

Early Educational Intervention, Early Cumulative Risk, and the Early Home Environment as Predictors of Young Adult Outcomes Within a High-Risk Sample

Elizabeth P. Pungello, Kirsten Kainz,
Margaret Burchinal, Barbara H. Wasik,
and Joseph J. Sparling
University of North Carolina at Chapel Hill

Craig T. Ramey
Georgetown University

Frances A. Campbell
University of North Carolina at Chapel Hill

The extent to which early educational intervention, early cumulative risk, and the early home environment were associated with young adult outcomes was investigated in a sample of 139 young adults (age 21) from high-risk families enrolled in randomized trials of early intervention. Positive effects of treatment were found for education attainment, attending college, and skilled employment; negative effects of risk were found for education attainment, graduating high school, being employed, and avoiding teen parenthood. The home mediated the effects of risk for graduating high school, but not being employed for teen parenthood. Evidence for moderated mediation was found for educational attainment; the home mediated the association between risk and educational attainment for the control group, but not the treated group.

Numerous studies have documented the negative impact of multiple social risk factors on children's development from early childhood through adolescence (e.g., Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987; Trentacosta et al., 2008). High-quality early educational programs are widely viewed by researchers, parents, and policy makers as a means of enhancing cognitive and social skills for young children exposed to such risk factors (Heckman, 2006). Enhancing early development is expected to lead to more positive educational, occupational, and social outcomes in adulthood. Findings from the Abecedarian Project, a study of intensive early educational intervention delivered to high-risk chil-

dren in a child-care setting, support this expectation by demonstrating that individuals randomly assigned to early educational treatment, when compared with those assigned to the control group, maintained cognitive gains and showed educational and occupational benefits into young adulthood (Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, 2001; Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002). Long-term educational and occupational benefits were replicated in a subsequent randomized study of early education, the Carolina Approach to Responsive Education (CARE; Campbell et al., 2008). The present study adds to the literature concerning the long-term effects of educational intervention and early risk by examining: (a) the extent to which exposure to multiple social risk factors in early childhood predicts outcomes in young adulthood over and above the effects of early educational intervention within a high-risk sample, and whether early risk and early intervention interact to influence adult outcomes, and (b) whether such distal risk factors are

This research was supported in part by grants from the National Institutes of Health (R01 HD040817), the Maternal and Child Health Bureau (6 R40 MC 00254, 6 R40 00067), the Office of Educational Research and Improvement (R306F960201), and the David and Lucille Packard Foundation. The authors also wish to thank Katherine Polk, the study's project coordinator, and Carrie Bynum, the study's family coordinator, for their tireless efforts, without which this work could not have been completed. Our extreme gratitude also goes out to the families who have participated in this work over these many years.

Correspondence concerning this article should be addressed to Elizabeth P. Pungello, Frank Porter Graham Child Development Institute, Campus Box 3270, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-8180. Electronic mail may be sent to liz_pungello@unc.edu.

associated with adult outcomes through proximal processes associated with the quality of the early home environment, and whether early intervention moderates the effects of the proximal processes in the early home on young adult outcomes.

Early Educational Intervention and Early Cumulative Risk

Head Start, public prekindergarten, and, to a lesser extent, subsidized child-care programs have been funded by local, state, and federal governments in an effort to enhance the early development of children raised in poverty to help them overcome their increased risk of academic failure, unemployment, teenage parenthood, and criminal behavior as young adults. These efforts have been undergirded by results from randomized experiments demonstrating enhanced outcomes associated with high-quality preschools or educational intervention in child-care settings targeting poor children (Berrueta-Clement, Schweinhart, Barnett, Epstein, & Weikart, 1984; Campbell et al., 2001, 2008; Hubbs-Tait et al., 2002) and observational studies suggesting that quality child care enhances children's development (see Vandell, 2004, for a review). Both the Abecedarian and CARE studies found positive effects for young adult education and occupational outcomes (Campbell et al., 2002; Campbell et al., 2008). More specifically, compared to controls, those who received the early educational intervention attained more years of education, were more likely to attend a 4-year college or university, and were more likely to have obtained skilled employment. However, no significant differences were found in either sample for high school graduation or employment rates. In addition, those treated in the Abecedarian Project were less likely to be teen parents compared to controls, although this was not replicated in the CARE sample. Neither the Abecedarian nor CARE projects found reductions in criminal behavior, but such effects were found for the Perry Preschool Study (Schweinhart, Barnes, & Weikart, 1993).

The multiple-risk model proposed by Rutter (1979) and Garmezy, Masten, and Tellegen (1984) posits that developmental outcomes are a function of individual responses to risk factors. This model focuses on pathways to competence in the context of adversity (Masten et al., 1999) and emphasizes identifying "protective factors" that weaken the link between adversity and child outcomes and promote "successful adaptation despite challenging or threatening circumstances" (Masten, Best, &

Garmezy, 1990, p. 426). The multiple-risk approach focuses on risk composites that describe the extent of exposure to various factors based on the recognition that distal indices such as poverty, single parenthood, large households, low parental education, unemployment, low-income communities and poor-quality schools, and more proximal measures, such as maternal depression and lack of social support, tend to cluster in the same individual (Masten et al., 1995). Accounting for these correlated constraints through multiple or cumulative risk indices may provide better theoretical and empirical models of how exposure to negative factors impacts children's development than does examining any single individual risk factor or examining them in an additive manner (Sameroff & MacKenzie, 2003).

Several studies have demonstrated that high scores on multiple risk indices are negatively related to cognitive, language, and socioemotional outcomes in early childhood, middle childhood, and adolescence (Brody & Flor, 1998; Brody, Kim, & Murry, 2003; Burchinal, Roberts, Hooper, & Zeisel, 2000; Burchinal, Roberts, Zeisel, Hennon, & Hooper, 2006; Evans, 2003; Forehand, Biggar, & Kochick, 1998; Gerard & Buehler, 2004; Gutman, Sameroff, & Eccles, 2002; Gutman, Sameroff, & Cole, 2003; Hooper, Burchinal, Roberts, Zeisel, & Neebe, 1998; Jones, Forehand, Brody, & Armistead, 2002; Krishnakumar & Black, 2002; Liaw & Brooks-Gunn, 1994; Linver, Brooks-Gunn, & Kohen, 2002; Luster & McAdoo, 1994; Prelow & Loukas, 2003; Pungello, Kupersmidt, Burchinal, & Patterson, 1996; Sameroff, Seifer, Baldwin, & Baldwin, 1993; Sameroff et al., 1987; Trentacosta et al., 2008). Less is known, however, about the very long term effects of early exposure to multiple risk factors. Young adulthood, spanning ages 18–25, is a time termed "emerging adulthood" by Arnett (2000), a life stage encompassing the transition between separation from the family of origin and becoming self-supporting. Previous research has linked individual early risk factors to young adult education outcomes, employment, teen parenthood, and criminal behavior (Aquilino, 1996; Ensimerger & Slusarcick, 1992; Gest, Mahoney, & Cairns, 1999; Haurin, 1992; Jaffee, 2002; Jimerson, Egeland, Sroufe, & Carlson, 2000; Xie, Cairns, & Cairns, 2001; Zill, Morrison, & Coiro, 1993), but to date, less research has examined whether exposure to multiple social risk factors during early childhood predicts adult outcomes. An exception is a study of over 30,000 individuals in Britain in which Schoon et al. (2002) found increased socioeconomic risk to be associated with lower academic attainment through adoles-

cence and lower social class attainment in adulthood.

Studies examining the effects of cumulative risk often include income and ethnicity among the multiple risk indices, yet investigating how cumulative risk affects outcomes within samples limited to such individuals is needed given their increased likelihood of experiencing multiple stressors. Children in poverty are more likely to experience both social risk (e.g., family disruption) and environmental risk (e.g., pollution; see review by Evans, 2004). African American children often experience racism in addition (Luster & McAdoo, 1994). Thus, "sociocultural forces such as poverty and racism tend to allocate risk disproportionately... to subsets of the population such as poor and ethnic minorities" (Evans, 2003, p. 924). Using heterogeneous samples, researchers have investigated the effects of additional risk over and above those associated with income and ethnicity, finding somewhat inconsistent results depending on the additional risk included (e.g., stressful life events, Pungello et al., 1996; low birth weight, Liaw & Brooks-Gunn, 1994). Others have examined the effects of additional risk within high-risk samples (Burchinal, Roberts, et al., 2000; Hooper et al., 1998; Shaw, Winslow, Owens, & Hood, 1998; Burchinal et al., 2006; Krishnakumar & Black, 2002; Brody et al., 2003; Gutman et al., 2002; Prelow & Loukas, 2003), finding negative associations between such risk and children's outcomes. However, although some longitudinal work has been carried out (Brody et al., 2003; Burchinal, Roberts, et al., 2000; Burchinal et al., 2006), most of these studies have investigated short-term links between risk and outcomes.

In addition to investigating the main effects of early education in a child-care setting and early cumulative risk, researchers have tested for interactions between early care experiences and early risk. Both compensatory effects (i.e., children with higher risk benefited more than children with lower risk) and leveraging effects (i.e., greater effects found for children with less risk than for those with more risk) have been found. Hubbs-Tait et al. (2002) found children with high family risk benefited more by Head Start attendance than those at low risk when predicting language scores. In contrast, Liaw and Brooks-Gunn (1994) examining the effects of the Infant Health and Development Program found that for children raised in poverty, the intervention had a greater effect for children with less risk than for children who experienced more risk.

The first goal of this study was to further the understanding of the effects of early intervention and early cumulative risk by: (a) investigating the associations between exposure to multiple social risk factors in early childhood and young adult outcomes within a sample drawn entirely from low-income families, almost all of whom were African American, over and above the effects of early educational intervention, and (b) examining whether early intervention and early risk interact to influence outcomes in young adulthood.

Moderated Mediation: The Early Home Environment

A number of risk indices have been constructed to examine how exposure to risk negatively affects developmental outcomes. Although both distal (e.g., poverty, unsafe neighborhoods, maternal education) and proximal (e.g., quality of the home environment) factors have often been included in risk indices (Barocas et al., 1991; Hooper et al., 1998; Luster & McAdoo, 1994; Prelow & Loukas, 2003; Sameroff et al., 1993), more recent studies have focused on how exposure to distal risk factors affects development via proximal processes (e.g., Brody et al., 2003; Trentacosta et al., 2008). Based upon ecological theory (Bronfenbrenner & Morris, 1998), researchers have hypothesized that the stress and lack of opportunities associated with poverty, low education, and large households may significantly diminish the family's psychological strengths, resulting in less responsive care by parents (e.g., Conger & Elder, 1994). Thus, not only do risk factors tend to cluster together, but the co-occurrence of multiple risks may overwhelm the family's ability to cope and provide positive parenting to the child (Sameroff et al., 1987).

A number of explanatory models have been tested in previous work, including additive (testing for independent effects of each variable), cumulative (testing the effect of a total risk score), interactive (testing if proximal variables moderate the effects of distal variables), and mediational (testing if the effects of distal variables are mediated through their effects on proximal variables), with the mediation model receiving the greatest support (e.g., Jones et al., 2002; Krishnakumar & Black, 2002). For example, proximal factors such as the quality of the home environment mediated distal risk factors in predicting cognitive outcomes prior to the age of 6 years (Barocas et al., 1991; Krishnakumar & Black, 2002), externalizing and internalizing problems among high-risk children in early childhood (Trentacosta et al., 2008), academic and social outcomes among

African American children in Grades 1–3 (Burchinal et al., 2006), and social outcomes for African American children 7–15 years of age (Brody et al., 2003; Jones et al., 2002). Thus, the weight of evidence from these and other prior studies supports the hypothesis that distal risk factors, such as poverty, maternal education, and family structure, predict child outcomes through effects on proximal processes (Guo & Harris, 2000; Guo & VanWey, 1999; Luster & McAdoo, 1994; National Institute of Child Health and Human Development Early Child Care Research Network, 2005). However, less is known about the duration of these effects, that is, the extent to which risk early in the life span may influence the quality of the home environment in early childhood, which may in turn affect outcomes across many years, even into young adulthood.

In addition, researchers have examined whether early care experiences may moderate the effects of the early home environment, finding both compensatory (Bradley, Corwyn, Burchinal, McAdoo, & Garcia-Coll, 2001) and leveraging (Bryant, Burchinal, Lau, & Sparling, 1994) effects. This is similar to findings from the studies examining the interaction between early care experiences and early cumulative risk described earlier.

The second overall goal of this study was to further understanding of the role of the early home environment by: (a) examining whether the early home environment mediates the effects of early cumulative risk on young adult outcomes and (b) investigating whether early educational intervention in a full-time child-care setting moderates the effects of the early home environment on young adult outcomes.

Present Study

This study used data from the Abecedarian Project (Ramey & Campbell, 1984) and CARE (Wasik, Ramey, Bryant, & Sparling, 1990) to examine the very long term effects of early educational intervention in a child-care setting, early multiple risk exposure, and the early home environment. These consecutive longitudinal programs have followed participating individuals from infancy through young adulthood. Early risk factors and the home environment were assessed during program implementation from infancy through age 5 (kindergarten entry), and the data on early circumstances were entered into predictive models to explain educational outcomes, employment outcomes, teen parenthood, and criminal behavior when these persons were 21–25 years of age.

Our hypotheses were as follows. Concerning the first overall goal of the study, prior analyses with these samples have demonstrated that those who received the early educational intervention showed benefits in terms of education and vocational outcomes (Campbell et al., 2002; Campbell et al., 2008). We hypothesized that within this high-risk sample, over and above any found effects of treatment, early cumulative risk would be negatively associated with young adult educational outcomes (education attainment in general, graduating high school specifically, and attending college specifically), employment outcomes (being employed, obtaining skilled employment), avoidance of teen parenthood, and avoidance of criminal behavior (i.e., individuals exposed to more risk would be more likely to be convicted of a misdemeanor, more likely to be convicted of a felony, and more likely to use illegal drugs). We also hypothesized that early intervention would moderate the effects of risk such that the effects of increased risk would be weaker for those who received the intervention than for those who did not. Concerning the second goal of the study, we hypothesized that the early home environment would mediate any found effects for early risk and that early educational intervention would moderate the effects of the early home environment such that the effects of a poor-quality home environment would be weaker for those who received treatment compared to those who did not.

Method

Participants

Participants were 139 young adults enrolled as infants in one of the two consecutive trials of early educational intervention. The Abecedarian study enrolled four cohorts of infants born between 1972 and 1977, and CARE added two more born between 1978 and 1980. To determine eligibility for both samples, families were screened with the same High Risk Index (Ramey & Smith, 1977) composed of sociodemographic factors associated with delays in cognitive development and educational failure. Among the factors were the educational levels of parents, family income, family structure, evidence of cognitive delays or academic failure in other family members, and the use of welfare funds to meet basic needs. Scores on the index were weighted and summed to measure the degree of risk for each family; to qualify, a score of 11 or higher was required.

The original Abecedarian sample consisted of 111 infants; CARE consisted of 66. Ninety-four per-

cent of the original high-risk families in the combined sample identified themselves as African American (the remaining 6% were Euro-American), and 53% of the infants were male. In the Abecedarian study, infants were randomly assigned to two groups: full-time educational treatment in a child-care setting or control. In the CARE study, infants were randomly assigned to three groups: full-time educational treatment in a child-care setting plus family education, family education only, or control. Table 1 summarizes for both samples the numbers of male and female study participants for whom data were collected in young adulthood. Attrition across the two studies was only 6%. At the time of the young adult follow-up, the individuals ranged in age from 20 to 25 years. For the Abecedarian study, the mean age at data collection was 21.2 years ($SD = 0.60$ years); for CARE, the mean age was 22.5 years ($SD = 0.71$ years).

Given that one of the main interests in this study was to learn the degree to which the early childhood educational treatment in a child-care setting influenced later outcomes in light of early risk and the quality of the early home environment, the present analyses were confined to individuals who received early educational treatment within the child-care setting (whether or not they also received family education) and those randomly assigned to the control groups. Thus, the treated group consisted of the Abecedarian treated group ($n = 53$), and the CARE treated group ($n = 14$). The control group consisted of the Abecedarian control group ($n = 51$), and the CARE control group ($n = 21$). The CARE group that received only the family education ($n = 25$ families) was not included in these analyses (see Wasik et al., 1990, for comparisons of early childhood outcomes for three CARE groups). Thus, the total sample size for the present analyses was 139 (73 males and 66 females; 67 who received

early educational treatment and 72 controls). Analyses of young adult outcomes for the Abecedarian and CARE projects have been based on an "intent-to-treat" model in which all individuals were classified according to their random group assignment in infancy. For specific outcomes, the numbers vary slightly depending upon the few young adults who chose not to disclose certain information.

Although the Abecedarian and CARE studies comprised separate samples, several factors provide confidence that they can be combined into one sample. First, the children in both the Abecedarian and CARE samples were recruited in the same manner from the same communities, and the center-based treatment in both samples was essentially the same (the early educational intervention staff was relatively stable, they were supervised by the same investigators, and the site and the curriculum were the same). Further, earlier analyses examining the effects of treatment on cognitive outcomes through age 8 found treatment and not sample to be substantively related to outcomes (with IQ differences between the samples being found at only 2 of the 10 assessment points) and no Treatment \times Sample interaction (Burchinal, Campbell, Bryant, Wasik, & Ramey, 1997). Prior analyses for age 21 outcomes compared 12 basic background factors (maternal age, education, marital status, teen parent, ethnicity, etc.) across the two study samples and found only one significant difference: Mothers of infants enrolled in CARE had more years of education at the time of the target child's birth (Campbell et al., 2008). These prior young adult analyses also compared the effects of treatment in the samples and found no evidence for a larger treatment effect in the CARE sample (i.e., for individuals who received both the child-care treatment and the family education component) than the Abecedarian sample (i.e., those who received only the child-care treatment) for long-term educational outcomes (Campbell et al., 2008). Finally, in analyses for the current study (described in the following), logistic regression on each of the individual risk factors that comprised the cumulative risk index employed in this study and a general linear model for the risk total score found no evidence that individual risk items or the total scores differed across samples.

Procedures

Treatment and control groups. The Abecedarian and CARE treatment involved early educational intervention beginning in infancy and lasting until the child started kindergarten. Age at entry ranged

Table 1
Number of Abecedarian and CARE Study Participants Interviewed as Young Adults

Group	Abecedarian		CARE		Total
	Males	Females	Males	Females	
Early educational treatment	28	25	9	5	67
Control	23	28	13	8	72
Family education only			15	10	25
Total	51	53	37	23	164

Note. The child-care treatment group in the Carolina Approach to Responsive Education (CARE) study received family education as well.

from 3 to 22 weeks, with a mean age of 9 weeks ($SD = 4.6$ weeks). The intervention was delivered in a full-time child-care facility housed in a university-based research center. Descriptions of the educational program and early childhood outcomes are provided in a number of earlier publications (i.e., McGinness & Ramey, 1981; Sparling, 1989; Sparling & Lewis, 1978, 1984; Ramey & Campbell, 1984; Wasik et al., 1990).

Longitudinal data collection. From infancy to age 5 years (i.e., early childhood), demographic circumstances for each child's family were repeatedly assessed. Data were collected at the point of study admission and at least annually thereafter to track changes in the child's family composition, parental education levels, and stability of living circumstances. Annual home visits were also made during which the educational atmosphere of the child's home environment was assessed. The focus of the present work is on how events in the first 5 years of life were related to long-term outcomes as represented in accomplishments assessed in the young adulthood follow-up.

Young adult follow-up. Young adults were contacted by letter and invited to enroll in this phase of the study. Assessors were advanced graduate students in clinical or school psychology. All were unaware of the participants' early treatment histories. Two of the assessors were African American and one was European American for the Abecedarian follow-up; the three assessors were European American for the CARE follow-up.

Measures

Early risk. The following variables were selected from data collected between infancy and 54 months to create the present cumulative risk index: teen mother when the participant was born (mother younger than 18), mother's educational level at birth less than high school graduate, parents not married at some point during this time period, participant did not live with the mother at some point during this period, large family size (participant had two or more siblings by age 54 months), and high mobility (the family made three or more moves during this time period). These factors were selected based upon prior studies examining the effects of early risk factors (Aquilino, 1996; Burchinal, Roberts, et al., 2000; Chase-Lansdale, Gordon, Brooks-Gunn, & Klebanov, 1997; Deater-Decker, Dodge, Bates, & Pettit, 1998; Dubow & Luster, 1990; Enslinger & Slusarcick, 1992; Furstenberg, Brooks-Gunn, & Chase-Lansdale, 1989; Gutman

et al., 2002; Hooper et al., 1998; Luster & McAdoo, 1994; McLanahan, 1997; Murry, Bynum, Brody, Willert, & Stephens, 2001; Prelow & Loukas, 2003; Sameroff et al., 1993; Sugawara, 1991; Williams, Anderson, McGee, & Silva, 1990; Zill et al., 1993). The cumulative risk score was derived by summing up 1 point for each of the factors that pertained to the family during the child's first 5 years. Thus, early risk scores could range from 0 to 6.

The early home environment. Abecedarian and CARE families were visited at home when study children were 6, 18, 30, 42, and 54 months of age. Based on observations and questions during the visits, the age-appropriate version of the Home Observation for Measurement of the Environment (HOME; Bradley & Caldwell, 1979; Caldwell & Bradley, 1984) was scored. Versions of the HOME suitable for infants/toddlers and preschool children aged 3–6 covered factors such as the affective quality of the parent (mother)–child interaction, the toys and educational materials provided, the parent's support for the child's learning, the stability of the family's routines, and the variety and breadth of stimulation made available to the child. Caldwell and Bradley (1984) reported internal consistency reliability of $r = .89$ for the infant/toddler version of the HOME, and $r = .93$ for the preschool version (Bradley, Caldwell, Rock, Hamrick, & Harris, 1988). Bradley (1992) found comparable factor structures and predictive validity for European American and African American samples. In the present sample, alpha levels for the HOME ranged from .75 at 6 months to .89 at 54 months, with an overall average alpha of .82.

The infant/toddler and preschool versions of the HOME differ in the number of items but are highly correlated ($.43 < r < .72$). Accordingly, an across-time composite HOME score was computed as the mean of the percent of items passed at 6, 18, 30, 42, and 54 months. This composite HOME score ranged from 0.40 to 0.94 ($M = 0.69$ and $SD = 0.11$). Thus, on average, 69% of the items were passed over time across the families in the sample.

Young adult outcomes. Outcomes for the analyses presented here include educational attainment, employment, teen parenthood, and criminal behavior. These data were collected through means of a semistructured interview covering these and other basic demographic factors. The use of illegal drugs was measured by self-scored answers to questions contained in the Behavioral Risk Factor Surveillance System (Kolbe, 1990).

Educational attainment was operationalized in three ways. First, a continuous measure of educa-

tion was created based on the number of years associated with the final degree obtained. The score was the highest grade completed if the participant did not graduate from high school or obtain a general equivalency diploma (GED), the score was 12 if the participant had graduated from high school or obtained a GED, 14 if the participant had completed some college or obtained an associate's degree, and 16 if the participant had obtained a bachelor's degree. To address policy questions, two categorical variables were also created: high school graduate (*yes-no*) and ever attended a 4-year college or university (*yes-no*).

Two binary employment outcomes were examined. First, whether or not the participant was employed in any capacity at the time of the young adult interview was analyzed. Second, positions were coded according to the Hollingshead Index of Social Class (Hollingshead, n.d.) and whether or not the participant was employed in a skilled labor occupation or higher (defined as Hollingshead rating of 4 or higher) was coded.

Teen parenthood was defined as having a first child before age 18. Criminal behavior was self-reported: whether or not the participant had been convicted of a misdemeanor, convicted of a felony, or reported any illegal drug use.

Analysis Strategy

Two sets of analyses were conducted to address the two goals of the study. First, the simultaneous effects of treatment and risk were investigated using general linear modeling (in the models predicting to the continuous variable for education attainment) and logistic regression techniques (in the models predicting to the dichotomous outcomes: high school graduate, ever attended college, currently employed, currently employed in a skilled job, teen parenthood, ever convicted of a misdemeanor, ever convicted of a felony, and use of illegal drugs) in SAS version 9.1 (Statistical Analysis Software, Cary, NC). For each outcome, two predictive models were run. The first tested for the main effects of early intervention and early risk; the second added an intervention by risk interaction term to the model.

In the second set of analyses, young adult developmental status was conceptualized within a moderated mediation framework, hypothesizing that the early home environment mediated the effect of early risk on young adult outcomes and that early educational intervention status moderated the relation between the home environment and young adult

outcomes (see Figure 1). Thus, for each outcome where significant effects of early risk above and beyond treatment were found in the first set of analyses, the moderated mediation hypothesis was investigated using Mplus version 5 (Muthén & Muthén, 1998–2007). Mplus provides several advantages for this analysis in that it: (a) allows for the proper specification and analysis of binary and continuous outcomes, (b) estimates bootstrapped standard errors and confidence intervals for each model coefficient, and (c) addresses missing data through a full information maximum likelihood (FIML) technique. Following recommendations by Preacher, Rucker, and Hayes (2007), the moderated mediation path model included the early risk index, early home environment, early childhood educational treatment status, and a Home Environment \times Treatment interaction term as predictors of young adult outcomes (see Figure 2). Additionally, the home environment was regressed on the child risk index. Each predictor was mean-centered for analysis and for the creation of the interaction term. The analysis plan focused on assessing the significance of simultaneous mediation and moderation within the path models. Significant mediation was determined by a nonzero product term of the a_1 and b_1 paths, controlling for all other variables in the model; this product term is referred to as the indirect effect or mediated effect (MacKinnon, 2008). The term indirect effect is used from this point forward. If the path between the interaction term and outcome was significant for a specific young adult outcome, post hoc evaluation of simple indirect effects within treatment levels was conducted (Tein, Sandler, MacKinnon, & Wolchik, 2004).

Results

Descriptive Findings

The number of early risk factors experienced by study participants ranged from 0 to 4 ($M = 2.31$, $SD = 1.10$). The mean cumulative risk scores were

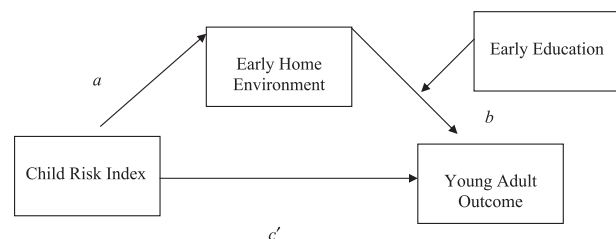


Figure 1. Conceptualization of moderated mediation.

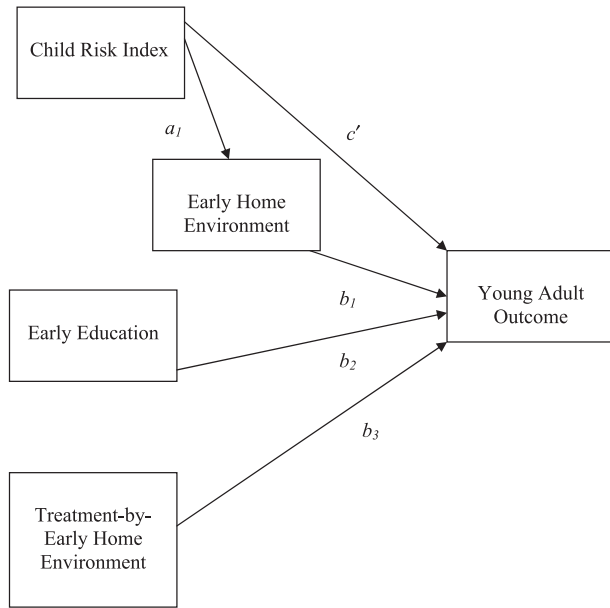


Figure 2. Moderated mediation path model specification.

2.32 ($SD = 1.06$) for the treated group and 2.38 ($SD = 1.18$) for the control group. The mean early home environment score for the treated group was 0.68 ($SD = 0.091$) and for the control group was 0.66 ($SD = 0.10$). There were no significant differences between the treated and control groups for any risk item, the total risk score, or the home environment score.

Table 2 provides the percentages of the treatment and control groups who experienced each risk factor and each of the binary young adult outcomes. Logistic regressions for each of the binary outcomes with only treatment as the predictor found significant differences between the treated and control groups for having attended college, $B = 1.31$ (0.43), $p < .01$, and skilled employment, $B = 0.98$ (0.37), $p < .01$. For the continuous educational outcome, the mean for the total sample was 12.31 ($SD = 1.64$), with $M = 12.77$ ($SD = 1.45$) for the treated group and $M = 11.88$ ($SD = 1.69$) for the control group; a general linear model with treatment alone as a predictor found a significant difference between the treated and control groups for this outcome, $B = 0.90$ (0.27), $p < .01$. The correlation between educational attainment and cumulative risk was $r = -.20$ ($p < .05$), and the correlation between educational level and the early home environment was $r = .36$ ($p < .0001$).

Research Goal 1: Prediction Models

Table 3 presents raw regression coefficients and standard errors for the linear education attainment outcome and odds ratios (ORs) and confidence intervals (CIs) for dichotomous outcomes. The findings indicate that when the effects of treatment and

Table 2
Descriptive Statistics for Individual Risk Factors and Binary Outcomes by Treatment Group

	Group					
	Treated		Control		Total	
	<i>n</i>	% of group	<i>n</i>	% of group	<i>N</i>	% of sample
Risk factors						
Teen mother	15	22.7	21	29.2	36	26.1
Mother less than high school graduate	37	56.1	46	63.9	83	60.1
Mother not always married	59	89.4	61	84.7	120	87.0
Mother out of home	10	15.5	8	11.1	18	13.0
Large family size	13	19.7	17	23.6	30	21.7
Frequent moves	20	30.3	18	25.0	38	27.5
Outcomes						
High school graduate	50	74.6	48	72.2	98	71.0
Attended college	25	37.9	10	14.8	35	25.6
Employed as young adult	45	67.2	40	56.3	85	61.6
Skilled employment	30	46.2	17	24.3	47	34.8
Teen parent	8	11.9	15	20.8	23	16.6
Misdemeanor	8	12.3	14	19.4	22	16.1
Felony	6	9.2	8	11.1	14	10.2
Used illegal drugs	44	67.7	50	69.4	94	68.6

risk on young adult outcomes were simultaneously estimated, positive treatment effects were found for educational attainment, the likelihood of attending college, and the likelihood of having obtained skilled employment. Risk was negatively associated with educational attainment, the likelihood of high school graduation, the likelihood of being employed in any capacity, and the likelihood of avoiding teen parenthood. Effect sizes indicate that, controlling for risk, treated participants obtained 0.87 more years of education, were 3.82 times more likely to have attended some college, and were 2.69 times more likely to have obtained skilled employment compared to control participants. Controlling for treatment, each additional risk factor was associated with 0.28 fewer years of education, being 1.45 times less likely to graduate from high school, 1.61 times less likely to be employed, and 1.78 times more likely to be a teen parent (for ORs less than one reported in the table, the inverse of the reported value is used to describe the odds). Neither treatment nor risk appeared to have a significant effect on self-reported involvement in crime.

In the second set of models that tested for a treatment by risk interaction in addition to simultaneously estimating the main effects of treatment and risk, no evidence was found to suggest treatment moderated the associations between risk and any of the young adult outcomes.

Table 3
Young Adult Outcomes as a Function of Early Educational Intervention and Early Cumulative Risk

	Model 1			
	Treat		Risk	
	B	SE	B	SE
Education attainment	0.87**	0.27	-0.28*	0.12
	OR	CI	OR	CI
High school graduate	1.30	0.61, 2.77	0.69*	0.49, 0.97
Employed	1.53	0.75, 3.13	0.62**	0.44, 0.87
Teen parent	0.53	0.20, 1.38	1.78*	1.13, 2.80
Any college	3.82**	1.66, 8.80	0.91	0.63, 1.31
Skilled employment	2.69**	1.29, 5.60	0.88	0.63, 1.22
Felony	0.86	0.28, 2.65	1.60	0.94, 2.75
Misdemeanor	0.60	0.23, 1.56	1.51	0.98, 2.33
Illegal drugs	0.90	0.44, 1.85	0.95	0.69, 1.31

Note. Values for treatment and risk were centered for analysis.
* $p < .05$. ** $p < .01$.

Research Goal 2: Moderated Mediation

The moderated mediation hypotheses was then tested for each outcome where a main effect for risk was found in the prediction models described earlier (i.e., educational attainment, graduated high school, being employed, and teen parenthood). Table 4 (for the educational outcomes) and Table 5 (for employment) provide the path coefficients, bias-corrected standard errors, and 95% CIs for the model path. In the final row of each table are the coefficient for the indirect effect, along with its bias-corrected standard error and CI.

Education attainment. Table 4 shows that early educational treatment, the home environment, and the Treatment \times Home interaction significantly predicted education attainment. Additionally, there was a significant indirect effect of risk on educational attainment as mediated by the home environment. This indirect effect is conditional because the Treatment \times Home interaction term was significant. Consequently, we followed up this finding with post hoc analyses of simple indirect effects by estimating the mediation model separately for the control and treated samples. These post hoc tests of simple indirect effects indicated that the home environment mediated the relation between risk and education attainment for participants in the control group (effect = -0.36, $SE = 0.13$, $CI = -76, -0.11$) but not for the treated group (effect = -0.04, $SE = 0.05$, $CI = -21, 0.04$). That is, for the control group, increases in education attainment were associated with increases in HOME scores ($B = 0.83$, $SE = 0.23$, $p < .000$), but not with child risk levels ($B = 0.01$, $SE = 0.14$, $p = .96$). For the treated group, education attainment was significantly related neither to HOME scores ($B = 0.19$, $SE = 0.19$, $p = .31$) nor to child risk levels ($B = -0.14$, $SE = 0.17$, $p = .41$).

Figure 3 depicts the Treatment \times Home interaction effect on education attainment. For children with lower quality home environment scores (1 SD below the mean), those in the treatment group attained on average 2 more years of education than did children in the control group ($p < .001$). Treatment was not associated with a significant increase in education attainment for children with average-quality home environments ($p = .25$) or higher quality home environments (1 SD above the mean; $p = .24$).

High school graduation. As seen in Table 4, only the home environment accounted for high school graduation in this sample. The home environment, in turn, was predicted by children's risk index.

Table 4
Moderated Mediation: Educational Outcomes

	Educational attainment			High school graduation		
	Coefficient	SE	95% CI	Coefficient	SE	95% CI
Effect on outcome						
Education treatment	.68**	0.24	0.22, 1.16	.06	0.26	-0.43, 0.62
Risk	-.06	0.11	-0.27, 0.17	-.09	0.12	-0.32, 0.13
Home environment	.51**	0.15	0.22, 0.79	.30*	0.12	0.05, 0.51
Treatment × Home	-.57*	0.27	-1.02, -0.02	-.41	0.26	-0.95, 0.05
Effect on home environment						
Risk	-.33***	0.07	-0.48, -0.22	-.33***	0.06	-0.49, -0.23
Indirect effect						
Indirect effect	-.17**	0.06	-0.31, -0.06	-.10*	0.05	-0.21, -0.02

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 5
Moderated Mediation: Employment

	Coefficient	SE	95% CI
Effect on employment			
Education treatment	.30	0.24	-0.24, 0.72
Risk	-.23*	0.12	-0.45, -0.01
Home environment	.25*	0.12	-0.01, 0.46
Treatment × Home	.07	0.24	-0.42, 0.51
Effect on home environment			
Risk	-.33***	0.06	-0.49, -0.23
Indirect effect			
Indirect effect	-.08	0.04	-0.17, -0.00

* $p < .05$. *** $p < .001$.

Thus, the effect of risk on high school graduation was significantly mediated by the home environment. However, there was no evidence of moderated mediation.

Employment. As seen in Table 5, as children’s risk levels increased, their likelihood of being employed at the time of the young adult interview decreased, but no evidence that this risk was mediated through its effects on the early home environment was found. Conversely, higher home environment scores were directly associated with greater likelihood of employment in young adulthood.

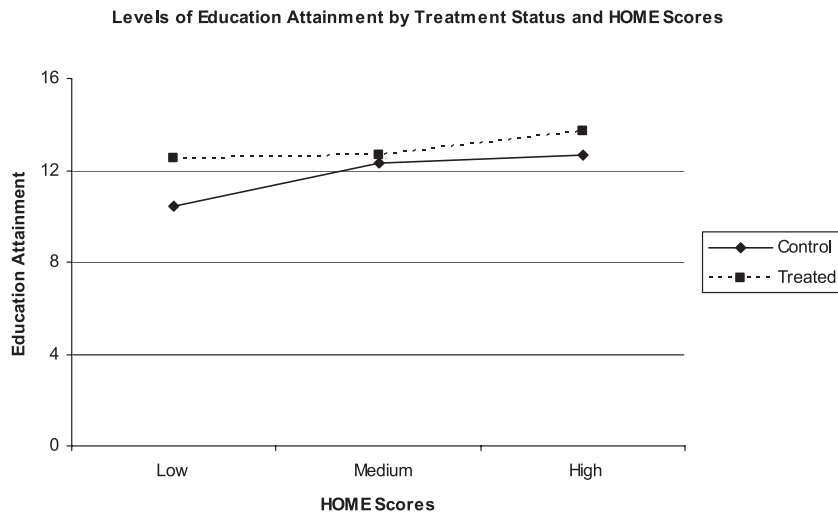


Figure 3. Years of education attainment by treatment status and Home Observation for Measurement of the Environment (HOME) scores.

Teen parenthood. Given the simultaneous estimation of effects, there was no evidence that the likelihood of having a child while a teen was related to risk level, the home environment, early education, nor an interactive effect of early education and the home environment.

Discussion

The first goal of the study was to examine the very long term effects of early cumulative risk over and above any effects of early intervention and to learn whether early intervention and early risk interacted when predicting the selected outcomes. As previously reported (Campbell et al., 2008), for the combined Abecedarian and CARE samples, early educational intervention was significantly associated with educational attainment in general, attending a 4-year college or university specifically, and obtaining skilled employment. The present analyses showed, in addition, that a prospective measure of cumulative risk summed across the first 5 years of life negatively predicted overall educational attainment, high school graduation specifically, and being employed as a young adult. Unexpectedly, early intervention was not found to moderate associations between early risk and young adult outcomes within this sample.

The second goal of this study was to examine a moderated mediation hypothesis: whether the quality of the early home mediated the found effects of early cumulative risk on later outcomes and whether early educational intervention moderated the effects of the early home environment on these outcomes. The results suggest that the home environment did mediate the effects of early risk for high school graduation but not for being employed or teen parenthood. Support for the moderated mediation hypothesis was found only for education attainment in general: The early home environment appeared to mediate the association between early risk and this outcome for the control group but not the treated group.

This study found associations between early risk and young adult accomplishments, a longer time span than is typical in the literature. The finding that early risk significantly predicted overall educational attainment and high school graduation specifically confirms as well as extends earlier work showing increased early cumulative risk to be associated with poor concurrent and shorter term academic outcomes (Brody et al., 2003; Forehand et al., 1998; Gutman et al., 2002; Gutman et al.,

2003; Prelow & Loukas, 2003). The finding that higher early risk was associated with an increased likelihood of teen parenthood adds to previous work showing how individual risk factors are associated with teen parenthood (Cairns & Cairns, 1994; Haveman, Wolfe, & Wilson, 1997; Ludtke, 1997; Miller-Johnson, Winn, Coie, Malone, & Lochman, 2004). The current finding is modified by the fact that, within this sample, teen parenthood was no longer significantly predicted by risk when models simultaneously examined early risk, the early home environment, and early treatment.

The present findings suggest that when early cumulative risk and intensive early education in a child-care setting are considered simultaneously, higher level accomplishments in young adulthood were affected by early educational intervention whereas more basic-level accomplishments were associated with early risk. High school graduation, being employed as a young adult, and teen parenthood were all predicted by early cumulative risk irrespective of early intervention, whereas going to college and having a skilled-level job in young adulthood were predicted by early treatment, irrespective of early risk. Perhaps early risk added little to the prediction of going to college because it was at the earlier stage of completing high school that risk did the most harm, precluding the possibility of going to college. This is consistent with the report by Teachman, Paasch, Day, and Carver (1997) that family poverty appears to exert its greatest impact on high school graduation rather than on college attendance. Thus, within a high-risk sample, those experiencing the higher levels of risk find it harder to achieve some of the basic accomplishments of young adulthood, such as graduating from high school or getting any job. Early intervention, however, may provide the boost needed for higher levels of success, such as attending college or obtaining skilled employment.

A key finding from the present analyses is that treatment moderated the mediation of risk through the quality of the home environment. This effect emerged when predicting to the linear measure of young adult education attainment. For children in the control group, early cumulative risk was associated with a poorer quality home environment, which in turn was associated with lower levels of education attainment in young adulthood. This was consistent with our hypotheses. In contrast, our analyses found no evidence of such mediation for the treated group. Having the 5 years of educational intervention in a high-quality child-care setting appeared to be protective; that is, it buffered

treated children against the long-term effects of a poor-quality early home environment on later educational attainment. This finding is consistent with other work suggesting that early intervention may moderate the effects of the early home environment (Bradley et al., 2001). Previous research involving the effects of child care on shorter term outcomes with high-risk samples has found evidence that child-care quality serves as a protective factor for some outcomes but not others. Burchinal et al. (2006) in their study of African American children in kindergarten through third grade found quality child care to be protective for math scores and behavior problems, but not for reading. Thus, different protective factors may be important for different outcomes (Gutman et al., 2003). The results here suggest that the effect for treatment was larger for those from poor-quality home environments than for those from higher quality early home environments. This implies that high-quality child care may be more effective for children whose parents are less responsive and provide less stimulating home environments than for other children.

Although evidence was found that early home environment mediated the effects of risk for educational outcomes, no evidence of such mediation was found for being employed or teen parenthood. The HOME, the measure used to assess the quality of the early home environment, has previously been shown to be associated with cognitive development and academic outcomes (Bradley, Caldwell, & Rock, 1988). Given this, its association with later educational outcomes in the present sample is consistent with the literature. One mechanism to explain the significant mediation findings is suggested by the work of Brody et al. (2003), who studied young African American adolescents growing up in single-mother homes in rural settings. These investigators found that cumulative risk was associated with parenting practices, which were in turn associated with youth self-regulation. Self-regulation was in turn associated with academic achievement. Heckman, Stixrud, and Urzua (2006) have suggested that noncognitive factors, as well as cognitive factors, strongly predict educational attainment. The environment provided by one's parents, combined with inherited ability and early intervention all play a role (Heckman et al., 2006). However, in the present study, the links between the early home environment and later educational attainments appear to be different from those that influence being employed and adolescent parenthood. The decision to become sexually active is complex (Michels, Kropp, Eyre, & Halpern-Felsher,

2005). Concurrent peer relationships and other adolescent circumstances undoubtedly play crucial roles in decisions made about parenthood when an adolescent is faced with such a life-altering experience. Young adult employment is subject to concurrent employment opportunities as well as personal characteristics influencing one's desire to seek work. Thus, the effects of early cumulative risk on employment and teen parenthood outcomes need further study; the links may be direct, as found here, or mediated through other early or concurrent factors not assessed in this study.

The hypothesis that increased early risk would be positively associated with illegal activity was not confirmed within this sample. In the present study, crime was represented by the young adults' self-reported convictions for misdemeanors and felonies and use of illegal drugs. A large body of research links risk and concurrent behavior problems. For example, using an index of cumulative risk, Furstenberg, Cook, Eccles, Elder, and Sameroff (1999) found that urban adolescents with 8 or more risk indicators (out of 10 possible) showed a 40% rate of behavior problems, compared to only 7% of those with 2 risk factors. However, these authors were examining current rates of problem behavior compared with current risk circumstances. Perhaps concurrent risk is more predictive of these outcomes than cumulative risk experienced much earlier in the life span.

No evidence was found that early educational intervention and early risk directly interacted to influence young adult outcomes. This finding was unexpected. It is noteworthy in this regard that the present sample consisted entirely of individuals who were drawn from high-risk backgrounds. Whether children exposed to more risk gain more from quality child care is a research question pertinent to policies regarding preferential entrance into public child-care programs, such as Head Start and prekindergarten, many of which use a high-risk index to determine who is recruited. Prior observational studies have found quality child care to be a stronger predictor of positive outcomes for children exposed to more social risk during early childhood (Burchinal et al., 2006; Burchinal, Peisner-Feinberg, Bryant, & Clifford, 2000; Caughy, DiPietro, & Strobino, 1994; Hubbs-Tait et al., 2002; Peisner-Feinberg & Burchinal, 1997; Peisner-Feinberg et al., 2001; Schliecker, White, & Jacobs, 1991; Vandell, 2004). This sample, however, consisted of individuals all considered high risk due to poverty and most considered at high risk due to minority ethnic status. This homogeneity within the present sample could

have precluded detection of the expected interaction between risk and treatment.

Some limitations should be considered in interpreting the findings of the study. First, the sample was limited to individuals born into low-income families almost all of whom were African American, and thus the findings generalize to that demographic group and may apply to other groups in unknown ways. As noted earlier, being minority ethnic status is a variable that in and of itself has been found to be a risk factor. In addition to being more likely to be of low income (Denavas-Walt, Proctor, & Lee, 2006) and to experience other stressors that European Americans (Evans, 2004), discrimination and racism experienced by ethnic minority families may also negatively influence development (Murry, Brown, Brody, Cutrona, & Simons, 2001; Prelow, Danoff-Burg, Swenson, & Pulgiano, 2004). That is, as Murry, Brown, et al. (2001) found, although a lack of income and other resources is a significant factor in families' stress and functioning, "simply being Black in America" (p. 917) also played a critical yet sometimes unacknowledged role affecting maternal psychological functioning, thus influencing the quality of relationships and interactions in the home environment.

A second caveat is that the sample size was small, which may have reduced the power to detect smaller relationships and interaction effects (McClellan & Judd, 1993). This may have been especially problematic when considering the data on illegal activity. The total sample size was relatively small, and the proportion of young adults who self-reported lawbreaking was smaller still. Admission of a misdemeanor occurred in only 17% of the sample, and only 10% admitted a felony. Power may also have been limited by the fact that most of the outcomes considered here were dichotomous rather than continuous variables.

Another limitation of this work, one generally shared by the literature in this area, is that some of the risk factors that may have contributed to outcomes were not assessed and thus were not included in the cumulative risk index. Within the literature on this topic, wide variety exists concerning this issue. For example, Brody et al. (2003) included 7 possible factors, Sameroff et al. (1993) had 10, and Evans (2003) listed 9. This diversity among risk factors makes it difficult to compare findings across studies. An alternate approach to studying the question of risk might be to combine risk variables empirically using factor analyses as was performed by Deater-Deckard et al. (1998).

Burchinal, Roberts, et al. (2000) compared three approaches to analyzing risk—testing individual risk factors, creating risk factor scores using factor analyses, and calculating a cumulative risk index—and found that similar, but not identical, conclusions could be drawn using each approach. Given sufficient sample sizes, considering domains of risk, rather than simply summing indicators, may be more appropriate for different outcomes. However, longitudinal studies often consist of small sample sizes, for which a cumulative risk index may be most appropriate (Burchinal, Roberts, et al., 2000).

Similarly, the models in the current analyses did not include protective factors (beyond early educational intervention) that may have been related to outcomes, nor did they include how the adolescents and young adults interpreted the early risk factors. Future research could include these variables to gain a better understanding of the effects of early risk as well as pathways to competence in the context of adversity (Masten et al., 1999).

Another caveat concerns generalizations that can be made about the effects of child care. Although the treatment took place in a full-time child-care setting, the educational intervention was not typical of the early child-care experience for most young children. Moreover, although the treatment and control groups differed by the fact that one received the systematic early treatment and the other did not, many children in the control group did experience out-of-home care before the age of 5. Different types were used by this group including relative care, family day care homes, and state-licensed center care, as determined by family circumstances. Thus, the group comparisons are between those who did and did not receive early educational intervention in a child-care setting, not between those who did and did not experience out-of-home child care.

Despite the limitations, several strengths of this study increase confidence in the findings. These strengths include the study's longitudinal nature, which provided prospective data on early risk, and the very long span of time covered by the data collection, from birth to young adulthood. This permitted early risk to be summed across early childhood, capturing the natural variation that occurred within individual lives as experienced at the time. As noted by Gerard and Buehler (2004), one of the strengths of cumulative risk models is "their potential to capture the natural covariation of risk factors" (p. 1833). In addition, both the Abecedarian and CARE studies had low rates of

attrition, increasing investigator confidence in long-term outcomes. Confidence in the conclusions pertaining to early educational intervention is increased by the fact that both Abecedarian and CARE were randomized studies. This degree of experimental control allows for the interpretation of early treatment's contribution to the outcomes with more confidence than would be possible in a naturalistic study where self-selection into treatment could have biased the findings.

These findings have implications for public policy-makers considering how to allocate limited resources. Given that the effects of early cumulative risk can be very long-lasting and impact important basic young adult outcomes, resources are needed to help protect high-risk children from the effects of such multiple stressors. Increased early risk may have a particularly negative effect on some of the basic-level accomplishments society requires for minimal self-sufficiency. Early intervention, however, moderated the effects of less optimal home environments on educational attainment and was promotive for the important outcomes of college attendance and obtaining skilled employment in this high-risk sample. These findings affirm the allocation of resources to provide early childhood programs for high-risk children.

References

- Aquilino, W. S. (1996). The life course of children born to unmarried mothers: Childhood living arrangements and young adult outcomes. *Journal of Marriage and the Family, 58*, 293–310.
- Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist, 55*, 469–479.
- Barocas, R., Seifer, R., Sameroff, A. J., Andrews, T. A., Croft, R. T., & Otrow, E. (1991). Social and interpersonal determinants of developmental risk. *Developmental Psychology, 27*, 479–488.
- Berrueta-Clement, J. R., Schweinhart, L. J., Barnett, W. S., Epstein, A. S., & Weikart, D. P. (1984). *Changed lives: The effects of the Perry Preschool Program on youths through age 19*. Ypsilanti, MI: High/Scope Press.
- Bradley, R. H. (1992). *A factor analytic study of the HOME inventory in Black, White and Hispanic Americans*. Paper presented at the International Conference on Children at Risk, Santa Fe, NM.
- Bradley, R. H., & Caldwell, B. M. (1979). Home Observation for Measurement of the Environment: A revision of the preschool scale. *American Journal of Mental Deficiency, 84*, 235–244.
- Bradley, R. H., Caldwell, B. M., & Rock, S. L. (1988). Home environment and school performance: A ten-year follow-up and examination of three models of environmental action. *Child Development, 59*, 852–867.
- Bradley, R. H., Caldwell, B. M., Rock, S. L., Hamrick, H. M., & Harris, P. (1988). Home Observation for Measurement of the Environment: Development of a home inventory for use with families having children 6 to 10 years old. *Contemporary Educational Psychology, 13*, 58–71.
- Bradley, R. H., Corwyn, R. F., Burchinal, M., McAdoo, H. P., & Garcia-Coll, C. (2001). The home environments of children in the United States: Part 2. Relations with behavioral development from birth through age 13. *Child Development, 72*, 1868–1886.
- Brody, G. H., & Flor, D. L. (1998). Maternal resources, parenting practices, and child competence in rural, single-parent African American families. *Child Development, 69*, 803–816.
- Brody, G. H., Kim, S., & Murry, V. M. (2003). Longitudinal links between contextual risks, parenting, and youth outcomes in rural African American families. *Journal of Black Psychology, 29*, 359–377.
- Bronfenbrenner, U., & Morris, P. A. (1998). The ecology of developmental processes. In W. Damon (Series Ed.) & R. M. Lerner (Vol. Ed.), *Handbook of child psychology: Vol. 1. Theoretical models of human development* (5th ed., pp. 993–1028). New York: Wiley.
- Bryant, D. M., Burchinal, M., Lau, L. B., & Sparling, J. J. (1994). Family and classroom correlates of Head Start children's developmental outcomes. *Early Childhood Research Quarterly, 9*, 289–309.
- Burchinal, M. R., Campbell, F. A., Bryant, D. M., Wasik, B. H., & Ramey, C. T. (1997). Early intervention and mediating processes in cognitive performance of children of low-income African American families. *Child Development, 68*, 935–954.
- Burchinal, M., Peisner-Feinberg, E., Bryant, D., & Clifford, R. (2000). Children's social and cognitive development and child-care quality: Testing for differential associations related to poverty, gender, or ethnicity. *Applied Developmental Science, 4*, 149–165.
- Burchinal, M. R., Roberts, J. E., Hooper, S., & Zeisel, S. A. (2000). Cumulative risk and early cognitive development: A comparison of statistical risk models. *Developmental Psychology, 36*, 793–807.
- Burchinal, M., Roberts, J. E., Zeisel, S. A., Hennon, E. A., & Hooper, S. (2006). Social risk and protective child, parenting, and child care factors in early elementary school years. *Parenting: Science and Practice, 6*, 79–113.
- Cairns, R. B., & Cairns, B. D. (1994). *Lifelines and risks: Pathways of youth in our time*. Cambridge, UK: Cambridge University Press.
- Caldwell, B. M., & Bradley, R. H. (1984). *Home observation for measurement of the environment*. Little Rock: University of Arkansas.
- Campbell, F. A., Pungello, E. P., Miller-Johnson, S., Burchinal, M., & Ramey, C. T. (2001). The development of cognitive and academic abilities: Growth curves from

- an early childhood educational experiment. *Developmental Psychology*, 37, 231–242.
- Campbell, F. A., Ramey, C. T., Pungello, E. P., Sparling, J., & Miller-Johnson, S. (2002). Early childhood education: Young adult outcomes from the Abecedarian Project. *Applied Developmental Science*, 6, 42–57.
- Campbell, F. A., Wasik, B. H., Pungello, E. P., Burchinal, M. R., Kainz, K., Barbarin, O., et al. (2008). Young adult outcomes from the Abecedarian and CARE early childhood educational interventions. *Early Childhood Research Quarterly*, 23, 452–466.
- Caughy, M. O., DiPietro, J. A., & Strobino, D. M. (1994). Day-care participation as a protective factor in the cognitive development of low-income children. *Child Development*, 65, 457–471.
- Chase-Lansdale, P. L., Gordon, R. A., Brooks-Gunn, J., & Klebanov, P. K. (1997). Neighborhood and family influences on the intellectual and behavioral competence of preschool and early school-age children. In J. Brooks-Gunn, G. J. Duncan, & J. L. Aber (Eds.), *Neighborhood poverty: Vol. 1. Context and consequences for children* (pp. 79–118). New York: Russell Sage Foundation.
- Conger, R. D., & Elder, G. H. (1994). Families in troubled times: The Iowa Youth and Families Project. In R. D. Conger & G. H. Elder Jr. (Eds.), *Troubled times: Adapting to change in rural America* (pp. 3–19). New York: Aldine.
- Deater-Deckard, K., Dodge, K. A., Bates, J. E., & Pettit, G. S. (1998). Multiple risk factors in the development of externalizing behavior problems: Group and individual differences. *Development and Psychopathology*, 10, 469–493.
- Denavas-Walt, C., Proctor, B. D., & Lee, C. H. (2006). *Income, poverty, and health insurance coverage in the United States* (U.S. Census Bureau, Current Population Reports, P60-231). Washington, DC: U.S. Government Printing Office.
- Dubow, E. F., & Luster, T. (1990). Adjustment of children born to teenage mothers: The contributions of risk and protective factors. *Journal of Marriage and the Family*, 52, 393–404.
- Ensiminger, M. E., & Slusarcick, A. L. (1992). Paths to high school graduation or dropout: A longitudinal study of a first-grade cohort. *Sociology of Education*, 65, 95–113.
- Evans, G. W. (2003). A multimethodological analysis of cumulative risk and allostatic load among rural children. *Developmental Psychology*, 39, 924–933.
- Evans, G. W. (2004). The environment of childhood poverty. *American Psychologist*, 59, 77–92.
- Forehand, R., Biggar, H., & Kochick, B. A. (1998). Cumulative risk across family stressors: Short- and long-term effects for adolescents. *Journal of Abnormal Child Psychology*, 26, 119–128.
- Furstenberg, F. F., Brooks-Gunn, J., & Chase-Lansdale, L. (1989). Teen-aged pregnancy and childbearing. *American Psychologist*, 44, 313–320.
- Furstenberg, F., Cook, T., Eccles, J., Elder, G., & Sameroff, A. (1999). *Managing to make it: Urban families in adolescent success*. Chicago: University of Chicago Press.
- Garnezy, N., Masten, A. S., & Tellegen, A. (1984). The study of stress and competence in children: A building block for developmental psychopathology. *Child Development*, 55, 97–111.
- Gerard, J. M., & Buehler, C. (2004). Cumulative environmental risk and youth maladjustment: The role of youth attributes. *Child Development*, 75, 1832–1849.
- Gest, S. D., Mahoney, J. L., & Cairns, R. B. (1999). A developmental approach to prevention research: Early adolescence configurations associated with teenage parenthood. *American Journal of Community Psychology*, 27, 543–565.
- Guo, G., & Harris, K. M. (2000). The mechanisms mediating the effects of poverty on children's intellectual development. *Demography*, 37, 431–447.
- Guo, G., & VanWey, L. K. (1999). Sibship size and intellectual development: Is the relationship causal? *American Sociological Review*, 64, 169–187.
- Gutman, L. M., Sameroff, A. J., & Cole, R. (2003). Academic trajectories from first to twelfth grades: Growth curves according to multiple risk and early child factors. *Developmental Psychology*, 39, 777–790.
- Gutman, L. M., Sameroff, A. J., & Eccles, J. S. (2002). The academic achievement of African American students during early adolescence: An examination of multiple risk, promotive, and protective factors. *American Journal of Community Psychology*, 30, 367–399.
- Haurin, R. J. (1992). Patterns of childhood residence and the relationship to young adult outcomes. *Journal of Marriage and the Family*, 54, 846–860.
- Haveman, R., Wolfe, B., & Wilson, K. (1997). Childhood poverty and adolescent schooling and fertility outcomes: Reduced-form and structural estimates. In G. Duncan & J. Brooks-Gunn (Eds.), *Consequences of growing up poor* (pp. 419–460). New York: Russell Sage Foundation.
- Heckman, J. (2006). Skill formation and the economics of investing in disadvantaged children. *Science*, 312, 1900–1902.
- Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics*, 24, 411–482.
- Hollingshead, A. B. (n.d.). *Four Factor Index of Social Status* (Working paper). New Haven, CT: Yale University, Department of Sociology.
- Hooper, S. R., Burchinal, M. R., Roberts, J. E., Zeisel, S., & Neebe, E. (1998). Social and family risk factors for infant development at one year: An application of the cumulative risk model. *Journal of Applied Developmental Psychology*, 19, 85–96.
- Hubbs-Tait, L., Culp, A. M., Huey, E., Culp, R. E., Starost, H. J., & Hare, C. (2002). Relation of Head Start attendance to children's cognitive and social outcomes:

- Moderation by family risk. *Early Childhood Research Quarterly*, 17, 539–558.
- Jaffee, S. (2002). Pathways to adversity in young adulthood among early childbearers. *Journal of Family Psychology*, 16, 38–49.
- Jimerson, S., Egeland, B., Sroufe, A., & Carlson, B. (2000). A prospective longitudinal study of high school dropouts: Examining multiple predictors across development. *Journal of School Psychology*, 38, 535–549.
- Jones, D. J., Forehand, R., Brody, G., & Armistead, L. (2002). Psychosocial adjustment of African American children in single-mother families: A test of three risk models. *Journal of Marriage and Family*, 64, 105–115.
- Kolbe, L. J. (1990). An epidemiological surveillance system to monitor the prevalence of youth behaviors that most affect health. *Health Education*, 21, 44–48.
- Krishnakumar, A., & Black, M. M. (2002). Longitudinal predictors of competence among African American children: The role of distal and proximal risk factors. *Journal of Applied Developmental Psychology*, 23, 237–266.
- Liaw, F., & Brooks-Gunn, J. (1994). Cumulative familial risks and low-birthweight children's cognitive and behavioral development. *Journal of Clinical and Child Psychology*, 23, 360–372.
- Linver, M., Brooks-Gunn, J., & Kohen, D. (2002). Family processes as pathways from income to young children's development. *Developmental Psychology*, 38, 719–734.
- Ludtke, L. (1997). *On our own: Unmarried motherhood in America*. New York: Random House.
- Luster, T., & McAdoo, H. P. (1994). Factors related to the achievement and adjustment of young African American children. *Child Development*, 65, 1080–1094.
- MacKinnon, D. P. (2008). *Introduction to statistical mediation analysis*. Mahwah, NJ: Erlbaum.
- Masten, A. S., Best, K. M., & Garmezy, N. (1990). Resilience and development: Contributions from the study of children who overcome adversity. *Development and Psychopathology*, 2, 425–444.
- Masten, A. S., Coatsworth, D. A., Neemann, J., Gest, S. D., Tellegen, A., & Garmezy, N. (1995). The structure and coherence of competence from childhood to adolescence. *Child Development*, 66, 1635–1659.
- Masten, A. S., Hubbard, J., Gest, S. D., Tellegen, A., Garmezy, N., & Ramirez, M. (1999). Adversity, resources and resilience: Pathways to competence from childhood to late adolescence. *Development and Psychopathology*, 11, 143–169.
- McClellan, G. H., & Judd, C. M. (1993). Statistical difficulties of detecting interactions and moderator effects. *Psychological Bulletin*, 114, 376–390.
- McGinness, G. D., & Ramey, C. T. (1981). Developing sociolinguistic competence in children. *Canadian Journal of Early Childhood Education*, 1, 22–43.
- McLanahan, S. (1997). Parent absence or poverty: Which matters worse? In G. J. Duncan & J. Brooks-Gunn (Eds.), *Consequences of growing up poor* (pp. 35–48). New York: Russell Sage Foundation.
- Michels, T. M., Kropp, R. Y., Eyre, S. L., & Halpern-Felsher, B. L. (2005). Initiating sexual experiences: How do young adolescents make decisions regarding early sexual activity? *Journal of Research on Adolescence*, 15, 583–607.
- Miller-Johnson, S., Winn, D.-M. C., Coie, J. D., Malone, P. S., & Lochman, J. (2004). Risk factors for adolescent pregnancy reports among African American males. *Journal of Research on Adolescence*, 14, 471–495.
- Murry, V. M., Brown, P. A., Brody, G. H., Cutrona, C. E., & Simons, R. L. (2001). Racial discrimination as a moderator of the links among stress, maternal psychological functioning and family relationships. *Journal of Marriage and the Family*, 63, 915–926.
- Murry, V. M., Bynum, M. S., Brody, G. H., Willert, A., & Stephens, D. (2001). African American single mothers and children in context: A review of studies on risk and resilience. *Clinical Child and Family Psychology Review*, 4, 133–155.
- Muthén, L. K., & Muthén, B. O. (1998–2007). *Mplus users guide* (5th ed.). Los Angeles: Author.
- National Institute of Child Health and Human Development Early Child Care Research Network. (2005). Duration and developmental timing of poverty and children's cognitive and social development from birth through third grade. *Child Development*, 74, 795–810.
- Peisner-Feinberg, E., & Burchinal, M. (1997). Relations between preschool children's child care experiences and concurrent development: The cost quality, and outcomes study. *Merrill-Palmer Quarterly*, 43, 451–477.
- Peisner-Feinberg, E., Burchinal, M., Clifford, R., Culkin, M., Howes, C., Kagan, S., et al. (2001). The relation of preschool child-care quality to children's cognitive and social developmental trajectories through second grade. *Child Development*, 72, 1534–1553.
- Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research*, 42, 185–227.
- Prelow, H. M., Danoff-Burg, S., Swenson, R. R., & Pulgiano, D. (2004). The impact of ecological risk and perceived discrimination on the psychological adjustment of African American and European American youth. *Journal of Community Psychology*, 32, 375–389.
- Prelow, H. M., & Loukas, A. (2003). The role of resource, protective, and risk factors on academic achievement-related outcomes of economically disadvantaged Latino youth. *Journal of Community Psychology*, 31, 513–529.
- Pungello, E. P., Kupersmidt, J. B., Burchinal, M. R., & Patterson, C. J. (1996). Environmental risk factors and children's achievement from middle childhood to early adolescence. *Developmental Psychology*, 32, 755–767.
- Ramey, C. T., & Campbell, F. A. (1984). Preventive education for high-risk children: Cognitive consequences of

- the Carolina Abecedarian Project. *American Journal of Mental Deficiency*, *88*, 515–523.
- Ramey, C. T., & Smith, B. (1977). Assessing the intellectual consequences of early intervention with high-risk infants. *American Journal of Mental Deficiency*, *81*, 318–324.
- Rutter, M. (1979). Protective factors in children's responses to stress and disadvantage. In M. W. Kent & J. E. Rolf (Eds.), *Primary prevention of psychopathology: Vol. 3. Social competence in children* (pp. 49–74). Hanover, NH: University Press of New England.
- Sameroff, A. J., & MacKenzie, M. J. (2003). Research strategies for capturing transactional models of development: The limits of the possible. *Development and Psychopathology*, *15*, 613–640.
- Sameroff, A. J., Seifer, R., Baldwin, A., & Baldwin, C. (1993). Stability of intelligence from preschool to adolescence: The influence of social and family risk factors. *Child Development*, *64*, 80–97.
- Sameroff, A. J., Seifer, R., Barocas, R., Zax, M., & Greenspan, S. (1987). Intelligence quotient scores of 4-year-old children: Social environmental risk factors. *Pediatrics*, *79*, 343–350.
- Schliecker, E., White, D., & Jacobs, E. (1991). The role of day care quality in the prediction of children's vocabulary. *Canadian Journal of Behavioral Science*, *23*, 12–24.
- Schoon, I. E., Bynner, J., Joshi, H., Parsons, S., Wiggins, R. D., & Sacker, A. (2002). The influence of context, timing, and duration of risk experiences for the passage from childhood to mid-adulthood. *Child Development*, *73*, 1486–1504.
- Schweinhart, L. J., Barnes, H. V., & Weikart, D. P. (1993). Significant benefits: The High/Scope Perry Preschool Study through age 27. *Monographs of the High/Scope Educational Research Foundation*, *10*. Ypsilanti, MI: High/Scope.
- Shaw, D. S., Winslow, E. B., Owens, E. B., & Hood, N. (1998). Young children's adjustment to chronic family adversity: A longitudinal study of low-income families. *Journal of the American Academy of Child and Adolescent Psychiatry*, *37*, 545–553.
- Sparling, J. J. (1989). Narrow- and broad-spectrum curricula, two necessary parts of the special child's program. *Infants and Young Children*, *1*, 1–8.
- Sparling, J. J., & Lewis, I. (1978). *Learning games for the first three years: A guide to parent-child play*. New York: Walker.
- Sparling, J. J., & Lewis, I. (1984). *Learning games for threes and fours: A guide to adult and child play*. New York: Walker.
- Sugawara, A. I. (1991). Selected child factors mediating the impact of maternal absence on children's behaviors and development. *Early Child Development and Care*, *72*, 1–22.
- Teachman, K. M., Paasch, R., Day, R. D., & Carver, K. P. (1997). Poverty during adolescence and subsequent educational attainment. In G. J. Duncan & J. Brooks-Gunn (Eds.), *Consequences of growing up poor* (pp. 382–418). New York: Russell Sage Foundation.
- Tein, J. Y., Sandler, I. N., MacKinnon, D. P., & Wolchik, S. A. (2004). How did it work? Who did it work for? Mediation in the context of a moderated prevention effect for children of divorce. *Journal of Consulting and Clinical Psychology*, *72*, 617–624.
- Trentacosta, C. J., Hyde, L. W., Shaw, D. S., Dishion, T. J., Gardner, F., & Wilson, M. (2008). The relations among cumulative risk, parenting, and behavior problems during early childhood. *Journal of Child Psychology and Psychiatry*, *49*, 1211–1219.
- Vandell, D. L. (2004). Early child care: The known and the unknown. *Merrill-Palmer Quarterly*, *50*, 387–414.
- Wasik, B. H., Ramey, C. T., Bryant, D., & Sparling, J. (1990). A longitudinal study of two early intervention strategies: Project CARE. *Child Development*, *61*, 1682–1696.
- Williams, S., Anderson, J., McGee, R., & Silva, P. A. (1990). Risk factors for behavioral and emotional disorder in preadolescent children. *Journal of the American Academy of Child and Adolescent Psychiatry*, *29*, 413–419.
- Xie, H., Cairns, B. D., & Cairns, R. B. (2001). Predicting teen motherhood and teen fatherhood: Individual characteristics and peer affiliations. *Social Development*, *10*, 488–511.
- Zill, N., Morrison, D. R., & Coiro, M. J. (1993). Long-term effects of parental divorce on parent-child relationships, adjustment, and achievement in young adults. *Journal of Family Psychology*, *7*, 91–103.

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.