit. I assigned one unique variance parameter per random effect and assumed the covariance parameters were zero. The basic model specification is:

$$Y_{ij} = \pi_{0i} + \pi_{1i}GRADE_{ij} + \pi_{2ni}W_i + \varepsilon_{ij}$$

$$\text{where: } \pi_{0i} = \gamma_{00} + \gamma_{0n}X_i + \xi_{0i}$$

$$\pi_{1i} = \gamma_{10} + \gamma_{1n}Z_i + \xi_{1i}$$

Y_{ij} shows the level-1 model which includes $GRADE$ (centered at kindergarten) as the trajectory of educational achievement across students and W as a matrix of time-varying predictors of educational achievement. π_{0i} and π_{0i} are the level-2 models which show how the initial status and trajectory are modified over time. X_i and Z_i are matrices of time-invariant variables that modify the intercept and slope over time, respectively. I use the Bayesian information criterion (BIC) and the Akaike information criteria (AIC) to assess model fit.

RESULTS

Descriptive Analysis

Table 5.1 presents a descriptive analysis of child, family, and school in the overall sample as well as stratified by ADHD diagnosis. As expected, children with ADHD had significantly lower reading and math scores than their non-impaired peers with an initial difference of around 5 points (half of one standard deviation) on both subjects. Generally, children with ADHD were less likely to be reported as "healthy" by parents, they were less likely to live in homes with married parents, and their parents were less involved in their education on both direct and indirect measures. On the other hand, compared to non-ADHD peers, ADHD youth were

generally white, male, lived in households with a higher socioeconomic status, and attended schools with lower proportions of minorities.

Table 5.2 presents a descriptive analysis of neighborhood characteristics in the pooled sample as well as stratified by ADHD diagnosis. Generally, elementary school students with and without ADHD were exposed to similar neighborhood contexts. However, on average, children with ADHD lived in or attended schools with significantly fewer uneducated residents, and were exposed to significantly less perceived disorder of the school neighborhood.

Growth Curve Models

Table 5.3 presents coefficients representing neighborhood effects on reading and math scores of youth with ADHD living in a high, relative to low, neighborhood context or experiencing a one standard deviation increase in perceived disorder, i.e., coefficients are calculated as $\beta_1 + \beta_3$. Due to convergence or over-fitting issues, I was unable to interact grade by neighborhood to examine neighborhood effects on trajectories of reading or math scores. Thus, coefficients represent effects at kindergarten. Compared to non-ADHD youth, kindergarten reading and math scores of children with ADHD were more heavily influenced by neighborhood context, after applying time-varying propensity scores, and controlling for family characteristics and school context. In particular, the association between kindergarten math scores and census tract and school attendance zone neighborhoods were especially strong. Across each context, children with ADHD living in high poverty neighborhoods, for example, had math scores that were roughly 1.7 standard deviations lower than their non-impaired counterparts, a 17 point deficit. Absolute effect sizes across neighborhoods characterized by high levels of affluence, diversity, and residents with less than a high school diploma also exerted strong and consistent effects,

with effect sizes ranging from 0.83 to 1.89. Associations between reading scores and census tract and school attendance zone neighborhoods were weaker and inconsistent. However, living in a high poverty census tract reduced initial reading scores by 19 points (*b*=1.89) for youth with ADHD compared to their non-impaired peers, and exposure to high levels of uneducated residents results in an 11 point deficit in reading scores for ADHD youth. Interestingly, perceived disorder of the school neighborhood was decreased reading scores by 0.27 standard deviations, relative to non-ADHD youth; no significant association was found for math scores.

Table 5.3. Coefficients from final growth curve models estimating neighborhood effects on initial math and reading scores for children with ADHD during elementary school, net of family characteristics, school context, and time-varying propensity scores.

	Reading	Math
	Mean = 50; SD=10	
Residential – Tract (ref=low)		
Poverty	-1.89**	-1.81*
Less than high school education	-1.13†	-1.07**
Affluence	1.15	1.89†
Diversity	-1.12†	-0.83*
School – Tract (ref=low)		
Poverty	-1.30	-1.71***
Less than high school education	-1.39†	-1.29**
Affluence	1.39	1.73**
Diversity	-1.06	-0.79
School - Attendance Zone (ref=low)		
Poverty	-1.20*	-1.72***
Less than high school education	-1.20†	-1.44***
Affluence	1.88	1.23†
Diversity	-0.87***	-1.28***
School - Perceived Disorder (z-score) [a]		
Principal's Opinion	-0.27**	-0.26†

N=9,810 students for math achievement; N=9,790 students for reading achievement. These are the final growth curve models, which include controls for: child's race/ethnicity, health status, sex, parental marital status, maternal education, family SES, parent communication with other parents, level of involvement with child's education, residential mobility, school minority levels, culture of active parenting within schools, problems with teacher turnover in schools, and time-varying propensity scores to mitigate selection bias. Each model is estimated with a measure (1=yes; 0=no) of whether or not the child has a diagnosis of ADHD and an interaction term between ADHD and neighborhood (1=high; 0=low) or perceived disorder (mean=0; standard deviation=1). The coefficients represent the effect of a child with ADHD living in a "high" neighborhood context or experiencing a 1 standard deviation increase in perceive disorder, i.e., $\beta_1 + \beta_3$. Each model is estimated with probability weights and sandwich estimators.

[a]Models estimating the effects of perceived disorder do not include time-varying propensity scores.

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001

DISCUSSION

This study used nationally representative data, growth curve models, longitudinal propensity scores, and residential and school neighborhood contexts to examine whether neighborhoods exert more influence on reading and math scores in elementary students with ADHD versus those without. I hypothesized that neighborhood effects would be stronger for elementary school students with ADHD relative to their non-impaired peers. Growth curve models supported my hypothesis and bolster behavioral theories suggesting youth with ADHD are especially responsive to context. Generally, the observed effects were strong for math scores across census tract and school attendance zone neighborhoods characterized by high levels of poverty, affluence, diversity, and uneducated residents, associations were weak and inconsistent for reading scores. Because I controlled for time-varying propensity scores, I do not believe these results are due to selection bias.

Theoretically, neighborhood environments may influence the manifestation of ADHD symptoms, which are directly related to educational outcomes (Langberg et al., 2008; Loe & Feldman, 2007). Generally, boys with ADHD display hyperactive and impulsive symptomology whereas girls with ADHD tend to display inattentive symptomology, frequently mistaken as depression or anxiety (Hinshaw & Scheffler, 2014). Several studies have shown that internalizing and externalizing behaviors vary systematically with the quality of children's neighborhoods. My previous work (chapter 3) demonstrated that residential environments directly influenced child behaviors, but also worked through family and school contexts to impact levels of internalizing and externalizing behaviors during elementary school. Because youth with ADHD are profoundly affected by the environments to which they are exposed, neighborhoods represent an important context for educational achievement in children diagnosed

with ADHD. To my knowledge, there have been three published studies that examined neighborhood effects on childhood ADHD. In each of these studies, the authors examined the association between perceived social support of the child's residential context and either ADHD diagnosis or severity (Butler et al., 2012; Hinojosa et al., 2012; Razani et al., 2014). Generally, they found that social support buffered or exacerbated ADHD for either parents (e.g., neighborhood social support increased parental mental health which reduced parent-child strain), or children (e.g., deprivation of social support was associated with increased ADHD symptomology). This research combined with the strong associations found in my study lend support for the notion that neighborhood context, be it residential or school and characterized by structural or social factors, is significantly associated with ADHD and subsequent educational outcomes.

In my previous work examining neighborhood effects on educational achievement (chapter 2, chapter 4), I found that the results for math scores were often weaker than those for reading scores in the general sample. In this study, I found the opposite to be true – there were stronger associations between neighborhood context and math scores for kindergarteners with ADHD than for reading scores. These findings mimic those at the individual level. That is, youth with ADHD often perform more poorly on math assessments than reading assessments. Mathematics learning requires memory, visuospatial skills, executive skills, and cumulative building blocks that children with ADHD struggle with due to developmentally excessive levels of trouble concentrating, paying attention, staying organized, and remembering details (Capano, Minden, Chen, Schachar, & Ickowicz, 2008; Loe & Feldman, 2007). Thus, it is unsurprising that neighborhood effects would be stronger for math scores as the growth models are likely picking up those differences. Given that we know children with ADHD have lower academic

achievement scores, they are particularly sensitive to local environments, and this research demonstrated non-trivial influences on initial math and reading scores, I believe neighborhood contexts need to be further explored across all academic outcomes, which are critical for future economic and social success.

LIMITATION

This study has several limitations. First, ADHD was measured by parent report rather than a clinical diagnosis. Similarly, psychologists are beginning to argue that, similar to autism, ADHD severity exists on a spectrum and should be treated as such (Hinshaw & Scheffler, 2014). Thus, my binary measure of ADHD may be underestimating diagnosis or symptomology that affects educational achievement. As such, I believe these are conservative estimates of neighborhood influences on educational achievement in children with ADHD. Second, residential census tracts, school census tracts, and school attendance zone environments were characterized in crude ways via low/high sociodemographic characteristics, which may mask a lot of variation. However, identifying more nuanced thresholds is difficult at a national scale, and I believe this research demonstrates the importance of considering neighborhood environments as an influential context for children with ADHD. Third, both reading and math outcomes used in this study were scaled to the 5^{th} grade. Thus, these measures were only available for children who remained in the survey through elementary school. However, I limited bias as much as possible by estimating models with survey weights that compensated for attrition. Another limitation is that the results are only generalizable to the U.S. population of kindergarten children in the 1998-1999 school year and first graders in 1999-2000; subsequent waves are only representative of the ECLS-K cohort. While this is important to consider when interpreting results, I also point out that the

ECLS-K surveyed a large and diverse population of children, which is a strength of the dataset and my analyses.

CONCLUSIONS

Despite these limitations, my findings have important implications for future studies examining contextual effects in children with ADHD. By using an inclusive growth curve modeling approach that simultaneously controlled for time-varying family and child characteristics, school context, and propensity scores to mitigate selection bias, I demonstrated that both residential and school neighborhoods more strongly influence educational outcomes for children with ADHD compared to their non-impaired pers. Given the high personal, societal, and economic costs associated with ADHD, my study has demonstrated the importance of exploring neighborhood as a relevant context in mitigating educational disparities between children with and without ADHD.

Since the passage of the Individuals with Disabilities Education Act (IDEA) in 2004, many schools have implemented a response to intervention (RTI) framework, whereby children with ADHD who struggle behaviorally or academically are provided with tiered evidence-based interventions (Tresco, Lefler, & Power, 2010). As children move up tiers within the RTI (e.g., children have more severe cases of ADHD), more intensive family- and school-level interventions are incorporated into plans to help children succeed. I believe this research could be used as evidence to conduct behavioral modification studies within the neighborhood context and to promote the incorporation of community-level factors into RTI frameworks for children with ADHD.

CHAPTER 6

CONCLUSIONS & FUTURE GOALS

This dissertation has important implications for future studies examining neighborhood effects on child health, well-being and development. Overall, I found that: (1) after controlling for multiple social ecologies as well as selection bias, residential and school neighborhood contexts exerted significant and direct effects on educational and behavioral outcomes, (2) both family and school contexts simultaneously mediated between residential neighborhood contexts and reading and math scores and internalizing and externalizing behaviors, (3) for reading and math scores, the mediating effect of family and school lessened over time whereas the direct effect of neighborhoods increased over time, (4) school attendance zones represented the ideal local context for examining contextual effects on childhood development, and (5) neighborhoods more strongly influence educational outcomes for children with ADHD relative to their non-impaired peers.

While writing this dissertation, I came to a few broad conclusions and ideas for future research in this area. First, I demonstrated that direct associations between residential context and math and reading scores increased over time, while indirect effects via family and school decreased over time. I believe these findings drive home my points about needing to model multiple social ecologies, the importance and impact of environmental and social contexts, and the timing associated with neighborhood effects. Although researchers and policymakers generally focus on the school as the critical arena in which development occurs, I argue that the focus should be on a combination of child, family, school, and neighborhood but the focus should shift over time. In light of these findings, it may be that policymakers focus on improving the social and structural components of family and school contexts in early childhood and

elementary school. However, in middle and high school, policy should focus on adolescents, peers, and non-familial environments in which youth can learn about themselves and their worlds, and can discover opportunities for carving their own versions of success.

Second, I believe the term "neighborhood" should be discarded when generally speaking about contextual effects on health. The term has connotations that are not translatable to quantitative work on a broad scale. However, in places like Chicago, New York, or Los Angeles, neighborhoods are often clearly defined spaces with distinct characteristics that differentially influence outcomes. For researchers on a national scale, phrases like "residential context," "local context," or "activity space" more accurately describe the environments we measure and make inferences about. Focusing on the term "neighborhood" distracts from how different dimensions of context across geographic scales become salient in the lives of children (Galster, 2008; Sharkey & Faber, 2014). I believe focusing on identifying, measuring, and estimating the mechanisms that affect child health and well-being is the part of "neighborhood effects" research that will move the field forward and have real and lasting impacts on policy.

Third, while I believe selection bias is a problem in neighborhood effects research, I am not convinced that selection should be equally weighted across classes of outcomes. By that, I mean that structural outcomes, like education, may be affected by selection, but to lesser degrees than psychosocial or health outcomes. I argue that omitting a key variable related to both neighborhood and outcome would matter less for educational achievement than psychosocial adjustment within an inclusive modeling strategy. Adding time-varying propensity scores to my education models did not remove the "effect" but slightly attenuated the association. On the other hand, almost all effects for internalizing and externalizing behaviors disappeared as soon as selection was accounted for, which mirrors findings from our self-rated health manuscript (Root

& Humphrey, 2014a). I think that the link between non-structural (psychosocial) outcomes and neighborhoods are stretched thin, thus any omitted variable (bias) may make a big impact on the context-outcome association. On the other hand, schools are so entrenched in the local neighborhood, that child and family characteristics can only go so far in limiting the effect that neighborhoods exert on schools, which directly affect educational outcomes.

Several researchers (see Sampson et al., 2008; Sharkey & Sampson, 2010 for examples) demonstrate that selection bias in longitudinal samples can be successfully addressed by estimating models that weight each subject by the inverse of the predicted probability that the subject received a treatment at a given time point conditional on prior treatment history, time-varying covariates, time-varying outcome history, and time-invariant covariates. The use of these inverse probability of treatment weights (IPTW) are not appropriate for growth curve models, but rather, are usually estimated in marginal structural models. The next step I would like to take is to estimate marginal structural models using both IPTW and the time-varying propensity scores (TVPS) used in this dissertation to (1) examine whether the same relationship between selection bias and structural vs. non-structural outcomes occur, and (2) examine the validity of the TVPS method. In addition, I would like to take cross-sections of the ECLS-K data (kindergarten, 5^{th}, and 8^{th} grade) and apply propensity score matching methodologies to examine the influence of selection for both educational and psychosocial outcomes across different developmental years.

Fourth, throughout this dissertation, I argued that it is imperative to simultaneously examine multiple social ecologies to avoid overestimating neighborhood effects. I believe my modeling strategy produced conservative neighborhood estimates and was a more realistic model of the contexts that influence development during childhood and early adolescence. I believe I

took the right "next step" by estimating direct and indirect effects via my inclusive growth curve modeling strategy, but cross-classified models that simultaneously estimate the variance of both school and neighborhood environments should be the next step in this line of research. The ECLS-K is a school-based sample and, thus schools are highly embedded within neighborhoods. Previous studies comparing HLM to cross-classified strategies (Carlson & Cowen, 2015; De Clercq et al., 2014), found that models estimated with HLM over estimated neighborhood effects. Thus, it is possible that my conservative estimates are not conservative enough. However, I think a combination of my growth curve models that estimated direct effects, parallel multiple mediator models that estimated indirect effects, and cross-classified models that break down the variance across contexts can provide policy-makers with more concrete evidence of where and how to intervene to affect child development.

Fifth, I often argued that neighborhood characteristics influenced reading and math scores and internalizing and externalizing behaviors through the availability and use of resources, either directly or indirectly via families and schools. Theories of neighborhood institutional resources support these assertions, but I measured "resources" indirectly by characterizing neighborhoods with sociodemographic characteristics like poverty or affluence, rather than the presence and quality of businesses, organizations, and institutions that contribute to the health and development of children and adolescents (Small & McDermott, 2006). The Census Bureau's dataset, County Business Patterns, annually assesses the number of businesses that provide goods or services necessary for day-to-day living, e.g., supermarkets or child care centers. These data are available each year from 1970 to 2012 with zip codes being the lowest level of geography available. Neighborhood institutional resources are often cited as important theoretical mechanisms linking neighborhoods to child health and development, but are rarely tested. The

ECLS-K provides zip code tabulation areas (ZCTAs) for both residential and school locations. In the future, I would like to model the effects of neighborhood institutional resources on educational and psychosocial outcomes and compare with sociodemographic characteristics, such as poverty or affluence, to assess if poverty or affluence represents a good measure of institutional resources within neighborhoods.

Sixth, I argued that school attendance zones represent an ideal "neighborhood" context for children as they: (1) simultaneously represent the area around the home and the school that children are exposed to each day, (2) are often larger than a census tract, but not so big that they overshadow the limited mobility of children this age, (3) may provide a more accurate depiction of children's exposure to or interaction with their environments than traditional contexts defined via administrative boundaries, and (4) provide more conservative estimates of neighborhood effects relative to census tract neighborhoods. Using the new and geocoded ECLS-K:2011 surveys with linked official SAZs as well as SAZs created from available geocoded data, I would like to further explore the utility of school attendance zones as relevant spatial context for children. In particular, I would like to estimate parallel multiple mediator models to examine whether family and school level mediators differ from those within residential census tract neighborhoods.

Finally, because youth with ADHD are so sensitive to place, I believe neighborhoods represent a context that should be further explored for this population. The data here are not strong enough to make any statement beyond the fact that neighborhoods exert a stronger association on educational outcomes for youth with ADHD compared to their non-impaired peers. Given the high "price" of this disorder, I believe any in-road to intervene is critical. The National Survey of Children's Health (NSCH) is a nationally representative dataset that incudes

mental health status – including ADHD – as well as information on the child's family, neighborhood, and social context. I would like recreate my analysis, as closely as possible, to test whether neighborhoods really are more impactful for children with ADHD, or if these findings are just an artifact of the ECLS-K data.

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Appendix A. List of variables included in time-varying propensity score equations

- Paternal education
- Mother's age
- Father's age
- Mother works full time
- Father works full time
- Parental health status
- Household income
- Urban/suburban/rural residential location
- Family living below federal poverty line
- Family receiving federal assistance via food stamps
- Student is eligible for free or reduced lunch at schools
- Parents chose where to live so child could attend his/her current school
- Child's school is chosen/assigned
- Parental social interaction
- English speaking household
- Distance from child's home to the school they attend
- Problems with safety issues for children to play outside during the day in the child's neighborhood
- Problems with garbage, litter, or broken glass in the street or road, on the sidewalks, or in the yards in the block around the child's house
- Problems with selling or using drugs or excessive drinking in the block around the child's house
- Problems with burglary or robbery in the block around the child's house
- Problems with violent crimes like drive-by shootings in the block around the child's house
- Problems with vacant houses and buildings in the block around the child's house
- Problems with vacant houses and buildings in the block around the child's house
- Parent suffering from depressive symptoms
- Parent feels lonely
- Parent feels sad
- Child race/ethnicity*
- Residential mobility*

*These variables are included in the growth curve models as well.

Appendix B. Nested growth curve models estimating the relationship between neighborhood context and reading scores among children and adolescents in the ECLS-K sample. Model 1 includes neighborhood context and TVPS. Model 2 adds child and family characteristics. Model 3 adds school characteristics.

	Poverty Model 1	Poverty Model 2	Poverty Model 3	Income Model 1	Income Model 2	Income Model 3
	b	b	b	b	b	b
Fixed Effects						
Initial status	32.4133 ***	16.6271 ***	16.4268 ***	32.6040 ***	17.2109 ***	16.6698 ***
Grade		71.8557 ***	70.9503 ***		71.8167 ***	70.9200 ***
Grade^2	-5.4250 ***	-8.4006 ***	-8.1675 ***	-5.4168 ***	-8.3980 ***	-8.1658 ***
Child/Family Characteristics						
Race (ref=white)						
Black		-9.3472 ***	-10.0164 ***		-9.8994 ***	-10.4094 ***
Hispanic		-5.8140 ***	-4.2177 ***		-6.4236 ***	-4.6005 ***
Asian		3.1103 *	3.5434 **		2.6710 *	3.3026 **
Other		-4.3596 †	-4.0752 *		-4.5991 †	-4.1800 *
Child in good health		2.6993 ***	3.0666 ***		2.7230 ***	3.0682 ***
Male		-4.5387 ***	-4.6112 ***		-4.5615 ***	-4.6457 ***
Parents not married		-1.8100 *	-1.4606 *		-1.8268 *	-1.4784 *
Residential Mobility		0.9419 ***	0.7237 **		0.9308 ***	0.7169 *
Maternal Education (ref=HSSC)						
LTHS		-5.9503 ***	-8.3199 ***		-6.0554 ***	-8.4233 ***
Bachelor		3.3640 ***	3.4494 ***		3.4348 ***	3.5159 ***
Grad/professional		5.6201 ***	5.5655 ***		5.5834 ***	5.5108 ***
SES (continuous measure)		6.3561 ***	6.3174 ***		6.4680 ***	6.4487 ***
Parent Communication		0.0347 †	0.0688 *		0.0351 †	0.0713 *
Parental Involvement in Education		0.2544 *	0.2383 †		0.2526 *	0.2307 †
School Characteristics						
% Minority Students (ref=0-<25%)						
25 - <50%			0.1497			-0.0035
50 - <75%			-0.3305			-0.7077
>=75%			-3.0482 **			-3.5230 ***

			1.0860			1.1398
Parents are active in school programs			†			†
Problem with teacher turnover			-1.069			-1.0612
Neighborhood Characteristics	**Poverty**	**Poverty**	**Poverty**	**Income**	**Income**	**Income**
	1.2904	1.6682	2.1051	0.5999	1.9963	2.6600
Time-Varying Propensity Score	†	**	**		†	***
Neighborhood Tertiles (ref= Moderate)						
	4.2019	1.9916	1.6613	-4.5422	-2.3610	-1.9485
Low	***	*	†	***	***	***
	-5.6865	-2.2506	-2.4342	3.9579	0.7687	0.7544
High	***	***	***	***	†	†
Random Effects						
Intercept						
Slope						
AIC	40446018	28890676	23603954	40477418	28894633	23607744
BIC	40446090	28890854	23604165	40477491	28894811	23607955

	LTHS Model 1	**LTHS Model 2**	**LTHS Model 3**	**Grad Model 1**	**Grad Model 2**	**Grad Model 3**
	b	**b**	**b**	**b**	**b**	**b**
Fixed Effects						
	32.8641	17.3916	16.6959	32.2339	16.6982	16.4316
Initial status	***	***	***	***	***	***
	55.8479	71.7945	70.9184	55.6787	71.7563	70.9029
Grade	***	***	***	***	***	***
	-5.4093	-8.3899	-8.1619	-5.3902	-8.3876	-8.1635
Grade^2	***	***	***	***	***	***
Child/Family Characteristics						
Race (ref=white)						
		-9.4847	-10.2090		-10.3452	-10.6830
Black		***	***		***	***
		-5.6288	-4.0769		-6.4057	-4.3990
Hispanic		***	***		***	***
		3.0794	3.5023		2.6948	3.4109
Asian		*	**		*	**
		-4.6158	-4.3556		-4.9088	-4.4347
Other		†	*		†	*
		2.6797	3.0578		2.7112	3.0848
Child in good health		***	***		***	***
		-4.5456	-4.6251		-4.5470	-4.6546
Male		***	***		***	***
		-1.8732	-1.5130		-1.9525	-1.5860
Parents not married		**	*		**	*
		0.8484	0.5989		0.9164	0.6802
Residential Mobility		**	*		***	*
Maternal Education (ref=HSSC)						
		-5.8543	-8.2682		-6.2104	-8.5684
LTHS		***	***		***	***
Bachelor		3.2886	3.3753		3.1893	3.3068

		***	***		***	***
Grad/professional		5.3929 ***	5.3498 ***		5.2154 ***	5.2108 ***
SES (continuous measure)		6.3655 ***	6.2938 ***		6.4521 ***	6.3477 ***
Parent Communication		0.0364 †	0.0747 **		0.0319 †	0.0676 *
Parental Involvement in Education		0.2720 *	0.2414 †		0.2768 *	0.2585 †
School Characteristics						
% Minority Students (ref=0-<25%)						
25 - <50%			0.2053			-0.0331
50 - <75%			-0.313			-0.7027
>=75%			-2.9537 **			-3.6828 ***
Parents are active in school programs			1.0347			1.0931 †
Problem with teacher turnover			-0.951			-0.964
Neighborhood Characteristics	**LTHS**	**LTHS**	**LTHS**	**Grad**	**Grad**	**Grad**
Time-Varying Propensity Score	1.7422 †	1.6627 *	2.6928 **	0.8772	1.8058	2.2955 *
Neighborhood Tertiles (ref= Moderate)						
Low	3.7388 ***	1.0762 *	1.1293 **	-3.7300 ***	-0.8975 **	-1.1132 ***
High	-6.3842 ***	-3.0777 ***	-3.0640 ***	4.8273 ***	2.0756 ***	1.8817 ***
Random Effects						
Intercept						
Slope						
AIC	40442589	28890913	23603003	40473722	28895892	23607577
BIC	40442661	28891091	23603214	40473795	28896070	23607788

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Appendix C. Nested growth curve models estimating the relationship between neighborhood context and math scores among children and adolescents in the ECLS-K sample. Model 1 includes neighborhood context and TVPS. Model 2 adds child and family characteristics. Model 3 adds school characteristics.

	Poverty Model 1	Poverty Model 2	Poverty Model 3	Income Model 1	Income Model 2	Income Model 3
	b	b	b	b	b	b
Fixed Effects						
Initial status	30.9334 ***	38.3816 ***	37.5624 ***	30.6779 ***	38.5514 ***	37.8610 ***
Grade	29.9530 ***	27.0413 ***	26.7394 ***	29.8990 ***	27.0156 ***	26.7146 ***
Grade^2						
Child/Family Characteristics						
Race (ref=white)						
Black		-11.9302 ***	-12.2160 ***		-12.2828 ***	-12.3805 ***
Hispanic		-3.8869 ***	-3.0888 *		-4.2128 ***	-3.2511 **
Asian		1.7759 *	2.6605 **		1.5473 *	2.5548 **
Other		-4.4697	-4.7368 †		-4.6314	-4.7907 †
Child in good health		1.4085 ***	1.2904 ***		1.4239 ***	1.2964 ***
Male		3.2870 ***	3.1947 ***		3.2782 ***	3.1787 ***
Parents not married		-2.2921 ***	-2.3368 ***		-2.3054 ***	-2.3361 ***
Residential Mobility		-3.3418 ***	-3.7536 ***		-3.3459 ***	-3.7506 ***
Maternal Education (ref=HSSC)						
LTHS		-4.0203 ***	-5.2377 ***		-4.1158 ***	-5.2849 ***
Bachelor		3.1619 ***	2.8097 ***		3.1744 ***	2.8325 ***
Grad/professional		4.1952 ***	3.6486 ***		4.1607 ***	3.6314 ***
SES (continuous measure)		5.6492 ***	6.1908 ***		5.6954 ***	6.2297 ***
Parent Communication		-0.0299	-0.0114		-0.0292	-0.0102
Parental Involvement in Education		0.4985 ***	0.2684		0.4976 ***	0.2652
School Characteristics						
% Minority Students (ref=0-<25%)						
25 - <50%			-0.8869			-0.937
50 - <75%			-0.9026			-1.0518
>=75%			-0.0928			-0.3023
Parents are active in school programs			3.1812 ***			3.1988 ***

Problem with teacher turnover			0.2776			0.2926
Neighborhood Characteristics	**Poverty**	**Poverty**	**Poverty**	**Income**	**Income**	**Income**
Time-Varying Propensity Score	1.6786 **	1.8858 **	1.6873 *	0.8386	1.6678 **	1.3619 *
Neighborhood Tertiles (ref= Moderate)						
Low	3.0050 ***	0.7466	0.4631	-3.6029 ***	-0.8391 *	-0.9746 **
High	-5.1864 ***	-1.2982 ***	-1.2521 ***	3.6094 ***	0.6365	0.2431
Random Effects						
Intercept						
Slope						
AIC	40242790	28226116	23023671	40271602	28228155	23024851
BIC	40242855	28226286	23023875	40271667	28228325	23025055

	LTHS Model 1	**LTHS Model 2**	**LTHS Model 3**	**Grad Model 1**	**Grad Model 2**	**Grad Model 3**
	b	**b**	**b**	**b**	**b**	**b**
Fixed Effects						
Initial status	29.9317 ***	37.3564 ***	36.4288 ***	30.1086 ***	37.7665 ***	36.7766 ***
Grade	29.9458 ***	27.0678 ***	26.7674 ***	29.8662 ***	27.0260 ***	26.7299 ***
Grade^2						
Child/Family Characteristics						
Race (ref=white)						
Black		-11.9327 ***	-12.2849 ***		-12.3524 ***	-12.4745 ***
Hispanic		-3.8008 ***	-3.0470 *		-4.0727 ***	-3.0926 *
Asian		1.6265 *	2.5144 **		1.4860 *	2.4956 *
Other		-4.5608	-4.8362 †		-4.6553	-4.8632 †
Child in good health		1.4009 ***	1.2947 ***		1.4143 ***	1.3017 ***
Male		3.2792 ***	3.1851 ***		3.2704 ***	3.1548 ***
Parents not married		-2.3349 ***	-2.3624 ***		-2.3595 ***	-2.3956 ***
Residential Mobility		-3.4033 ***	-3.8082 ***		-3.3838 ***	-3.8006 ***
Maternal Education (ref=HSSC)						
LTHS		-3.9821 ***	-5.2442 ***		-4.1191 ***	-5.3558 ***
Bachelor		3.1232 ***	2.7790 ***		3.0052 ***	2.6787 ***
Grad/professional		4.0377 ***	3.5123 ***		3.9574 ***	3.4430 ***

		5.6459	6.1841		5.6391	6.1095
SES (continuous measure)		***	***		***	***
Parent Communication		-0.0285	-0.0082		-0.0323	-0.0132
		0.5086	0.2704		0.5067	0.2800
Parental Involvement in Education		***	†		***	†
School Characteristics						
% Minority Students (ref=0-<25%)						
25 - <50%			-0.8832			-0.9697
50 - <75%			-0.9635			-1.028
>=75%			-0.1398			-0.3416
			3.1406			3.1379
Parents are active in school programs			***			***
Problem with teacher turnover			0.3292			0.36
Neighborhood Characteristics	**LTHS**	**LTHS**	**LTHS**	**Grad**	**Grad**	**Grad**
	4.0033	4.7785	4.4100	2.1946	3.7370	3.5620
Time-Varying Propensity Score	***	***	***	**	***	***
Neighborhood Tertiles (ref= Moderate)						
	3.5090	0.3975	0.3920	-3.5166	-1.1291	-0.9361
Low	***			***	***	*
	-5.2630	-1.7368	-1.3549	4.1380	0.9228	1.0283
High	***	**	*	***	*	*
Random Effects						
Intercept						
Slope						
AIC	40224306	28218668	23018914	40257331	28223463	23021123
BIC	40224371	28218839	23019118	40257395	28223634	23021327

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Appendix D. Nested growth curve models estimating the relationship between neighborhood context and internalizing behaviors among elementary school children in the ECLS-K sample. Model 1 includes neighborhood context and TVPS. Model 2 adds child and family characteristics. Model 3 adds school characteristics.

	FHHH Model 1	FHHH Model 2	FHHH Model 3	Instability Model 1	Instability Model 2	Instability Model 3
	b	b	b	b	b	b
Fixed Effects						
Initial status	-0.1864 ***	0.2091 **	0.1871 **	-0.2467 ***	0.2961 ***	0.2920 ***
Grade	0.0001	0.0024	0.0057	-0.0003	0.0028	0.0063
Child/Family Characteristics						
Race (ref=white)						
Black		-0.1236 ***	-0.1037 ***		-0.0782 **	-0.0760 ***
Hispanic		-0.1656 ***	-0.1112 ***		-0.1336 ***	-0.0945 ***
Other		-0.1061 **	-0.1214 ***		-0.0862 *	-0.1114 **
Child in good health		-0.1237 ***	-0.1493 ***		-0.1335 ***	-0.1612 ***
Male		0.0760 ***	0.0709 ***		0.0752 ***	0.0701 ***
Parents married		-0.2020 ***	-0.1890 ***		-0.2195 ***	-0.2099 ***
Maternal Education (ref=LTHS)						
HSSC		-0.0571 *	-0.0580 *		-0.0587 *	-0.0568 *
Bachelor		-0.0858 **	-0.0686 *		-0.0870 **	-0.0663 †
Grad/professional		-0.0605	-0.0478		-0.0475	-0.0303
SES (continuous measure)		-0.0839 ***	-0.0887 ***		-0.1179 ***	-0.1277 ***
Mobility		0.0670 ***	0.0775 ***		0.0703 ***	0.0822 ***
School Characteristics						
% Minority Students (ref=0-<25%)						
25 - <50%			0.0092			0.0264
50 - <75%			-0.0538			-0.0198
>=75%			-0.0988 ***			-0.0556 *
Parents are active in school programs			0.0113			0.0051
Neighborhood Characteristics	**FHHH**	**FHHH**	**FHHH**	**Instability**	**Instability**	**Instability**
Time-Varying Propensity Score	0.3868 ***	0.1693 ***	0.2168 ***	0.4460 ***	0.0043	0.0137
High Neighborhood (Ref=Low)	0.0272	0.0414 *	0.0418 *	0.0408 ***	0.0382 *	0.0315 †

Random Effects						
Intercept	0.2560 ***	0.2473 ***	0.2469 ***	0.2660 ***	0.2488 ***	0.2490 ***
Slope						
AIC	22780709	12953796	10426214	22828820	12958265	10431536
BIC	22780760	12953933	10426379	22828871	12958402	10431701

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Appendix E. Nested growth curve models estimating the relationship between neighborhood context and externalizing behaviors among elementary school children in the ECLS-K sample. Model 1 includes neighborhood context and TVPS. Model 2 adds child and family characteristics. Model 3 adds school characteristics.

	FHHH Model 1	FHHH Model 2	FHHH Model 3	Instability Model 1	Instability Model 2	Instability Model 3
	b	b	b	b	b	b
Fixed Effects						
Initial status	-0.2166***	-0.2544***	-0.2659***	-0.3184***	-0.2026*	-0.2171**
Grade	0.0220***	0.0193***	0.0167**	0.0211***	0.0200***	0.0174**
Child/Family Characteristics						
Race (ref=white)						
Black		0.2964***	0.3464***		0.3376***	0.3720***
Hispanic		-0.1153*	-0.0591		-0.0881*	-0.0453
Other		-0.1121*	-0.1194*		-0.0943†	-0.1097*
Child in good health		-0.0057	-0.0096		-0.0153	-0.0215
Male		0.4157***	0.4104***		0.4149***	0.4097***
Parents married		-0.1352***	-0.1381***		-0.1516***	-0.1572***
Maternal Education (ref=LTHS)						
HSSC		0.0024	0.028		0.002	0.0297
Bachelor		-0.051	-0.0274		-0.0511	-0.0249
Grad/professional		-0.0306	-0.0273		-0.0158	-0.008
SES (continuous measure)		-0.0715***	-0.0662***		-0.1087***	-0.1085***
Mobility		0.0129	0.0053		0.0125	0.0043
School Characteristics						
% Minority Students (ref=0-<25%)						
25 - <50%			-0.0544***			-0.0436**
50 - <75%			-0.0262			-0.0044
>=75%			-0.0865**			-0.0572†
Parents are active in school programs			-0.0067			-0.0107
Neighborhood Characteristics	**FHHH**	**FHHH**	**FHHH**	**Instability**	**Instability**	**Instability**
Time-Varying Propensity Score	0.3073***	0.2134***	0.2667***	0.5210***	0.0971***	0.153
High Neighborhood (Ref=Low)	0.1329***	0.0280†	0.0197	0.0649***	0.0391*	0.0283†
Random Effects						

Intercept	0.5440 ***	0.4638 ***	0.4553 ***	0.5568 ***	0.4651 ***	0.4573 ***
Slope	0.0092 ***	0E+00	0E+00	0.0101 ***	0E+00	0E+00
AIC	21340603	12302153	9940315	21387698	12306997	9945898
BIC	21340664	12302299	9940488	21387758	12307143	9946071

† p <0.10. * p<0.05. ** p<0.01. *** p<0.001.

Appendix F. Descriptive statistics of child, family, and school, characteristics for reading and math achievement and internalizing and externalizing behaviors. Weighted and pooled sample from the ECLS-K sample – kindergarten through 5th grade.

	Pooled Sample				
	N	**Mean**	**SE**	**Min**	**Max**
Outcomes					
Reading Scores	40700	49.79	0.24	15.00	143.68
Math Scores	41580	49.84	0.27	18.62	120.17
Internalizing Behaviors	52130	0.01	0.01	-1.17	4.67
Externalizing Behaviors	52480	0.02	0.01	-1.14	4.06
Child and Family Characteristics					
Race and Ethnicity					
White	60110	0.58	0.02	0	1
Black	60110	0.15	0.02	0	1
Hispanic	60110	0.19	0.02	0	1
Other	60110	0.07	0.01	0	1
Child in good health	60110	0.83	0.01	0	1
Male	60300	0.52	0.01	0	1
Parents married	57030	0.71	0.01	0	1
Residential Mobility	41350	0.14	0.00	0	1
Maternal Education					
LTHS	53410	0.13	0.01	0	1
High school and some college	53410	0.63	0.01	0	1
Bachelor's degree	53410	0.18	0.01	0	1
Graduate or professional degree	53410	0.07	0.00	0	1
SES	57440	-0.03	0.03	-4.75	2.88
Parent Communication	56720	2.61	0.05	0	99
Parental Involvement in Education	57100	-0.01	0.02	-3.89	2.18
School Characteristics					
% Minority Students					
0- <25%	57660	0.49	0.03	0	1
25 - <50%	57660	0.17	0.01	0	1
50 - <75%	57660	0.12	0.01	0	1
>=75%	57660	0.23	0.02	0	1
Parents are active in school programs	46460	0.78	0.01	0	1
Problem with teacher turnover	46490	0.07	0.01	0	1

N=9,810 students for math achievement; N=9,790 students for reading achievement. Reading and math scores were standardized with mean=50 and standard deviation=10. N=16,080 students for internalizing behaviors; 16,160 students for externalizing behaviors. Internalizing and externalizing behavior scores were standardized with mean=1 and standard deviation=0. Per ECLS-K guidelines, all N's are rounded to the nearest 10 to protect student privacy and weighted with sample weights.

Appendix G. Scale and Variable Description for *K*-means Cluster Analysis Creation:
Following the work of Sampson (1999; 1997), Krieger (1997), and Townsend (1988), I created a socioeconomic deprivation index using the proportion of residents living below the federal line, proportion who receive public assistance, proportion who identify as non-Hispanic black, the proportion of unemployed male residents, the proportion of renter occupied housing, and the proportion of households that do not have access to a car. For each wave, these variables were a principal components analysis was estimated to ensure that these variables could be condensed into one dimension. At each wave, the PCA produced one factor with and Eigenvalue over three. For ease of interpretation, the socioeconomic deprivation index was create by summing standardized z-values for each of the component variables.

Because the 2000 Decennial Census asked if residents lived in the same residence 5-years prior to the survey, while the 2005-2009 ACS asked if residents lived in the same residence 1-year prior to the survey, the measure could not be directly compared across data. Thus, I transformed each measure of residential stability into quintiles where 1 represented school tracts with the lowest levels of residential stability and 5 represented the highest stability. This allowed for comparisons of levels of stability across the census and ACS datasets.

The Diversity Index (Meyer & McIntosh, 1992) represents the likelihood that two persons, chosen at random from the same area, belong to different racial groups. This equation is:

$$V_i = (1 - \sum {p_i}^2)$$

where p_i represents the proportion of the population in each racial group for each census tract.

All variables/scales were time varying.