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EARLY ASSOCIATIONS BETWEEN ADVERSITY AND CHILD BEHAVIORAL OUTCOMES: AN EXAMINATION OF THE FUNCTIONAL FORM AND THE ROLE OF NEIGHBORHOOD CONTEXT

Dissertation

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ABSTRACT

Early Associations Between Adversity and Child Behavioral Outcomes: An Examination of the Functional Form and the Role of Neighborhood Context

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Research on adverse childhood experiences (ACEs) has demonstrated high prevalence rates of such experiences, with about 60% of individuals in national U.S. samples reporting experiencing ACEs as children (Chapman et al., 2013; Finkelhor et al., 2015). Further, research has established robust links between ACEs and a range of negative behavioral and health outcomes in adulthood (Felitti et al., 1998; Hughes et al., 2017; Kalmakis & Chandler, 2015; Wolff et al., 2018). Less is known about when potential negative consequences of ACEs exposure emerge. The few studies that have examined the relationship between ACEs and early outcomes have employed inconsistent modeling strategies which has left the functional form of the relationship unclear (Crouch et al., 2019; Hughes et al., 2017; Lanier et al., 2018; Wang et al., 2019). Further, these studies have not comprehensively examined the potential moderating role of neighborhood context. In order to address these gaps, the currently study examined the functional form of the relationship between ACEs experienced in the first four years of life and kindergarten behavioral outcomes and tested the moderating role of neighborhood resources and neighborhood adversities in a large, nationally representative sample of young children drawn from the Early Childhood Longitudinal Study - Birth Cohort (ECLS-B; N≈10,700) linked with neighborhood administrative data. Using inverse probability weighting to strengthen internal validity, numerous modeling strategies supported a linear relationship between early childhood

ACEs and kindergarten behavioral outcomes. Greater ACEs exposure was associated with significantly lower prosocial skills and significantly higher externalizing behavior problems, with small effect sizes of 0.075 to 0.143 standard deviation shifts in behaviors for each additional ACEs exposure. Interaction models found that ACEs were significantly associated with behavioral consequences regardless of neighborhood context. Overall, the robust modeling strategies employed provide the strongest evidence to date of the significant, linear relationship between ACEs and early behavioral consequences.

Keywords: Adverse childhood experiences; Early childhood; Behavioral outcomes; Neighborhood context

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CHAPTER ONE: INTRODUCTION

The topic of child trauma has progressively made its way into public conversation as parents, educators, and health professionals have become increasingly aware of and concerned about disrupting the negative consequences associated with traumatic life experiences in childhood, thanks in large part to the landmark CDC-Kaiser study which brought the prevalence of this issue to the forefront. A common construct used to study and discuss traumatic child experiences - introduced by Felitti and colleagues (1998) in the CDC-Kaiser study - is adverse childhood experiences (ACEs). ACEs refer to a constellation of childhood experiences (e.g., parent mental illness, divorce, child neglect, etc.) which tend to be associated with increased risk for negative, long-term adult outcomes, particularly health and behavioral outcomes as a function of the stress induced by these experiences and resulting biological and neurological shifts that can occur as a result of the body's stress response (Dong et al, 2004; Felitti et al., 1998; Shonkoff et al., 2012; Turner et al., 2020).

While debate continues regarding the inclusiveness of the original ACEs measure (e.g., Finkelhor et al., 2013; Mersky et al., 2017; Turner et al., 2020), it is still widely used in research on the topic. This ACEs composite measure included ten factors: psychological or emotional abuse, physical abuse, sexual abuse, psychological or emotional neglect, physical neglect, intimate partner violence (IPV), parent substance abuse, parent mental illness, parent divorce or separation, and parent incarceration (Dong et al., 2004; Felitti et al., 1998). The initial ACEs study shed a light on the flooring prevalence of such experiences in middle and upper class American families with about two thirds of people surveyed in the CDC-Kaiser ACEs study having reported experiencing at least one of these types of ACEs sometime during childhood, and the majority of those having reported experiencing more than one type of ACE (Felitti et al.,

1998). According to analyses using data from nationally representative and more modern datasets, about 60% of individuals reported experiencing one or more types of ACEs as children (Chapman et al., 2013; Finkelhor et al., 2015). Narrowing the scope to consider ACEs exposure during early childhood - that is, exposure prior to formal school entry - studies have found that between 41%-55% of children have experienced at least one type of ACE by age five (Jimenez et al., 2016; Jimenez et al., 2017). Together, these statistics suggest that ACEs exposure is pervasive and, for many who have these experiences, exposure begins early on in life.

Making the high incidence rate of these types of experiences more concerning is research demonstrating a link between ACEs and children's cognitive, social-emotional, behavioral, and mental and physical health outcomes spanning into adulthood (Dong et al., 2004; Felitti et al., 1998; Hughes et al., 2017; Kalmakis & Chandler, 2015; Wang et al., 2020; Wang & Maguire-Jack, 2018; Wolff et al., 2018). Though considerably less research has examined short-term outcomes of ACE exposure compared to long-term adolescent and adult outcomes, some research has suggested that ACE exposure is associated with lower literacy, lower academic performance, and higher rates of behavior problems in kindergarten (Jimenez et al., 2016). These early negative outcomes have the potential to cascade if not caught, leading to long-term repercussions across academic, social, and socioeconomic aspects of life (Felitti et al., 1998; Hughes et al., 2017; Kalmakis & Chandler, 2015). Further, descriptive research in a convenience sample suggests that the health and behavioral risks associated with ACEs increase as the number of different types of adverse experiences a child is exposed to grows (Felitti et al., 1998).

While a body of literature demonstrating the negative consequences associated with adverse childhood experiences has existed for decades (e.g., Augoustinos, 1987; Wind & Silvern, 1992), work by Felitti and colleagues in the original ACEs study brought to light, for the

first time, both the staggering prevalence of ACEs in middle and upper income families and the surprisingly robust connection between ACEs and a wide array of behavioral and physical health outcomes into adulthood (Felitti et al., 1998). The results of this study made salient the relevance of early adversity to public health and medical fields, which had previously not given due consideration to the implications of these socio-ecological factors on health outcomes (Anda et al., 2010; Kelly-Irving & Delpierre, 2019). Further, the tool developed in this study to assess ACEs provided the public, researchers, practitioners, and policy makers with an accessible and shared framework for thinking about and practically evaluating risk for child trauma for intervention purposes (though practical use has been critiqued; Dube, 2018; Kelly-Irving & Delpierre, 2019; Lacey & Minnis, 2020). This landmark study has stimulated a range of further research on the topic which has confirmed and expanded upon its findings, including exploration into the mechanisms linking adversity and outcomes, interactive contextual factors, and additional adversities not included in the original ACEs composite which have been linked to similar behavioral and health consequences (e.g., Cronholm et al., 2015; Hughes et al., 2017; Kalmakis & Chandler, 2015; Wang et al., 2020; Wang & Maguire-Jack, 2018; Wolff et al., 2018). The pervasiveness and detrimental repercussions suggested by the literature increases the urgency for us to ensure the use of the most appropriate methods for predicting behavioral risks associated with ACE exposure so that practitioners working with children can better assess adversity, predict potential risk, and steer children and families towards appropriate resources. Additionally, it's important that we identify mechanisms which might buffer or protect against associations with negative outcomes as this is key information which practitioners may be able to leverage to more effectively intervene early in children's lives. The current study seeks to build upon the foundation paved by Felitti and colleagues to support progress towards these goals.

While the landmark ACEs study was innovative and formative for this line of work, it is not without its limitations which leave ample room for further, more precise exploration. Common criticisms of this study include but are not limited to the use of a convenience sample of primarily White, middle and upper class families not representative of the U.S. population; the use of retrospective, adult data which does not allow for more close attention to timing of ACEs nor short-run consequences of ACEs and has the potential for recall bias; and the lack of ability to clearly examine mechanisms or moderators of the associations found (Hartas, 2019; Kelly-Irving & Delpierre, 2019). The current study seeks to improve upon these limitations by studying ACEs using a nationally representative sample which collected prospective data on early child experiences and development via a combination of direct assessment, parent report, and teacher report on children from birth through kindergarten merged with neighborhood demographic data to allow for the study of short-run links between early ACEs (reported roughly in real time) and early behavioral outcomes as well as the examination of moderating factors.

Moving beyond the initial ACEs study to consider the body of work that has followed, many gaps remain in the extant literature. First, while there is a wealth of evidence suggesting ACE exposure prior to age 18 is connected with a range of adolescent and adult behavior and health outcomes (e.g., Felitti et al., 1998; Hughes et al., 2017; Kalmakis & Chandler, 2015), comparatively few studies have examined how ACE exposure in the first years of life is connected to early childhood outcomes. Second, while research has generally suggested that accumulating multiple types of ACE exposure (e.g., child physical abuse, child emotional neglect, parent mental illness, etc.) is associated with greater risk of developing negative behavioral and health outcomes (Crandall et al, 2019; Felitti et al., 1998), studies tend to either create count variables of ACEs and assess linear association with outcomes (e.g., Crandall et al,

2019; Schilling et al., 2007) or examine non-linearity crudely through the use of a dichotomous variables differentiating high versus low ACEs exposure. A practice of cutting at four or more ACEs versus less than four is a convention that was seemingly developed arbitrarily rather than from theoretical or empirical evidence (e.g., Felitti et al., 1998; Wang et al., 2020; Wang & Maguire-Jack, 2018). This specification approach could lead to imprecise estimation of the outcomes associated with ACEs (Royston et al., 2006). On the one hand, reducing data into categories could result in the loss of key data and an underestimation of the outcomes associated with ACEs while an incorrect functional form could give undue weight to a subset of children, potentially leading to an overestimation.

Beyond the lack of clarity around the functional form or shape of the association between increased types of ACE exposure and early childhood outcomes, a third limitation in the literature is a lack of attention to factors that moderate this relationship. While neighborhood stressors like neighborhood violence and disorder have been connected to worse outcomes for ACE exposed children (Wang et al., 2020; Wang & Maguire-Jack, 2018; Wolff et al., 2018), a more comprehensive set of neighborhood-level stressors that mirror those experienced by ACEs exposed children (e.g., poverty rates, unemployment rates, percent of single-family households, parent mortality rates, justice-involvement rates) have yet to be systematically explored. Additionally, research has not systematically explored whether neighborhood resources, such as social services or early education programs, might temper the effects of ACEs.

The current study seeks to fill these gaps in the extant literature. First, it seeks to more thoroughly explore the functional form of the relationship between ACEs exposure and early behavioral outcomes to understand whether the relationship between the number of discrete types of ACEs experienced in early childhood is related linearly or nonlinearly with early

behavioral outcomes. While past work has largely used linear analytic tools to model this relationship, it could be that the negative short-run behavioral outcomes associated with ACE exposure increase steeply at first and then plateau at some critical number of ACE types. Indeed, some work suggests that inclines in negative elementary and adolescent outcomes could be steeper at lower ACE scores, possibly to the point of demonstrating a ceiling effect on behavior scales by an ACE score of two to three (Kowalski et al., 2022; Turner et al., 2020). Alternatively, some research on adult outcomes has suggested a quadratic relationship between ACE scores and a range of behaviors such that steeper increases in behavioral outcomes are seen at higher ACE scores compared to lower ones (Lamela & Figueiredo, 2018; Mersky & Lee, 2019; Tan & Mao, 2023). However, prior literature has not studied potential non-linearities between early ACEs and outcomes for children prior to school entry.

By exploring whether the functional form of the relationship between ACE exposure and early behavioral outcomes is linear or non-linear and analyzing the data for the most appropriate cut-points between high- and low- ACE exposure, a more precise estimation of their associated outcomes can be identified. Delineating more precise ways of estimating the relationship between ACE exposure and child behavioral outcomes may, in turn, allow for more precise identification of the children most at risk and appropriate intervention targets. As tiered intervention strategies show increasing promise in supporting students with appropriate intensity of intervention and resources based on demonstrated need (e.g., Walsh et al., 2016), better understanding the nature of a child's risk as a function of their breadth of ACE exposure may allow practitioners to allocate resources and support to children more effectively.

In addition to the value in understanding the form of the relationship between ACEs and short-run outcomes, there is also value in exploring moderating factors that might minimize or

exacerbate this relationship. One set of moderating factors which are important to explore exists at the neighborhood level. For example, it is essential to assess whether neighborhood resources such as educational resources, medical resources, cultural resources, and social services buffer the negative behavioral outcomes associated with ACEs for young children. Each of these resources could be theorized to support families through provision of financial, physical, and/or social resources to parents and/or children. Additionally, it is important to explore neighborhood-level ACEs like unemployment rates, single parent household rates, violent crime rates, arrest rates, poverty rates, and parent mortality rates as amplifiers of children's family-level exposure to ACEs, as these neighborhood stressors are expected to decrease access to resources (fueled by increased demand), decrease social support for parents, and/or increase stress on parents and children.

As one of a small number of studies to explore the role of neighborhoods in modifying the relationship between ACEs and early child behavioral outcomes, this study is novel in its exploration of neighborhood resources and neighborhood-level ACE exposure in relation to early childhood outcomes. Understanding which of these neighborhood resources are most promotive of children's positive outcomes could help practitioners develop more targeted interventions that utilize the most helpful community resources to support children with ACE exposure. Further, understanding whether rates of neighborhood-level ACEs exacerbate negative outcomes associated with ACE exposure could be leveraged to better identify and monitor risk at the community level.

CHAPTER TWO: LITERATURE REVIEW

Consequences of ACE Exposure

Building upon earlier work linking traumatic childhood experiences and a range of health and behavioral outcomes (Augoustinos, 1987; Kempe et al., 1962; Wind & Silvern, 1992), research over the past two decades has utilized the ACEs framework to establish a clear connection between childhood adversity and the potential for negative long-run health and behavioral outcomes. ACEs exposure has been linked to a variety of negative health and behavioral outcomes in adulthood including but not limited to risk of sleep problems, obesity, COPD, heart disease, mental illness, and substance abuse (for review see Hughes et al., 2017; Kalmakis & Chandler, 2015). A number of studies examining ACEs have focused on long-run outcomes, often because their methodologies have employed self-report, retrospective data collection from adolescents and adults about their childhood experiences to explore connections between ACEs and adult/adolescent outcomes (e.g., Choi et al., 2019; Felitti et al., 1998; Lee et al., 2020). These studies have proven valuable in establishing a potential connection between ACEs and a range of individual outcomes and highlighting the potentially dire long-term behavioral and health consequences of such early experiences. However, these methods do not provide us with the opportunity to learn about how and when negative outcomes associated with ACEs might begin to arise in childhood and to pinpoint opportunities for early intervention.

In response to this, a few studies have begun to examine earlier child outcomes associated with ACEs, generally suggesting that there are often short-run negative outcomes associated with traumatic life events as well (e.g., Clarkson Freeman, 2014; Jimenez et al., 2016; Wang et al., 2019; Wang et al., 2020). Specifically, some of these studies have found that early childhood ACEs have short-run associations with behavioral outcomes for children as young as

three exhibiting significantly lower rates of prosocial skills and higher rates of internalizing and externalizing behaviors compared to children without ACE exposure, though the magnitude of differences has been relatively small (Clarkson Freeman, 2014; Wang et al., 2019). These behavioral differences have been found to be maintained from childhood into adolescence (Wang et al., 2019) and tied to dosage such that increased ACEs exposure was associated with increased risk of experiencing behavioral problems (Clarkson Freeman, 2014). Further, some evidence suggests that early ACEs are also tied to academic outcomes including lower math, language and literacy skills in kindergarten (Jimenez et al., 2016). By focusing on short-run behavioral implications of ACEs, we have the opportunity to gain a better understanding of early repercussions of these experiences which may contribute to long-run outcomes.

Looking at methodologies employed in this set of studies, all have been correlational in nature, examining the association between ACEs and outcomes in a range of representative and non-representative datasets of varying sizes (N = 1,000-3,000). This set of studies relied on mother-reported ACEs data collected at one or two time points, in some cases reported retrospectively at the same time that outcome data was collected (Jimenez et al., 2016; Wang et al., 2020), which had the potential to introduce error via recall bias. ACEs measures in the studies varied somewhat in terms of which types of ACEs were included with some relying on a measure more analogous to the original ACEs study (Clarkson Freeman, 2014; Jimenez et al., 2016) and others incorporating newer indicators of economic adversity alongside traditional indicators (Wang & McGuire-Jack, 2018; Wang et al., 2020). Across studies, outcome data reported by one individual (the child's teacher or parent), with half of these studies relying on parent-reported predictor and outcome data raising concerns about single-reporter bias (Wang & McGuire-Jack, 2018; Wang et al., 2020). None of these studies have incorporated quasi-

experimental analytic techniques to reduce selection bias and enhance the causal strength of findings. Improving upon some of the methodological weaknesses in studies could provide an opportunity to deepen our understanding of how ACEs are associated with children's development in the earliest years, which has the potential to support efforts to design and implement effective early interventions that may curtail longer-run adverse outcomes.

Toxic stress theory. In order to understand why early ACEs exposure would be connected to short-run behavioral consequences, we can look to toxic stress theory (Gilbert et al., 2015; Shonkoff et al., 2012). Toxic stress theory suggests that the physiological stress response system, which typically aids us in responding to stressful situations, can become dysregulated in response to extreme or chronic high-stress situations. This biological dysregulation, in turn, has been hypothesized to have both short- and long- run repercussions for both physical and behavioral health (Shonkoff et al., 2012). Indeed, there is evidence of this biological dysregulation in both animals and humans as a function of prenatal exposure to stress (Brand et al., 2006; Cottrell & Seckl, 2009; Darnaudery & Maccari, 2008; Murgatroyd et al., 2009; Oberlander et al., 2008). Fetal studies have shown that prenatal adverse experiences and subsequent stress can influence later stress responsiveness (Brand et al., 2006; Cottrell & Seckl, 2009; Oberlander et al., 2008) while research with animals has linked stress dysregulation in offspring with stress dysregulation in later generations (Darnaudery & Maccari, 2008; Murgatroyd et al., 2009). Some post-natal research suggests that early exposure to adverse experiences may dysregulate the stress response through alteration of brain regions like the amygdala, hippocampus, and prefrontal cortex which all play a role in producing and regulating the hormonal stress response (Roth, Lubin, Funk, & Sweatt, 2009; Szyf, 2009). The potential for stress associated with ACEs to disrupt normative physiological and neurological development in

early childhood places further gravity on the importance of research which betters our understanding the relationship between early ACEs and early outcomes towards the goal of supporting the development of better ACEs identification and intervention tools.

Another similar theoretical perspective developed by Evans and colleagues (2002), suggests that stress induced by the presence of risk factors in a child's environment (both stressors like ACEs and biological hazards like pollution or water contamination) experienced cumulatively have the potential in increase a child's allostatic load (the cumulative wear and tear on the body caused by frequent or chronic overactivation of neuronal, endocrine, and cardiovascular systems). High allostatic loads in early childhood have, in turn, been shown to have repercussions for a variety of cognitive, behavioral, and health outcomes across the life-course (Evans, 2003; Evans & Schamberg, 2009; Johnston-Brooks et al., 1998; Rogosch et al., 2011).

Ecobiodevelopmental theory. The evidence laid out in support of toxic stress theory is in line with Shonkoff's ecobiodevelopmental theory (2012) which argues that early exposure to adversity and stress can initiate neurological and biological processes that, in turn, can have negative consequences for physical, mental, and cognitive development. By emphasizing the importance of environmental influences that intersect with children's neurological development, this theory suggests that early periods of development may be particularly important. Early childhood is a time of rapid neurological development during which the plasticity of the brain may make it particularly sensitive to insults from elevated stress hormones (Shonkoff et al., 2012). This suggests stressors like ACEs as well as potential moderators, like home and neighborhood contexts, experienced early in life could play an outsized role in children's behavioral and cognitive development as a function of their ability to disrupt or aid typical

neurological development. Considering this, we might expect to find early ACE exposure is uniquely associated with early outcomes in a way that is distinct from ACE exposure in middle childhood and adolescence. Specifically, it's possible that heightened sensitivity to stress in early childhood could lead to particularly steep inclines in behavioral consequences at low ACE scores. This lends credence to the argument for examining possible non-linearities in the relationship between ACEs and early behavior.

Multiple ACE Exposure and Child Outcomes

Factors included in ACEs composite measures. As discussed in chapter one, there are ten factors related to child abuse, neglect, and household challenges that were included in the ACEs composite developed in the CDC-Kaiser ACEs study (Dong et al., 2004; Felitti et al., 1998). While there was no empirical process for delineating what types of adverse experiences should be included in a wholistic ACEs scale (Turner et al., 2020), there was evidence linking the ACEs ultimately included in the original measure to child trauma and the negative behavioral repercussions of child trauma. For example, decades of evidence suggest that experiencing child neglect or emotional, physical, or sexual abuse is associated with a range of behavioral consequences including increased aggression and antisocial behavior, increased withdrawn behavior, and increased risk of mental illness, drug use, and risky sexual behavior into adulthood (Burns et al., 2010; Finkelhor, 2010; Norman et al., 2012; Prino & Peyrot, 1994; Yates, 2007). Child maltreatment may be linked to adverse outcomes via the stress produced by various forms of maltreatment, the detrimental impact of maltreatment on a child's ability to form secure relationship with their caregivers, and/or the strategies children develop for protecting themselves in an unsafe environment which may be productive for that environment but

maladaptive in other settings (Bowlby, 1978; Gilbert et al., 2015; Shonkoff et al., 2012; Thompson & Calkins, 1996).

In addition to child maltreatment, factors in the ACEs composite related to the physical absence of a caregiver such as parent death, divorce, or incarceration are likely to be traumatic for children. Parental absence could induce stress for a child both as a function of how that child experiences these events individually and how such events may increase emotional stress in their household among other caregivers (which could have repercussions for parental warmth and parenting behaviors; Conger & Conger, 2012; Gilbert et al., 2015; Shonkoff et al., 2012). The absence of a parent could also have repercussions for household finances, affecting both the resources a child has access to (i.e., food, enriching toys, high quality child care) and the time their remaining caregiver(s) have to engage with them (e.g., if a parent has to take on additional work to make ends meet; Bianchi, 2011). Similar to maltreatment, the loss of a parent through one of these modes could be associated with difficulty forming secure attachments to others as well as the development of coping mechanisms which are protective given the circumstances but maladaptive in other contexts (Bowlby, 1978; Thompson & Calkins, 1996). When studied individually, all of these factors have shown to be associated with negative consequences for children's behavioral and cognitive development (Berg et al., 2014; Kim, 2011; Malone et al., 2004; Turney & Goodsell, 2018).

Lastly, adversities like parent mental illness, substance use, and IPV may contribute to a mental or emotional distance between parents and children as a function of children's perceptions of danger or the temporary incapability of caregivers to engage in optimal parenting behaviors, provide emotional support, or maintain a healthy and safe home environment for the child. Further, research has established that parent mental illness, substance use, and IPV are

likely risk factors for child maltreatment (Chaffin et al., 1996; Dubowitz et al., 2011; Holmes, 2013; Taylor et al., 2009). IPV, in particular, has been shown to have similar negative consequences for children's behavior and wellbeing as direct abuse (for review see: Artz et al., 2014; Bair-Merritt et al., 2006). As with the other factors included in this composite, these factors also have been shown to be related to negative childhood and long-run outcomes (Carpenter & Stacks, 2009; Stallard et al., 2004).

While theoretical processes guided the choice to include of this particular set of evidence-based adversities and not others in the original ACEs composite, more recent research has confirmed the efficacy of several of these factors in predicting trauma symptomology (Turner et al., 2020). Notably, work by Turner and colleagues (2020) suggested that indicators of child maltreatment and parent mental illness were predictive of child trauma symptomology for children between the ages of two and nine, though they did not find this to be the case for other factors in the original ACEs composite. Further, Turner and colleagues (2020), along with others in the field (Afifi et al., 2017; Mersky et al., 2017), have provided evidence supporting the idea that other adversities like economic hardship belong in the ACEs composite. Turner and colleagues (2020) found that aspects of economic hardship in the home including low income status, welfare receipt, and unemployment were all predictive of trauma symptomology in young children. Further, Afifi and colleagues (2017) provide evidence that supports the inclusion of corporal punishment in ACE scales. Evidence from other work relying on a sample of families in MIECHVE programming argued for the inclusion of economic hardship, food insecurity, and homelessness in the ACEs composite (Mersky et al., 2017).

Operationalizing Multiple ACE Exposure and Child Risk. This line of research has focused heavily on identifying which factors best fit into the construct of ACEs with the goal of

ultimately being able to develop better measures to assess ACEs exposure. Such work is necessary and important if the applied goal of ACEs research is to develop tools that allow practitioners to identify children who may be at risk of trauma as a function of their experiences. However, creating a predictive measurement of ACEs is not the stopping point for developing such a tool. In order to practically use such a tool, it is important to understand how children's ACEs exposure is related to disruption of normative behavioral development in order to ensure that any intervention provides the correct level of support. In the original ACEs study (Felitti et al., 1998), ACEs scores were converted into a dichotomous variable which arbitrarily set a score of four as the cut point for the difference between "high ACEs" and "low ACEs." Despite this operationalization of ACEs extending from an arbitrary choice rather than theoretical rational or empirical evaluation, many studies have continued to use this threshold citing the original Felitti study (e.g. Crouch et al., 2019; Hughes et al., 2017).

Turner and colleagues (2020) set out to improve upon this model by determining an appropriate threshold using an empirical process. In this study, which used data pooled from three national surveys of children's exposure to violence (NatSCEV) conducted between 2008 and 2014, children's trauma symptomology was assessed through an empirically validated measure. A descriptive analysis examining the average number of ACEs for children in the top decile on the trauma symptomology measure was followed by receiver operator characteristic (ROC) analysis to access which ACEs cut point showed the strongest validity in predicting children's placement in the top decile of trauma symptomology (Turner et al., 2020). This research found that children in the top decile of trauma symptomology had experienced an average of 2.21 ACEs compared to an average of 0.74 ACEs for children not in the top decile of trauma symptomology (Turner et al., 2020). ROC analysis determined at cut point of four had

the strongest validity in predicting high trauma symptomology with a 73% success rate (Turner et al., 2020). Findings suggested that dichotomous measure of ACEs could be likely to over or underestimate developmental consequences and also indicated a steep rise in consequences associated with relatively low ACE scores. Such findings could suggest either a ceiling effect or a plateau in risk for children with a higher number of ACEs. While this process for determining a threshold between "higher risk" and "lower risk" children improves upon the original model introduced by Felitti and colleagues (1998), this study does not resolve concerns that estimating potential risk using limited categorical designations could lead to an under- or overestimating of risk for children, particularly those children who have ACEs scores near the threshold. Practically, if such designations were used in practice to determine allocation of resources, this could result in children not receiving the appropriate level of support or intervention.

While other studies also use a dichotomous variable with a cut point at an ACE score of four to represent high or low risk based on the number of distinct ACEs a child has been exposed to (e.g., Crouch et al., 2019; Hughes et al., 2017), there are many more which use a continuous count variable of ACEs and linear modeling strategies to assess connections to children's short run behavioral outcomes and adult health and behavior outcomes finding significant associations between ACEs and short-term externalizing behavior problems and long-term mental distress (e.g., Lanier et al., 2018; Wang et al., 2019). The extant literature has yet to answer the question of the shape and nature of the relationship between number of ACEs and assessing risk. This paper aims to fill this gap in our knowledge by exploring the functional form of the relationship between increased ACEs and children's behavioral outcomes.

Ecological Systems Theory and the Role of the Neighborhood

Beyond better understanding the relationship between ACEs and early childhood outcomes, it is also important to identify the contextual factors which might moderate this relationship. While the role of proximal forces like parent support and warmth have received ample attention as potential protectors against ACE-linked outcomes (e.g., Cohrdes & Mauz, 2020; Crandall et al., 2019; Crouch et al., 2019), less work has explored the role that neighborhood-level factors may play. Bronfenbrenner's ecological systems theory (1974) suggests that more distal factors like the neighborhood context can shape child development particularly as a function of how they intersect with more proximal aspects of a child's environment. Considering both the direct contact young children may have with features of the neighborhood like early education and care, parks, and museums and the likely limited unsupervised time young children spend out experiencing their neighborhood, we might expect neighborhood context to be both directly and indirectly related to child outcomes. Indeed, research has demonstrated a direct association between access to early education, pediatric care, and community spaces like parks to early childhood outcomes (Meloy et al., 2019; Reuben et al, 2019; Stevens et al., 2006).

However, the neighborhood context is also likely to matter for child development indirectly via how this context relates to parent stress and support. For example, neighborhood violence is associated with children's behavioral outcomes, and this connection is proposed to occur for younger children, at least partially, because of the threat to parent mental health and wellbeing neighborhood violence poses (Aisenberg & Herrenkohl, 2008; Busby, Lambert & Ialongo 2013; Cooley-Strickland, et al. 2011; Votruba-Drzal et al., 2020). Alternatively, research has documented indirect associations between neighborhood resources like educational and

cultural resources and young children's behavioral development functioning through parenting behaviors like discipline and stimulation, indicating there may be positive resources in the neighborhood that indirectly support early child development (Coley et al., 2021). Indeed, evidence dating back to the 1980s suggests that a range of neighborhood factors can play either beneficial or detrimental roles in children's cognitive and behavioral outcomes either via children's direct interaction with aspects of the neighborhood or indirectly via the ways that the neighborhood context does or does not support parents (for review see Leventhal, Dupéré, & Shuey, 2015).

Neighborhood resources as buffers against behavioral outcomes. Neighborhood contexts may play a salient role in disrupting or exacerbating the outcomes associated with ACEs as a function of social and physical resources they offer (or lack). On the one hand, it is possible that key resources in the neighborhood could support both children and families in ways that disrupt the relationship between ACEs and early outcomes.

Resource theory. As argued in the resource model, the availability and quality of resources like child care centers and cultural centers are likely to affect the enriching resources children have access to (Becker, 1991; Duncan, Magnuson, & Votruba-Drzal, 2017). Children's exposure to enriching materials and experiences like high quality early education promotes early behavioral and cognitive development (Duncan, Magnuson, & Votruba-Drzal, 2017). Therefore, availability of these sorts of resources in the neighborhood setting has the potential to directly shape early development. Research has found that the resources children and families have access to within their communities can offer key supports that are associated with cognitive and behavioral outcomes for children (for review see Leventhal et al., 2015). For example, Dupéré and colleagues (2010) found a direct link between neighborhood affluence and children's

achievement which was moderated by quality of child care options. Such resources may be particularly important for disrupting negative outcomes associated with early ACE exposure. For example, access to resources like childcare and early education may offer a reprieve from stressful home contexts and increase access to warm, supportive adult caregivers, potentially buffering children's potential for behavior problems.

Family stress theory. Alternatively, access to cultural and social resources like religious centers, community centers, mental health professionals, and social services may offer key supports to families that help to reduce parental stress and support parents in finding and implementing more productive parenting strategies, which in turn might buffer children from the negative consequences of ACE exposure as might be suggested by the family stress model (Conger & Conger, 2002). Lending support to this idea, a recent study exploring the relationship between neighborhood resources, parenting practices, and child outcomes, found evidence supporting the idea that the association between neighborhood contexts and child outcomes is mediated by parenting practices. Coley et al. (2021) found that community educational and cultural resources were associated with early behavioral development through indirect pathways mediated by harsh discipline. Through these two different mechanisms, neighborhood resources may function to disrupt the pathway between ACE exposure and early behavioral consequences for young children.

Neighborhood-level ACE-like factors exacerbating behavioral outcomes. It is also important to understand the ways in which neighborhood factors might heighten the negative outcomes associated with ACE exposure. Research suggests that stressors like neighborhood violence may be associated with worse outcomes for ACE exposed children (Wang et al., 2020). However, constructs used to explore neighborhood stressors like neighborhood disorder are

typically constructs developed with a focus on the adult experiences within the environment. Incorporating a broader view inclusive of neighborhood-level stressors that may be directly experienced by children (e.g., divorce rates, parent-age mortality rates, etc.) using a measure analogous to neighborhood-level ACE factors may provide an innovative approach to examine how child-centric, community-level stressors moderate an individual child's ACE-related outcomes.

Stress theories. Stress models suggest that stressors in the environment have the potential to play a role in children's development both directly, as proposed by the ecobiodevelopmental model and indirectly through the family and environmental stress models (Conger & Conger, 2002; Leventhal et al., 2015; Shonkoff et al., 2012). Young children may have less direct exposure to neighborhood-level stressors, but still have the potential for both direct and indirect mechanism of repercussions associated with neighborhood stressors. For example, it is possible that neighborhood-level ACEs children are directly exposed to would be associated with young children's stress levels and feelings of safety while neighborhood-level ACEs could also shape early child development through parents' interactions with the environment. Stress theories might suggest that neighborhood-level ACEs (or aspects of the neighborhood which are analogous to the experiences included in ACEs scales) may translate to increased disorganization in the neighborhood and reduced social support for parents and families, which has the potential to influence parent stress, subsequent parenting practices, and child outcomes (Conger & Conger, 2002). For example, while the experience of parent incarceration within a single family may have implications for parent and child stress within that family, high neighborhood-level rates of justice-involvement may signal neighborhood-level stress and limited supports in a neighborhood, which, in turn, may have implications for both parent and child well-being. In this

way, neighborhood stressors captured by neighborhood-level ACEs may moderate children's ACE-related behavioral outcomes as a function of the added stress and reduced social support they confer to both children and parents. Examining ACE-like stressors at the neighborhood level has the potential to provide more information about the types of stressors that exacerbate ACEs risk.

The Current Study

The proposed research will explore both the functional form of the relationship between ACEs and behavioral outcomes as well as how neighborhood-level factors may moderate this relationship. The study will focus on young children's ACE exposure and behavioral outcomes, specifically focusing on children's experiences from birth through kindergarten, which have received less attention in the literature than longer-term consequences. In sum, this study builds on the existing research related to ACEs and will contribute novel findings by examining the short run behavioral outcomes associated with early childhood ACEs and exploring the potential moderating role of neighborhood-level resources. Specifically, this study will answer the following research questions:

1. Is ACE exposure linked to early childhood behavioral outcomes?
    a. What is the functional form of the relationship between ACE exposure and early childhood behavioral outcomes?
2. Does the relationship between ACE exposure and early behavioral outcomes differ as a function of the availability of resources in the neighborhood (e.g., social services, educational resources, cultural resources, and medical resources)?
3. Does the relationship between ACE exposure and early behavioral outcomes differ as a function of the prevalence of ACE-like stressors in the neighborhood?

I have developed hypotheses related to each research question based on my review of the literature. Based on the limited research from Turner and colleagues (2020) suggesting an early peak in the number of ACEs associated with severe trauma symptomatology for children between the ages of two and seventeen, I tentatively hypothesize that the relationship between ACEs and early behavioral functioning may not be linear but rather logarithmic in function such that after a certain number of unique types of ACE exposure, behavioral consequences plateau, diminishing the negative behavioral consequences of additional types of exposure. Based on the breadth of evidence about how neighborhood resources and neighborhood stressors operate in children's lives across a range of behavioral outcomes, I predict that neighborhood resources will buffer negative behavioral outcomes and ACE-like exposure in the neighborhood will exacerbate negative behavioral outcomes associated with early childhood ACEs.

CHAPTER THREE: METHODS

This study sought to enhance the existing body of literature that has quantitatively examined the relationship between exposure to adverse events and early behavioral development by first elucidating the functional form of the relationship and then by exploring the potential moderating role of neighborhood contextual factors. This observational study utilized a large, nationally representative, secondary data set merged with national administrative data to conduct a non-experimental, quantitative analysis testing associations between ACEs and short-run child outcomes as well as interactions with neighborhood-level resources and stressors.

Sampling and Data Collection

Analyses for this study were conducted using data from the Early Childhood Longitudinal Study - Birth Cohort (ECLS-B). This is a large, nationally representative study

sponsored by the National Center for Education Statistics (NCES) which followed a cohort of about 10,700 children born in 2001 from infancy through kindergarten. The sample was created using a complex random cluster sampling design. Twins, American Indian, Asian/Pacific Islanders, and low-birth weight children were oversampled to allow for meaningful analysis of these subgroups (NCES, 2005). Data were collected over the course of five waves with wave one collected when target children averaged ten months (2001-2002; response rate 74.1%), wave two collected at two years (2003-2004; retention rate 92.0%), wave three at four years (2005-2006; retention rate 83.2%), wave four at age five when most children had entered kindergarten (2006-2007; retention rate 65.0%), and wave five at age six for a subset of children who entered kindergarten a year behind their peers (2007-2008; retention rate 93.7% of children eligible for inclusion in the subsample based on kindergarten entry status). The primary parent (identified as the birth mother in 99% of cases and from this point forward termed mother) of the study child was interviewed at all five waves. The fathers, either resident or non-resident fathers, of study children were interviewed at the first three and two waves, respectively. The childcare provider or preschool teacher of each study child were interviewed in waves two through five; children in the sample only have this data in waves corresponding with years that they were enrolled in some form of child care or preschool. Kindergarten teachers of each study child were interviewed at either wave four or five; children only have kindergarten teacher interview data at one of the two waves which corresponds to the year they entered kindergarten. Data from waves one through five were used for this study. This study included an analytic sample of children with a valid survey weight and behavioral outcome data from both parents and teachers in their kindergarten year ($N \approx 5,050$).

A multiple reporter method was used to capture data from parents, teachers, and direct child assessments. A combination of direct assessment data, parent-reported data, and teacher-reported data was used in this study to minimize the risk of error due to shared method variance. The ECLS-B was an ideal dataset for the study because it included a rich set of items over several waves including those related to child ACEs, child behavioral outcomes, child and family demographic information, and weights adjusting for sample selection and nonresponse to create estimates representative of the national population of children born in 2001. Because geographic identifiers were also available in this dataset, these data were merged with national administrative data in order to create measures of neighborhood resources and neighborhood-level ACE exposure. Neighborhood-level data were drawn from several public sources of national administrative data and were merged into the ECLS-B analytic dataset using household zip codes. Specifically, national administrative data was drawn from the 2000 U.S. Census Bureau (collected every ten years), the 2002 and 2007 Economic Census (EC) and National Center of Educational Statistics (NCES; collected every five years), annual National Center for Health Statistics (NCHS) and annual data from the FBI uniform crime reporting (FBI UCR) database corresponding with the first three waves of data collection (2001, 2003, 2005).

Measures

The proposed study used parent-reported and observational data on child ACEs and child behavioral outcomes reported by parents and teachers drawn from five waves of the ECLS-B in order to explore the relationship between early ACEs and short-run behavioral outcomes. Administrative data were used to create measures of neighborhood-level ACEs and resources in order to explore the potential moderating power of these factors. Child-level and family-level

covariates drawn from the ECLS-B were included in all models to help account for issues of endogeneity.

Behavioral Outcomes. The key outcome variables of interest in this study included internalizing, externalizing, and prosocial behavior. Prior research has suggested that ACE exposure is particularly detrimental for early behavioral development (Freeman, 2014; Grasso et al., 2016; Jimenez et al., 2016; Kerker et al., 2015), which can, in turn, have repercussions for children's school readiness, success in the academic arena, and long-term success into adulthood (Breslau et al., 2009; Kremer et al., 2016). Items for these measures were drawn from the Preschool and Kindergarten Behavior Scales - Second Edition (PKBS-2) and the Social Skills Rating System (Gresham & Elliott, 1990), which indicated how often children engaged in externalizing behaviors (e.g., antisocial or impulsive behavior), internalizing behaviors (e.g., anxious or withdrawn behavior), and prosocial behaviors (e.g., sharing, playing well with others). These variables were captured via both parent and teacher reports at waves four and five in the ECLS-B. Outcome data at wave four were used for children who entered kindergarten at wave four, and outcome data at wave five were used for children who entered kindergarten at wave five. Teacher and parent reported outcomes were used as they provide different insights into child behavior across school and home contexts. Teachers and parents reported how often on a scale of one (never), two (rarely), three (sometimes), four (often), or five (very often) children exhibited a range of externalizing, internalizing, and prosocial behaviors. Based on prior research and confirmatory factor analysis with the analytic sample, seven items tapping into externalizing behavior, two items tapping into internalizing behavior, and eleven items tapping into prosocial behavior were used to create scales for each construct (externalizing scale α = 0.79-0.92; internalizing scale α = 0.32-0.34; prosocial scale α = 0.80-0.91 across reporters in the analytic

sample; teacher-reported scales had consistently higher reliability compared to parent-report scales in line with previous evidence suggesting this difference; Stone et al., 2010). While the reliability for the internalizing scale is low across reporters, this scale has been used in a number of other analyses (e.g., Han et al., 2012; Pilkauskas, 2014). For each outcome variable, items used to create the measure were averaged and then standardized to aid comparison of results across outcomes.

Child ACEs. Several items were used to create an ACE composite measure that mirrors similar measures used in other literature to represent this construct (Felitti et al., 1998; Mersky et al., 2017; Turner et al., 2020; Wang et al., 2020; Wang & Maguire-Jack, 2018). These included six of the ten items that were included in the original ACE composite - parent IPV, parent divorce or separation, parent incarceration, parent mental illness, parent substance abuse, and emotional neglect (proxied with a measure of parent emotional support and warmth, reverse coded) (Felitti et al., 1998) - as well as four items that have since been studied and proposed for inclusion in ACEs - corporal punishment, parent death, economic hardship, and food scarcity (Afifi et al., 2017; Mersky et al., 2017; Turner et al., 2020). Note that four indicators from the original ACEs composite - physical abuse, sexual abuse, emotional abuse, and physical neglect - were not available in this dataset. All items used to create this ACE composite derived from either parent report, except in the case of direct assessment of emotional neglect via the two bags task. Additional information about each variable included in this construct is detailed in the following subsections below. As a note, for all items except emotional neglect, mother report data is used. For four indicators – parent mental illness, parent substance abuse, IPV, and corporal punishment - father-reported data is included in measure creation jointly with mother-reported data in order to have a more comprehensive understanding of child exposure to ACEs

from either parent. However, only a subset of fathers was included in the study. Most father data come from fathers residing in the household though a portion of father data comes from nonresidential fathers who have more than monthly contact with the study child.

IPV. Prior work suggests that IPV can have lasting consequences for young children's behavioral development and social and emotional wellbeing (for a review of this topic see: Carpenter & Stacks, 2009). This measure has been included in measures of ACEs since the construct's conception in the 1990s (Felitti et al., 1998). The ECLS-B asked both mother and fathers about conflict tactics used with each other, including two items on physical aggression, a measure of IPV similar to those used in other studies (Taylor et al., 2009). At waves two and three in the mother and father surveys, both parents reported whether they hit or threw things at the other parent when arguing. If either parent responded often, sometimes, or hardly ever to either question at either wave, the IPV variable was coded as one indicating IPV had occurred at least once; otherwise the variable was coded zero indicating no IPV had occurred.

Parent Divorce. Parent divorce or separation is another experience that has long been considered to have potential consequences for children's well-being as a function of a combination of the stress negotiating discord between parents, potential strain or in some cases severing of the relationship with one parent and potential hardship that could come from living in a single-parent household (Kim, 2011; Malone et al., 2004). For these reasons, parent divorce is typically included in the ACE construct. At each wave in the ECLS-B, the mothers reported on their marital status with the opportunity to choose married, widowed, separated, or divorced. If the parent reported being "separated" or "divorced" at wave one, two, or three, the parent divorce variable was coded as one; otherwise, the variable was coded as zero indicating the child's parents have not separated or divorced during this period.

Parent Incarceration. Parent incarceration can have wide-ranging impacts on young children stemming from the absence of the incarcerated parent, the stress associated with navigating the criminal justice system for both parents and children, and potential financial burdens placed on the non-incarcerated parent due to the loss of income from the incarcerated parent (Turney & Goodsell, 2018). All of these repercussions of parent incarceration have the potential to influence children's wellbeing, behavior, and development, and as such, this difficult family experience is included as an ACE. At wave one of the ECLS-B, the primary parent reported on whether the child's other parent was a member of the household. If not, the parent then reported whether the parent living outside the home saw their child, and if not why. One possible response as to why the parent did not see the child was incarceration. At all other waves, the survey respondent was asked for each member of the family reported as living in the household (e.g., mother, father, other relatives) at wave one whether they were still in the household. If the response was no, the reporter was then asked to give a reason why this person left the household with one possible response being incarceration. If the reporter indicated a parent could not see their child at wave one due to incarceration or was not in the household due to incarceration at waves two or three, children were coded as one for incarceration; otherwise, they were coded zero indicating no incarceration.

Parent Mental Illness. Being the child of a parent with mental illness has been linked to a range of maladaptive social, emotional, and behavioral outcomes for children as a function of a parent's mental illness impacting a parent's ability to give emotional and physical support to the child and engage in adaptive parenting behaviors (Stallard, et al., 2004; Thompson & Calkins, 1996). Therefore, this is yet another early life experience that fits into the ACE construct. At wave two, both parents reported whether they have had a serious mental illness (such as

schizophrenia, a paranoid disorder, a bipolar disorder, or manic episodes) or major depression. At waves one and three, mothers also completed a shortened 12-item version of the Center for Epidemiological Studies Depression scale (CES-D) used in other studies which is a highly reliable, commonly-used scale to assess depression in adults (Lewinsohn et al., 1997). The CES-D was also included in the wave one father surveys. If either parent reported they have a serious mental illness or major depression at wave two or any parent had a score on the CES-D indicative of moderate to severe depression at waves one or three (noted as a score of 10 or higher on the CES-D 12; National Center for Education Statistics, 2005), they were coded as a one for having a parent with mental illness; otherwise, the child was coded as zero for this variable.

Parent Substance Abuse. Parent substance abuse has been shown to disrupt more typical social, emotional, and behavioral development in favor of strategies that, while adaptive for a dangerous home environment, may not suit them in settings outside of the home (Thompson & Calkins, 1996). Both parents were asked to report on whether they had an alcohol abuse problem or disorder or a drug abuse problem or disorder at waves one and two. If either parent reported a drug or alcohol problem or disorder at either wave, they were coded as one for having a parent with substance abuse; otherwise, the child was coded zero for this variable.

Parent Emotional Neglect. A critical component of children's social, emotional, and behavioral development is the presence of a supportive, caring, and attentive parent with whom they can establish a secure relationship (Gilbert et al., 2009; Hildyard & Wolfe, 2002; Todd et al., 2001). A parent's consistent lack of attention and responsiveness to children's physical and emotional needs has been demonstrated to have lasting negative consequences across a number of physical and mental well-being metrics making this another standard factor in any measure of

global ACEs (Currie & Spatz Widom, 2010; Hussey et al., 2006; Wilson & Spatz Widom, 2010). Direct assessment at waves two and three using the two bags task captured parental emotional support, sensitivity, and positive regard among other factors via recordings of two parent-child play activities that were designed for use across economically, linguistically, and culturally diverse families (Najarian et al., 2010). Parent-child interactions were scored from one (very low) to seven (very high) by reliable, extensively trained coders on factors including parents' emotional support, sensitivity, and positive regard during play. Parent's scores on emotional support, sensitivity, and positive regard were averaged at each wave. If a parent had an average score below 4 (i.e., below the median-value score on the likert scale, which was equivalent to being below the 25th percentile) at either wave, their child was coded one for emotional neglect; otherwise children were coded zero.

Corporal Punishment. Evidence suggests that corporal punishment is a strong proxy for physical and emotional abuse and has a negative influence on children's social-emotional development and long-term mental health (Afifi et al., 2017; Gershoff & Grogan-Kaylor, 2016). It has therefore been argued to be an additional experience that qualifies as fitting under the ACE umbrella (Afifi et al., 2017). At waves two and three, both parents reported on whether they use hitting or spanking as a form of punishment when children misbehave. If either parent reported that they used either of these corporal punishment strategies at either wave, children were coded as one for experiencing corporal punishment; otherwise they were coded zero for this variable.

Parent Death. The death of a parent at an early age can have a myriad of repercussions on children's social-emotional wellbeing, behavior, and mental health as function of the trauma that can surround death and the grieving process, permanent loss of a relationship with that parent, repercussions to the remaining parent's mental and emotional well-being, and concrete

losses in time and monetary resources that may follow the loss of one parent (Berg et al., 2014). Theoretically, it would seem that parent death could have similar repercussions for children as other established ACEs, and psychometric analysis has confirmed that measures of parent death belong under the broader ACE construct (Mersky et al., 2017). In the first wave of the ECLS-B, if the primary parent reported that either the biological mother and/or father does not live with the child, they were asked to report why with one of the reasons reporters could choose being that the family member is deceased. Each wave following, if the reporter indicated that either the biological mother or father no longer lived in the household, this follow-up question was repeated. If either parent was reported as deceased at wave one, two, or three, the child was coded as one for parent death; otherwise they were coded zero.

Poverty. Family economic hardship has been linked to repercussions for a number of developmental domains both early in life and lasting into adulthood due to the stress this hardship places on parents with consequences for parents social and emotional wellbeing, potential trickle-down implications for parenting practices, and higher restrictions on the quantity and quality of tangible resources parents can provide their children (Conger & Conger, 2002; Neppl et al., 2016). It makes sense that this experience could be similarly detrimental for individuals compared to other ACE factors, and analysis confirms that this factor improves predictions of child outcomes when added to ACE measures (Finkelhor et al., 2013; Green et al., 2010; Mersky et al., 2017). In the ECLS-B, the mothers reported the annual household income at each wave. This data was used to make an indicator of whether the family's household income fell at or below the federal policy threshold for the year in which the data were collected. If a child’s household income fell at or below the federal poverty threshold for any of the three

waves, they were coded one for experiencing economic hardship; otherwise they were coded zero.

Food Scarcity. Food insecurity has been shown to be linked to health outcomes for young children as well as both behavioral and cognitive outcomes (for review see: Chilton et al., 2007; Perez-Escamilla & de Toledo Vianna, 2012). Again, analyses suggest that this variable aligns with the others included in standard ACE measures and inclusion of this variable strengthens the ability of ACE measures to predict children's outcomes, a strong argument for its inclusion (Mersky et al., 2017). At each wave, the primary parent reported on five items connected to direct repercussions of food insecurity to the study child including whether in the prior twelve months this child was ever not eating enough, had to have their portions cut, had to skip a meal, couldn't eat despite being hungry, or had to skip meals for an entire day because there wasn't enough money for food. If the parent answered yes to any of these questions during any of the first three waves, the child was coded one for food scarcity; otherwise, they were coded zero.

Creating the ACE Composite. Each indicator was then combined across the three waves, dichotomized to indicate the presence versus absence of each ACE across the time period from infancy through age 4. These indicators were then summed to capture the total number of ACEs a child has been exposed to, ranging from zero to ten. This method for coding ACEs is frequently used to capture ACE exposure in the literature (e.g., Felitti et al., 1998; Wang et al., 2020; Wang & Maguire-Jack, 2018). An examination of the histogram, skew (0.57), and kurtosis (2.75) for the ACEs composite suggested moderate skew and initial step analysis suggested that cases with scores above 7 (0.24% of the sample; $N < 50$) may be outliers across outcomes. It was decided that the measure would be top coded at the 99th percentile, which was equal to a score of 7. The composite was centered in interaction models to aid interpretation.

Neighborhood-Level Variables. A key element of this study is exploring how aspects of the neighborhood environment might either temper or exacerbate the relationship between child ACEs and early behavioral development. The ECLS-B had zip code geo-identifiers which allowed us to link each child's zip code at each wave with administrative data in order to examine both neighborhood-level resource and neighborhood-level ACE-like exposure. More information on how each measure was created is provided below.

Neighborhood-level Resources. There are a number of neighborhood-level resources which could support children and families in ways that might temper possible negative behavioral consequences of children's ACE exposure. EC and NCES data from 2002 and 2007 (both are collected every five years) were used to create count variables for four types of resources in each child's neighborhood (defined as their zip code): educational, health, social service, and cultural resources (U.S. Census Bureau, 2021), matched to each child's zip code at wave 1, 2, and 3. Data from the closest year to data collection was used for each wave: 2002 data were used for waves 1 and 2 and 2007 data were used for wave 3. First, a count of educational resources in the neighborhood was created including the number of schools, libraries, daycares, and parent education/training institutions. This educational resource variable captured resources that could support families via pathways for socioeconomic gains (through parent schooling and child care) as well as support the child's social-emotional, behavioral, and cognitive development via access to educational opportunities offered at schools and libraries (Coley et al., 2021; Votruba et al., 2020). Then a count of medical services including medical institutions like hospitals, clinics, and pharmacies in the neighborhood which have the potential to lessen ACE consequences as a function of supporting both parents' and children's mental and physical well-being was created (Coley et al., 2021; Votruba et al., 2020). Third, a count of social services

including the number of shelters, food services, family and youth services, rehabilitation services, and emergency services in the neighborhood was created to assess family access to economic and physical resources that might decrease household stress and support adaptive parenting behaviors which could buffer against behavioral consequences associated with ACEs (Coley et al., 2021; Votruba et al., 2020). Finally, a count of neighborhood cultural resources including religious organizations, parks, amusements, museums, historical sites, and sports/fitness resources was created as cultural resources like this may dampen behavioral outcomes linked with ACEs as a function of the social and cognitive stimulation they provide children and the social support networks they have the potential to provide to parents (Coley et al., 2021; Votruba et al., 2020).

For each of these four constructs, proportions of resources per 1,000 people were created. To account for high skew in all four constructs, variables were then log transformed. For the primary operationalization of these variables, the four categories of resources were then used to create an overall measure of neighborhood resources by averaging across waves and standardizing (see Appendix A for the factor analysis of this composite). Alternate models explored these neighborhood resources in a disaggregated fashion to examine their unique potential to moderate or buffer the relationship between ACEs and outcomes. In this case, the logged proportions of each variable previously calculated were standardized.

Neighborhood-level ACE-like Exposure. 2000 Census data, annual NCHS data, and annual FBI UCR data from the years of data collection (2001, 2003, 2005) were merged with ECLS-B data in order to assess neighborhood-level ACE-like exposure, again drawing administrative data at the zip code level. The measure of ACE-like exposure used drew upon three data points collected in the 2000 decennial census: percent of female headed households,

poverty rates, and unemployment rates. Percent of female headed households in the neighborhood was included because it aligns to child experiences of divorce and other ACE constructs that leave children with a single-parent family structure (e.g., parent incarceration, parent death). Poverty rate was operationalized as number of households at or below the federal poverty line per 100,000 people and aligns with the poverty indicator used in the individual ACE measure. Unemployment rate was defined as the percentage of unemployed individuals out of the full labor force (where the labor force is defined as all individuals over 16 designated as employed or unemployed). This was added as an additional measure of socioeconomic adversity. Parent-age mortality rate, derived from the NCHS, was defined as the number of people per 100,000 between the age of 20 to 50 who died of any cause. This measure was included in the neighborhood ACE scale as it aligned with the parent death indicator in the individual ACEs scale. Finally, annual FBI UCR data on violent crime rates per 100,000 people and arrest rates per 100,000 people were used as neighborhood-level variables which aligned most closely to the measures of violence in the home (i.e., IPV) and justice-involvement (i.e., incarceration), which are included in individual ACE scores. Overall, these items were chosen as a function of providing neighborhood-level data approximating key constructs covered under the ACE umbrella.

Similar to neighborhood resources, these factors were explored via a composite measure of ACE-like characteristics of the neighborhood. This allowed for a single measure of neighborhood adversity somewhat analogous to the single scale used at the individual level. Further, factor analysis forcing a one-factor solution suggested variables hung well together with all loadings greater than 0.54 and a strong internal reliability (α=0.82). In order to create this composite, all variables were set to the same scale (rate per 100 people or percent) and logged to

improve normality, then averaged across waves. Variables were then averaged and standardized to create the final composite.

Alternate models somewhat disaggregating this construct into three variables were also run. Three variables - neighborhood socioeconomic distress (a composite of female headed households, poverty rates, and unemployment rates), neighborhood crime and arrest (a composite of violent crime and arrest rates), and parent-age mortality – were used in order to study their unique potential to moderate the relationship between ACEs and outcomes. These composite choices were made based on a combination of theoretical and empirical rationale. Empirically, factor analysis not forcing a one factor solution suggested a three-factor solution aligned to the scheme above and review of correlations suggested that the three socioeconomic factors were moderately to highly correlated (p=0.69-0.76) as were the crime and arrest rates (p=0.68; see Appendix A for all factor analysis results). Theoretically, these three factors do seem to be conceptually distinct with one factor signaling socioeconomic adversity, one signaling crime, and a third lone variable capturing mortality. Composites used in these alternate models were created using the same protocol as was used for the single measure of neighborhood-level ACEs.

Covariates. A number of child-level and family-level covariates were included to adjust for factors which might influence children's likelihood of experiencing ACEs or developing maladaptive externalizing, internalizing, or prosocial behaviors. Child-level covariates included child sex assigned at birth, child race/ethnicity, child age at kindergarten assessment, number of months in kindergarten at assessment, premature birth and low birthweight status. Family-level covariates included maternal age at child's birth, maternal education level at birth, and the number of children in the household at birth.

Analytic Plan

Secondary data often has missing data. In order to assess missingness, a missing data analysis was conducted, finding that missing values ranged from 0 to 86% with data from the FBI UCR database and father report data (which was only collected for a subset of children) accounting for variables with a missingness rate higher than 32%. To handle missingness in the independent variables and covariates (there were no missing values in dependent variables due to the sample selection), missing data was imputed to create 30 complete datasets using the Amelia II package in R, which utilizes a bootstrap-based Expectation Maximization Bayesian (EMB) algorithm (Honaker & King, 2010). This form of multiple imputation (MI) has the advantage of allowing for a larger set of variables to be included in imputation and faster imputation time for large datasets with comparable imputation results to other MI strategies (Honaker & King, 2010). Imputation was conducted on cross-wave composites (for ACEs and Neighborhood variables, multiple waves of data where used) owing to multicollinearity issues with conducting imputation on all wave level items.

Following a descriptive analysis of the key study variables, the first research question was addressed via a series of regression models. First, the connection between child ACEs and behavioral outcomes was assessed using linear regression models performed in STATA 15. Next a series of alternate specifications including step functions, spline functions, and regressions with quadratic terms were estimated in order to assess potential non-linearities in the relationship between ACEs and behavioral outcomes. Based on the analysis conducted above, linear regression analysis was used for the second set of analyses. Interaction models were used to explore the potential moderating role of neighborhood resources and neighborhood-level ACEs. A centered measure of ACEs was used in interaction models. Neighborhood resources and

neighborhood ACEs were included together in the models given low correlation (p=0.09) though they were also tested separately.

Measures were taken to bolster the rigor of analysis by employing inverse probability weighting (IPW). IPW is a form of propensity score analysis, an umbrella of quasi-experimental statistical strategies used to estimate the likelihood of exposure or treatment by accounting for covariates likely to predict exposure (Li & Li, 2021). This approach attempts to reduce selection bias and increase the causal strength of findings. Taking this approach is an improvement on past literature exploring the relationship between ACEs and outcomes using correlational approaches. IPW is a propensity score weighting (PSW) technique used to weight each case by the reciprocal of that case's conditional probability of being in a particular treatment group (i.e., in this case, having a particular ACE score) given covariates (Guo & Fraser, 2015; Li & Li, 2021). Inverse probability weights were then employed in analyses in order to estimate the average treatment effect (ATE; Guo & Fraser, 2015; Li & Li, 2021).

For this study, inverse probability weights were created using covariates assessing time-invariant and time-varying child and family characteristics prior to ACEs exposure: child sex assigned at birth, child race/ethnicity, premature birth, low birthweight status, maternal age at birth, maternal education level at birth, and the number of children in the household at birth. An ordered logit model was run with covariates predicting ACE scores. This model was weighted with the ECLS-B's survey weights (WK45T0) which were applied according to procedures recommended by Ridgeway and colleagues (2015). Survey weights were incorporated into inverse probability weights using the Taylor Series linearization method, a method that accounts for clustering by specifying the primary sampling unit (PSU) and stratum variables as advised by

the ECLS-B user's manual in order to estimate proper variance (Snow et al., 2007). This procedure allowed all analyses to incorporate both propensity score weights and survey weights.

Based on results from the weighted ordered logit model, the inverse probability of receiving the actual ACE score was calculated for each case which constituted the raw IPW. Weights were then stabilized as recommended by Chesnaye and colleagues (2022) to handle balancing constraints often associated with weighting when there are a large number of "treatment groups." Balancing checks employed to ensure weights were created correctly can be found in Appendix B. All analyses used this weight and were adjusted for both child- and family-level covariates (indicated above in the measures section) to minimize the heterogeneity bias that could result from factors that are associated both with children's exposure to ACEs and with their behavioral outcomes.

CHAPTER FOUR: RESULTS

Sample Characteristics

Table 1 presents descriptive data on each of the ACE indicators included in the ACEs composite. Results indicate that there is a fair bit of variation in the prevalence of ACE types which ranged from 1% (parent incarceration and parent death) to 68% (corporal punishment).

Table 1. *Weighted ACE Prevalence by Experience Type*

	% Yes
Parent Divorce	10%
Parent Incarceration	1%
Parent Death	1%
Parent IPV	21%
Parent Mental Illness	35%
Parent Substance Abuse	19%
Corporal Punishment	68%
Emotional Neglect	19%

Poverty	29%
Food Insecurity	18%

N ≈ *5,050,* aggregated over 30 imputed datasets;
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Sample descriptive statistics shown in Table 2 and Table 3 provide an overview of the analytic sample. The sample skews slightly more male (52%), and over half the sample is White (53%). The majority of the sample was born neither premature (88%) nor low birthweight (92%). Children were 68.62 months old at the time of kindergarten assessment, on average.

Weighted sample correlations presented in Table 4 suggest weak, negative correlations between child ACE scores and prosocial skills, and weak, positive correlations between ACE scores and behavior problems (with the link between ACEs and externalizing behavior problems being much stronger than that between ACEs and internalizing behavior problems). Correlations between neighborhood indicators and both ACE scores and outcomes were weak. Neighborhood resource indicators were moderately correlated with one another.

Table 2. *Weighted Sample Descriptive Statistics*

	Mean	Standard Deviation	% Missing[a]
Outcomes			
K Prosocial Skills (parent-report)	3.98	0.94	0%
K Prosocial Skills (teacher-report)	3.91	1.22	0%
K Externalizing Behaviors (parent-report)	2.11	1.21	0%
K Externalizing Behaviors (teacher-report)	1.93	1.37	0%
K Internalizing Behaviors (parent-report)	2.53	2.01	0%
K Internalizing Behaviors (teacher-report)	2.25	1.55	0%
Predictors			
Child ACEs	2.21	3.38	0%-32%[b]
Number of Medical Resources	41.96	70.79	7%
Number of Cultural Resources	5.49	8.03	4%

Number of Educational Resources	16.38	18.69	14%
Number of Social Services	5.55	10.06	19%
Poverty Rate	12.55	14.95	1%
Unemployment Rate	3.76	3.76	1%
% Female Headed Households	7.58	6.54	1%
Arrest Rate	10.96	25.45	41%
Violent Crime Rate	0.98	2.51	61%
Parent Age Mortality Rate	2.21	1.10	1%
Covariates			
Child Age at time of assessment (months)	68.62	9.05	0%
Months in Kindergarten at time of assessment	2.91	2.68	1%
Mom age (years) W1	28.44	13.92	<1%
Mom Education (years) W1	13.20	5.33	<1%
Number of Children Under 18 in Household W1	2.10	1.99	<1%

		Proportion	% Missing
Sex Assigned at Birth			0%
	Male	51.65%	
	Female	48.35%	
Child Race/Ethnicity			<1%
	White	52.89%	
	Black	11.81%	
	Hispanic	26.93%	
	Asian	2.75%	
	Multiracial	0.71%	
	Other	4.91%	
Low Birthweight			<1%
	Yes	7.54%	
	No	92.46%	
Born Premature			2%
	Yes	11.72%	
	No	88.28%	

N ≈ 5,050, aggregated over 30 imputed dataset; Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

[a] Missing data is shown at the cross-wave composite level for ACE indicators and Neighborhood level variables because this was the level at which data was imputed. Ranges of missing data at the wave level for each of these variables can be found in Appendix C
[b] Represents range of missing data in cross-wave indicators included in the measure.

Table 3. *Weighted ACE Score Prevalence and Children's Behavioral Skills in Kindergarten by ACE score*

ACE Score	0	1	2	3	4	5	6	7
	12.58%	25.92%	23.74%	16.82%	11.46%	6.23%	2.45%	0.81%
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Prosocial Skills (parent-report)	0.20 (0.92)	0.16 (0.95)	0.01 (0.95)	-0.08 (1.02)	-0.15 (1.01)	-0.23 (1.07)	-0.28 (1.10)	-0.51 (1.15)
Prosocial Skills (teacher-report)	0.29 (0.95)	0.20 (0.94)	0.06 (0.96)	-0.13 (1.00)	-0.21 (1.05)	-0.37 (1.01)	-0.41 (1.05)	-0.63 (0.99)
Externalizing Behaviors (parent-report)	-0.33 (0.86)	-0.21 (0.84)	0.01 (0.98)	0.05 (1.02)	0.25 (1.07)	0.36 (1.06)	0.57 (1.17)	0.92 (1.10)
Externalizing Behaviors (teacher-report)	-0.31 (0.87)	-0.18 (0.90)	-0.05 (0.98)	0.06 (0.99)	0.24 (1.07)	0.41 (1.07)	0.53 (1.05)	0.85 (1.27)
Internalizing Behaviors (parent-report)	0.16 (0.93)	0.03 (0.94)	0.01 (0.97)	-0.05 (1.04)	0.01 (1.07)	-0.02 (1.05)	0.08 (1.11)	-0.05 (0.92)
Internalizing Behaviors (teacher-report)	0.03 (0.97)	-0.07 (0.99)	-0.01 (1.04)	0.02 (1.01)	0.04 (0.97)	0.05 (0.96)	0.06 (1.01)	0.2 (0.89)

N≈5,050, aggregated over 30 imputed datasets; Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Table 4. *Weighted Sample Correlations*

	1	2	3	4	5	6	7	8
1. K Prosocial Skills (parent-report)	1							
2. K Externalizing Behaviors (parent-report)	-0.38	1						
3. K Internalizing Behaviors (parent-report)	0.03	0.17	1					
4. K Prosocial Skills (teacher-report)	0.34	-0.33	0.01	1				
5. K Externalizing Behaviors (teacher-report)	-0.27	0.41	-0.03	-0.65	1			
6. K Internalizing Behaviors (teacher-report)	-0.02	-0.06	0.07	-0.21	0.01	1		
7. ACES	-0.12	0.22	0.02	-0.17	0.19	0.03	1	
8. Medical Resources	<0.01	<0.01	<0.01	<0.01	-0.01	0.02	<0.01	1
9. Cultural Resources	<0.01	0.00	0.01	<0.01	-0.01	0.02	<0.01	0.68
10. Educational Resources	<0.01	<0.01	0.01	0.01	-0.01	0.01	0.01	0.36
11. Social Services	-0.01	-0.01	-0.01	-0.02	<0.01	0.02	<0.01	0.60
12. Neighborhood SES Adversity	-0.01	-0.03	0.06	-0.05	0.03	-0.01	0.11	-0.01
13. Neighborhood Crime & Arrest Rates	-0.01	-0.01	0.04	-0.02	0.02	-0.01	0.08	-0.01
14. Neighborhood Parent-Age Mortality	-0.02	0.05	-0.09	-0.02	0.03	0.02	0.13	0.04
15. Sex Assigned at Birth	0.16	-0.14	0.03	0.21	-0.27	0.02	0.03	0.02
16. Child Race/Ethnicity	-0.04	-0.01	-0.01	-0.05	-0.02	0.03	0.01	-0.03
17. Child Age at Kindergarten Assessment	0.03	-0.03	0.02	0.07	-0.05	0.02	0.01	0.02
18. Months in Kindergarten at Assessment	0.02	-0.04	-0.05	0.02	-0.01	0.05	0.07	0.02
19. Low Birthweight	-0.04	0.03	-0.02	-0.03	0.03	0.01	0.02	0.02
20. W1 Mom Age	-0.03	<0.01	<0.01	0.05	-0.07	0.04	-0.05	0.01
21. W1 Mom Education	0.05	<0.01	0.05	0.09	-0.04	0.01	-0.07	0.03
22. W1 hh children	-0.02	0.05	-0.10	-0.01	-0.03	<0.01	0.09	-0.01
23. Premature Birth	-0.06	0.03	<0.01	-0.04	0.04	0.04	0.04	<0.01

	9	10	11	12	13	14	15	16
9. Cultural Resources	1							
10. Educational Resources	0.40	1						
11. Social Services	0.61	0.29	1					
12. Neighborhood SES Adversity	0.04	-0.02	0.04	1				
13. Neighborhood Crime & Arrest Rates	-0.01	<0.01	<0.01	0.32	1			
14. Neighborhood Parent-Age Mortality	0.04	0.03	0.04	0.23	0.21	1		
15. Sex Assigned at Birth	0.01	<0.01	0.01	-0.01	0.02	<-0.01	1	
16. Child Race/Ethnicity	-0.04	-0.03	-0.02	0.21	0.07	-0.10	0.01	1
17. Child Age at Kindergarten Assessment	0.02	0.01	0.03	-0.06	0.05	0.13	-0.02	-0.04
18. Months in Kindergarten at Assessment	0.01	-0.01	0.02	-0.01	0.06	0.11	0.05	0.04
19. Low Birthweight	0.02	<0.01	0.03	0.04	0.03	0.04	0.03	0.02
20. W1 Mom Age	0.01	<0.01	-0.02	-0.22	-0.13	-0.18	0.03	-0.10
21. W1 Mom Education	0.03	0.04	<0.01	-0.36	-0.18	-0.15	0.02	-0.18
22. W1 hh children	-0.01	<0.01	-0.01	0.09	<-0.01	<0.01	0.03	0.07
23. Premature Birth	<0.01	-0.01	-0.01	0.03	0.02	0.03	0.02	0.03

	17	18	19	20	21	22	23
17. Child Age at Kindergarten Assessment	1						
18. Months in Kindergarten at Assessment	0.50	1					
19. Low Birthweight	0.03	0.03	1				
20. W1 Mom Age	-0.01	-0.02	-0.01	1			
21. W1 Mom Education	-0.01	-0.04	-0.02	0.44	1		
22. W1 hh children	0.03	0.05	0.05	0.16	0.16	1	
23. Premature Birth	0.05	0.02	0.47	0.01	-0.02	0.06	1

Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Links between ACEs and Early Behavioral Outcomes

The first set of analyses set out to assess links between ACEs and behavioral functioning in kindergarten. Results from adjusted OLS linear regressions employing propensity score weights can be found in Table 3. These results suggest a significant relationship between the number of ACEs a child has and both prosocial and externalizing behaviors reported by both parents and teachers, but not internalizing behaviors.

First looking at the association between ACEs and children's kindergarten prosocial skills, findings suggest a significant, negative relationship regardless of outcome reporter (β = -0.075 and β = -0.103 for parent and teacher report, respectively). This indicates that each additional ACE was associated with a 0.075 standard deviation decrease in parent reported prosocial skills and a 0.103 standard deviation decrease in teacher reported prosocial skills. Similarly, there is a significant, positive relationship found between ACEs and children's kindergarten externalizing behavior problems, which is consistent across reporters (β = 0.143 and β = 0.120 for parent and teacher report, respectively) indicating that each additional ACE was associated with a 0.143 standard deviation increase in parent reported externalizing behavior problems and a 0.120 increase in teacher reported externalizing behavior problems. ACEs did not significantly predict internalizing behavior problems across either reporter.

Examining the relationship between covariates and outcomes, being assigned female at birth was associated with significantly greater prosocial skills and significantly less externalizing behavior problems across reporters with teacher-reported outcomes having moderate coefficients and parent-reported outcomes having weaker effect sizes. Maternal education was consistently

positively associated with prosocial skills across reporters. The relationship between other covariates and outcomes were more mixed and inconsistent across reporters.

Table 5. *Weighted Adjusted Linear Regression Models, N ≈5,050*

	Parent-Report Outcomes			Teacher-Report Outcomes		
	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
ACEs	-0.075** (0.018)	0.143** (0.022)	0.035 (0.019)	-0.103** (0.017)	0.120** (0.017)	0.021 (0.019)
Child Sex	0.309** (0.049)	-0.303** (0.056)	0.073 (0.052)	0.429** (0.048)	-0.539** (0.047)	0.032 (0.052)
Child Race						
Black	0.188* (0.080)	-0.181* (0.087)	-0.621** (0.059)	0.029 (0.104)	0.069 (0.112)	-0.099 (0.110)
Hispanic	0.102 (0.060)	-0.154* (0.077)	0.185* (0.078)	-0.028 (0.061)	-0.103 (0.057)	-0.019 (0.067)
Asian	-0.162* (0.076)	-0.255** (0.072)	-0.096 (0.065)	0.008 (0.064)	-0.303** (0.057)	-0.004 (0.084)
Multiracial	-0.383* (0.149)	0.164 (0.160)	-0.055 (0.140)	0.108 (0.122)	-0.252 (0.130)	0.146 (0.164)
Other	-0.236 (0.111)	0.147 (0.098)	-0.172* (0.077)	-0.189 (0.103)	0.067 (0.089)	0.194 (0.145)
Child Age at K Assessment	0.028 (0.027)	-0.027 (0.029)	0.071* (0.031)	0.086* (0.029)	-0.083* (0.028)	-0.013 (0.036)
Months of Kindergarten at K Assessment	0.010 (0.027)	-0.028 (0.036)	-0.092* (0.037)	-0.020 (0.027)	0.036 (0.026)	0.057 (0.030)
Low Birthweight	-0.105 (0.070)	0.143 (0.074)	-0.019 (0.066)	-0.088 (0.076)	0.099 (0.077)	-0.060 (0.075)
Mom age at wave 1	-0.010* (0.005)	<0.001 (0.005)	-0.004 (0.006)	0.000 (0.004)	-0.007 (0.004)	0.007 (0.004)
Mom education at wave 1	0.103* (0.031)	-0.008 (0.035)	0.058 (0.032)	0.074* (0.032)	-0.009 (0.027)	-0.018 (0.034)
Number of children in household	0.016 (0.028)	0.036 (0.027)	-0.092** (0.025)	0.012 (0.029)	-0.034 (0.025)	-0.020 (0.028)

Premature Birth	-0.123 (0.082)	-0.009 (0.078)	0.048 (0.076)	-0.062 (0.074)	0.053 (0.074)	0.147 (0.087)
Constant	0.247 (0.138)	0.163* (0.149)	0.155 (0.174)	-0.129 (0.125)	0.465** (0.128)	-0.265* (0.133)

Note: *p<.05, **p<.01; Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

The Functional Form of Links between ACE Exposure and Early Behavioral Outcomes

A series of analyses were conducted in order to examine whether non-linear relationships were more appropriate for describing the relationship between ACE exposure and early behavioral outcomes. First, adjusted, weighted step functions were performed and results were graphed in order to visually assess differences across ACE scores. Further, post hoc pairwise comparisons of ACE scores were performed to determine significant differences. Results from these models can be found in Table 6 and Figures 1a-1f. These results generally suggested a linear pattern of association between ACE scores and outcomes with the potential for a slight change in slope at a score of four for some outcomes. Pairwise comparisons suggested significant differences between scores of 0 and 1 compared to all scores 2 and greater for externalizing behavior models across reporters. This pattern was somewhat similar for prosocial skills models, though less consistent. Across externalizing behavior models and prosocial skills, a score of four was always significantly different than scores of 0, 1, and 2. None of these patterns extended to internalizing behavior models. Next, orthogonal polynomial contrast analysis was performed, in order to test for polynomial patterns in the data (e.g., quadratic, cubic, quartic, etc.). Results seen in Table 7 provide support for a linear relationship; a finding which was consistent across outcomes and reporters.

Table 6. *Weighted, Adjusted Step Functions, N≈5,050*

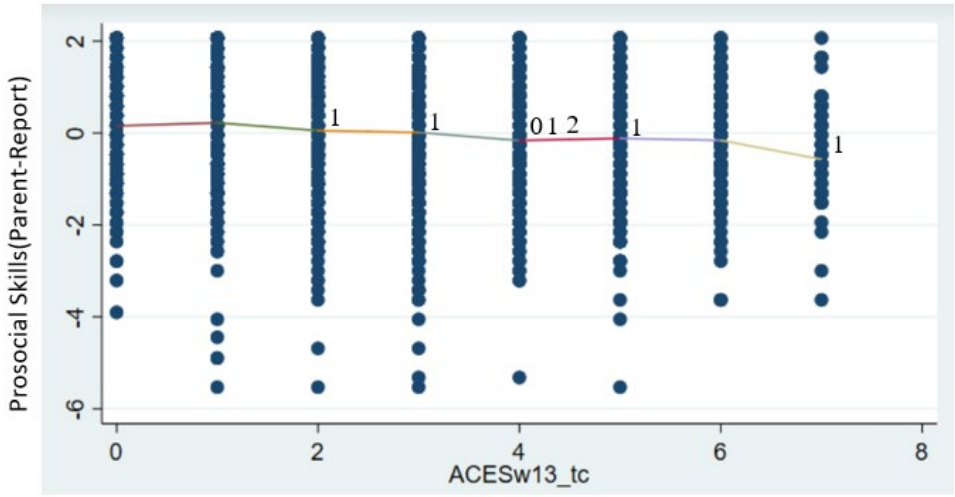
	Parent-Reported Outcome			Teacher-Reported Outcome		
	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
ACE Score: 1	0.061	0.119	-0.092	0.126	-0.022	0.001
	(0.113)	(0.124)	(0.094)	(0.096)	(0.103)	(0.099)
ACE Score: 2	-0.100	0.345*	-0.075	-0.049	0.208*	0.037
	(0.105)	(0.0121)	(0.091)	(0.091)	(0.102)	(0.096)
ACE Score: 3	-0.138	0.452*	-0.057	-0.120	0.248*	0.177
	(0.117)	(0.133)	(0.096)	(0.094)	(0.110)	(0.105)
ACE Score: 4	-0.337*	0.664**	0.030	-0.263*	0.425*	0.123
	(0.129)	(0.147)	(0.101)	(0.128)	(0.129)	(0.109)
ACE Score: 5	-0.234	0.690**	0.114	-0.327*	0.421*	0.163
	(0.153)	(0.174)	(0.136)	(0.134)	(0.153)	(0.203)
ACE Score: 6	-0.312	0.833**	0.398*	-0.352	0.620*	-0.142
	(0.184)	(0.221)	(0.142)	(0.285)	(0.186)	(0.204)
ACE Score: 7	-0.447	1.404**	0.113	-0.699*	0.992*	0.066
	(0.318)	(0.337)	(0.239)	(0.213)	(0.328)	(0.173)
Assigned Sex	0.308**	-0.345**	0.058	0.422**	-0.534**	-0.008
	(0.049)	(0.057)	(0.048)	(0.050)	(0.052)	(0.056)
Child Race						
Black	0.187*	-0.098	-0.598**	0.006	0.141	-0.213*
	(0.079)	(0.094)	(0.061)	(0.094)	(0.106)	(0.103)
Hispanic	0.111	-0.108	0.151*	0.052	-0.096	-0.029
	(0.027)	(0.084)	(0.068)	(0.066)	(0.067)	(0.074)
Asian	-0.154*	-0.249*	-0.109	-0.037	-0.267**	-0.021
	(0.077)	(0.074)	(0.067)	(0.074)	(0.067)	(0.077)
Multiracial	-0.390*	0.075	-0.234	-0.098	-0.006	0.011
	(0.145)	(0.179)	(0.124)	(0.170)	(0.119)	(0.168)
Other	-0.239*	0.148	-0.110	-0.144	0.190	0.024
	(0.111)	(0.122)	(0.101)	(0.093)	(0.101)	(0.112)
Child Age at K Assessment	0.027	-0.025	0.043	0.085*	-0.059	-0.026
	(0.027)	(0.032)	(0.029)	(0.031)	(0.031)	(0.039)
Months of Kindergarten	0.009	-0.029	-0.057	-0.030	0.027	0.048
	(0.027)	(0.037)	(0.030)	(0.031)	(0.029)	(0.034)

Low Birthweight	-0.103* (0.070)	0.189* (0.080)	-0.015 (0.073)	-0.132 (0.079)	0.148 (0.083)	-0.024 (0.071)
Mom age at wave 1	-0.068* (0.031)	0.028 (0.033)	-0.020 (0.028)	0.020 (0.030)	-0.047 (0.029)	0.054 (0.031)
Mom education at wave 1	0.103** (0.031)	-0.006 (0.037)	0.041 (0.030)	0.113** (0.031)	-0.008 (0.029)	-0.033 (0.032)
Number of children in household	0.017 (0.028)	0.027 (0.028)	-0.108** (0.025)	0.027 (0.031)	-0.044 (0.029)	0.014 (0.029)
Premature Birth	-0.126 (0.081)	-0.074 (0.085)	0.083 (0.083)	-0.011 (0.079)	-0.011 (0.075)	0.145 (0.080)
Constant	0.068 (0.098)	-0.170 (0.127)	0.084 (0.088)	-0.074 (0.089)	0.070 (0.102)	-0.092 (0.095)

Note: *p<.05, **p<.01; Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

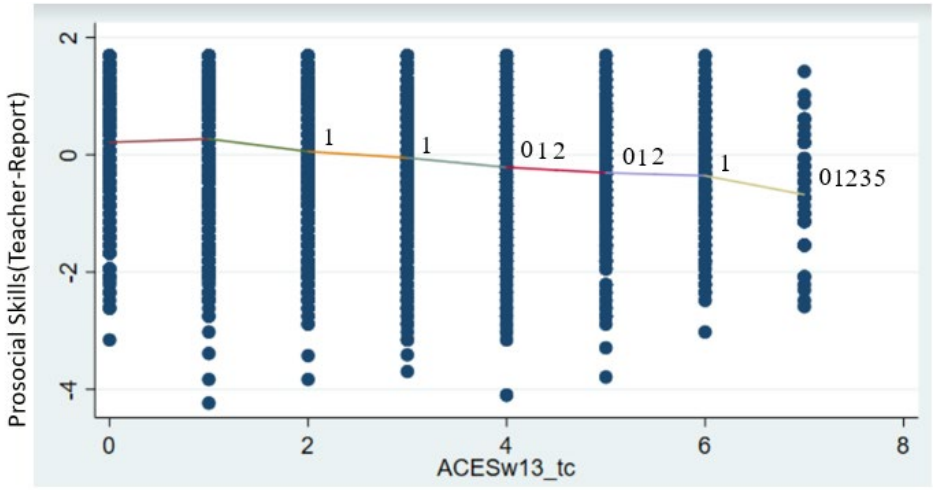
Figure 1a-f. *Step Function Plots with Significant Pairwise Comparisons*

a) Plot of Step Function Predicting Prosocial Skills (Parent-Reported)



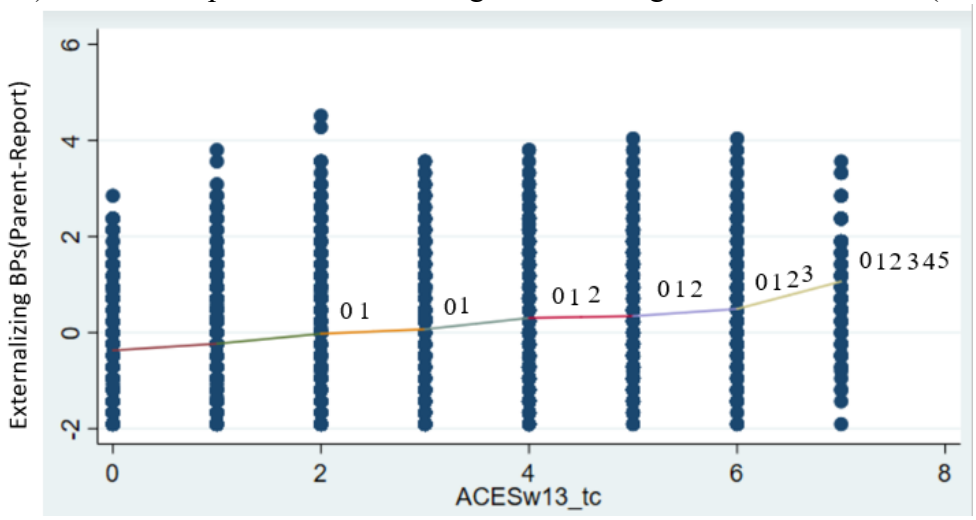
Note: 0 indicates ACE scores significantly different from 0; 1 indicates ACE scores significantly different from 1; 2 indicated ACE scores significantly different from 2
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

b) Plot of Step Function Predicting Prosocial Skills (Teacher-Reported)



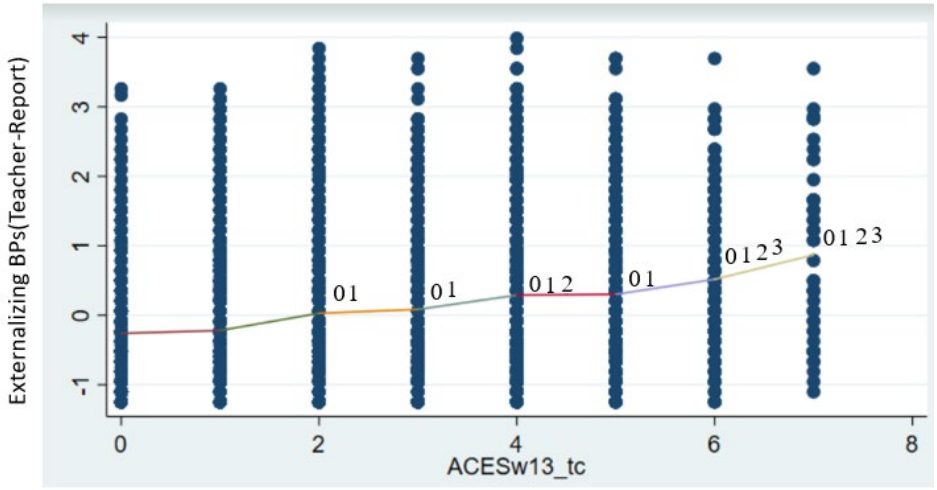
Note: 0 indicates ACE scores significantly different from 0; 1 indicates ACE scores significantly different from 1; 2 indicates ACE scores significantly different from 2; 3 indicates ACE scores significantly different from 3; 5 indicates ACE scores significantly different from 5
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

c) Plot of Step Function Predicting Externalizing Behavior Problems (Parent-Reported)



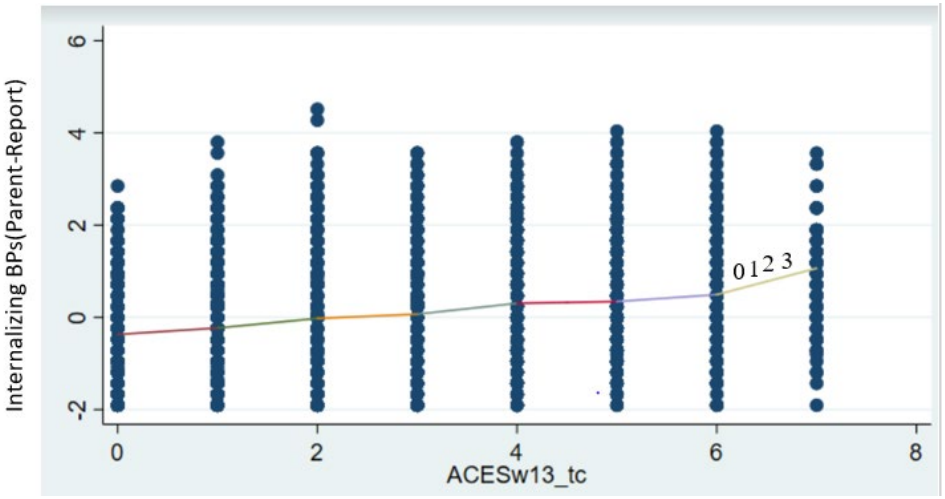
Note: 0 indicates ACE scores significantly different from 0; 1 indicates ACE scores significantly different from 1; 2 indicates ACE scores significantly different from 2; 3 indicates ACE scores significantly different from 3; 4 indicates ACE scores significantly different from 4; 5 indicates ACE scores significantly different from 5
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

d) Plot of Step Function Predicting Externalizing Behavior Problems (Teacher-Reported)



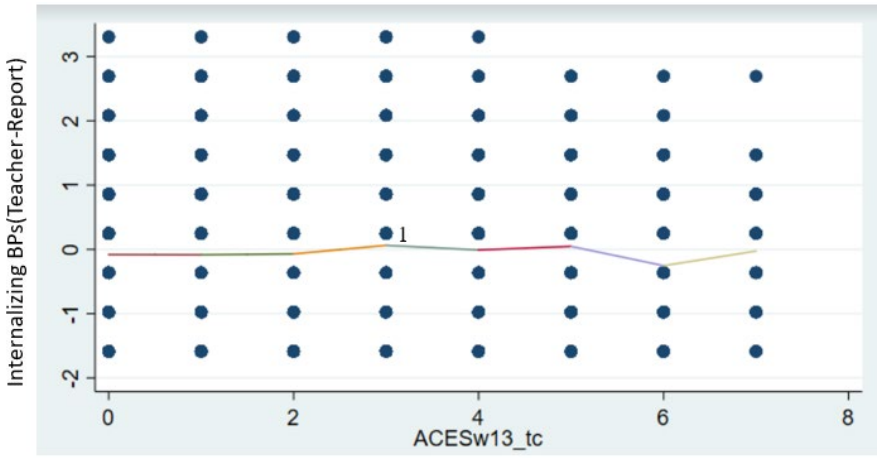
Note: 0 indicates ACE scores significantly different from 0; 1 indicates ACE scores significantly different from 1; 2 indicates ACE scores significantly different from 2; 3 indicates ACE scores significantly different from 3
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

e) Plot of Step Function Predicting Internalizing Behavior Problems (Parent-Reported)



Note: 0 indicates ACE scores significantly different from 0; 1 indicates ACE scores significantly different from 1; 2 indicates ACE scores significantly different from 2; 3 indicates ACE scores significantly different from 3
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

f) Plot of Step Function Predicting Internalizing Behavior Problems (Teacher-Reported)



Note: 1 indicates ACE scores significantly different from 1
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Table 7. *Orthogonal Polynomial Contrasts*

	Contrast	SE	95% CI	
ACES > Parent Reported Prosocial Skills				
(linear)	**-0.191**	**0.074**	**-0.336**	**-0.047**
(quadratic)	-0.046	0.070	-0.183	0.091
(cubic)	-0.026	0.061	-0.146	0.093
(quartic)	-0.076	0.052	-0.177	0.025
(quintic)	-0.013	0.042	-0.096	0.069
(sextic)	-0.015	0.034	-0.081	0.051
(septic)	0.029	0.027	-0.023	0.082
ACES > Parent Reported Externalizing BPs				
(linear)	**0.399**	**0.071**	**0.260**	**0.538**
(quadratic)	0.057	0.066	-0.073	0.187
(cubic)	0.070	0.058	-0.045	0.184
(quartic)	0.063	0.051	-0.037	0.163
(quintic)	0.019	0.043	-0.065	0.103
(sextic)	0.008	0.036	-0.062	0.079
(septic)	-0.023	0.030	-0.081	0.036
ACES > Parent Reported Internalizing BPs				
(linear)	**0.106**	**0.050**	**0.008**	**0.205**
(quadratic)	0.031	0.048	-0.063	0.124
(cubic)	-0.071	0.043	-0.155	0.014
(quartic)	-0.050	0.035	-0.119	0.018
(quintic)	-0.045	0.030	-0.105	0.015
(sextic)	-0.020	0.028	-0.076	0.035
(septic)	-0.014	0.023	-0.060	0.031

ACES > Teacher Reported Prosocial Skills				
(linear)	**-0.225**	**0.049**	**-0.321**	**-0.130**
(quadratic)	-0.057	0.044	-0.143	0.030
(cubic)	-0.003	0.042	-0.085	0.079
(quartic)	-0.061	0.041	-0.142	0.020
(quintic)	-0.006	0.037	-0.079	0.067
(sextic)	-0.023	0.032	-0.086	0.040
(septic)	0.011	0.028	-0.044	0.066
ACES > Teacher Reported Externalizing BPs				
(linear)	**0.299**	**0.068**	**0.166**	**0.432**
(quadratic)	0.062	0.065	-0.064	0.189
(cubic)	0.037	0.057	-0.075	0.149
(quartic)	0.048	0.047	-0.045	0.140
(quintic)	-0.012	0.039	-0.089	0.065
(sextic)	0.007	0.034	-0.060	0.073
(septic)	-0.032	0.029	-0.087	0.024
ACES > Teacher Reported Internalizing BPs				
(linear)	0.002	0.046	-0.087	0.091
(quadratic)	-0.049	0.038	-0.124	0.027
(cubic)	0.010	0.046	-0.081	0.100
(quartic)	0.063	0.042	-0.020	0.145
(quintic)	0.038	0.044	-0.047	0.124
(sextic)	0.023	0.044	-0.063	0.109
(septic)	0.034	0.032	-0.030	0.097

Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Because previous research has used a cutoff of four ACEs (Crouch et al., 2019; Hughes et al., 2017) and the step functions showed some slight evidence that scores or four and above might be substantively different than scores below four, adjusted, weighted spline regression models with a knot at four were performed and results were graphed in order to assess differences in slopes above and below this threshold. Results, found in table 8, suggest fairly inconsistent results, with coefficients sometimes larger in the lower levels of ACEs (e.g., parent reported prosocial skills and externalizing) and others larger in the higher levels of ACEs (e.g., parent reported internalizing and teacher reported prosocial skills and internalizing behaviors).

However, there were no significant differences between coefficients between 0-3 and 4-7 ACEs across any of the six outcomes.

Table 8. *Weighted, Adjusted Spline Functions, N≈5,050*

	Parent-Reported Outcomes			Teacher-Reported Outcomes		
	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
ACEs, 0-3	-0.082** (0.023)	0.161** (0.028)	0.012 (0.021)	-0.082* (0.025)	0.111** (0.025)	0.049* (0.023)
ACEs, 4-7	-0.057 (0.071)	0.141* (0.071)	0.136* (0.054)	-0.116* (0.059)	0.126 (0.067)	-0.070 (0.069)
Assigned Sex	0.340** (0.048)	-0.345** (0.058)	0.059 (0.048)	0.419** (0.051)	-0.533** (0.052)	-0.005 (0.056)
Child Race						
Black	0.159* (0.073)	-0.095 (0.093)	-0.599** (0.061)	-0.001 (0.096)	0.146 (0.108)	-0.207* (0.102)
Hispanic	0.050 (0.066)	-0.108 (0.084)	0.154* (0.068)	0.041 (0.067)	-0.092 (0.068)	-0.021 (0.074)
Asian	-0.239* (0.077)	-0.246* (0.073)	-0.105 (0.067)	-0.045 (0.073)	-0.260** (0.067)	-0.020 (0.078)
Multiracial	-0.199 (0.204)	0.087 (0.184)	-0.242 (0.125)	-0.099 (0.172)	0.001 (0.123)	0.009 (0.171)
Other	-0.107 (0.099)	0.147 (0.124)	-0.105 (0.103)	-0.146 (0.093)	0.190 (0.101)	0.024 (0.112)
Child Age at K Assessment	0.017 (0.028)	-0.027 (0.033)	0.046 (0.029)	0.083* (0.031)	-0.060 (0.032)	-0.025 (0.039)
Months of Kindergarten at K Assessment	0.022 (0.028)	-0.027 (0.038)	-0.061* (0.030)	-0.027 (0.031)	0.028 (0.029)	0.048 (0.033)
Low Birthweight	-0.167* (0.071)	0.192* (0.081)	-0.011 (0.073)	-0.133 (0.081)	0.152 (0.084)	-0.030 (0.071)
Mom age at wave 1	-0.091* (0.029)	0.027 (0.033)	-0.021 (0.028)	0.021 (0.031)	-0.049 (0.029)	0.055 (0.031)
Mom education at wave 1	0.122** (0.030)	-0.004 (0.038)	0.039 (0.030)	0.113** (0.032)	-0.006 (0.029)	-0.032 (0.032)
Number of children in household	0.001 (0.027)	0.026 (0.028)	-0.109** (0.025)	0.028 (0.031)	-0.045 (0.029)	0.015 (0.029)

Premature Birth	-0.044 (0.077)	-0.075 (0.086)	0.082 (0.084)	-0.011 (0.081)	-0.012 (0.076)	0.148 (0.080)
Constant	0.120* (0.059)	-0.185* (0.075)	0.009 (0.062)	0.052 (0.064)	0.004 (0.066)	-0.126 (0.068)

Note: Note: *p<.05, **p<.01; There are no significant differences in slopes of the ACE splines across outcomes.
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

While orthogonal polynomial contrasts did not find evidence of a significant quadratic relationship between ACEs and outcomes, given the support for a quadratic relationship in the literature when examining long-term outcomes (Lamela & Figueiredo, 2018; Mersky & Lee, 2019; Tan & Mao, 2023), a final set of analyses added a quadratic ACEs term to the linear regression models to corroborate findings from contrasts. Results, presented in table 9, found the quadratic term to be extremely small and nonsignificant across outcomes and reporters. All together, these results provide evidence that the relationship between ACEs and the behavioral outcomes is likely linear in function.

Table 9. *Weighted, Adjusted Regression Models with Quadratic Terms, N≈5,050*

	Parent-Reported Outcomes			Teacher-Reported Outcomes		
	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
ACEs	-0.068* (0.020)	0.153** (0.025)	0.024 (0.018)	-0.088** (0.020)	0.117** (0.021)	0.028 (0.021)
ACEs^2	-0.007 (0.009)	-0.003 (0.011)	0.016 (0.009)	-0.007 (0.008)	-0.000 (0.010)	-0.005 (0.010)
Assigned Sex	0.342** (0.048)	-0.345** (0.058)	0.058 (0.048)	0.421** (0.051)	-0.531** (0.052)	-0.006 (0.056)
Child Race						
Black	0.161* (0.076)	-0.116 (0.093)	-0.603** (0.061)	0.016 (0.094)	0.129 (0.106)	-0.213* (0.104)
Hispanic	0.047 (0.066)	-0.118 (0.084)	0.149* (0.069)	0.047 (0.066)	-0.099 (0.068)	-0.018 (0.074)
Asian	-0.229* (0.078)	-0.275** (0.072)	-0.110 (0.067)	-0.033 (0.073)	-0.280** (0.067)	-0.021 (0.078)

Multiracial	-0.191	0.069	-0.251*	-0.066	-0.020	-0.008
	(0.206)	(0.192)	(0.125)	(0.166)	(0.128)	(0.170)
Other	-0.104	0.135	-0.117	-0.141	0.183	0.026
	(0.100)	(0.121)	(0.103)	(0.095)	(0.101)	(0.113)
Child Age at K Assessment	0.019	-0.024	0.042	0.083*	-0.060	-0.024
	(0.028)	(0.032)	(0.028)	(0.030)	(0.031)	(0.038)
Months of Kindergarten at K Assessment	0.020	-0.028	-0.057	-0.026	0.026	0.047
	(0.027)	(0.037)	(0.029)	(0.030)	(0.029)	(0.032)
Low Birthweight	-0.156*	0.186*	-0.009	-0.124	0.145	-0.033
	(0.070)	(0.081)	(0.073)	(0.081)	(0.083)	(0.070)
Mom age at wave 1	-0.097*	0.041	-0.025	0.024	-0.046	0.054
	(0.029)	(0.033)	(0.029)	(0.030)	(0.029)	(0.031)
Mom education at wave 1	0.122**	-0.005	0.047	0.101*	0.002	-0.029
	(0.030)	(0.038)	(0.031)	(0.032)	(0.029)	(0.032)
Number of children in household	0.017	-0.003	-0.098**	0.014	-0.047	0.014
	(0.028)	(0.028)	(0.027)	(0.031)	(0.029)	(0.028)
Premature Birth	-0.054	-0.064	0.075	-0.015	-0.009	0.147
	(0.077)	(0.087)	(0.084)	(0.081)	(0.076)	(0.080)
Constant	-0.046	-0.193**	0.000	0.123*	0.265**	-0.015
	(0.054)	(0.055)	(0.051)	(0.055)	(0.057)	(0.057)

Note: Note: *p<.05, **p<.01; Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

The Moderating Role of Neighborhood Resources and Neighborhood-level ACE-like Stressors

In order to examine the role of neighborhood resources and neighborhood ACE-like stressors on kindergarten behavioral outcomes and test possible interactions with child ACE scores, neighborhood variables were added to the linear regression models, followed by interactions between each neighborhood variable and (centered) ACEs scores. Main effects model results shown in Table 10 indicated that results for ACEs did not change substantively with the inclusion of neighborhood resources and neighborhood ACEs composite variables. Neither neighborhood resources nor neighborhood ACEs were significantly associated with any

outcomes. Results from interaction models are shown in Table 11. No significant interactions emerged between ACEs and neighborhood factors.

Table 10. *Weighted and Adjusted Main Effect Models, N≈5,050*

	Parent-Reported Outcomes			Teacher-Reported Outcomes		
	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
ACEs	-0.074** (0.019)	0.143** (0.022)	0.033 (0.020)	-0.102** (0.017)	0.119** (0.017)	0.021 (0.019)
Neighborhood Resources	-0.011 (0.025)	0.024 (0.030)	0.030 (0.029)	-0.030 (0.027)	0.028 (0.026)	-0.020 (0.028)
Neighborhood Level ACEs	-.018 (0.060)	-0.024 (0.062)	.011 (0.060)	-0.005 (0.058)	0.002 (0.054)	0.013 (0.062)
Assigned Sex	0.310** (0.083)	-0.304** (0.056)	0.073 (0.051)	0.430** (0.048)	-0.539** (0.047)	0.032 (0.052)
Child Race						
Black	0.190* (0.083)	-0.162 (0.090)	-0.612** (0.065)	0.019 (0.102)	0.081 (0.113)	-0.113 (0.110)
Hispanic	0.099 (0.602)	-0.137 (0.075)	0.200* (0.077)	-0.043 (0.062)	-0.088 (0.059)	-0.032 (0.069)
Asian	-0.166* (0.077)	-0.249** (0.071)	-0.086 (0.065)	-0.001 (0.064)	-0.295** (0.058)	-0.010 (0.084)
Multiracial	-0.375* (0.152)	0.170 (0.166)	-0.064 (0.141)	0.114 (0.121)	-0.257 (0.130)	0.144 (0.168)
Other	-0.237* (0.111)	0.150 (0.098)	-0.167* (0.076)	-0.194 (0.103)	0.071 (0.089)	0.191 (0.144)
Child Age at K Assessment	0.028 (0.027)	-0.027 (0.029)	0.071* (0.031)	0.086* (0.029)	-0.083* (0.028)	-0.013 (0.035)
Months of Kindergarten at K Assessment	0.010 (0.027)	-0.028 (0.036)	-0.092* (0.036)	-0.019 (0.027)	0.035 (0.026)	0.058 (0.030)
Low Birthweight	-0.104 (0.070)	0.143 (0.074)	-0.020 (0.066)	-0.086 (0.076)	0.098 (0.077)	-0.059 (0.076)
Mom age at wave 1	-0.010* (0.005)	0.000 (0.005)	-0.004 (0.006)	0.000 (0.004)	-0.007 (0.004)	0.007 (0.004)
Mom education at wave 1	0.102* (0.031)	-0.012 (0.035)	0.056 (0.032)	0.076* (0.032)	-0.012 (0.027)	-0.014 (0.035)

Number of children in household	0.016 (0.028)	0.035 (0.027)	-0.092** (0.025)	0.012 (0.029)	-0.034 (0.025)	-0.020 (0.028)
Premature Birth	-0.123 (0.082)	-0.006 (0.079)	0.051 (0.076)	-0.065 (0.074)	0.055 (0.074)	0.145 (0.087)
Constant	0.253 (0.137)	0.160 (0.148)	0.145 (0.174)	-0.119 (0.127)	0.457** (0.130)	-0.260 (0.133)

Note: *p<.05, **p<.01; Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Table. 11. *Weighted and Adjusted Interaction Effect Models, N≈5,050*

	Parent-Reported Outcome			Teacher-Reported Outcome		
	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
ACEs	-0.073** (0.019)	0.144** (0.022)	0.033 (0.019)	-0.103** (0.017)	0.122** (0.017)	0.020 (0.019)
Neighborhood Resources	-0.012 (0.025)	0.023 (0.028)	0.029 (0.028)	-0.034 (0.027)	0.034 (0.025)	-0.013 (0.028)
ACEs x Neighborhood Resources	-0.006 (0.017)	-0.004 (0.023)	-0.004 (0.020)	-0.018 (0.018)	0.024 (0.017)	0.031 (0.017)
Neighborhood Level ACEs	-0.030 (0.064)	-0.041 (0.059)	0.009 (0.059)	-0.006 (0.060)	-0.011 (0.056)	0.032 (0.065)
ACEs x Neighborhood Level ACEs	-0.030 (0.041)	-0.038 (0.039)	-0.006 (0.038)	-0.003 (0.033)	-0.030 (0.032)	0.046 (0.040)
Assigned Sex	0.310** (0.049)	-0.304** (0.056)	0.073 (0.052)	0.430** (0.048)	-0.541** (0.047)	0.030 (0.052)
Child Race						
Black	0.195* (0.083)	-0.155 (0.090)	-0.612** (0.064)	0.017 (0.105)	0.089 (0.116)	-0.118 (0.112)
Hispanic	0.099 (0.060)	-0.138 (0.074)	0.200* (0.076)	-0.042 (0.062)	-0.090 (0.059)	-0.034 (0.069)
Asian	-0.167* (0.077)	-0.250** (0.071)	-0.086 (0.065)	-0.002 (0.064)	-0.296** (0.058)	-0.009 (0.083)
Multiracial	-0.374* (0.153)	0.171 (0.165)	-0.063 (0.142)	0.116 (0.119)	-0.259 (0.131)	0.138 (0.163)
Other	-0.239* (0.111)	0.148 (0.098)	-0.167* (0.077)	-0.192 (0.103)	0.067 (0.090)	0.191 (0.145)

Child Age at K Assessment	0.028 (0.027)	-0.026 (0.029)	0.071* (0.031)	0.087* (0.029)	-0.084* (0.028)	-0.015 (0.035)
Months of Kindergarten at K Assessment	0.009 (0.027)	-0.030 (0.037)	-0.093* (0.037)	-0.020 (0.027)	0.035 (0.026)	0.060* (0.030)
Low Birthweight	-0.104 (0.070)	0.143 (0.074)	-0.021 (0.066)	-0.088 (0.076)	0.100 (0.077)	-0.057 (0.076)
Mom age at wave 1	-0.010* (0.005)	0.000 (0.005)	-0.004 (0.006)	0.000 (0.004)	-0.007 (0.004)	0.007 (0.004)
Mom education at wave 1	0.103* (0.030)	-0.011 (0.036)	0.056 (0.032)	0.074* (0.032)	-0.007 (0.027)	-0.012 (0.034)
Number of children in household	0.017 (0.028)	0.037 (0.027)	-0.092** (0.025)	0.011 (0.029)	-0.031 (0.025)	-0.020 (0.028)
Premature Birth	-0.123 (0.082)	-0.005 (0.079)	0.051 (0.076)	-0.065 (0.074)	0.057 (0.074)	0.144 (0.087)
Constant	0.259 (0.136)	0.170 (0.150)	0.145 (0.176)	-0.122 (0.127)	0.470** (0.130)	-0.265* (0.133)

Note: *p<.05, **p<.01; Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Alternate Specifications

A number of alternate specifications were run to test to robustness of results. First, additional models were run to explore whether there were particular ACE indicators used in the composite driving model results by including all ten ACE indicators in adjusted OLS models predicting each outcome. All ACE indicators, with the exception of parent substance use, were significantly associated with one or more measures of children's behavioral functioning in kindergarten, with parent mental illness showing the most consistent connections. These findings generally suggest that no one indicator is likely responsible for model results (See Appendix D for results).

Additionally, a number of alternate models were run to test consistency of results across variations in weighting and variable operationalization. Specifically, interactions between neighborhood composite measures (resources and ACEs) and child ACEs were entered one at a

time; main effects of neighborhood composites and interactions with ACEs remained nonsignificant. Another set of models included disaggregated neighborhood resources (with medical resources, cultural resources, educational resources, and social services added as unique predictors in the model) and disaggregated neighborhood ACEs (split into three variables: socioeconomic adversity, violence and arrest, and parent-age mortality). Neighborhood variables were not significantly associated with outcomes (except for one significant association between parent-age mortality and internalizing behavior which was not consistent across reporters) and none of the interactions between neighborhood variables and ACEs were significant. See Appendix E for these model results. The neighborhood ACEs measure was even further disaggregated (e.g. testing each neighborhood ACE variable as its own predictor). In these models, there were a handful of significant interactions which were not consistent across reporters nor across the inclusion or exclusion of various neighborhood variables. VIFs were run to check for multicollinearity in all versions of interaction models; no multicollinearity issues were found in the models presented.

CHAPTER FIVE: DISCUSSION

ACEs are a common and risky occurrence for children with 40-50% of children experiencing at least one by age five and 60% experiencing one by age eighteen (Chapman et al., 2013; Finkelhor et al., 2015; Jimenez et al., 2016; Jimenez et al., 2017). Toxic stress, attachment, and ecobiodevelopmental theories suggest ACEs might disrupt stress response systems as well as relational bonding, in turn impacting children's ability to regulate behaviors, build peer relationships, and succeed in academic settings. These consequences felt in early childhood have the potential to cascade into long run adolescent and adult health, behavior, and wellbeing. Using multi-reporter longitudinal data with a nationally representative sample of young children and a

rigorous analytic technique to help adjust for factors that may select children into ACEs, this study sought to address two key issues in the field: 1) the lack of clarity regarding the functional form of the relationship between ACEs and behavioral outcomes and 2) the limited understanding of the role the neighborhood context plays in relation to ACEs and early behavioral outcomes.

The Functional Form of the Relation between ACEs and Early Behavioral Outcomes

Linear analysis found a robust association between ACEs experienced between nine months and four years of age and both prosocial skills and externalizing behavior problems at kindergarten entry. These findings expand on prior research, strengthening the evidence of these relationships as a product of the analytic strategy employed. Results suggest that with the addition of each ACE a child is exposed to by the age of four, prosocial skills decrease by 0.075-0.105 standard deviations and externalizing behavior problems increase by 0.120-0.143 standard deviations according to both parent and teacher reports during children's kindergarten year. The magnitude of the relationship between ACEs and externalizing behavior problems was about double that of the relationship between ACEs and prosocial skills, though both sets of effect sizes were small in magnitude. These findings are in line with and extend previous research which has found associations between early ACE exposure and kindergarten behavioral outcomes (Jimenez et al., 2016; Wang & McGuire-Jack, 2018; Wang et al., 2020). For example, Jimenez and colleagues (2016) found that having three or more ACEs was associated with greater attention problems, social problems, and aggression in kindergarten. Another study by Wang and colleagues found significant relationships between ACEs and attention problems, withdrawal, aggression, and depression/anxiety symptoms in five year old children ($\beta = 0.14$-0.29 across outcomes; Wang & McGuire-Jack, 2018). Other work by Wang and colleagues

(2020) found a significant relationship between ACEs and five year old externalizing behavioral problems at a magnitude in line with those found in this study ($\beta = 0.12$).

There are key improvements the current study makes compared to prior work. This study utilizes a larger sample of children (other study samples ranged from N = 1,007-3,001), followed over more frequent time points. Whereas both papers by Wang and colleagues (2018; 2020) utilize data collected at two time points (age 3 and age 5) and Jimenez and colleagues (2016) rely on parents' retrospective report of ACEs collected at the same time period as outcome data, the current study creates a cumulative measure of ACEs from concurrent reporting over the course of three waves of data collection, which has the potential to reduce recall bias. While all of these studies rely on parent report of ACEs, the current study includes multiple-parent reports and direct assessment data where available. It is also noteworthy that the current study included outcomes from multiple reporters where other studies consistently rely on a single reporter, in some cases relying on parent-report across both predictors and outcomes (Wang & McGuire-Jack, 2018; Wang et al., 2020). Findings were consistent across reporters reflecting the ways in which children's behavior may differ across context and potential biases and insights different reporters have. This suggests that early behavioral outcomes associated with ACEs are translating across both school and home contexts.

ACEs was never found to be significantly associated with internalizing behavior problems, a finding which was consistent across both parent and teacher reports and various model iterations in contrast to prior research. There could be several reasons for these null results. On the one hand, it is possible that these results are reflective of a true lack of association between ACE exposure and internalizing behaviors at this age. Alternatively, error could have been introduced to the models due to measurement issues. Reflecting ongoing challenges in the

field regarding capturing internalizing problems in children too young to self-report, the internalizing behavior problems measure in the ECLS-B is composed of just two items with relatively low reliability. Finally, a third option be related to the improved modeling strategy. As such, these findings may be the result of error introduced by measurement limitations. The findings of this study are contrary to much of the limited literature examining early internalizing behavioral outcomes (Clarkson Freeman, 2014; Wang et al., 2020). Clarkson Freeman (2014) studied the relationship between parent reported ACEs (using a categorical measure) for children under six and associations with parent-reported behavioral outcomes collected roughly two years later in a sample of 1,670 children finding significant associations between ACE scores of two and higher and internalizing behavior. Wang and colleagues found a significant association between age three parent-reported ACEs and age five parent-reported internalizing behavior in a sample of 3,001 with a magnitude of .08. It is possible that significant associations were found in these studies owing to the inclusion of more comprehensive data on abuse and neglect in their ACEs constructs. Alternatively, it is possible that differences are due to the more robust controls utilized by the present study.

In addition to expanding evidence of connections between early childhood ACEs and children's behavioral functioning, this study sought to more rigorously assess the functional form of this relationship. This goal sought to address inconsistencies in the field in which some work has presumed a linear function while others have created dichotomous variables delineating high- versus low-ACE scores with limited empirical justification. Across numerous modeling techniques – step functions with post hoc contrasts, spline, and quadratic models – results failed to find compelling evidence of nonlinear relationships between ACEs and young children's behavioral functioning. Together, results support the interpretation that these relationships are

roughly linear. These results are beneficial from a modeling perspective as they suggest that linear models are appropriate, and are provide a good confirmation that past work employing linear modeling likely assumed the appropriate functional form.

The Moderating Role of Neighborhood Resources and Neighborhood-level ACE-like Stressors

The second goal in this study was to explore the role of the neighborhood context as a potential buffer between ACEs and early behavioral outcomes using a more comprehensive measure of neighborhood resources than previously studied as well as employing a novel approach to assessing neighborhood adversity via a neighborhood-level ACE measure. While the relationship between ACEs and outcomes was maintained in models incorporating neighborhood factors, neither neighborhood resources, nor neighborhood ACEs were significant as predictors of behavioral outcomes or as moderators of the relationship between ACEs and outcomes. These results are surprising given that prior research using ECLS-B data has found negative associations between neighborhood educational and cultural resources and child externalizing behavior, as well as positive associations between neighborhood stressors like concentrated disadvantage and crime and child externalizing behavior (with both associations being largely mediated through parenting behaviors; Coley et al., 2021). Other studies have also demonstrated support for the relationship between neighborhood resources and stressors and a variety of childhood outcomes (see Leventhal et al., 2015 for a review).

While it is possible that these results are reflective of the real role neighborhood context plays in early behavioral development, it is also possible that the lack of findings is due to issues of measurement or the conceptual model. One example of a measurement issue involved could be the use of zip code to define neighborhood boundaries. These boundaries are not necessarily

reflective of how children and families operationalize their neighborhood context for themselves nor how they experience and traverse the geographic location around them. Some studies examining the neighborhood context have used much narrower boundaries suggesting that these boundaries may be more closely related to perceived neighborhood safety (Burdick et al., 2011; Sharkey, 2010). Alternatively, some studies have broadened boundaries in order to use measures more reflective of how far families may travel to access certain resources (Coley et al., 2021; Votruba-Drzal, 2020).

Another aspect to consider is whether the overarching nature of the neighborhood resource measure used – one which combines multiple aspects of the neighborhood and counts the number of resources rather than attending to aspects of these resources like accessibility, quality, or proximity – may limit the power of this measure. Thinking through the potential importance of not just prevalence but accessibility of neighborhood resources, there are a number of reasons why families might not be able to benefit from supports these aspects of the neighborhood offer. For example, while there might be five preschools located in a family's zip code, a family might lack access to transportation required to reach any of these preschools. Other barriers to accessing neighborhood resources could include factors such as financial cost, language barriers, the physical space not being able to accommodate disabled individuals, and resources not being accessible at the times when families need them (e.g., not having early education options that meet the time demands of shift work; Lazar & Davenport, 2018; Torres Sanchez et al., 2022; Wu & Eamon, 2010).

A second key issue that was not addressed in the neighborhood resource measure is that of the quality of services provided. Quality may be a more potent factor in buffering the stresses imposed by child ACEs. Quality of resources like educational services, for example, have been

shown to promote positive outcomes for children (Hong et al., 2019). Unfortunately, measuring the accessibility and quality of neighborhood services is a challenging task that the field continues to grapple with. Finally, our measures of neighborhood resources did not tap into whether families actually used the resources in their neighborhood. Exploring the moderating effect of direct resource use might lead to different outcomes than the present study. In line with this, it is possible that the measure used in this study does not get at more proximal neighborhood resources which may be more important in buffering consequences associated with ACEs. Findings from past research suggests that neighborhood social support (or lack thereof) may be an important neighborhood feature buffering links between ACEs and wellbeing (Henderson-Posther, 2022; McCoy, 2020). For example, in a sample of 26,500 adolescents, McCoy (2020) found both school and community support moderated the relationship between self-reported, retrospective ACEs and risky behaviors. Recognizing the ways in which prior research has found connections between more proximal neighborhood resources and ACEs, it may be that the study measures of neighborhood resources were too distal to moderate consequences associated with ACEs.

Also surprising was the lack of findings related to neighborhood-level ACEs given the breadth of literature connecting neighborhood adversity to child outcomes (see Leventhal, 2015 for review). While there is limited literature on the topic, results contrast with a handful of prior reports finding neighborhood adversity to be related to the relationship between ACES and behavioral outcomes during early childhood (Wang et al., 2020; Wang & Maguire-Jack, 2018). In both of these studies, parent reported measures of perceived community violence and social disorder were studied. This brings to light the possibility that perceptions of neighborhood adversity, presumably developed through direct experience in the environment, may be more

indicative of the kind of proximal stress that might be associated with exacerbated ACEs consequences. Similar to the measurement of neighborhood resources in this study, perhaps the comparatively distal measure of adversity used has a more limited relationship with children's outcomes.

From a theoretical perspective, the null results could also reflect a mis-specified conceptual model. While this study is exploring the moderating role of the neighborhood context on the relationship between ACEs and behavioral outcomes, it is possible that the inclusion of household poverty as well as factors such as parental divorce, death, and mental and behavioral health and parenting challenges in the ACE scale muddies the ability to disentangle the role of ACEs and the neighborhood context. Household poverty as well as factors like marital status are likely to be drivers of neighborhood context as a function of how families' financial and social resources affect the neighborhoods they can afford to live in (Coley et al., 2021; Votruba-Drzal et al., 2020). It is also possible for a bidirectional relationship to exist whereby neighborhood contexts may affect families' economic and social resources just as such family factors affect families' selection into neighborhoods (Green et al., 2021). While no issues of multicollinearity arose via correlation analysis and examination of VIFs, it is possible that neighborhood contextual factors are drivers and/or products of some of the indicators included in the ACEs scale rather than moderators of them. Alternatively and finally, differences in findings could be the product of differences in measurement and analytic strategy, including but not limited to the use of propensity score weighting for this analysis, which was not used in prior work.

Limitations and Future Directions

In interpreting the results of this work, it is essential to consider the limitations. One limitation of this analysis was the narrow and limited measurement of internalizing behavior

problems. Although reported by both parents and teachers, the measure of internalizing behavior problems available in the ECLS-B included only two items with low reliability. As such, it is unclear whether the lack of significant results related to internalizing behavior problems are the product of measurement error. It would be useful to replicate these findings in a sample with a more reliable measure of internalizing behavior problems in order to better understand these relationships. A second limitation, common to a great many studies of ACEs, is reliance on count measures of different types of ACE exposures which omits information about the depth, timing, and chronicity of such experiences. While this operationalization of ACEs is standard in the field and therefore allows for easier comparison of findings across studies, future work may benefit from exploring how timing and duration of ACE exposure is related to early behavioral outcomes. For example, although the current work represented an improvement on many prior measures by using multiple current reports of ACEs exposure rather than retrospective reports from a single point in time, the operationalization of ACEs did not exploit the availability of multiple reports on most of the ACE constructs. Using these data to assess chronicity of exposure would be an important topic for future research. A third limitation concerns the age of the dataset, which may have implications for its interpretation and generalizability. The ECLS-B has many benefits as it offers the ability to look at a large, nationally representative cohort of children across the first five to six years of life, and also has the unique benefit of having geographic identifiers allowing for the linking of administrative data. However, data collection occurred two decades ago, which has implications for the generalizability of findings to modern contexts.

An additional umbrella of limitations has to do with the use of administrative data to capture neighborhood contexts. There are many strengths to this approach including the wide

array of data available across time, the objective measure of neighborhoods captured by these measures, and the low rate of missing data at the zip-code level in some administrative data like the ACS. However, there are also drawbacks, some of which are unique to this study and some of which are universal to work using administrative data. First, due to constraints of the ECLS-B geographic identifiers, neighborhood data were coded at the zip code level, a rather broad geographic area which varies dramatically in size across rural and urban areas and does not necessarily comport with how families conceptualize their neighborhoods. For some resources and stressors, the geographic location at which families access or perceive these aspects of the neighborhood may be smaller or larger than the geographic region of the zip code. Beyond this, one issue particular to the FBI uniform crime reporting database is the voluntary nature of reporting on the part of local law enforcement and subsequent high rates of missing data. While imputation methods were employed to handle this missing data, it is likely that there is an underestimation of violent crime and arrest rates used in the study as a product of variability in local agency reporting. When considering neighborhood resources, as noted above, the measures employed in this work focused solely on availability of resources and could not assess aspects of quality, accessibility, and use. Exploring these elements of the neighborhood resource context would be an ideal next step in this line of research in order to better understand how ACEs involved families may avail themselves of supportive resources and how such resources may serve as protective forces in the early behavioral development of ACE- exposed children. Further, it may be useful to consider alternative conceptual models for the role that the neighborhood plays, perhaps testing whether neighborhoods are connected to behavioral outcomes via mediators of parenting stress and subsequent ACE scores.

Contributions and Implications

Despite limitations, this paper makes a number of contributions to the extant body of literature on ACEs, which has implications for the field of ACEs research as well as trauma intervention and prevention work. First, in exploring the functional form of the relationship between ACEs and short-run behavioral outcomes, this study found that the relationship is roughly linear. This suggests that research exploring this relationship should be employing linear modeling strategies. While the use of ACEs scales in practical setting is controversial (Kelly-Irving & Delpierre, 2019), those using this type of screener to assess child adversity should do so with an understanding of this linear relationship and implications for the way in which intervention may need to be tiered to best support children and avoid behavioral consequences associated with ACE scores. This avoids potential practical underestimation of child risk and required supports for children with lower ACE scores, which alternative dichotomous conceptualizations of lower and higher ACEs have the potential to exacerbate. For example, the findings of this study support the idea that each additional ACE could have serious negative consequences for kindergarten behavior, which might suggest that even children experiencing a low number of ACEs may need additional supports to avoid these repercussions.

Exploration of the role of the neighborhood context in this study has provided potentially surprising insights regarding the lack of involvement of both neighborhood resources and ACE-like stressors in the relationship between child ACEs and early behavioral outcomes. While these findings should not be taken as evidence that the neighborhood context does not play a significant role in early development writ large, the findings do suggest that 1) the availability of resources in the neighborhood context alone may be insufficient to promote early behavioral outcomes and 2) the presence of neighborhood level stressors analogous to adversity in the ACE

measure is still unclear. These results add to the growing body of literature suggesting that neighborhood contexts may be more important in early childhood in the way in which they promote or inhibit engaged and responsive parenting and in the longer-term trajectories they set children on rather than showing substantive direct links with short term outcomes (Chetty et al., 2016; Coley et al., 2021; Votruba-Drzal, et al., 2020). The role of neighborhoods in young children's ACE exposure and subsequent outcomes remains an open question. Still, this study takes a substantial step forward by examining a comprehensive set of neighborhood characteristics utilizing a rigorous analytic strategy and nationally representative data.

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APPENDIX

Appendix A: Factor Analysis of Neighborhood Indicators

Table A1. *Factor Analysis of Neighborhood Resources*

	Factor1
Medical Resources	**0.797**
Cultural Resources	**0.750**
Educational Resources	**0.745**
Social Resources	**0.675**

Note: Extraction Method: PCF; Rotation: Oblique; Loadings larger than .40 are in bold.
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Table A2. *Factor Analysis of Neighborhood ACEs, 1 Factor Solution*

	Factor1
Unemployment Rate	**0.790**
Poverty Rate	**0.843**
% Female Headed HH	**0.815**
Parent Age Mortality Rate	**0.544**
Violent Crime Rate	**0.758**
Arrest Rate	**0.600**

Note: Extraction Method: PCF; Rotation: Oblique; Loadings larger than .40 are in bold.
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Table A3. *Factor Analysis of Neighborhood ACEs, No Forced Solution*

	Factor1	Factor2	Factor3
Unemployment Rate	**0.907**	-0.006	0.006
Poverty Rate	**0.827**	0.311	-0.105
% Female Headed HH	**0.865**	-0.087	0.104
Parent Age Mortality Rate	0.129	**0.885**	-0.135
Violent Crime Rate	0.263	0.108	**0.742**
Arrest Rate	-0.110	-0.069	**0.954**

Note: Extraction Method: PCF; Rotation: Oblique; Loadings larger than .40 are in bold.
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Appendix B: Propensity Score Weighting Balance Checks

Table B1. *IPW Balance Checks*

	Pre-IPW Creation		Post-IPW Creation	
	Coef.	S.E.	Coef.	S.E.
ACES > Black				
1	**-1.731**	**0.216**	-0.245	0.468
2	**-1.485**	**0.120**	0.002	0.432
3	**-1.058**	**0.136**	0.428	0.437
4	**-1.339**	**0.164**	0.147	0.446
5	**-1.618**	**0.258**	-0.132	0.488
6	**-1.570**	**0.356**	-0.083	0.547
7	-1.310	0.717	0.176	0.828
ACES > Hispanic				
1	**-0.939**	**0.122**	-0.491	0.258
2	**-0.828**	**0.106**	-0.379	0.251
3	**-0.368**	**0.151**	0.061	0.271
4	**-0.655**	**0.174**	-0.206	0.287
5	-0.545	0.284	-0.096	0.364
6	**-1.133**	**0.384**	-0.684	0.446
7	-1.067	0.772	-0.618	0.805
ACES > Asian				
1	**-3.202**	**0.133**	-0.326	0.250
2	**-2.936**	**0.135**	-0.060	0.251
3	**-2.674**	**0.156**	0.200	0.263
4	**-2.739**	**0.292**	0.075	0.356
5	**-3.965**	**0.468**	**-1.090**	**0.514**
6	**-3.875**	**0.532**	-1.000	0.573
7	**-26.963**	**0.545**	**-19.625**	**0.585**
ACES > Multiracial				
1	**-4.933**	**0.381**	0.462	0.759
2	**-5.054**	**0.224**	0.362	0.696
3	**-5.310**	**0.259**	0.106	0.707
4	**-4.715**	**0.293**	0.701	0.721
5	**-5.058**	**0.328**	0.358	0.736
6	**-4.947**	**0.473**	0.468	0.811
7	**-3.510**	**1.002**	1.905	1.199
ACES > Other				
1	**-2.084**	**0.230**	-0.168	0.382
2	**-2.718**	**0.203**	-0.402	0.396
3	**-1.640**	**0.514**	0.098	0.424

4	**-2.340**	**0.298**	-0.061	0.452
5	**-3.117**	**0.358**	-0.800	0.494
6	**-2.380**	**0.501**	-0.064	0.606
7	**-3.462**	**1.058**	-1.145	1.111
ACES > Maternal Birth Age				
1	**27.610**	**0.308**	0.288	0.723
2	**27.196**	**0.268**	-0.154	0.708
3	**27.437**	**0.426**	-0.027	0.785
4	**27.290**	**0.455**	-0.094	0.798
5	**27.512**	**0.743**	0.162	0.991
6	**25.958**	**0.970**	-1.391	1.171
7	**27.652**	**2.394**	0.303	2.483
ACES > Maternal Education				
1	**13.183**	**0.136**	0.133	0.259
2	**13.481**	**0.129**	0.372	0.256
3	**13.478**	**0.265**	0.155	0.288
4	**13.013**	**0.185**	-0.118	0.287
5	**12.703**	**0.306**	-0.406	0.377
6	**12.340**	**0.318**	**-0.769**	**0.388**
7	**12.368**	**0.545**	-0.741	0.588
ACES > hh Children				
1	0.097	0.210	0.140	0.203
2	-0.049	0.202	0.015	0.196
3	0.165	0.210	0.236	0.204
4	0.194	0.246	0.259	0.240
5	**0.449**	**0.227**	**0.509**	**0.220**
6	0.168	0.370	0.230	0.364
7	0.754	0.505	0.806	0.485
ACES > Low Birthweight				
1	**-2.306**	**0.165**	-0.076	0.282
2	**-2.581**	**0.103**	-0.223	0.271
3	**-2.726**	**0.124**	-0.325	0.277
4	**-2.418**	**0.165**	-0.056	0.301
5	**-2.733**	**0.201**	-0.376	0.321
6	**-1.933**	**0.360**	0.424	0.439
7	**-1.821**	**0.571**	0.536	0.623
ACES > Child Sex Assigned at Birth				
1	-0.165	0.100	-0.158	0.225
2	-0.047	0.088	-0.027	0.221
3	-0.031	0.141	0.051	0.235
4	-0.189	0.152	-0.170	0.254
5	0.149	0.257	0.169	0.327
6	0.175	0.313	0.195	0.373
7	0.228	0.727	0.248	0.755

ACES > Premature Birth				
1	**-2.008**	**0.150**	0.000	0.302
2	**-2.100**	**0.114**	0.000	0.295
3	**-2.025**	**0.161**	0.125	0.313
4	**-2.020**	**0.172**	0.085	0.322
5	**-1.909**	**0.288**	0.192	0.396
6	**-1.735**	**0.381**	0.365	0.468
7	**-1.612**	**0.542**	0.488	0.607

Note: Bold coefficients are significant
Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Appendix C: Cross Wave Missing Rates for ACEs and Neighborhood Indicators

Table C1. *Missing Rates for Wave level Items Used in Cross-Wave Composites*

	Percent of Values Missing
ACEs	
Parent Divorce	0%-3%
Parent Incarceration	0%-1%
Parent Death	0%-1%
Parent IPV	11%-40%
Parent Mental Illness	5%-86%
Parent Substance Abuse	10%-77%
Corporal Punishment	0%-34%
Emotional Neglect	14%-20%
Poverty	0%-<0.01%
Food Insecurity	0%-<0.01%
Neighborhood Variables	
Medical Resources	7%-8%
Educational Resources	4%-5%
Cultural Resources	14%-16%
Social Services	19%-20%
Poverty Rate	1%-3%
Unemployment Rate	1%-3%
Percent Female Headed Household	1%-3%

Mortality Rate	1%-3%
Arrest Rate	53%-54%
Violent Crime Rate	59%-61%

Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Appendix D: Pre-Analysis Tests of ACE indicators

Table D1. *Weighted and Adjusted Linear Models with ACE Indicators Predicting Behavioral Outcomes, N≈5,050*

	Parent-Reported Outcomes			Teacher-Reported Outcomes		
	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
IPV	-0.092	0.203*	0.042	-0.136*	0.144*	0.066
	(0.063)	(0.065)	(0.005)	(0.063)	(0.064)	(0.069)
Corporal Punishment	-0.002	0.148*	-0.116	0.048	0.109	-0.036
	(0.058)	(0.070)	(0.063)	(0.057)	(0.060)	(0.061)
Parent Mental Illness	-0.110*	0.228**	0.109	-0.147*	0.198**	0.005
	(0.054)	(0.055)	(0.057)	(0.057)	(0.056)	(0.061)
Parent Substance Abuse	0.020	0.002	0.031	0.018	-0.012	0.035
	(0.076)	(0.070)	(0.073)	(0.072)	(0.069)	(0.082)
Parent Death	-0.074	-0.008	-0.007	-0.325*	0.159	-0.163
	(0.210)	(0.178)	(0.131)	(0.158)	(0.223)	(0.188)
Separation/Divorce	0.000	0.075	-0.001	-0.165*	0.213*	0.119
	(0.086)	(0.072)	(0.073)	(0.074)	(0.079)	(0.090)
Household Poverty	0.019	0.101	-0.020	-0.195*	0.057	-0.023
	(0.063)	(0.068)	(0.075)	(0.062)	(0.063)	(0.070)
Parent Incarceration	-0.219	0.510*	-0.134	-0.089	0.266	-0.192
	(0.204)	(0.0256)	(0.155)	(0.158)	(0.212)	(0.160)
Food Insecurity	-0.158*	0.187*	0.097	-0.110	0.191*	0.050
	(0.065)	(0.063)	(0.059)	(0.067)	(0.061)	(0.069)
Emotional Neglect	-0.243**	0.081	0.113	-0.082	0.005	0.029
	(0.062)	(0.069)	(0.061)	(0.065)	(0.064)	(0.066)
Assigned Sex	0.303**	-0.301**	0.074	0.429**	-0.537**	0.031
	(0.048)	(0.056)	(0.052)	(0.047)	(0.046)	(0.052)
Child Race						
Black	0.195*	-0.186*	-0.598	0.027	0.088	-0.072
	(0.082)	(0.087)	(0.061)	(0.104)	(0.116)	(0.114)

Hispanic	0.136*	-0.151	0.155	0.019	-0.086	-0.018
	(0.062)	(0.082)	(0.081)	(0.065)	(0.060)	(0.067)
Asian	-0.116	-0.269**	-0.123	0.043	-0.289**	0.000
	(0.077)	(0.076)	(0.068)	(0.069)	(0.062)	(0.085)
Multiracial	-0.388*	0.181	-0.041	0.093	-0.227	0.153
	(0.151)	(0.162)	(0.136)	(0.119)	(0.132)	(0.162)
Other	-0.236*	0.149	-0.172*	-0.174	0.072	0.199
	(0.110)	(0.098)	(0.077)	(0.102)	(0.088)	(0.144)
Child Age at K Assessment	0.029	-0.030	0.072*	0.087*	-0.084*	-0.011
	(0.027)	(0.029)	(0.031)	(0.028)	(0.027)	(0.035)
Months of Kindergarten at K Assessment	0.009	-0.027	-0.088*	-0.026	0.038	0.058
	(0.027)	(0.036)	(0.036)	(0.027)	(0.025)	(0.030)
Low Birthweight	-0.108	0.142	-0.022	-0.076	0.096	-0.061
	(0.071)	(0.074)	(0.066)	(0.076)	(0.076)	(0.076)
Mom age at wave 1	-0.009*	0.001	-0.005	0.000	-0.007	0.006
	(0.005)	(0.005)	(0.006)	(0.004)	(0.004)	(0.004)
Mom education at wave 1	0.101*	-0.016	0.063	0.060	-0.019	-0.017
	(0.033)	(0.036)	(0.034)	(0.034)	(0.029)	(0.037)
Number of children in household	0.012	0.035	-0.088*	0.017	-0.030	-0.017
	(0.028)	(0.027)	(0.025)	(0.028)	(0.025)	(0.028)
Premature Birth	-0.122	0.001	0.051	-0.064	0.061	0.150
	(0.083)	(0.078)	(0.075)	(0.073)	(0.073)	(0.089)
Constant	0.363**	-0.202	0.191	0.045	0.185	-0.258
	(0.153)	(0.205)	(0.210)	(0.144)	(0.154)	(0.154)

Note: *p<.05, **p<.01; Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Appendix E: Alternate Models

Table E1. *Weighted and Adjusted Main Effect Models, Disaggregated Neighborhood Predictors, N≈5,050*

	Parent-Reported Outcomes			Teacher-Reported Outcomes		
	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
ACEs	-0.074 **	0.142**	0.036	-0.103**	0.120**	0.020
	(0.019)	(0.022)	(0.020)	(0.017)	(0.017)	(0.019)

Medical Resources	-0.002 (0.025)	0.014 (0.034)	0.004 (0.034)	-0.042 (0.033)	0.033 (0.027)	-0.024 (0.034)
Cultural Resources	0.010 (0.040)	0.011 (0.042)	0.008 (0.038)	0.007 (0.041)	0.017 (0.030)	0.006 (0.042)
Educational Resources	0.013 (0.025)	-0.017 (0.038)	0.026 (0.031)	0.029 (0.026)	-0.038 (0.032)	0.000 (0.034)
Social Services	-0.013 (0.030)	0.020 (0.031)	0.003 (0.030)	-0.016 (0.037)	0.027 (0.028)	-0.014 (0.035)
Neighborhood Socioecomic Adversity	0.005 (0.041)	-0.050 (0.041)	0.018 (0.045)	-0.014 (0.040)	0.015 (0.035)	0.011 (0.042)
Neighborhood Crime	-0.032 (0.043)	0.013 (0.048)	0.037 (0.045)	-0.005 (0.038)	0.010 (0.039)	-0.035 (0.040)
Parent-Age Mortalitiy Rates	-0.008 (0.026)	0.025 (0.031)	-0.072* (0.027)	0.011 (0.025)	-0.018 (0.023)	0.022 (0.028)
Assigned Sex	0.311** (0.049)	-0.305** (0.056)	0.071 (0.051)	0.430** (0.048)	-0.540** (0.046)	0.033 (0.052)
Child Race						
Black	0.196* (0.085)	-0.149 (0.092)	-0.622** (0.066)	0.037 (0.110)	0.066 (0.116)	-0.107 (0.116)
Hispanic	0.107 (0.062)	-0.124 (0.074)	0.157* (0.076)	-0.013 (0.065)	-0.117 (0.062)	-0.014 (0.069)
Asian	-0.165* (0.078)	-0.239* (0.073)	-0.118 (0.066)	0.017 (0.067)	-0.312** (0.060)	0.002 (0.085)
Multiracial	-0.376* (0.156)	0.187 (0.168)	-0.047 (0.144)	0.101 (0.125)	-0.236 (0.132)	0.135 (0.165)
Other	-0.236* (0.111)	0.156 (0.097)	-0.192* (0.078)	-0.182 (0.105)	0.056 (0.090)	0.198 (0.146)
Child Age at K Assessment	0.030 (0.027)	-0.030 (0.029)	0.075* (0.032)	0.083* (0.028)	-0.079* (0.027)	-0.013 (0.035)
Months of Kindergarten at K Assessment	0.010 (0.027)	-0.032 (0.037)	-0.085* (0.036)	-0.019 (0.027)	0.035 (0.025)	0.056 (0.030)
Low Birthweight	-0.105 (0.070)	0.142 (0.074)	-0.019 (0.066)	-0.086 (0.076)	0.097 (0.077)	-0.059 (0.076)
Mom age at wave 1	-0.010* (0.005)	0.000 (0.005)	-0.005 (0.006)	0.000 (0.004)	-0.007 (0.004)	0.007 (0.004)
Mom education at wave 1	0.099* (0.031)	-0.014 (0.035)	0.050 (0.032)	0.075* (0.033)	-0.012 (0.028)	-0.013 (0.035)
Number of children in household	0.016 (0.028)	0.037 (0.027)	-0.093** (0.025)	0.011 (0.029)	-0.033 (0.025)	-0.021 (0.028)

Premature Birth	-0.122	-0.007	0.055	-0.066	0.057	0.142
	(0.081)	(0.078)	(0.076)	(0.073)	(0.074)	(0.087)
Constant	0.252	0.153	0.186	-0.136	0.470**	-0.269*
	(0.135)	(0.146)	(0.174)	(0.126)	(0.130)	(0.133)

Note: *p<.05, **p<.01; Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).

Table E2. *Weighted and Adjusted Main Effect Models, Disaggregated Neighborhood Predictors, N≈5,050*

	Parent-Reported Outcome			Teacher-Reported Outcome		
	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors	Prosocial Skills	Externalizing Behaviors	Internalizing Behaviors
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
ACEs	-0.075**	0.143**	0.037*	-0.103**	0.122**	0.020
	(0.018)	(0.022)	(0.018)	(0.017)	(0.017)	(0.019)
Medical Resources	-0.002	0.009	0.002	-0.042	0.034	-0.024
	(0.026)	(0.032)	(0.032)	(0.033)	(0.027)	(0.033)
ACEs x Medical	0.003	-0.021	-0.014	-0.003	0.007	0.004
	(0.015)	(0.024)	(0.023)	(0.021)	(0.019)	(0.020)
Cultural Resources	0.008	0.010	0.008	0.008	0.017	0.009
	(0.039)	(0.041)	(0.038)	(0.040)	(0.030)	(0.042)
ACEs x Cultural	-0.010	-0.008	-0.011	0.010	-0.004	0.015
	(0.021)	(0.026)	(0.019)	(0.026)	(0.023)	(0.021)
Educational Resources	0.012	-0.014	0.033	0.028	-0.038	0.001
	(0.025)	(0.035)	(0.031)	(0.026)	(0.031)	(0.033)
ACEs x Educational	-0.006	0.010	0.020	-0.006	0.002	0.009
	(0.016)	(0.025)	(0.020)	(0.018)	(0.020)	(0.021)
Social Services	-0.014	0.021	0.003	-0.023	0.036	-0.016
	(0.033)	(0.030)	(0.029)	(0.035)	(0.028)	(0.033)
ACEs x Social Services	-0.006	0.006	0.002	-0.018	0.020	-0.004
	(0.018)	(0.022)	(0.018)	(0.021)	(0.017)	(0.023)
Neighborhood Socioecomic Adversity	-0.005	-0.054		-0.016	0.006	0.021
	(0.041)	(0.042)	0.019 (0.041)	(0.042)	(0.037)	(0.043)
ACEs x SES Adversity	-0.016	-0.014	-0.001	0.003	-0.024	0.021
	(0.028)	(0.028)	(0.030)	(0.025)	(0.022)	(0.024)
Neighborhood Crime	-0.022	-0.003	0.026	0.004	0.006	-0.036
	(0.047)	(0.043)	(0.044)	(0.039)	(0.039)	(0.043)

ACEs x Neighborhood Crime	0.020	-0.030	-0.021	0.018	-0.010	-0.003
	(0.028)	(0.035)	(0.028)	(0.024)	(0.025)	(0.028)
Parent-Age Mortalitiy Rates	-0.014	0.025	-0.071*	0.010	-0.017	0.025
	(0.026)	(0.029)	(0.026)	(0.026)	(0.024)	(0.028)
ACEs x Mortality Rates	-0.032	0.005	0.012	-0.014	0.003	0.017
	(0.018)	(0.024)	(0.018)	(0.018)	(0.015)	(0.017)
Assigned Sex	0.313**	-0.309**	0.071	0.430**	-0.540**	0.031
	(0.048)	(0.056)	(0.051)	(0.048)	(0.046)	(0.052)
Child Race						
Black	0.208*	-0.148	-0.625**	0.040	0.075	-0.118
	(0.085)	(0.091)	(0.064)	(0.112)	(0.119)	(0.119)
Hispanic	0.110	-0.126	0.157*	-0.011	-0.117	-0.018
	(0.062)	(0.073)	(0.075)	(0.065)	(0.062)	(0.069)
Asian	-0.162*	-0.242*	-0.118	0.018	-0.312**	-0.001
	(0.078)	(0.072)	(0.067)	(0.067)	(0.061)	(0.084)
Multiracial	-0.364*	0.182	-0.053	0.108	-0.236	0.130
	(0.156)	(0.163)	(0.143)	(0.124)	(0.134)	(0.163)
Other	-0.239*	0.152	-0.191*	-0.181	0.053	0.200
	(0.112)	(0.098)	(0.079)	(0.105)	(0.089)	(0.146)
Child Age at K Assessment	0.030	-0.030	0.075*	0.083*	-0.079*	-0.014
	(0.027)	(0.028)	(0.032)	(0.028)	(0.027)	(0.035)
Months of Kindergarten at K Assessment	0.008*	-0.033	-0.085*	-0.018	0.033	0.058
	(0.027)	(0.036)	(0.036)	(0.027)	(0.026)	(0.030)
Low Birthweight	-0.106	0.141	-0.020	-0.086	0.098	-0.058
	(0.070)	(0.074)	(0.067)	(0.076)	(0.076)	(0.076)
Mom age at wave 1	-0.010	-0.000	-0.005	0.001	-0.007	0.007
	(0.005)	(0.005)	(0.006)	(0.004)	(0.004)	(0.004)
Mom education at wave 1	0.100*	-0.015	0.048	0.074*	-0.008	-0.013
	(0.030)	(0.035)	(0.031)	(0.033)	(0.028)	(0.035)
Number of children in household	0.016	0.036	-0.094**	0.011	-0.031	-0.022
	(0.028)	(0.028)	(0.025)	(0.029)	(0.025)	(0.028)
Premature Birth	-0.123	-0.004	0.056	-0.069	0.061	0.140
	(0.082)	(0.078)	(0.076)	(0.074)	(0.074)	(0.087)
Constant	0.250	0.173	0.187	-0.138	0.477**	-0.269*
	(0.134)	(0.145)	(0.174)	(0.127)	(0.131)	(0.132)

Note: *p<.05, **p<.01; Data Source: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Birth Cohort (ECLS-B: 2001).