Multiple Environmental Risk and Early Head Start Program Efficacy

by

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ABSTRACT

This study investigated the efficacy of Early Head Start home-based, center-based and mixed-approach programs on cognitive, language and behavioral outcomes at different levels of cumulative environmental risk. Early Head Start is a federal program that provides low-income families and their children from birth to age three with childcare, parenting education, healthcare and other family supports. As part of Early Head Start's initiation, a program evaluation was begun involving 3,001 children from 17 programs around the country. Half of the children were randomly assigned to the control group, who received no Early Head Start services. Data were collected through program application and enrollment forms, interviews of parents and child and family assessments. Almost all of the children's primary caretakers were mothers, ranging in age from 18 to 26. One-third were African American, one-third white, and one-fourth Hispanic. Almost half of the parents did not have a high school diploma at the time of enrollment, and most of the families received public support of some kind. For each child, a multiple environmental risk score was calculated, which was the sum of 10 possible environmental risks. Each of four outcomes was regressed onto the ten risks individually and also as a cumulative risk index along with program type and covariates. There were significant negative relations of accumulated risk to reductions in reasoning, spatial ability and vocabulary and increased behavior problems. Children with at least eight risks scored 1.48 standard deviations lower on reasoning ability and vocabulary, .48 standard deviations lower on spatial ability and .48 standard deviations higher

on behavior problems. The home-based program showed significant benefit for reasoning and vocabulary. Versus the control group, home-based programs increased average reasoning scores by .24 of a standard deviation and increased vocabulary by .14 of a standard deviation. There was no significant difference in program benefits at different levels of risk. This suggests that for reasoning and vocabulary, the home-based program is promotive because the degree of benefit Early Head Start appears to provide is consistent across all levels of risk for the set of risks and outcomes examined in this study.

TABLE OF CONTENTS

Page

Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

Introduction

Exposure to conditions of risk negatively affects the course of development and is additive in its effect. Children exposed to higher numbers of risks do less well on a host of developmental outcomes than children with fewer risks (Sameroff, Bartko, Baldwin, Baldwin, & Seifer, 1998; Morales & Guerra, 2006), and children from poorer families are far more likely to encounter higher numbers of risks in their environments (Evans, 2004). Those outcomes include early academic abilities, social skills and emotional attributes that contribute to school readiness and later academic attainment (Gutman, Sameroff, & Cole, 2003). Because educational attainment is linked to occupational opportunity and higher social capital in adulthood, educating children is often viewed as critical to breaking the poverty cycle. Further, because educational trajectories tend to be established in the first few years of formal schooling and are relatively stable thereafter (Belsky & MacKinnon, 1994), importance has been given to programs that involve both children and parents in ways that promote school readiness and school engagement. More specifically, emphasis is given to programs, such as Head Start and Early Head Start, which support a diverse array of health and developmental competencies needed for long-term success in school and life. Such programs intend to enable children from high-risk environments to achieve better than expected academic and social outcomes based on risk level. However, the risks associated with low-income family situations are multiple, and their effects on children's health and behavior are complex (Bradley & Corwyn, 2002; Brooks-Gunn, Klebanov, & Liaw, 1995; Conger & Donnellan, 2007); thus, there

is a need to better understand how the presence of accumulated risk in children's environments interacts with the efficacy of programs intended to compensate for those risks in promoting school readiness. This study's purpose is to clarify the relation between accumulated risk and program efficacy of Early Head Start.

Early Head Start (EHS) serves low-income children and families, many of whom are below the poverty level. Most children who attend EHS are exposed to multiple environmental risks. As part of their initial evaluation of EHS, Love et al. (2001) found that program benefit significantly varied based on children's levels of environmental risk. Although this effort to investigate how EHS benefits children exposed to various levels of risk indicates that there may be differential benefits based on risk accumulation, Love et al. only considered five types of risk in their analysis, all of which represent status characteristics of participants. Though useful, their study does not fully substantiate the idea of cumulative risk and the ideas from ecological developmental theories. Critically, by only considering status risk conditions, the Love et al. (2001) study does not shed light on how the many components of EHS compensate for children's overall risk exposure. This study attempts to further unpack what is likely a complex set of relations between risk exposure, program involvement and child development for children and families living in poverty.

To provide a framework for the specific research questions, the following topics will be discussed: the relation between poverty and the confluence of environmental risk; the environmental ecology of risk; types of risk and affected developmental outcomes; the dynamics of how risk operates on those outcomes;

the construct of resilience as a way of understanding how positive factors counteract risk; the importance of school readiness on ultimate academic attainment; and EHS's program design and research findings.

Poverty and Risk

One in five children in the U.S. is growing up in poverty (U.S. Bureau of the Census, 2008). Children growing up in poverty are significantly more likely to be exposed to multiple physical and psychosocial environmental risks (Evans & English, 2002). The physical environmental conditions include environmental toxins, poor air quality, noise, polluted water, poor housing, lack of learning materials, too much time watching television, lack of learning tools, physical hazards, reduced school funding and facilities. The psychosocial environmental conditions include violence, reduced family stability, separation from family, low marital quality, poor parenting style, lack of social support, poor neighborhood quality, lack of emotional support, low parental warmth, reduced cognitive stimulation and language exposure, lower educational involvement and support, low quality early care and education, low quality schools, lack of constancy and predictability (Evans, 2004).

The presence of environmental risks, however, is not limited to children growing up in poverty. Children from families that are not necessarily in poverty but are of lower socioeconomic status (SES) are likely to have multiple risks in their environments as well. SES, which takes into account not only family income but also parental education and occupational status, relates to access to material and social resources as well as potentially stress-inducing conditions in families

and neighborhoods. However, the fact that children's characteristics, family characteristics and external support systems moderate these effects, provides evidence that it is the environmental risks associated with poverty and low SES generally that are responsible for much the consequential reduction in developmental outcomes (Bradley & Corwyn, 2002). This understanding has lead some researchers to propose measures other than SES should be used to describe family situations to better capture the likely level of risk to which children are exposed. One suggested index would be composed of five variables: family income, family structure, parent education, family size and home ownership. Such an index provides more information about the family situational factors that research has shown are strongly associated with child well-being (Moore, Vandivere, & Redd, 2006). The psychosocial risks measured in this study encompass these five categories.

Conger and Donnellan (2007) further elucidate the relation between SES and children's development over time. Their interactionist model (Figure 1) incorporates the family investment model and the family stress model as well as the influence of parent's personal characteristics in explaining the relations of SES to family stress, parental investments and child developmental status. In doing so, this model illustrates how SES affects development through the mediating factors of family processes and parental investments while acknowledging the direct influence of parental characteristics. It also illuminates how risk conditions in the family ecology affect the developmental process. The risk factors used in this study characterize parental characteristics (e.g., race,

mental health and teen mother), SES (parent education and occupation), family stress processes (e.g., father absence, large family size, low family income and assets) and parental beliefs and behaviors (e.g., parental modernity and parent supportiveness).

Environmental Risk Ecology

Low-income and poverty family situations are associated with a confluence of risk exposure (Whipple, Evans, Barry, & Maxwell, 2010; Bradley & Corwyn, 2002). Bronfenbrenner's ecological systems theory (Bronfenbrenner, 1986) provides a theoretical framework for understanding how proximal and distal environmental factors affect family situations and children's development. Bronfenbrenner identified five environmental systems affecting children's development (Figure 2). The microsystem includes the self and all settings a child directly experiences, which include the characteristics of those setting and the people in them. For example, all aspects of the home and daycare or school environments are part of the microsystem. Thus, many strong influencers of development are part of the microsystem (e.g., parental warmth and attention, siblings, materials to interact with, language and literacy exposure). The mesosystem is the set of connections that exist between elements of the microsystem. It takes into account that events at home influence what happens at daycare or in school and vice versa. The exosystem encompasses environmental settings with which children do not come into direct contact but that do affect development, e.g., neighborhood or community conditions and a parent's employment situation. The macrosystem is the attitudes and ideologies of the

culture that surrounds children (e.g., American children grow up in a democracy). And finally, the chronosystem is the context of time in which life events occur. Events and characteristics of these systems have the potential to affect development directly or by mediating or moderating conditions in other layers of the ecology.

Bronfenbrenner's ecological systems theory facilitates the conceptualization of how more distal factors (i.e., those in the macrosystem), influence development though their effect on a child's immediate environment (i.e., the microsystem). Many studies have demonstrated the strong influence of more proximal, microsystem factors on development. However, research has also demonstrated that more distal environmental elements, such as neighborhood risk factors, can also significantly affect outcomes (Morales & Guerra, 2006). One study demonstrated a strong negative relation between the number of accumulated risk factors within schools and their neighborhoods and elementary school-wide achievement. The researchers found a consistent difference between the average achievement of students in schools depending on whether they had low, moderate or high numbers of school-level risks. However, regardless of school-level risk, the average student achievement in high-risk neighborhoods was consistently lower than the achievement in all schools in low risk neighborhoods. In other words, even low-risk schools in high-risk neighborhoods had lower overall achievement than high-risk schools in low-risk neighborhoods (Whipple et al., 2010). Thus, even the neighborhood situation has a significant influence on educational outcomes. Such findings support the idea that a broad-based

cumulative risk model is more likely to capture the full level of risk exposure a child experiences and therefore be more indicative of the full level of downward pressure on children's wellbeing.

The impact of particular types of risks on particular outcomes depends on when during development they occur and the duration of exposure. Poverty experienced in the pre-school and early school years has been shown to have a greater effect on outcomes, such as education achievement, than poverty that begins in later childhood (Brooks-Gunn & Duncan, 1997). In another example, children who experienced greater numbers of social and family risks in infancy had lower levels of cognitive ability, self-regulation and higher levels of problematic behavior at pre-kindergarten entry than children who experienced high levels of risk after infancy (Mistry, Benner, Biesanz, Clark, & Howes, 2010). Along with timing of onset, duration of risk also makes a difference in its effect. The effects of persistent poverty have been found to be between 60% and 80% greater than the effects of temporary poverty. These results may also imply that the effects of poverty are cumulative over time (Duncan, Brooks-Gunn, & Klebanov, 1994). Therefore, early interventions can be especially potent in reducing or compensating for risk because they address problems early in development, and early intervention followed by sustained support throughout development will yield the greatest overall benefits for children's competencies.

Types of Risk and Outcomes

Sameroff, Seifer, Baldwin and Baldwin (1993) tested the individual effect of each of 10 environmental risk factors on children's I.Q. at 4 and 13 years of

age. The participants were 152 families, who represented a broad range of SES status, from the Rochester Longitudinal Study (Sameroff et al., 1982, as cited in Sameroff et al., 1993). The contextual risks they evaluated were: minority group status, occupation of head of household, maternal education, family size, father absence, stressful life events, parental perspectives, maternal anxiety, maternal mental health and mother-child interaction. They dichotomously classified participants as "at-risk" for each category of risk as follows: *minority status* if nonwhite; *occupation* if scored 1 or 2 on the Hollingshead nine-point scale, which indicates unemployed, laborer or semiskilled; *maternal education* if mother had no high school diploma; *family size* if four or more children in household; *father absence* if no father or stepfather present in the family; *stressful life events* if there had been a major event such as job loss, death or serious physical illness in the immediate family; *parental perspectives* if scores on two measures used (Concepts of Development Questionnaire, 1985; and Kohn, 1977, as cited in Sameroff et al., 1993) indicated significant rigidity versus flexibility in parents' attitudes, beliefs and values with regard to child development; *maternal anxiety* if score was 6 or higher on the Rutter Malaise Scale (Rutter, 1976, as cited in Sameroff et al., 1993); *maternal mental health* if psychopathology was present at either one of two interviews, which were given while mother was pregnant and at child's age of 30 months; *parent-child interaction* if mother's affect during an interaction task was mostly negative or flattened rather than positive and involved. They found that all risk factors significantly correlated to I.Q. at the 4-year assessment, and all but life events, maternal anxiety and parent-child

interaction significantly correlated at the 13-year assessment. The factors with the greatest influence at four years of age, in order of influence, were: minority status, maternal education, head of household occupation, parent-child interaction and parenting perspectives. Our study includes all of the risk factors Sameroff et al. found to be most influential.

Environmental risk also has significant effects on social-emotional outcomes. A study that examined the effects of environmental risk factors on social-emotional outcomes as well as cognitive abilities looked at factors of marital status, employment, income-to-needs ratio, receipt of public assistance, maternal depression, ability to meet basic needs, and ability to meet medical/health needs. The investigators found that these risks had significant negative effects on cognitive and social-emotional functioning at entry to pre-kindergarten. Their overall model, which incorporated mediating factors of language stimulation and parental warmth, predicted 55% of the variance in children's cognitive achievement, 68% of the variance in attentional/behavioral regulation and 17% of the variance in children's problematic social behavior (Mistry et al., 2010). This provides evidence that these family and social risk factors have significant effect, not only on cognitive capability, but also social and emotional outcomes.

Continuing this line of investigation, Morales and Guerra (2006) investigated the effects of risks in three environmental realms -- family, school and neighborhood -- on children's achievement, depression and aggression. They measured the effects of family poverty, family transitions, peer rejection, peer

victimization, school problems and neighborhood violence at time 1 (grades 1 – 4) on children's school achievement, depression and aggression, at time 2, which was 2 years later (grades 3 – 6). They found that the stressors in all three contexts – family, school and neighborhood – contributed significantly to lower reading and math achievement and higher levels of depression and aggression both concurrently and longitudinally. These contextual risks contributed to reduced academic achievement and emotional and social problems.

Environmental Risk Dynamics

Many studies have demonstrated a strong, negative relation between accumulated environmental risk and cognitive and socio-emotional outcomes. The recognition of the predictive power of accumulated risk was first illuminated by Rutter's work (1979). In studying the incidence of psychiatric disorders in 10-year-olds, Rutter measured factors of martial distress, low SES, large family size or crowding, paternal criminality, maternal psychiatric disorder and placement of child in foster care, and found that the incidence of children's psychiatric problems rose from 2%, in children from families with zero or one risk, up to 20%, in children from families with four or more risks (Rutter, 1979 as cited in Sameroff, Gutman, & Peck, 2003).

Sameroff, Seifer, Barocas, Zax, and Greenspan (1987) examined the individual and cumulative effects of ten risks (maternal mental health, maternal anxiety, parental perspective, parent-child interaction, maternal education, parental occupation, minority status, family support, life events and family size) on I.Q. and found that, even though each risk factor varied in its strength of

significant correlation to I.Q., different combinations of equal numbers of risk factors predicted similar reductions in I.Q. As the authors concluded, this indicates that the number of risks, rather than which risks were present, were associated with significant differences in I.Q. outcomes. Further, Sameroff et al. (1993) found that, when examining the same set of ten risk factors, cumulative risk (measured at four years of age) correlated with between one third and one half of I.Q. variance at 4 and 13 years of age.

Deater-Deckard, Dodge, Bates, and Pettit (1998) extended this research by measuring the individual and cumulative effect of twenty risk variables in five environmental categories (child, socio-cultural, parenting and peer-related) measured at five years of age on children's externalizing behaviors in middle childhood. They found that risk factors predicted one-third to one-half of the variability in externalizing problems and that the number of risks present uniquely contributed between 19% and 32% of the variance. They also confirmed that even though there were differences in prediction based on the specific set of risks present, there were different clusters of the same numbers of risks that correlated with similar reductions in developmental capabilities. This further affirms the strength of cumulative risk in predicting developmental outcomes and suggests that there is equifinality in how risks collectively operate to affect behavioral outcomes because different clusters of risk are associated with similar long-term behavioral impacts.

Adding to the complexity of the long-term consequences of risk is the fact that the strength of the effect on development can change over time. Laucht et al.

(2004) found that the progression of the negative impact of the organic risks flattened over time, but the deleterious effects of risk factors for the children with family risks became more pronounced in later ages. They determined that children with both organic and family risks had the most unfavorable results over time and that the effect of multiple risks appeared to be additive but not multiplicative.

Other studies have also found that different outcomes have different sensitivities to accumulated risk. Sameroff et al. (1998) found that multiple environmental risks had significant, negative linear impact on adolescents' psychological adjustment, self-competence, problem behavior, activity involvement and academic performance. Psychological adjustment and academic performance were most affected by cumulative risk, with a difference of more than 1.5 standard deviations between youths with one risk and those with nine or more. Self-competence and activity involvement were least sensitive to risk, with a difference of less than one standard deviation between one and nine or more risks (Figure 3).

The fact that different outcome domains have different sensitivities to environmental risk is not inconsistent with domain-specific socialization theory, which suggests that socio-emotional development occurs differently in different domains. Just as different outcomes are differently affected by risk, different domains of socialization are affected differently based on the context and agents of socialization. An important implication of this theory is that particular aspects of parenting and care giving differently affect different social domain outcomes (Grusec & Davidov, 2010). This has implications for early intervention programs,

such as EHS, because they employ a range of family and center-based support strategies to impact multiple developmental domains.

The complexities of risk dynamics are subject to systems theory, which suggests that the whole is more than the sum of the parts because there is an interaction between the parts, and therefore the whole cannot be adequately appreciated by examining separate parts. Human development involves a continual interaction of the attributes of the individual within the context of his or her environment. One of the implications of the application of systems theory in combination with domain-specific socialization theory is that positively affecting multiple domains (e.g., cognition and emotion) may have a multiplicative effect over longer-term development. That is, developmental domains interact with each other in synergistic fashion in ways that promote overall capability. Another implication is that more extensive characterization of the constellation of risk factors in a child's early environment will better explain the potential impacts on development.

In addition to the environment, risks can also be introduced by genetics and gene by environment interactions. Specific characteristics of the individual and the environment, as well as the interaction between the two, can increase children's vulnerability to environmental threats (Lemery-Chalfant, 2010). Biological risks and environmental risks in children's early development have been found to be associated with different developmental impacts. Whereas prenatal and perinatal complications were associated with deficits in motor and cognitive functioning, environmental risks associated with family situation in

early life were correlated with later cognitive and social-emotional impairment (Laucht, Schimidt, & Esser, 2004). Another study demonstrated that, when measured along with a broad range of medical and behavioral variables, family SES and mother's education had the greatest predictive power on intellectual ability at 4-years of age (Broman, Nichols, & Kennedy, 1975, as cited in Sameroff, Seifer, Baldwin, & Baldwin, 1993). Thus, although risk can be introduced by biology, environmental risk has significant effect on cognitive and social-emotional outcomes.

The dynamics of how risk factors operate in affecting development is complex. Both the severity and number of environmental risk factors matters in predicting developmental impacts. The strength of the effect of risk on outcomes changes over time and differs depending on type of outcome. Because of the dynamic nature of risk, equifinality should not be confused with equality in considering the negative effects of cumulative risk on outcomes. It is worth noting that even though different combinations of the same number of risks may result in a similar depression of performance on certain areas of competence, this does not imply that the same intervention is appropriate to compensate for different clusters of risks.

Resilience

The construct of resilience provides a useful framework for understanding the dynamics of how positive factors can counteract the effects of risks on outcomes. Resilience is defined as good outcomes in spite of risks, which introduce threats to adaptation or development (Garmezy, 1991; Masten, 2001).

Resilience is often conceived of as the variance between actual and expected outcome despite risk levels, which can be expressed as the residual of an individual's actual score on an outcome measure versus the expected score based on the typical risk to outcome relation (see Figure 4). Thus, individuals who have better outcomes despite threats are considered more resilient (above the best fit line of the data), and individuals who do less well than expected are considered less resilient. Programs such as EHS intend to promote resilience by compensating for environmental deficits associated with low-income family situations. The resulting benefit of such programs may be similar at all levels of risk, or there may be differential benefit depending on risk level. Therefore, understanding whether such programs build children's resilience uniformly across all levels or risk or affect children with different risk profiles differently is critical to understanding how to evaluate program efficacy.

Positive factors, which compensate for or counteract the effects of risk, are labeled promotive or protective. Promotive factors have beneficial effect at all levels of risk, and protective factors have greater beneficial effect at high levels of risk. The distinction is that the strength of the effect of protective factors on outcomes changes over different levels of risk. Thus, promotive factors result in statistical main effects, and protective factors produce interactive effects. Figures 5 and 6 (Masten, 2001) illustrate of how promotive factors (Figure 5) mediate risk and protective factors (Figure 6) moderate risk in promoting resilience. For example, responsive and sensitive parenting has been shown to be a protective factor because effective parenting strategies can make a significant and sizeable

difference in reading and math ability despite exposure to high levels of risk but has less benefit at lower levels of risk (Burchinal, Roberts, Zeisel, Hennon, & Hooper, 2006).

The distinction between promotive and protective factors is important because protective factors have reduced or negligible benefit at lower levels of risk and therefore may not be identified as significant in some research because of study design. For example, Zhai, Brooks-Gunn, and Waldfogel (2011) investigated cognitive ability, social competence, attention problems and internalizing and externalizing problems in children attending Head Start compared with children at home and in other forms of non parental care. When compared with at home care (parental and non parental), Head Start attendees had improved cognition, social competence and reduced attention problems at school entry. However, when compared with other pre-kindergarten or center-based care, Head Start attendance was not associated with improved cognition but did result in improved social competence and reduced behavior problems. Thus, Head Start could be argued to be protective for cognitive outcomes and promotive for social competence.

In another example, Seifer, Sameroff, Baldwin, and Baldwin (1992) investigated the effects of positive factors in three domains, personality disposition, social support, and family cohesion, on cognitive and social-emotional outcomes for children with varying levels of cumulative environmental risk between 4 and 13 years of age. The factors with significant beneficial effect were positive mother-child interaction, child-perceived competence and locus of

control, social support, and positive maternal parenting. Some of the factors interacted significantly with child cumulative risk level indicating that they are protective, and others did not, indicating that they are promotive.

As with risk factors, different protective and promotive factors will support different domains of development differently. An example of this is that Gutman, Sameroff, and Eccles (2002) found that in middle school children, specific promotive and protective factors had different effects on academic achievement depending on what specific outcomes were measured. They also concluded that the effects of certain protective factors were magnified in the presence of multiple risks. These findings provide more evidence that different outcomes are affected differently by risk and protective or promotive factors, and they further indicate that the beneficial effects of interventions may differ in strength based on level of accumulated risk.

In attempting to facilitate resilience, we must consider the complexities of how positive and negative factors interact in affecting outcomes as well as the predictive power of accumulated risk. Early care and education programs, such as EHS, which are intended to compensate for or reduce risk, would be best served by understanding how children's levels of accumulated risk interact with program benefit. This will clarify whether programs are protective or promotive in their effect and better enable program designers and administrators to meet the desired goals of benefiting the children they serve, their families and communities.

School Readiness

Because of the recognition that children who are ready for school are far more likely to succeed academically in later grades and attain higher levels of education, school readiness is a concept that has gained much attention in the last two decades (Snow, 2006). Although emphasis on different components of readiness has shifted over the years, a child's school readiness can generally be defined as being at appropriate levels of (a) physical well-being, motor development, health and growth; (b) social and emotional development, including turn-taking, cooperation, empathy, and the ability to express emotions; (c) approaches to learning, including enthusiasm, curiosity, temperament, culture and values; (d) language development (listening, speaking and vocabulary), literacy skills, writing and drawing processes; and (e) general knowledge and cognition (including sound-letter association, spatial relations and number concepts; High, 2008).

Mashburn and Pianta (2006) present a developmental systems perspective of school readiness, which emphasizes the central role of relationships in the ecology of the child's environment. They suggest that because school readiness should be interpreted as a characterization of child functioning, which is determined by the quality and type of interactions a child has had in his or her environment, measures of readiness should include characterizations of these relationships. This approach is consistent with Bronfenbrenner's ecological systems theory (Bronfenbrenner, 1986), which recognizes the central,

instrumental role that proximal and even distal environmental factors and risks play in children's development.

Children who come from families with multiple environmental risks tend to be less advanced in early reading, math and general knowledge and are therefore less likely to fare well in kindergarten (Zill & West, 2001). Social and emotional development and approaches to learning are also critical to kindergarten success, although there has been less attention paid in recent years to these domains (Raver, 2002).

Early school success is not only important as a positive developmental milestone but also because academic trajectories are set in the first years of schooling and are largely stable. A meta-analysis of six longitudinal data sets concluded that school entry math, reading and attention-related abilities correlate consistently with academic performance in later grades (Duncan et al., 2007). Adjustment problems that are apparent in the first few years of school predict later academic problems and low education attainment rates. Children who get off to slow starts are much more likely to develop negative academic self-images and inadequate social coping strategies, which later hinder academic performance (Belsky & MacKinnon, 1994). Thus, early intervention designed to compensate for risk and promote school readiness is a powerful strategy to enable children from high-risk situations to achieve better than expected academic attainment. EHS is a program that, through site-based care and family support, implements such a strategy.

Early Head Start

Funded by the Administration on Children, Youth and Families beginning in 1995, EHS provides low-income families and their children under age three with child care, parenting education, healthcare and referrals, and other family supports. These services are delivered in the home, at centers or a combination of the two and are locally implemented. Beginning not long after program initiation, seventeen sites around the U.S. participated in an extensive, random-assignment program evaluation. The overall findings were that, compared with non-participating control children with matched demographics, EHS participants had better cognitive, language and attention abilities and lower levels of aggressive behavior (Love et al., 2005).

However, The EHS Impact Study (Love et al., 2001) revealed an unexpected relation between risk and program efficacy. The five risks accounted for were: being a single parent, receiving public assistance, being neither employed nor in school or job training, being a teenage parent, and lacking a high school diploma or GED. Compared with the control group, EHS-participating children with two or three of these risks showed the greatest improvement in cognitive and socio-emotional outcomes. Children with zero or one risk were benefitted to a lesser degree, and children with four or five risks who were in EHS did less well than children who were not in the program (Love et al., 2001). Specifically, for low risk groups, EHS had no significant effects on cognitive or language outcomes and had negative outcomes on some social-emotional measures. The moderate-risk EHS participants showed significant improvement

over the control group children on all of these measures, but the high-risk EHS participants had improvement in only language outcomes and, like the low-risk group, had negative impacts on some social-emotional outcomes. Thus, Love et al. (2001) found that the benefit of being in EHS interacted with the number of environmental risks present, and there were different results depending on whether cognitive, language or behavior outcomes were tested.

This finding is unexpected and may be due to differences in how families at different risk levels use the program. It is interesting to note that the five risks measured in the Love et al. (2001) analysis are a narrow set of *status* characteristics, which are not as comprehensive as the sets of risks typically included in cumulative risk research (e.g., Gutman et al. 2003; Sameroff et al. 1987; Sameroff et al. 1993; Sameroff et al. 1998; Seifer et al, 1992). The Love et al. (2001) study does not take into account important family stressors (e.g., family size) and parent characteristics (e.g., race, parental modernity and supportiveness, and maternal mental health), which have been shown to significantly impact child outcomes consistent with the interactionist model (Conger & Donnellan, 2007) and the concept of social capital (Coleman, 1988).

Research Questions

The purpose of this study is to investigate further the relation between environmental risk and developmental outcomes for boys and girls in EHS and the control group. The outcome measures are vocabulary, reasoning, spatial ability and behavior. The cumulative risk index is composed of: race, family size, teen mother, parent occupation status, maternal education level, presence of a

father or father figure, maternal mental health, parental modernity, parental supportiveness and total family resources. Our specific research questions are these:

1. Is there a negative relation of accumulated risk and children's competence and behavior problems?
2. Does participation in EHS increase children's competence and adaptive functioning?
3. Does accumulated risk interact with program participation in terms of children's competence and adaptive functioning such that there is a differential benefit depending on level of risk exposure?

Method

Data and Participants

Trained program administrators and researchers collected data on 3001 children from 17 program sites around the U.S. Children were randomly designated as in program (1,513) or not in program (1,488) using a waitlist control method at each site. The data represent a mix of all three program approaches: seven sites were home-based, four were center-based, and six were a combination of home and center-based. Although the studied program sites were not randomly selected, they were chosen with the intention of reflecting diverse program and family characteristics so that when data from the 17 sites were considered all together, it would be representative of EHS programs nationally.

The characteristics of the families served by the 17 sites in aggregate were as follows. 99% of applicants were mothers, ranging 18 to 26 and averaging 23 years of age. About 62% were first-time parents. One-third were African American, one-third white, and one-fourth were Hispanic. About 20% of the parents did not speak English. Almost half of the parents did not have a high school diploma at the time of enrollment, and 45% were employed, in school or in training of some kind. Most of the families received public support (77% Medicaid, 88% WIC, 50% food stamps, 33% AFDC or TANF, and 7% SSI benefits).

The full dataset includes 839 variables for each of the 3001 children. Data were collected through a range of means. Data used for this study were collected from: program application and enrollment forms, interviews of parents, child and family assessments at program entry, 14, 24 and 36 months of age.

The risk index is composed as the sum of 10 dichotomized risk variables with being "at risk" for each defined as: non-white, more than four children in the family, teen mother, parent neither employed nor in school nor training, maternal education less than high school diploma, no or inconsistent presence of a father or father figure, low maternal mental health, low parental modernity, low parental supportiveness, and low total family resources. Mothers who were severely depressed (greater than 24 on the CES-D) at either the 14 months or 36 months time point are considered to have "low" mental health. For parental modernity and parental supportiveness, "low" is defined as the lowest 20% of the distribution. For total family resources, "low" is defined as the lowest 25% of the

distribution. These cut points were determined by examination of distributions taking into account natural breaks in the data and distance from mean in standard deviations.

Measures

The independent variables used for this study are program type and a risk index composed of the sum of the binary variables indicating whether child is at risk due to: race, family size, teen mother, parent occupation, mother education, maternal mental health, parental modernity, parent supportiveness, total family resources, and father presence. Program type is a computed variable, which indicates whether children are in EHS or not (control) and if they are in EHS, what kind of program approach they and their families experienced. A program type of 0 indicates children not in EHS, and program type values of 1, 2 and 3 are children in EHS, with 1 = center-based, 2 = home-based, and 3 = a mix of both home and center-based approach.

The binary risk variables were computed such that 1 = at risk and 0 = not at risk. The specific definitions based on the information available in the dataset are as follows. Teen mother risk is if mother was less than 20 years old at birth of first child. Parent occupation status risk is if the parent was neither employed nor in school nor in training at program intake. At risk for being non-white is if the race of the primary caregiver is coded as African American, Hispanic, or "other." Mother education risk is if mother had less than high school (no diploma or GED) at intake. Large family risk is if the number of children under 18 years of age in the family household is 4 or greater.

Maternal mental health is determined by mother's depression score at 14 months using the Center for Epidemiologic Studies Depression Scale (CES-D) with "at risk" defined as having a mother who is severely depressed (CES-D > 23).

The Parental Modernity Scale (Schaefer & Edgerton, 1985) measures parental beliefs by determining the extent to which parental views are progressive or traditional. Scores on the Progressive subscale, which is used for this study, indicate the degree to which parents believe that children learn actively, should be treated as individuals and are encouraged to express their own ideas. Examples of progressive beliefs are parents' agreement that "parents should encouraged expression of child's ideas," "children learn actively," and "the aim of education is learning how to learn" (Schaefer, 1987). Scores in the scale range from 5 to 20 with higher scores representing more progressive views. This was measured at 24 months only. Cases "at risk" due to low parental modernity are those with scores less than 18, which is the lowest fifth of the distribution of scores for all participants. This cut off is just slightly above the mean minus one standard deviation, which is 17.47.

Parental supportiveness measures primary parent's sensitivity, positive regard toward child and cognitive stimulation provided the child. This was determined using a "three bag," semi-structured exercise that generated a supportiveness composite score and was based on an assessment that was used by the National Institute of Child Health and Human Development Study of Early Child Care (1999). The EHS dataset has parental supportiveness scores measured

at 14, 24 and 36 months, and the range of possible scores is from 1 to 7. We use the average of all three scores or the remaining score(s) if not all are available. Children's scores in the bottom fifth of the distribution (below 3.22) are considered "at risk." This is just below the mean minus one standard deviation, which is 3.05.

Total Family Resources was also measured at three time points: 6, 15 and 26 months. This measure is based on the Dunst Family Resources Scale (Dunst & Leet, 1987), which more completely characterizes a family's asset situation than parental income alone. Total family resources includes measures of basic needs (food, clothing, shelter, medical and dental) and other resources such as access to transportation, telephone and babysitting as well as whether there are funds available for leisure activities and time available for family interaction and engagement. The range of possible scores of the scale is 60 to 192. Children from families falling in the bottom quarter of the participants' distribution (below 140.33) are considered "at risk." This is just above the mean minus one standard deviation, which is 134.5.

Father presence was derived from one variable in the dataset that measures whether the biological father or a father figure was present at 14, 24 and 36 months. If a father or father figure was not present at any one of the three time points, then the child was considered "at risk" for single parent family.

Additional covariates are sex and site. Sex is coded as *male* = 1 and *female* = 0, and site is coded to indicate by which of the 17 sites each child and his or her family were served.

The dependent variables were vocabulary, reasoning ability, spatial ability and behavior. All were measured at 36 months. Vocabulary was measured in English or Spanish depending on the child's first language. The English version used the Peabody Picture Vocabulary Test, Third Edition (Dunn & Dunn, 1997). The Spanish version used the Test de Vocaulario en Imagenes Peabody (Dunn et al., 1986). The tests measure listening comprehension of spoken words (English or Spanish) for children over 2 ½. The tests have evaluators present four pictures and ask children to indicate which picture matches the word spoken by the evaluators. The outcome data for both tests were standardized and then combined to form the language outcome variable.

The Bayley Mental Development Index (Bayley, 1993) was used to measure reasoning and spatial ability. The whole test is designed to measure cognitive, language and personal-social development of children under 3 ½. The researchers summed 13 items from the test to comprise the reasoning score and 6 other items to compute the spatial score.

Parents completed the Aggressive Subscale of the Child Behavior Checklist for ages 1 ½ to 5 years (Achenbach, 1993; Achenbach, Edelbrock, & Howell, 1987) as a measure of behavior problems. This measure counts the frequency of 32 child behavior problems. High scores indicate frequent problems, and low scores to 0 indicate infrequent to no problems.

Results

Descriptive Statistics and Diagnostics

Distributions of all continuous study variables were examined for normality, extremity and missing data patterns. See Table 1 for descriptive statistics of original study variables. No variables were significantly non-normal: none had a skew outside the acceptable range of -2 to +2 or a kurtosis outside the acceptable range of -4 to +7. Although there are outliers on each of the continuous independent variables, all fall within the designated ranges of the scales. Analyses of variance were conducted to test for independence violations, and significant relations were found between site and dependent variable scores. Site was therefore added as a control variable to all regression models.

The distributions of covariates were as follows. The division between girls (N =1466) and boys (N = 1535) was close to even as was the division between control group (N = 1474) and program group (N = 1503). The numbers of children in each type of program were as follows: center-based N = 305, home-based N = 700, and mixed-approach N = 498. The total number of children by group is 2977 rather than 3001 because there were 24 children for whom information on program type was missing.

Before imputation was used to deal with missing data, binary risk variables were formed for each risk in order to examine the risk distributions and study variable correlations. The range of total risks (listwise deletion) was 0 to 8 i.e., there were no children with more than 8 risks. The distribution of total risks (N = 1216) was as follows: 5.9% with 0 risks, 16.1% with 1 risk, 18.8% with 2

risks, 22.5% with 3 risks, 20.5% with 4 risks, 8.5% with 5 risks, 5.8% with 6 risks, 1.6% with 7 risks, and 0.4% with 8 risks. The percentage of children positive for each risk before imputation (pairwise deletion) is provided in Table 2.

Bivariate correlations of binary risk variables, covariates and outcome variables were examined. This confirmed that there were no moderately or highly correlated clusters of risks (see Table 3). The only correlation of any two risks that was greater than .30 and therefore considered moderate in strength (Cohen, 1988) is that of low mother education and teen mother ($r = .39$, $p < .01$).

The numbers of individual risks that significantly correlate to each outcome are eight for vocabulary, seven for reasoning, and five for both spatial and behavior. Of the four study outcomes, all four correlate individually with low supportiveness and race non-white; three correlate with low modernity, low family resources, low mother education and father absent; two correlate with large family size and teen mother; one correlates with mother depressed; and none correlate with low occupation status.

Missing Data Handling and Binary Risk Variable Computation

Due to the high percentage of missing data on many of the study variables, multiple imputation was used prior to the computation of the binary risk variables, the risk index and all analyses of regression. Multiple imputation is considered state of the art for data that are missing at random (MAR; Schafer & Graham, 2002, as cited in Enders, 2010). The data missing from the EHS data variables used in this study are considered to be MAR rather than missing completely at random (MCAR) because their incidence of missingness is likely correlated with

other variables, e.g., demographic variables, rather than being missing completely at random. Therefore, listwise or pairwise deletion would significantly reduce power, and multiple imputation is ideal for generating estimated population parameters (Enders, 2010).

Binary risk variables were generated after imputation with 1 = "at risk" for each of the ten risk categories and then summed to generate a total risk number (between 0 and 10 possible) for each child. The mean number of risks by imputation was 3.14 (*SD* = 1.67).

Regression Analyses

All regression analyses were performed with imputation. As a preliminary step, a regression of each outcome onto the ten binary risk variables in one model (for each of the four outcomes) was performed. Dummy-coded covariates included in the model were sex, program type and site with the reference group (coded 0) assigned to the categories of female for sex and no program for program type. Dummy-coded variable, program1, indicates children in center-based programs, program2 indicates home-based programs, and program3 indicates mixed programs. To account for unmeasured differences associated with site, site was included as a control variable in all models. Outcome variables were standardized before regression analyses to enable comparative effects of the predictors on the different outcomes. The regression equation for each outcome onto the ten risks and program type with covariates is expressed $Y_{predicted} = b_1$ mother depressed + b_2 low modernity + b_3 low supportiveness + b_4 low family resources + b_5 race non-white + b_6 large family size + b_7 low mother ed + b_8

father absent + b_9 teen mother + b_{10} low occupation + b_{11}sex + b_{12} program1 + b_{13} program2 + b_{14} program3 + b_{15} site1 + … + b_{30} site 16 + $b_{0,}$ where $Y_{predicted}$ is each of the four outcome variables: reasoning, spatial, vocabulary and behavior. See Table 4 for regression outcome statistics. None of the risk variables carried inordinate weights in any of the four regressions. Overall, the model for reasoning accounted for 17% of variation, for spatial 6%, for vocabulary 14% and for behavior 3%. The home-based approach (program2) was the only program type that was a significant predictor in this model, and it was only significant in the models predicting reasoning (β = .22, p < .01), and vocabulary (β = .14, p = .033). Additionally, being male significantly predicted reduced reasoning capability (β = -.20, p < .01), reduced vocabulary (β = -.12, p = .047) and increased behavior problems (β = .15, p < .01).

To test whether accumulated risk interacted with program efficacy, the next model tested was a regression of each outcome onto the risk index (risk10), program1, program2, program3, risk10*program1, risk10*program2, risk10*program3, sex, and site. None of the interaction terms was statistically significant for any of the outcomes.

Curvilinearity was also tested by adding risk10*risk10 to the model with the risk10 by program interaction terms removed. Thus, each outcome was regressed onto the three program variables, risk10, risk10*risk10, sex and site. None of the risk10*risk10 terms was significant for any of the outcomes.

To examine the effects of cumulative risk and each program type on outcomes, main effects were then tested. The main effects models for each

outcome were structured just as the interaction models were except that the interaction terms were removed. This overall model is expressed: $Y_{predicted} = b_1$ risk10 + b_2 program1 + b_3 program2 + b_4 program3 + b_5 sex + b_6 site1 + … + b_{21} site 16 + b_0, where $Y_{predicted}$ is each of the four outcome variables: reasoning, spatial, vocabulary and behavior. See table 5 for specific estimates of regression coefficients, standard errors, t statistics and proportions of variation accounted for. Overall, the model for reasoning accounted for 17% of variation, for spatial skills 6%, for vocabulary 14% and for behavior 3%. Cumulative risk was a significant predictor of reduced reasoning (β = -.16, p < .01), reduced spatial capability (β = -.06, p < .01), reduced vocabulary (β = -.16, p < .01) and increased behavior problems (β = .06, p < .01). In this model, home-based EHS programs were a significant predictor of improved reasoning (β = .24, p < .01) and a significant predictor of increased vocabulary (β = .14, p =.031). Also in this model, being male significantly predicted reduced reasoning capability (β = -.21, p < .01), reduced vocabulary (β = -.12, p = .039) and increased behavior problems (β = .16, p < .01).

Additionally, to test program effects with Risk10 removed from the model, each outcome was regressed onto the three program types, sex and site. Results were consistent with those of the model that included the cumulative risk variable. Specifically, home-based program (program 2) was the only program type to show significant impact on reasoning (β = .25, p < .01) and increased vocabulary (β = .15, p =.020).

Discussion

This study investigated EHS program efficacy at different levels of risk using a more comprehensive set of environmental and situational risks than had previously been examined using the EHS evaluation data. Because cumulative environmental risk has been repeatedly shown to be a potent predictor of reduced developmental outcomes, it is important to better understand the interplay of risk and the benefit of programs, such as EHS, which are designed to serve populations with reduced environmental assets due to low-income family situations. This is of particular interest to government agencies who wish to design programs that effectively support low-income families by helping their children be school ready by kindergarten entry. The importance of school-readiness has gained much attention over the last decade because of the demonstrated links between school-readiness and academic attainment along with the ever-increasing need for higher levels of education for job acquisition. Without interventions, children from low-income family situations are far less likely to arrive at school with the required levels of physical health, language, cognitive abilities and social-emotional development necessary to start off prepared for school and ultimately thrive academically. EHS and Head Start aim to promote school-readiness for children of low-income family situations, which are associated with a host of environmental and situational risks. In their initial analysis of EHS program efficacy, Love et al. (2001) found an unexpected relation between multiple risk and EHS program efficacy. In their study, EHS was found to be most effective for children with two or three of the five risks they

examined and less effective or even had negative benefit for children with no or one risk and children with more than three risks. Our study investigated this relation further by testing the program impacts in the context of the potential accumulation of 10 environmental and situational risks.

This study had three specific aims: (a) to determine the extent to which accumulated environmental and situational risks negatively impact children's intellectual and behavioral outcomes, (b) to determine whether program benefits vary depending on program approach, and (c) to determine whether accumulated risk interacts with program participation in terms of children's competence and adaptive functioning such that there is a differential program benefit depending on level of risk exposure. The findings confirm the significant negative relation of accumulated risk to all four outcomes examined: reasoning, spatial ability, vocabulary and behavior. Each additional risk was associated with a reduction in the average reasoning and vocabulary score by .16 of a standard deviation, which amounts to total of 1.28 standard deviations difference over the span of eight risks. Each additional risk was associated with a reduction in the average spatial ability score by .06 of a standard deviation and increased behavior problems by .06 of a standard deviation. This amounts to a .48 standard deviation change (reduction in spatial ability and increase in behavior problems) over all eight risks.

The findings for program benefit varied by program type and the outcome examined. The home-based program was the only program type that showed significant benefit over the control group (no EHS program), and it was only

significant for reasoning and vocabulary. Versus the control group, home-based programs increased average reasoning scores by .24 of a standard deviation and increased vocabulary by .14 of a standard deviation. There was no significant average benefit found on any of the outcomes for center or mixed-approach programs versus control. These findings were in a model that included the multiple risk index (risk10), program, sex and site, and explained 17% of total variance for reasoning, 6% for spatial, 14% for vocabulary and 3% for behavior.

Contrary to expectations, there was no finding of an interaction of accumulated risk and program status. Thus, there was no significant difference in program benefit at different levels of risk. This suggests that for reasoning and vocabulary, the home-based program is promotive rather than protective because the degree of benefit it provides is consistent across all levels of risk for the set of risks and outcomes examined in this study.

Results in the Context of Prior Research

This study's findings are consistent with much existing literature demonstrating that poor developmental status often accompanies high levels of risk exposure (Gutman et al., 2003; Morales & Guerra, 2006; Sameroff et al. 1987; Sameroff et al. 1993; Sameroff et al. 1998). This is the case with the correlations of individual risks to reduced developmental outcomes as well as the strength of the associations of accumulated risk and reduced outcomes. Different risks are associated with different degrees of reduction in performance depending on which area of development is examined. Vocabulary and reasoning were negatively correlated with eight and seven risks respectively, whereas spatial

ability and behavior problems were each correlated with only five individual risks. Additionally, reductions of vocabulary (β = -.16, p < .01) and reasoning (β = -.16, p < .01) were more strongly related to cumulative risk than spatial ability (β = -.06, p < .01) or behavior problems (β = .06, p < .01). All of the risks that correlated with vocabulary, except for presence of a father or father figure, correlated with reasoning. The risks that did not correlate with vocabulary were low occupation status and mother depression. It is notable that the only outcome that correlated with the risk of mother depression was behavior problems, which is the only social-emotional outcome variable examined. This is not inconsistent with multiple risk studies that found that maternal mental health did not strongly correlate with reduced developmental capabilities because they looked only at I.Q. and no behavioral outcome measures (Sameroff et al., 1987; Sameroff et al., 1998). Further, of the risks that correlated with behavior, mother depression was the strongest (r = .15, p < .01). Thus, even though mother depression did not correlate with any of the cognitive outcomes, it was the strongest single correlate to the one social-emotional outcome examined.

Consistent with expectations, we found that some risks showed stronger relations with children's competence and adaptive functioning than did others. Low parent supportiveness and being non-white showed significant associations with all four developmental outcomes examined and were the two risks that correlated most strongly to the cognitive outcomes (i.e., reasoning, spatial and vocabulary). For reasoning and vocabulary, the strength of the risks associated with each fall in the same order (from strongest to least strong): race non-white,

low supportiveness, low mother education, low modernity, teen mother, low family resources, large family size, father absent (for vocabulary only). This is consistent with many studies that have found strong relations between child cognitive outcomes and parenting style (supportiveness and modernity) and parent education level. The order of the strength of correlation of the individual risks found in this study is fairly consistent with that found between the 10 individual risks and I.Q. examined by Sameroff et al. (1987; 1993) with one exception, which is that of parent occupation. The authors found parent occupation to be the strongest correlate with I.Q., but we found no correlation of low occupation status with any of the outcome variables. The difference could be attributed to two reasons. The first is that the sample of children in the Sameroff et al. (1987; 1993) studies came from families of diverse SES, and therefore, those parents had far more varied occupations than the EHS group of parents, all of whom come from low-income families. This represents a reduced range of occupational status (as well as income level) in our study, which reduces the potential for correlation with child outcomes (Cohen, Cohen, West, & Aiken, 2003). Second, our study operationalized occupation status differently than the Sameroff et al. (1987; 1993) studies. In our study, "at risk" was defined as not being employed, nor in job training, nor in school, whereas in the Sameroff et al. (1987; 1993) studies, the "at risk" division was based on whether the parent's occupation was semiskilled or skilled.

The regression of each outcome onto the ten risks revealed a similar set of relations between risks and outcomes with an only slightly different order of

strength of the risk coefficients. For reasoning and vocabulary the strongest correlates were low parent supportiveness, race non-white, low mother education and low family resources. Thus, when covariance among risks is controlled by including all risks in one model, we find that the strength of association of low total family resources with outcomes increases relative to other risks, but still falls below the top three factors of parent supportiveness, race and mother education. It could be argued that in a population such as those involved in EHS, where most families have quite limited assets, having a few more material assets carries benefits for children.

The results of the regression of behavior onto the 10 risks reveal an interesting finding, which is a negative relation of accumulated risk and behavior problems for participants of non-white race and who were in a family with four or more children. In interpreting this finding it is useful to consider that behavior is based on parent report, and it may be the case that parents of different ethnic groups interpret behaviors differently. Additionally, parents of four or more children may have a greater tolerance for some of the negative behaviors defined in the questionnaire. Furthermore, consistent with the findings of some research on high risk, non-white populations, some parents may have more controlling parenting techniques as risks increase, which may reduce or suppress negative behaviors.

The finding of a strong negative, linear relation between multiple risk and cognitive outcomes as well as the strong positive, linear relation between multiple risk and behavior problems is consistent with previous findings of studies of the

effects of multiple risks on outcomes (Sameroff et al. 1987; Sameroff et al. 1993; Sameroff et al. 1998). Specifically, this study found that across the range of eight risks, multiple risk reduced reasoning ability and vocabulary by 1.28 SD, reduced spatial ability by .48 of a SD and increased behavior problems by .48 of a SD. Overall the model for reasoning accounted for 17% of variance, vocabulary 14%, spatial 6% and behavior 3%. The percentages of variance accounted for in this study are smaller than the studies of 4-year-olds, which range from 20% to 50% for groups of environmental risks or SES characteristics (Sameroff et al., 1987; Sameroff et al., 1993). The smaller variances accounted for in this study are likely due to younger age of the focus children and the population of children studied. Children in the EHS trial were tested at 36 months of age, rather than 48 months as in the comparison studies, which may reduce the sensitivity of the tests, and it shortens the amount of developmental exposure to varying levels of risk, which reduces the overall range of impact of those risks. Additionally, as already discussed, the EHS trial children come from family situations that are more similar than the general population, and the ranges of variation on the studied outcomes are reduced compared with those of the general population. This reduced range will limit the ability of this study to account for variance in those outcomes.

No interaction of risk and program status emerged in this study. This is different than the results of the Love et al. (2001) study, which found differing levels of benefit based on risk level and outcome measured. Most notably, for behavioral outcomes, the Love et al. (2001) found that children with moderate

risk levels benefited most from EHS, while children with low and high risk levels who were in EHS had worse outcomes than did control children. There are several possible reasons for the difference in findings. The first is that in this study we examined 10 risks, which included family stressors and parent characteristics, whereas Love et al. (2001) looked at five risks, which were solely "status" characteristics. They were: being a single parent, receiving public assistance, being neither employed nor in school or job training, being a teenage parent, and lacking a high school diploma or GED. It is interesting to note that in our study, three of the Love et al. (2001) risks – being neither employed nor in school or job training, being a teenage parent, and lacking a high school diploma or GED – did not correlate individually with the behavior problems. This suggests that the different program impacts on behavior based on risk level that Love et al. (2001) found may be due to factors correlated with risk level rather than risk level itself. One possibility is that families in the low and high risk groups use the EHS program differently, which leads to different or even negative benefits of the program for those families. As Love et al. (2001) identified, the negative relation of program to behavioral outcomes for children in the high risk group may be due to the fact that those families were more likely to use programs that were not as fully implemented as the programs used by the moderate risk families, and the high risk families within the control group were more likely than lower risk families to seek other community supports, which rendered them a less meaningful control. The possible reasons for the negative impact on behavioral outcomes of EHS children in the low risk group are less clear but may also be

rooted in differences between how families with different risk profiles use the program.

EHS program efficacy was thoroughly investigated by Love et al. (2005), who controlled for critical factors in teasing out program effects. They examined program efficacy by type of program (center, home and mixed) as well as program implementation level (early vs. late/incomplete) and looked at child cognitive, language and social-emotional development as well as child health indicators and a range of indicators of parenting quality. It is important to note that they found significant, moderate positive effects on a number of parenting indicators for both the mixed-approach and home-based programs, and these effects were stronger among the programs that were early implementers. Consistent with the results of this study, Love et al (2005) found no program impacts for any program type on behavior problems (Aggressive Subscale of the Child Behavior Checklist). They did, however, find program impacts on behavioral outcomes not examined by this study. Specifically, they found moderate program impacts on sustained attention and engagement of parent in play for the mixed-approach programs, and they found small program impact on engagement of parent in play for home-based programs. To measure cognitive impacts, Love et al. (2005) used the average Bayley MDI, which is a combination of the reasoning and spatial ability outcomes used by this study. They found no program impacts on the MDI, whereas this study found significant impacts on reasoning for the home-based program. This is likely due to the fact that program impacts were diluted and no longer detectable when the reasoning subscale was

combined with the spatial subscale. Thus, this study finds positive cognitive impact of the home-based approach, whereas the Love et al. (2005) study found none for any program type. Another difference versus the Love et al. (2005) study was found with language. Love et al. (2005) found small effects for the mixed-approach group on the Peabody Picture Vocabulary Test but no effects for the other program types, whereas this study found small effects for the home-based approach but none for the other program types. This difference may be due to the inclusion of the results for the Spanish-speaking children in this study. One other important overall note is that the home-based program group had the largest number of participants (N = 700) and would therefore have the greatest power to detect effects. Given the small effect sizes, this may contribute to why this study found no effects for mixed-approach programs (N = 498).

Implications of the Findings

The relation of risks and outcomes differs depending on the outcome being examined. In this study, the risks that had the greatest correlation with reduced cognitive ability also correlated with reduced language, but the one risk (i.e., parental mental health) with the strongest correlation to behavior problems did not correlate at all with cognitive and language outcomes. This is an important observation because even though many studies have demonstrated that increasing numbers of risks are a potent correlate with reduced outcomes overall, different types of risks will have different correlations with cognitive and language ability versus behavioral outcomes, which means that taking into account which risks a child has in his environment can be important in designing the most effective

intervention strategy. It is also useful to observe the consistently high correlation of three risks in particular – non-white race, low parent supportiveness, low total family resources – with reduction in all outcomes measured in this study. This finding reinforces the correlation of higher parenting quality (sensitivity, positive regard toward child and the provision of cognitive stimulation) as well as higher family resources to better child outcomes. Combining the findings of this study with those of Love et al. (2005) reinforces the correlation of improved parenting practices with higher language ability and improvement on some behavioral indicators. If the improved parenting practices are maintained, it is likely that they will coincide with improved child outcomes in later development. It would be ideal to continue to study this group of children as they progress over time to measure correlations of risks present in the first three years of life to outcomes later on. It is possible that EHS program benefits to behavioral and health outcomes may not be evident until later childhood.

Dividing the cognitive measure into the reasoning and spatial subscales may have been what enabled this study's detection of improved reasoning ability for children in the home-based programs. This indicates that it may be fruitful to test cognitive subscales in the investigation of program impacts. It is possible that spatial ability is less environmentally sensitive than reasoning and therefore not as prone to program impact. This is not inconsistent with studies that have shown that genetic contributions differ based on which type of cognitive ability is examined (Plomin, DeFries, McClearn, & McGuffin, 2008). Because the goal of programs such as EHS are to improve as many aspects of cognitive, language and

social functioning possible, it is useful to analyze subtest results because they may better illuminate program efficacy.

The finding of greater program efficacy of home-based programs by this study may also be related to the age of EHS children because the youngest children may be best served by improvements to the home environment rather than by being taken out of it. This would be consistent with attachment theory and some of the findings of research on the effects of programs that are solely center-based, which indicate mixed benefit to very young children of even the highest quality centers.

The findings of this study support the ideas conveyed in Conger & Donnellan's (2007) interactionist model of the relation between family SES and child development as well as the importance of Coleman's (1988) concept of social capital by demonstrating the correlations between outcomes and the environmental characteristics of parenting, parent education level and total family resources as well as race, which is likely a surrogate for a lack of assets that can be cumulatively defined as reduced social capital. It is useful to observe that even in this group of children and families, where income level is of a compressed range and controlled along with other variables that correlate with race and outcomes, race of non-white continues to be such a strong predictor of outcomes. This suggests that something about race, other than its correlation with risk variables, is partly responsible for reduced outcomes. This is where the theory of social capital likely comes into play because race is likely correlated with significantly lower social capital, which effects child outcomes even after the

effects of other important variables, such as income, parenting practices, and parent education, are partialed out.

Limitations of the Current Study

There are important limitations of this study. One is the reduced ability to detect changes in development due program impacts because of the young age of the study participants. Tests of very young children are not as reliable as tests of older children and introduce more variability, reducing detection of program effects. In addition, it is important to note that the average program participation was 22 months, rather than 36 months, which represents a significantly shorter program dose than intended by the program design.

There is also variability in program dose. The average participation time in center-based programs was 20 months, in home-based programs it was 22 months, and in mixed-approach programs it was 23 months. Further, different families used programs differently such that not all children benefit from all services offered.

Another important issue is the lack of control for program implementation level (early versus late or incomplete). It is not known whether there is a correlation between program implementation and program type. If the home-based programs were among the most thoroughly implemented, then the home-based program efficacy found in this study may be at least partly due to program implementation level rather than program type. Love et al. (2005) demonstrated significant differences in early-implemented programs versus late or incomplete implementers. In fact, the behavior and cognitive program effects (for mixed-

approach programs) did not become significant until implementation level was controlled.

Another limitation is the correlational nature of this study's design with regard to the relations between risks and outcomes as well as program type. Because we could not use random assignment to place children in certain risk groups, we are not able to make causal inferences about risks and outcomes. Additionally, families chose which program type they used rather than being randomly assigned, which means that some of the differences in efficacy by program type could be due to family characteristics or other factors correlated with program choice rather than program effects.

Finally, as with all studies of EHS program efficacy, this study is limited by the fact that control group children and families may have participated in other environmentally enhancing programs. EHS used a wait list control method, and families not admitted to EHS may well have found other programs. Therefore, the control group is not purely a "no program" control group. In addition, we don't know if there is a relation between risk level and the likelihood of finding other programs. If that likelihood were not evenly distributed across accumulated risk level, this could further confound our ability to detect differences in program benefit over different levels of accumulated risk.

Future Directions

There are three areas that deserve particular attention in future research. They are the need to better understand the longer-term EHS effects, the need for

more accurate comparison groups and the need for a greater focus on social-emotional development.

Longitudinal research could help determine if early benefits of programs such as EHS can be maintained by continued high quality learning environments. In addition, it will be important to determine if the parenting improvements demonstrated by EHS hold over time and whether they correlate with better child outcomes in later developmental stages. In other words, an important part of the value of EHS may be the resulting parenting improvement which, even though it may not correlate with improved outcomes at the exit point of EHS (36 months), may ultimately correlate with, and potentially be responsible for, improved child outcomes later in development. This may also be the case for other environmental effects of EHS program exposure, such that benefits are not demonstrated until after program evaluation occurs.

There is also a need for research designs that use more effective control groups. One of the great challenges in evaluating EHS program effects is the fact that the "no program" control group may indeed experience other programs, and this likely reduces the size of EHS program effects. In effect, the "no program" control is actually a "no EHS program" control. Capturing more information on control children participation in other programs and controlling for the variance it shares will help to better illuminate EHS effects.

Because school readiness and ultimate academic attainment requires appropriate levels of social-emotional development (in addition to the physical, language and cognitive requirements) it is critical that importance is given to

measurement of social-emotional development. Most research to date has concentrated on early cognitive and language development, but as indicated by this study, significant correlates to social-emotional outcomes differ and must be taken into account in program development and measurement. Adding to the importance of this in consideration of programs like EHS, which are designed to serve high risk populations, is that there is some evidence that environmental risk may have a greater effect on certain social and emotional outcomes (i.e., attention and behavior regulation) than cognitive outcomes (Mistry et al., 2010). Additionally, emotional capacities and social skills interact with cognitive development (Shonkoff, 2009), which implies that they are not only directly important for school success but also integral to cognitive development and therefore academic achievement (Raver, 2002; Arnold et al., 1999). Therefore, investigating further the relation of environmental risk to behavioral outcomes and interventions is an important area of future focus.

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Table 1

Descriptive Statistics of Study Variables

Continuous Risk Variables	*N*	*M*	*SD*
Maternal Mental Health	2300	13.37	9.90
Parental Modernity	2131	20.91	3.44
Parent Supportiveness	2384	3.95	.90
Total Family Resources	2085	151.65	17.20
Nominal and Ordinal Risk Variables	***N***	**Mode**	**Range**
Race (White = 1, Black = 2, Hispanic = 3, Other = 4)	2933	1	1 - 4
Family Size (number of children 18 and under)	2999	1	1 – 8
Mother Education (Less than H.S. = 1, H.S. or GED = 2, Greater than H.S. = 3)	2879	1	1 - 3
Father Presence (No father = 0, Father present =1)	1561	1	0 - 1
Teen Mother (Mom > 20 = 0, Mom < 20 = 1)	2913	0	0 - 1
Parent Occupation (Employed = 1, School/Training = 2, Other = 3)	2897	3	1 - 3
Covariates	***N***		**Range**
Program Type (No program = 0, Center = 1, Home = 2, Mixed = 3)	2977		0 - 3
Child Sex (Female = 0, Male = 1)	3001		0 - 1
Site (17 sites coded even numbers)	3001		2 - 34
Outcome Variables	***N***	***M***	***SD***
Reasoning	1658	5.56	3.15
Spatial	1658	.75	1.30
Vocabulary English	1424	83.01	15.56
Vocabulary Spanish	233	95.11	8.16
Behavior	2031	18.81	10.84

Note. *N* is number of cases with data of total 3001 cases with the exception of vocabulary for which the *N*'s should be combined to provide an overall available vocabulary *N*. Range for reasoning is 0 to 13. Range for spatial is 0 to 6. Range for English vocabulary is 40 to 125. Range for Spanish vocabulary is 78 to 131. Range for behavior is 0 to 37.

Table 2

Percentages of Children Positive for Each Risk

Risk Variable	*N*	% at Risk
Mother Depression	2300	16.3
Low Modernity	2131	20.7
Low Supportiveness	2384	19.9
Low Family Resources	2085	24.6
Race Non-White	2933	62.8
Large Family Size	2999	9.6
Low Mother Education	2879	47.8
Father Absent	1561	17.9
Teen Mother	2913	39.2
Low Occupation	2897	54.9

Note. *N* is number of cases with data of total 3,001 cases.

Table 3

Bivariate Correlations between Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Mom Depression																
2 Low Modernity	-.02															
3 Low Support	.05*	.15**														
4 Low Resources	.17**	.10**	.03													
5 Race Non-White	-.03	.21**	.20**	.11*												
6 Large Family	.03	.02	.07**	.07**	.07**											
7 Low Mother Ed	.07**	.16**	.21**	.08**	.23**	.14**										
8 Father Absent	.04	.01	.10**	.04	.04	.00	.06*									
9 Teen Mother	.01	-.03	.11**	-.16**	.11**	.02	.39**	.04								
10 Low Occupation	.05*	.01	-.03	.12**	-.07**	-.02	-.04*	-.07*	-.24**							
11 Program Type	.02	-.06**	-.03	-.03	-.01	.04*	.01	.06*	-.01	.03						
12 Sex	.02	.01	.06**	.00	.01	.00	.00	.02	.01	-.01	.00					
13 Site	.00	.06**	.06**	-.03	-.02	.02	.05*	.02	.08**	-.01	.02	.02				
14 Reasoning	-.04	-.17**	-.24**	-.11**	-.26**	-.09**	-.22**	-.02	-.09**	.00	.05*	-.12**	-.10**			
15 Spatial	.02	-.05*	-.11**	-.05	-.13**	-.03	-.08**	-.08**	-.05	.02	-.01	.03	-.18**	.22**		
16 Vocabulary	-.05	-.13**	-.21**	-.12**	-.22**	-.06*	-.19**	-.06*	-.12**	-.10	.05	-.09**	-.08**	.55**	.17**	
17 Behavior	.15**	-.02	.07**	.10**	-.07**	-.04	.00	.08**	.00	.03	-.02	.08**	-.01	-.10**	-.03	-.11**

Note. Risks (variables 1 through 10) are in binary form. *$p < .05$, two-tailed; **$p < .01$, two-tailed.

Table 4

Regression of Each Outcome on 10 Risks with Covariates

	Reasoning				Spatial				Vocabulary				Behavior			
	β	SE β	t-ratio	R^2	β	SE β	t-ratio	R^2	β	SE β	t-ratio	R^2	β	SE β	t-ratio	R^2
Risk Factors																
Mother Depression	-.08	.07	-1.18		.10	.07	1.31		-.10	.08	-1.19		.38	.07	5.67**	
Low Modernity	-.11	.06	-1.76		-.02	.06	-.27		-.06	.07	-.93		-.01	.06	-.09	
Low Supportiveness	-.38	.05	-7.40**		-.15	.06	-2.41**		-.34	.06	-6.17**		.16	.06	2.85**	
Low Resources	-.13	.06	-2.39*		-.07	.06	-1.11		-.16	.06	-2.67**		.21	.05	3.94**	
Race Non-White	-.32	.06	-5.14**		-.18	.06	-2.97**		-.27	.06	-4.80**		-.19	.06	-3.22**	
Large Family Size	-.12	.07	-1.80		-.04	.08	-.46		-.07	.08	-.92		-.18	.09	-2.03*	
Low Mother Ed	-.26	.05	-5.10**		-.08	.06	-1.21		-.17	.06	-2.96**		-.03	.05	-.60	
Father Absent	-.01	.06	-.22		-.17	.07	-2.49*		-.08	.07	-1.12		.19	.06	3.09**	
Teen Mother	.02	.06	.42		.02	.06	.37		-.14	.05	-2.68**		.06	.05	1.13	
Low Occupation	-.07	.04	-1.58		-.02	.04	-.35		-.09	.05	-.17		.01	.05	.13	
Covariates																
Sex	-.20	.05	-4.30**		.07	.05	1.27		-.12	.06	-2.10*		.15	.05	3.36**	
Program 1	.13	.10	1.38		-.16	.10	-1.54		.08	.09	.95		-.15	.09	-1.70	
Program 2	.22	.06	3.54**		.02	.07	.28		.14	.06	2.17*		-.04	.06	-.62	
Program 3	.02	.07	.28		-.04	.08	-.47		.07	.08	.89		-.07	.09	-.81	
R^2				.19				.07				.16				.07

Note. *$p < .05$, two-tailed; **$p < .01$, two-tailed. Outcome variables are standardized.

Table 5

Regression of Each Outcome on Risk Index and Program Type with Covariates

	Reasoning				Spatial				Vocabulary				Behavior			
	β	SE β	t-ratio	R^2	β	SE β	t-ratio	R^2	β	SE β	t-ratio	R^2	β	SE β	t-ratio	R^2
Risk 10	-.16	.02	-10.43**		-.06	.02	-4.20**		-.16	.02	-9.69**		.06	.02	3.86**	
Program 1	.15	.10	1.54		-.16	.10	-1.59		.09	.09	1.05		-.15	.09	-1.68	
Program 2	.24	.07	3.66**		.02	.07	.21		.14	.06	2.21*		-.04	.06	-.60	
Program 3	.02	.07	.32		-.04	.08	-.51		.08	.08	.99		-.08	.09	-.86	
Sex	-.21	.05	-4.38**		.06	.05	1.23		-.12	.06	-2.19*		.16	.04	3.60**	
R^2				.17				.06				.14				.03

Note. *$p < .05$, two-tailed; **$p < .01$, two-tailed. Outcome variables are standardized.

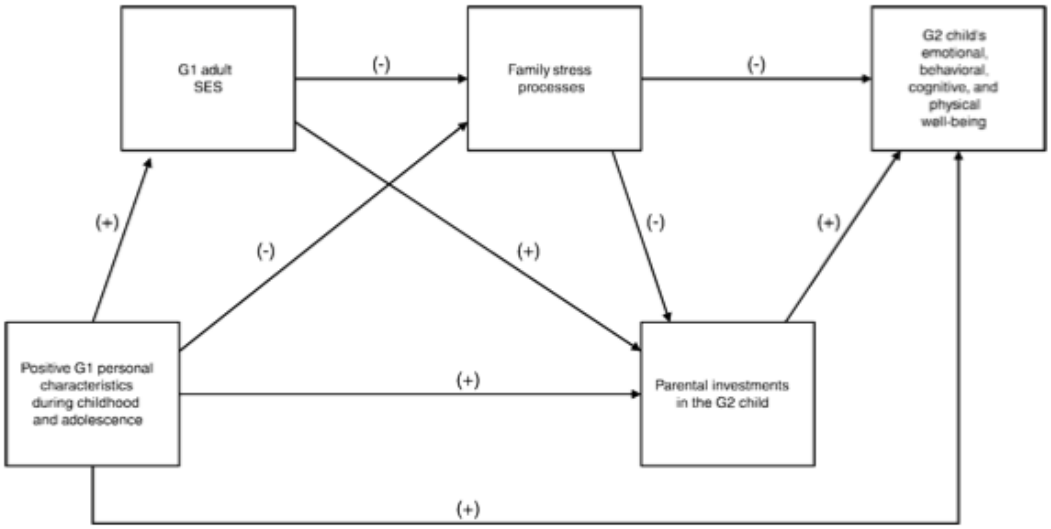

Figure 1. Interactionist model of socioeconomic status and human development.

Source: Conger & Donnellan, 2007.

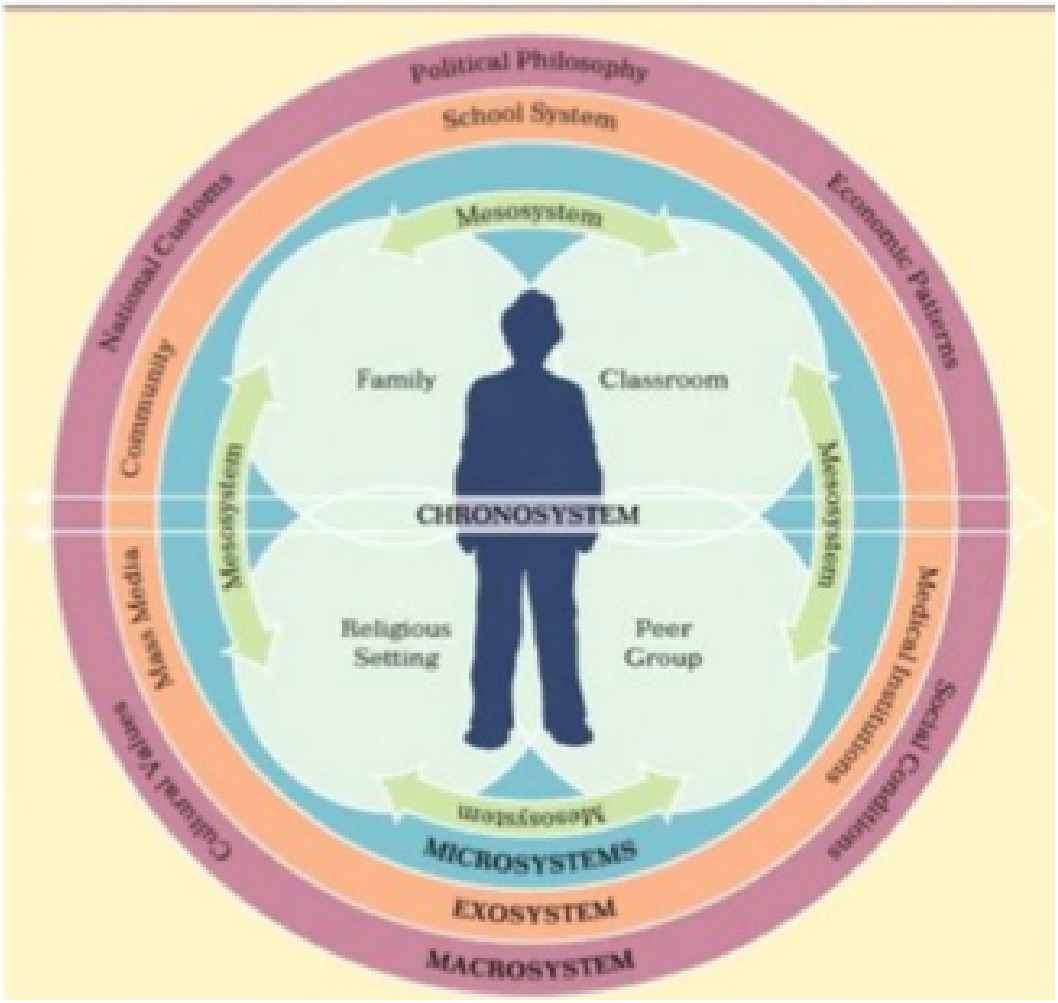

Figure 2. Ecology of human development. Source: Bronfenbrenner, 1986.

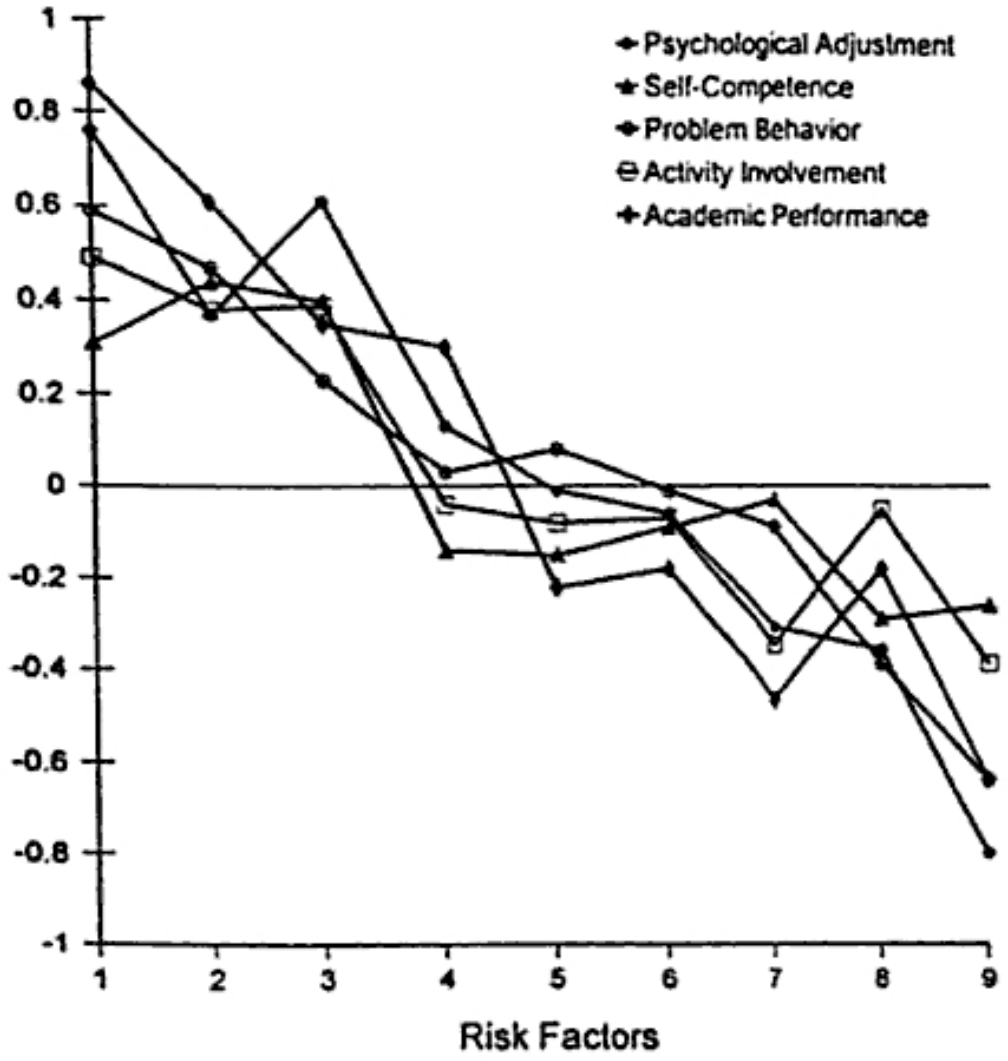

Figure 3. Relation of five developmental outcomes to multiple risk. Source: Sameroff et al., 1998.

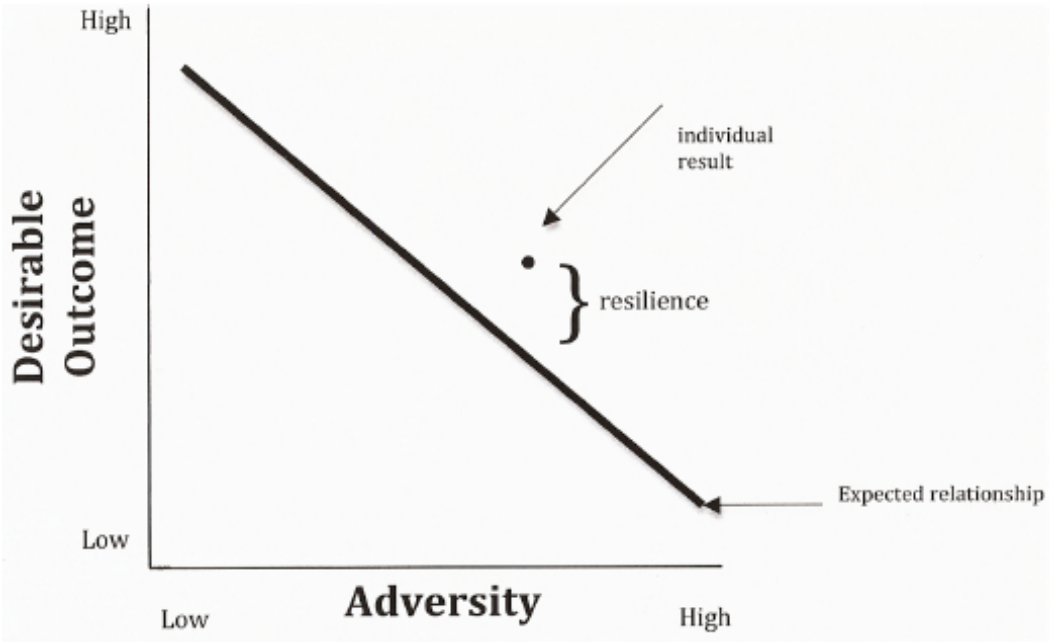

Figure 4. Resilience as a function of improved outcome despite adversity.

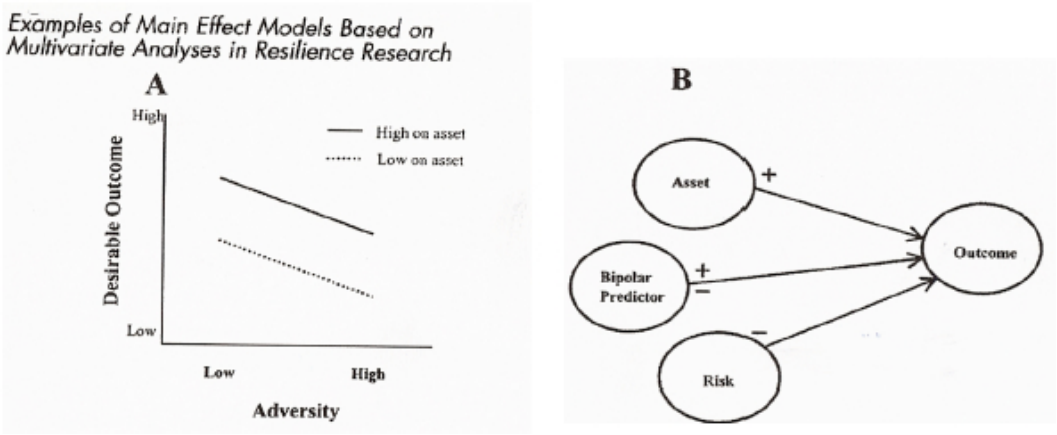

Figure 5. Promotive factors in main effects models (Masten, 2001).

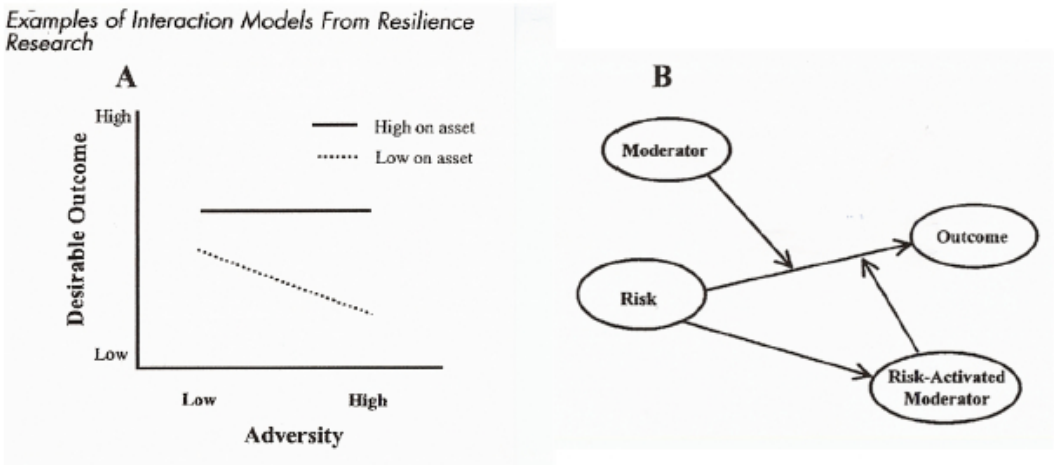

Figure 6. Protective factors in interaction models (Masten, 2001).