Published in final edited form as:
Early Child Res Q. 2015 ; 32: 94–104. doi:10.1016/j.ecresq.2015.03.001.

Early Exposure to Environmental Chaos and Children's Physical and Mental Health

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Abstract

Environmental chaos has been proposed as a central influence impeding children's health and development, with the potential for particularly pernicious effects during the earliest years when children are most susceptible to environmental insults. This study evaluated a high-risk sample, following 495 low-income children living in poor urban neighborhoods from infancy to age 6. Longitudinal multilevel models tested the main tenets of the ecobiodevelopmental theory, finding that: (1) numerous distinct domains of environmental chaos were associated with children's physical and mental health outcomes, including housing disorder, neighborhood disorder, and relationship instability, with no significant results for residential instability; (2) different patterns emerged in relation to the timing of exposure to chaos, with more proximal exposure most strongly associated with children's functioning; and (3) the intensity of chaos also was a robust predictor of child functioning. Contrary to expectations, neither biological vulnerability (proxied through low birth weight status), maternal sensitivity, nor maternal distress moderated the role of chaos. Rather, maternal psychological distress functioned as a pathway through which environmental chaos was associated with children's functioning.

Keywords

Environmental Chaos; Instability; Disorder; Mental Health; Physical Health; Low-Income Families; Poverty

In recent years, American families have experienced growing economic instability, heightened volatility in the housing market, and greater flux and variability in family structure. For children and families, these forces translate into more chaos and uncertainty in their day-today lives with increasing disorder and instability in families, homes, and communities (Annie E. Casey Foundation, 2011). These stressors, which are often conceptualized in the literature as environmental chaos (Bronfenbrenner & Evans, 2000), confer strain on children and parents and undermine healthy functioning (Deater-Deckard et al., 2009; Evans, Boxhill, & Pinkava, 2008). Numerous studies have identified links between environmental chaos and children's physical, socio-emotional, and cognitive well-being (Coldwell, Pike, & Dunn, 2006; Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005; Vernon-Feagans, Garrett-Peters, Willoughby, Mills-Koonce, & The Family Life Project Key Investigators, 2012). Research has shown that experiences of environmental chaos are especially common among low-income families, with economic, housing, and relational insecurities both contributing to and being affected by poverty (Deater-Deckard et al., 2009; Evans et al., 2005; Newman, 2008). Nonetheless, notable variation exists among low-income families, and it is essential to increase understanding of individual differences in order to delineate factors supporting children's resilient and successful functioning in the face of economic and social risk (Mendez, Fantuzzo, & Cicchetti, 2002; Vernon-Feagans et al., 2012; Vernon-Feagans, Cox, & The Family Life Project Key Investigators, 2013).

Although there is a substantial body of literature linking chaotic experiences to negative outcomes for children, our current understanding of the role of chaos in children's lives is constrained by a lack of conceptual and operational clarity regarding the definition of chaos. There also remain questions regarding when, for whom, and under what conditions environmental chaos is most detrimental to children's healthy development. In this research, we draw on Shonkoff's (2010; Shonkoff & Garner, 2012) ecobiodevelopmental theory on the implications of pernicious early experiences to build a rich, theoretically-anchored conceptualization of environmental chaos. The ecobiodevelopmental theory has five key components. Below we briefly discuss each of the five components, review relevant empirical support, and identify enduring questions.

Conceptualizing and Operationalizing Environmental Chaos

First, the ecobiodevelopmental model (Shonkoff, 2010; Shonkoff & Garner, 2012) proposes that different domains of environmental chaos, including environmental disorder (a lack of safety and supportiveness in the physical and built environments surrounding children) and environmental instability (a lack of consistency and stability in primary caregivers and contexts) negatively affect children's healthy development. Extant empirical literature has employed a broad range of operationalizations of environmental chaos, ranging from broad composite measures of household chaos to narrow conceptualizations focusing on a specific arena. For example, a number of studies have used composite measures such the Confusion, Hubbub, and Order Scale (Matheny, Wachs, Ludwig, & Phillips, 1995) which captures in-home family processes, generally characterized as disorder, like "being able to hear yourself think" and "usually able to stay on top of things." Studies employing this scale have linked higher levels of household chaos with children's heightened behavior problems (Coldwell et al., 2006; Supplee, Unikel, & Shaw, 2007), lower IQ (Deater-Deckard et al., 2009), and lower early literacy skills (Johnson, Martin, Brooks-Gunn, & Petrill, 2008). Other composite measures of chaos that broadly capture household disorder through a lack of organization and presence of ambient noise have been linked with aggressive behaviors, attention problems (Martin, Razza, & Brooks-Gunn, 2012) and inhibited language development (Martin et al., 2012; Vernon-Fagan et al., 2012) among young children, as well as heightened psychological distress in youth (Evans et al., 2005).

Other studies have focused on more distinct aspects of environmental disorder, such as unsafe housing conditions, maintenance deficiencies, pollution, and neighborhood crime (Evans & Kim, 2012; 2013; Roche & Leventhal, 2009; Schofield et al., 2012; Vernon-Feagan et al., 2012), arguing for the importance of safety and order at both household and neighborhood levels. A recent study of low-income urban families using the same dataset as the current study but focused on older children, for example, identified housing disorder as the most potent housing feature associated with children's emotional and behavioral problems (Coley, Leventhal, Lynch, & Kull, 2013). Neighborhood disorder has also been associated with less advanced behavioral and cognitive skills among young children in studies using a variety of maternal, observational, and census measures of neighborhood disorder (Caughy & O'Campo, 2006; Farver, Natera, & Frosch, 1999; Jackson, 2003; Kohen, Leventhal, Dahinten, & McIntosh, 2008; Supplee et al., 2007; Vaden-Kiernan et al., 2010). Little past research has assessed both housing and neighborhood disorder concurrently to identify their unique contributions to children's development. Since poor quality housing is often located in neighborhoods with greater poverty, crime, and social disorder (Coley, Kull, Leventhal, & Lynch, 2014), studies that attend to only one of these disordered contexts may suffer from unmeasured heterogeneity bias, overestimating the effects of a particular domain of disorder in children's lives.

Turning to instability as a domain of environmental chaos, similarly, limited research has considered comprehensive conceptualizations of instability. The most-studied types of instability for young children include caregiver instability (operationalized as parental relationship transitions) and residential instability. Research has found associations between maternal relationship instability (movements in or out of marriage or cohabitation) and young children's behavior problems in both low-income and economically diverse samples of families (Ackerman, Brown, D'Ermo, & Izard, 2002; Ackerman, Kogos, Youngstrom, Schoff, & Izard, 1999; Cavanagh & Huston, 2006; Fomby & Cherlin, 2007; Magnuson & Berger 2009; Osborne & McLanahan 2007), with some evidence of links to emotional problems as well, as found in research with older children from the same sample as the current study (Bachman, Coley, & Carrano, 2011). Work on residential instability has delineated associations with worse physical health outcomes (Busaker & Kasehagen, 2012; Cutts et al., 2011; Kamp Dush, Schmeer, & Taylor, 2013) as well as heightened emotional and behavioral problems among young children, as found in research with older children from the current study as well as other datasets (Coley et al., 2013; Ziol-Guest & McKenna, 2013). As with environmental disorder, evidence suggests that aspects of environmental instability are correlated within families (Kull, Coley, & Lynch, 2013). Thus it is important for research to concurrently consider the role of multiple aspects of instability in children's lives.

Together, recent research has shown empirical support for the importance of household and neighborhood disorder as well as residential and caregiver instability, but little work has assessed these constructs simultaneously. As an important exception, in a study of low-income rural children from birth to age three, Vernon-Feagans and colleagues (2012) factor analyzed a broad range of environmental chaos measures, delineating one domain describing physical disorder and disorganization within the household and neighborhood (e.g., the presence of ambient household and neighborhood noise, crowded and unclean housing) and a second domain capturing instability in residence and family composition (residential moves, primary and secondary caregiver changes). This work found that environmental disorder but not instability was predictive of young children's language skills; other important arenas of child functioning such as physical and mental health were not addressed.

Developmental Timing of Environmental Chaos

The second tenet of the ecobiodevelopmental model contends that the developmental timing of chaotic experiences matters. Infancy represents an exceptionally sensitive period of development characterized by vulnerability to environmental insults (Shonkoff, 2010; Shonkoff & Garner, 2012). Experiences of environmental chaos early in life have the capacity to disrupt the processes involved in young children's stress reactivity, neural circuitry, physiological regulation, as well as metabolic, cardiovascular, and immunological systems, in turn impacting short and long-term health and development (Blair, 2002; Blair, Raver, Granger, Mills-Koonce, Hibel, & The Family Life Project Key Investigators, 2011; Meaney, 2010; Shonkoff & Garner, 2012). Recent research has focused on links between chaos and psychological functioning in adolescents (Evans, Saltzman, & Cooperman, 2001; Evans et al., 2005), but there is little work that attends to nuanced associations between the developmental timing of experiences of chaos and young children's functioning. Research on a variety of environmental chaos domains has failed to identify stronger effects of instability during early childhood than during later childhood, although few studies have included infants (Bachman et al., 2011; Coley et al., 2013; Fomby & Cherlin, 2007; Supplee et al., 2007). Thus, empirical support for the importance of developmental timing in the role of environmental chaos is limited.

The Intensity of Chaos

In addition to the domains and timing of chaos, ecobiodevelopmental theory argues that the intensity of environmental chaos is important- that adverse environmental experiences which are deep, prolonged, and extensive are more detrimental to children's health and well-being than unfavorable experiences that are targeted and short-term (Shonkoff, 2010; Shonkoff & Garner, 2012). Yet most extant research measures environmental chaos at one point in time as a simple linear construct, lacking measurement or analytic techniques to delineate nonlinear or cumulative effects of chaos on children's health and development across time.

Moderating Roles of Biological Vulnerability and Parenting

The fourth and fifth tenets of bioecodevelopmental theory focus on individual differences to delineate for whom environmental chaos will be most influential. Drawing on a long history of developmental theory (Bronfenbrenner & Morris, 1998), the model argues that chaos is likely to interact with children's biological vulnerabilities. Children with a biological vulnerability may be influenced most strongly by unstable and disordered environments, lacking the regulatory skills to self-sooth or garner caregiver resources (Ackerman et al., 1999). For example, low birth weight is a long-established biological indicator of heightened risk for poor health outcomes (Barker, 1992; 1995) and susceptibility to environmental influences (Escalona, 1982; Kalmar & Boronkai, 1991; Shonkoff, Boyce, & McEwan, 2009). Thus, low birthweight status may amplify the negative effects of environmental disorder and instability on children's physical and mental health, although research has not directly tested this supposition.

The model further argues for the central role of consistent and sensitive caregiving as a buffering force with the potential to modulate the negative effects of environmental chaos (Shonkoff, 2010; Shonkoff & Garner, 2012). A breadth of research supports the central role of parenting for young children's development, delineating how sensitive and responsive parenting practices can support children's healthy development in physical, emotional, and behavioral realms (Holden, Vittrup, & Rosen, 2011). Such parenting practices also serve as protective factors in the face of contextual and economic risks, supporting resilience and positive development (Masten & Gewirtz, 2006). However, there is relatively little empirical support to suggest that parenting serves a protective role by buffering children from the negative effects of environmental chaos. For example, Coldwell and colleagues (2006) found some evidence that children experiencing a combination of high household chaos and negative parenting showed the highest levels of behavior problems. Others have found that parenting moderates links between neighborhood disorder and children's behavioral functioning (Paat, 2010; Schofield et al., 2011; Supplee et al., 2007). On the whole, empirical support for parental functioning as a moderator of environmental chaos is limited at this time.

In this paper, we argue that this final aspect of the ecobiodevelopmental theory might be reframed. The ecobiodevelopmental model views parenting as a buffer against environmental chaos, suggesting that parental functioning is a stable trait that is nonresponsive to environmental chaos. Yet other work argues that chaos may negatively affect parents as well as children, and further that parental functioning and behaviors may serve as a conduit through which environmental forces affect children (Bradley, 2002; Bronfenbrenner & Evans, 2000; Masten & Gewirtz, 2006). Parents, like children, may be negatively affected by disorder and instability in their proximal environments, responding with increased stress and a decreased ability to provide sensitive parenting to children (Corpaci & Wachs, 2002; Deater-Deckard et al., 2009; Matheny et al., 1995), which in turn may negatively influence children's health and well-being. Indeed, research has found that mothers' psychological distress and negative parenting were significant mediators of associations between domains of environmental disorder and instability and children's well-being (Bachman, Coley, & Carrano, 2012; Coley et al., 2013; Osborne & McLanahan, 2007; Valiente, Lemery-Chalfant, & Reiser, 2007; Vernon-Feagans et al., 2012). Others have found similar patterns in relation to household chaos and children's cognitive and language outcomes, with parental sensitivity and stimulation serving as mediators Evans, Maxwell, & Hart, 1999; Martin et al., 2012; Vernon-Feagans et al., 2012). In short, theoretical frameworks provide contrasting hypotheses regarding the role of parental sensitivity and distress. Similarly, extant research has used a broad range of measures and methods, with few studies directly contrasting the theoretical suppositions that parental functioning serves a moderating versus mediating role vis-à-vis environmental chaos.

Present Study

In summary, theory and research argue that early childhood environmental chaos can permeate multiple ecologies of children's lives with negative implications across a range of developmental outcomes. Although the evidence base is growing regarding the role of chaos in children's lives, numerous gaps remain in empirical support for the ecobiodevelopmental model. The present study seeks to address these gaps by addressing the following research questions. First, examining environmental chaos and child functioning across a six-year period from infancy to age 6, we assessed whether distinct domains of environmental chaos have unique associations with children's development. Second, we asked whether the timing of chaos shows unique associations with children's development, and third, questioned whether the intensity of chaos is influential. Our fourth research question addressed whether low birthweight moderates the role of environmental chaos. Finally, we asked whether parental functioning acts as a moderator or mediator of chaos. In contrast to much past research which has highlighted differential rates of chaotic conditions among children from low-income families compared to their economically advantaged peers (Evans, 2004; Evans et al., 2005; Evans & Kantrowitz, 2002), this study takes a within-group approach to more carefully attend to the notable variation in environmental contexts and child functioning within low-income families (Vernon-Feagans et al., 2012).

Following the ecobiodevelopmental model (Shonkoff, 2010; Shonkoff & Garner, 2012) and prior research, we hypothesize that (1) distinct domains of chaotic experiences (housing and neighborhood disorder and relationship and residential instability) will have unique associations with children's development, focusing specifically on children's physical and mental health; (2) environmental chaos during infancy will be more strongly associated with children's physical and mental health than later environmental chaos; (3) the intensity of environmental chaos will be important for children's outcomes; (4) biological vulnerabilities will interact with environmental chaos to predict developmental outcomes; and (5) parental sensitivity and distress will mediate rather than moderate associations between environmental chaos and children's outcomes.

Method

Participants

Data for this study were drawn from the Three-City Study, a longitudinal, multi-method study of low-income children and families living in moderate- to high-poverty neighborhoods in Boston, Chicago, and San Antonio (for a detailed description of the research design of the Three-City Study, see Winston et al., 1999). A stratified random sampling procedure selected families with incomes below 200% of the poverty line, a child between the ages of 0 to 4 or 10 to 14 years, and a primary female caregiver. The screening response rate was 90%, with an interview rate of approximately 83%, leading to a 74% response rate for the first wave of data collection in 1999 and a sample size of approximately 2,400 families. Families were re-interviewed 1½ years later in 2001 (88% retention rate of wave 1) and 4½ years after that, in 2005–2006 (80% retention rate of wave 1). At each wave, primary caregivers (over 90% of whom were biological mothers of the focal child) participated in 2-hour face-to-face surveys in English or Spanish, children were directly assessed, and older children participated in interviews.

The analytic sample for this study included families with focal children who were less than 2 years old at the first wave of data collection (N = 495) in order to focus on infant environmental contexts. Focal children averaged 12 months of age in wave 1, 2½ years in wave 2, and 6 years in wave 3. Table 1 presents weighted descriptive data on the sample. Forty-eight percent of children were male, and 6% had been classified as low birth weight. Just over half of mothers were Hispanic, 41% African American, and 6% were White/other. Thirty-eight percent of mothers had completed some education beyond high school. In regard to financial well-being, 38% of mothers were employed, 40% were receiving TANF assistance, and most families were poor, with an average income to needs ratio of 0.85.

Measures

Child outcomes—Children's developmental delays and general health were assessed at wave 2. At wave 3, the study assessed general health and added additional developmentally appropriate measures of emotional and behavioral functioning.

Developmental delays were measured at the second wave of data collection using mother-report and interviewer assessments from the Ages and Stages Questionnaire (ASQ; Squires, Potter, & Bricker, 1999), a well-validated screener for potential developmental problems among young children (Gollenberg, Lynch, Jackson, McGuinness, & Small, 2010). The ASQ assessed children's functioning in the domains of communication, problem-solving, fine-motor skills, gross-motor skills, and personality-social development. Indicator variables delineated the likelihood of delayed development in each of the five domains, which were summed to create a count of the domains of delay for each child. Children's *poor health* was reported by mothers at waves 2 and 3 with a single item assessing the child's general health status ("*In general, would you say [child's] health is…* 1 = *excellent* to 5 = *poor*). This single-item measure has been used extensively in national and local studies of children and adults, and has been shown to have strong reliability and discriminant validity (Bowling, 2005).

Externalizing, internalizing, and total problems were measured at wave 3 using the well-validated mother-reported Child Behavior Checklist (CBCL; Achenbach, 1991; 1992; Achenbach & Rescorla, 2001). Broadband standardized scores were computed for each child to assess externalizing behavior problems, capturing aggressive and rule-breaking behaviors (α= .90), internalizing problems, capturing anxiety, depression, withdrawal, and somatization (α = .87), and total problems, which include the previous domains as well as social, thought, attention, and other aspects of problem behaviors (α = .95).

Environmental chaos—Chaos was assessed across four domains, with parallel measures used at all three waves of the survey. Two measures assessed aspects of environmental disorder. *Housing disorder* was assessed using a count of mother-reported and interviewer-observed structural and safety concerns. Eight mother-report eight items captured issues like broken windows, exposed wires, peeling paint, and rodents. Four interviewer-observed items (drawn from the Home Observation for Measure of the Environment-Short Form

(HOME; Bradley & Caldwell, 1979) delineated the presence of unsafe, unsanitary, or dark conditions in the home. Items were dichotomized and summed to a total count (Coley et al., 2013). *Neighborhood disorder* was assessed using seven mother-report items drawn from Elliott and colleagues (1996) that capture the severity of neighborhood crime and social disorder like abandoned houses and burglaries, assaults, and drug dealing (1 = *not a problem*; 2 = *somewhat of a problem*; 3 = *a big problem*). Items were averaged to create a continuous measure of mothers' perceptions of neighborhood disorder at each wave (α_{1-3} = .86 – .89).

Family instability was captured using reports of residential instability and maternal relationship instability. *Residential instability* was reported by mothers and coded as a count indicating how many times the family had moved between study waves (starting from the child's birth for wave 1). *Relationship instability* was reported by mothers in a relationship history module of the survey that was administered at wave 3. Using a calendar, mothers recounted the start and end dates of all co-residential relationships including marriages and non-marital cohabitations that lasted at least one month. From these data, counts of the number of mothers' relationship transitions between survey waves were computed (from the child's birth for wave 1). These counts included both entrances into and exits from cohabitations and marriages. Prior research has demonstrated the predictive validity of these measures (Bachman et al., 2011; Bachman et al., 2012).

The twelve individual chaos measures were standardized and combined into broader composites for analyses. To assess *domains of environmental chaos*, measures of each construct were averaged over the waves to create composites of housing disorder, neighborhood disorder, residential instability, and relationship instability. The *timing of chaos* was assessed by averaging the four measures within each wave to create composites of wave 1 chaos wave 2 chaos, and wave 3 chaos. *Chaos intensity* was assessed by creating an indicator for each of the twelve variables designating whether the child's experience of chaos was one standard deviation or more above the sample mean (indicating the depth of chaos), and summing the indicators across constructs (breadth) and time (chronicity) into a total chaos intensity score. Across all of the measures of environmental chaos, measures from waves 1 and 2 were used to predict children's outcomes at wave 2, and measures from waves 1, 2, and 3 were included to predict children's outcomes at wave 3.

Parental functioning—Two measures of parental functioning were incorporated. Mothers' sensitive parenting was assessed with three observer report items from the HOME scale (Bradley & Caldwell, 1979) which measured displays of affection such as hugging, kissing, and saying something warm and loving. Participants were given a score of "1" if they demonstrated the behavior and a score of "0" if they did not, and items were summed. Mothers' psychological distress was evaluated using the 18-item Brief Symptom Inventory (BSI; Derogatis, 2000), which assessed symptoms of somatization, depression, and anxiety. Items were averaged such that higher scores indicated greater maternal psychological distress (α_{1-3} = .90 – .93). Each parental functioning measure was standardized and used as separate measures at each wave to parallel the chaos timing measures, or averaged over waves 1 and 2 or over waves 1, 2, and 3 as appropriate to parallel the chaos domains and intensity measures.

Biological vulnerability—Children's biological vulnerability was proxied with a measure of low birth weight. Children were designated as low birth weight if they were born at less than 2500 grams.

Covariates—A number of child, mother, family, and community characteristics that have been linked with the primary variables of interest and with children's development were included in analyses to decrease concerns over omitted variable bias. All covariates were drawn from wave 1. Child age was coded in months and child gender was coded 1 = *male* and 0 = *female*. Race/ethnicity was designated as White/other, African American (omitted), or Hispanic. Mothers' educational attainment was coded categorically as less than high school, a high school degree or GED (omitted), or college/technical training. Indicators assessed mother's employment status and receipt of TANF. Family income was assessed through an income-to-needs ratio, comparing the total household income from all sources to the federal poverty standards adjusting for family size. Each family's city of residence was designated to adjust for macroeconomic and policy differences across locations.

Analytic Approach

Analyses employed multilevel regression models to test associations between environmental chaos and children's physical and psychological health. Multilevel models (with children nested within cities) were used to address the clustering of children within the three cities with random effects for city. Four sets of main effects models were run. To focus on the domains of environmental chaos, the first set of models predicted children's developmental delays and poor health at wave 2 (age 2½ years) with the waves 1–2 averages of housing disorder, neighborhood disorder, residential instability, and relationship instability. Additional models predicted children's physical health and internalizing, externalizing, and total problems at wave 3 (age 6 years) with waves 1–3 averages of each of the four chaos constructs. The second set of analyses assessed the timing of chaos using the waves 1, 2, and 3 chaos composites. Finally, the intensity of environmental chaos was assessed using the total chaos intensity measures, again using chaos variables from waves 1 and 2 to predict children's wave 2 functioning and from waves 1 through 3 to predict children's wave 3 functioning.

Following the main-effects models, each set of models was rerun including interactions between the low birth weight indicator and each environmental chaos variable, and then interactions between the maternal sensitivity and distress measures and each chaos variable to assess whether biological vulnerability or parenting moderated the effects of chaos. The final models assessed mediation by first running models using each set of the environmental chaos variables to predict each of the parental functioning variables, and second including both chaos and parental functioning variables in models predicting child outcomes, followed by Sobel tests to assess indirect effects. All models included the full set of covariates noted above to help isolate unique associations between our primary measures of environmental chaos and children's functioning and incorporated probability weights that adjust for the sampling frame and differential response, thereby making the sample representative of low-income mothers and young children living in high poverty neighborhoods in Boston, Chicago, and San Antonio.

Prior to conducting analyses, we explored the presence of missing data due to attrition and item nonresponse, which was moderate and indicated that data were missing at random, supporting the appropriateness of imputing missing data to decrease concerns over sample bias. Multiple imputation using a bootstrap-based Expectation Maximization Bayesian (EMB) algorithm (Honaker & King, 2010) was conducted in R to create 30 complete data sets.

Results

Domains of Environmental Chaos

Results from the first set of multilevel regression models, which explored the relationship between the domains of chaos and child outcomes, are presented in the top panel of Table 2. Few significant associations emerged between domains of environmental chaos and children's functioning in early childhood, assessed at wave 2. The only significant result indicated that higher levels of housing disorder predicted greater developmental delays among children. The size of the effect was small, with a 1 standard deviation (*SD*) difference in housing disorder predicting a .25 *SD* difference in the number of developmental delays. More consistent results were found in relation to children's functioning assessed at wave 3. Children experiencing greater housing disorder had poorer general health at age 6, with an effect size of .18 *SD* units. In addition, neighborhood disorder was associated with heightened externalizing and total behavior problems, with effect sizes of.21 *SD*s and .30 *SD*s respectively. Children experiencing greater relationship instability from birth through age 6 also showed worse mental health, with effect sizes of .14 *SD*s for internalizing problems and .13 *SD*s for total problems. No significant associations emerged between residential instability and children's physical or mental health.

Developmental Timing of Chaos

The top panel of Table 3 presents results for models delineating chaos by developmental timing. No significant links emerged between environmental chaos at wave 1 or 2 and children's functioning at wave 2. In relation to children's functioning at wave 3, results suggest recency effects. Although no significant results emerged for wave 1 or wave 2 chaos, chaos at wave 3 predicted .20 *SD* higher externalizing problems, .19 *SD* greater internalizing problems, and .40 *SD* greater total problems.

Intensity of Environmental Chaos

Our final set of main effects models used a sum of high levels of environmental chaos across domains and timing to assess the importance of deep, broad, and sustained environmental stress on children. The models, presented in the top panel of Table 4, showed that the intensity of environmental chaos from waves 1 to 2 was associated with children's developmental delays at wave 2, with a 1 *SD* difference in chaos intensity predicting a .15 *SD* difference in the number of delays. Chaos intensity from waves 1 through 3 was associated with a .18 *SD* increment in poor health as well as heightened externalizing (.17 *SD*s) and total (.21 *SD*s) problems among children at wave 3.

Early Biological Vulnerability as a Moderator of Environmental Chaos

To test the tenet of the ecobiodevelopmental theory arguing that children's biological vulnerability should exacerbate negative effects of environmental chaos, we reran each of the models described above including interactions between the environmental chaos variables and children's low birth weight status. Results (available in online supplemental materials Appendix Table 1) indicated null effects. Of the 46 interactions tested only one reached statistical significance, below the frequency of significant results expected by chance.

Parental Functioning as Moderator or Mediator of Environmental Chaos

The final sets of models assessed the role of parental functioning as a moderator or mediator of environmental chaos. First, we included interactions between chaos and maternal sensitivity and between chaos and maternal distress to the models to test for moderation. Results (available in online supplemental materials Appendix Table 2) showed null results, with the number of significant interaction results below the level expected by chance.

Some evidence emerged supporting the role of parental functioning as a mediator, however. Results from the first step of the mediation models are presented in Table 5, showing significant associations between environmental chaos and mothers' distress, but no significant associations with maternal sensitivity. Models including both chaos and parental functioning measures predicting child outcomes are presented in the second panel of Tables 2 through 4. Considering the domains of environmental chaos models, presented in Table 2, results indicate that neither of the parental functioning variables was significantly associated with children's developmental delays or physical health. Both maternal distress and sensitivity, on the other hand, were significantly predictive of children's externalizing, internalizing, and total problems. Sobel tests indicated significant indirect effects from housing disorder through psychological distress to children's externalizing problems (z = 2.34, p =.02), internalizing problems (z = 2.04, p = .04), and total problems (z = 2.14, p =. 03). Similarly, indirect effects of neighborhood disorder also functioned through maternal distress to children's externalizing (z = 2.34, p =.02), internalizing (z = 2.04, p .04), and total problems (z = 2.14, p =.03). Maternal distress also mediated the link between relationship instability and children's externalizing (z = 1.99, p =.05). Maternal sensitivity, in contrast, was not a significant mediator of any of the domains of chaos and children's functioning.

Turning to the timing of chaos models (Table 3), results found that maternal distress at wave 3 as well as maternal sensitivity at wave 1 were both associated with children's mental health outcomes, although once again only maternal distress served as a mediator of chaos. Specifically, wave 3 environmental chaos displayed an indirect effect via maternal psychological distress in predicting externalizing (z = 2.52, p =.01), internalizing (z = 3.43, p =.00), and total problems (z = 2.98, p =.00). Similar results emerged in relation to chaos intensity (Table 4): here again maternal sensitivity and distress predicted all three measures of children's mental health, but only maternal distress served as a mediator between environmental chaos and children's functioning. Specifically, Sobel tests found that the relationship between chaos intensity and wave 3 externalizing (z = 3.62, p =.00), internalizing (z = 3.11, p =.00), and total problems (z = 3.44, p < .001) acted indirectly via maternal psychological distress.

Discussion

Recent years have brought increased insecurity in many realms of family life, including economic resources, housing and community contexts, and family relationships (Annie E. Casey Foundation, 2011). Concurrently, theoretical and empirical research has made inroads in delineating how broader contextual forces translate into environmental chaos at a proximal level, which can affect children's healthy growth and development across many domains (Bronfenbrenner & Evans, 2000; Shonkoff, 2010; Shonkoff & Garner, 2012). These two shifts heighten the need to further our understanding of the role of environmental chaos in economically disadvantaged families and communities, and to more carefully delineate associations with children's development. Employing a within-group approach focused exclusively on low-income children in high poverty urban neighborhoods to test the tenets of Shonkoff's ecobiodevelopmental model (2010; Shonkoff & Garner, 2012), this study added to the extant literature on environmental chaos in four key realms.

An Expanded Definition of Chaos across Multiple Domains

Following the ecobiodevelopmental model as well as prior empirical evidence from Vernon-Feagans and colleagues (2012), this study conceptualized environmental chaos as transpiring within the two broad arenas of environmental disorder and environmental instability. Expanding most prior research that has used narrower conceptualizations of chaos, we captured distinct domains of each arena, assessing disorder through both structural/maintenance deficiencies in home contexts and crime, danger, and social dislocation in neighborhood contexts, and assessing instability through shifts in both where and with whom children live. Analyses prospectively linking these domains of environmental chaos to children's physical and psychological health found evidence for the importance of all but one of the four aspects of chaos. Young children's experiences of residential instability were not associated with their later physical or mental health functioning. In contrast, heightened levels of housing disorder predicted modest disparities in physical health and developmental delays, while both neighborhood disorder and relationship instability were associated with amplified mental health problems among children at age 6. These findings replicate and extend other recent research which has found stronger effects of environmental disorder than of environmental instability in predicting children's well-being across various domains (Coley et al., 2013; Vernon-Feagans et al., 2012).

One explanation for the greater predictive strength of disorder than instability concerns the potential for instability to change children's contexts for the better. For example, an occurrence of relationship instability may extricate a mother and child from a violent partner; similarly, a residential move may lead a family to a neighborhood with enhanced educational and social opportunities, thereby supporting improved child functioning (Coley et al., 2013; Roy, McCoy, & Raver, 2014). Thus, whereas theoretical frameworks often depict residential and relational instability as stressors, some occurrences of instability may in fact improve children's proximal contexts, thus weakening or negating the overall effects of environmental instability.

How the Timing of Chaos Matters for Children

In addition to assessing differences between domains of environmental chaos, a second goal of this research was to consider distinctions related to the developmental timing of chaos. Based upon infants' rapid development and immature neurbiological and social systems, ecobiodevelopmental theory hypothesized that infants would be more susceptible to environmental insults than older children (Bronfenbrenner & Evans, 2000; Shonkoff, 2010). Results in this study failed to support this hypothesis. Environmental chaos experienced during infancy (measured at wave 1) showed no significant associations with children's physical or mental health assessed at ages 2 ½ or 6 in models including later measures of chaos. Instead, results supported a recency effect, showing that environmental chaos assessed at wave 3 was significantly associated with children's mental health functioning at age 6. This pattern of results mirrors some prior research, such as work on relationship instability which has found that recent transitions in family structure were more consistently associated with low-income children's mental health outcomes than were transitions during infancy (Bachman et al., 2011).

Yet, given the difficulty of measuring children's development during infancy and early childhood in a valid and reliable manner (National Research Council and Institute of Medicine, 2000), we caution that these results may be affected by measurement issues, and encourage future research that delineates the role of the developmental timing of environmental chaos. Infant chaos, for example, may inhibit the development of healthy stress reactivity and self regulation systems that disrupt other aspects of physiological development (Blair, 2002; Blair et al., 2011; Shonkoff, 2010). Our inability to measure such processes during infancy or to assess long-term physical and psychological sequelae may have limited evidence of infant chaos effects. Similarly, it is important to acknowledge that the results linking chaos assessed at wave 3 with child functioning assessed at wave 3 raise some concerns over reporter bias and unmeasured heterogeneity.

Modeling the Intensity of Early Chaos

A third primary tenet of the ecobiodevelopmental model (Shonkoff, 2010; Shonkoff & Garner, 2012) is that environmental forces that are recurring, broad, and deep will be more influential in affecting children's healthy development than more transitory and narrow forces. Results of this study provided support for this supposition. Models capturing the intensity (depth, breadth, and chronicity) of environmental chaos showed significant links with children's developmental delays at wave 2, as well as their physical and mental health at wave 3, although effect sizes were small, ranging from .15–.21. One explanation for these findings may be the restricted range of chaotic experiences for children in this economically disadvantaged sample. Given that much prior research has examined chaos as a mediator between low family income and deficits in child functioning (Evans & Kim, 2013), it is possible that the intensity of chaos might show stronger links with functioning in a sample with greater variability in experiences of environmental chaos.

Chaos and Biological Vulnerability

Although this study provided some support for the hypotheses regarding the domains and intensity of chaos, we did not find support for the hypothesis that chaos interacts with children's biological risks to predict later functioning. To proxy biological vulnerability, we assessed children's birth weight, as prior research has shown low birth weight to be an indicator of fetal development and risk (Barker, 1992; 1995) and to heighten children's susceptibility to environmental influences (Escalona, 1982; Kalmar & Boronkai, 1991; Shonkoff et al., 2009). Yet our results unearthed no significant patterns of interactions between low birth weight and environmental chaos. It is important to note that the prevalence of low birth weight, reported retrospectively by mothers at 6% in this sample, was somewhat low in comparison to national rates in 1999, which were 13% among African American mothers, 6% for Hispanics, and 7% for Whites (Advisory Committee on Infant Mortality, 2001). This lower than expected rate in our low-income ethnic minority sample may have diminished the statistical power to detect interaction effects. Unfortunately, the data used in these analyses were lacking other measures of biological risks incurred both pre- and post-natally (Barker, 1992; 1995), leaving open the question of interactive effects for future research.

Parental Functioning: Mediator or Moderator of Environmental Chaos?

In interpreting the effects of environmental chaos, it is important to consider how these contextual forces may translate into proximal processes influencing children's health and development. Disorder and instability in children's primary environments and relationships may directly influence their physical and mental health through physical insults, increases in physiological stress, or fear or anger responses. For example, environmental chaos may increase children's asthma and illnesses, heighten stress responses, and decrease regulation skills, translating into poorer physical, emotional, and behavioral health. The ecobiodevelopmental model (Shonkoff, 2010; Shonkoff & Garner, 2012) argues that consistent and sensitive parenting may buffer these effects, with parental functioning acting as a moderator of environmental chaos. In this paper, we argue instead that parental functioning may serve as a mediator linking environmental chaos with children's functioning. That is, environmental chaos may affect mothers' stress levels and their ability to provide sensitive and supportive parenting, in turn affecting children's health and functioning (Bronfenbrenner & Evans, 2000; Deater-Deckard et al., 2009; Evans & Kim, 2013). Our results provided support for direct and mediational models of environmental chaos, but not for moderated effects. On one hand, mediation models found that the links between environmental chaos and children's physical health and developmental delays were not attenuated by the inclusion of maternal distress and sensitivity variables, suggesting that the physical repercussions of chaos (driven primarily by intense chaos and housing disorder) may be largely direct. On the other hand, results suggest that the relationships between environmental chaos and children's mental health problems were explained in part by mothers' psychological distress. In each set of models tested (domains of chaos, developmental timing of chaos, intensity of chaos), there was evidence that the relationship between chaos and children's emotional and behavioral functioning acted indirectly via maternal psychological distress. Mothers' sensitive and warm parenting similarly was significantly associated with children's internalizing, externalizing, and total behavior problems, but unlike maternal distress, maternal sensitivity did not serve as a mediating process linking environmental chaos and children's functioning. Our findings relating to parental functioning as a mediator of environmental chaos mirror results from both environmental and genetics models with older children and adolescents (Coley et al., 2013; Jaffee, Hanscombe, Haworth, Davis, & Plomin, 2012) highlighting the role of maternal psychological distress.

In contrast, results from this study did not provide support for the ecobiodevelopmental argument that parental functioning would serve as a buffer, protecting children against the detrimental effects of environmental chaos. One explanation may be that parental functioning is not a stable trait, but rather responds to environmental forces, particularly for parents with very limited economic and social resources (Corapci & Wachs, 2002; Kotchick, Dorsey, & Heller, 2005). In addition, we note the quite limited nature of the maternal sensitivity measure; a richer and more extensive view of parental sensitivity, responsivity, and harshness may provide greater insights in how parents effect children's functioning in the face of environmental chaos.

Limitations

In closing, it is important to acknowledge additional limitations in this research. Although the sample was randomly selected, it represents a particular population of disadvantaged, urban families in three cities and cannot necessarily be generalized to other populations. Similarly, although we modeled prospective longitudinal data and adjusted for a range of child, family, and community covariates, the data were correlational and results cannot be construed as causal. There are also concerns about reporter and measurement bias, as many of the measures were derived from maternal reports, with some (i.e., relationship instability) derived from retrospective reports that may have suffered from recall bias, and others (i.e., children's health) derived from single-item reports. Similarly, many of the measures captured mothers' perceptions of their context and their children's functioning. Neighborhood disorder, for example, represented mothers' perceptions of crime and social disorder in the neighborhood because more objective measures of neighborhood contexts (e.g., from Census data) were not collected frequently enough to capture changing contexts in short-term longitudinal designs such as this. Relatedly, the measures of housing and neighborhood disorder used in this research captured particular snapshots in children's lives and may have missed proximal forces occurring between the survey waves. It is also important to note that additional aspects of environmental chaos, such as crowding or pollution in housing and community contexts, and instability in other arenas such as childcare or work schedules or primary caregiver shifts, were not assessed in this research. We also focused on measures of maternal functioning, without access to information on the functioning of fathers and other caregivers. Additionally, we were limited in our attempt to gauge the role of biological vulnerability through the use of a low birth weight indicator rather than process measures of vulnerability such as stress reactivity, which has been shown to interact with children's experiences of environmental stress to predict physical and mental health problems (Boyce et al., 2005; Boyce & Jemerin, 1990; Gunnar & Quevedo, 2007). The limited prevalence of low birth weight also limited the statistical power to detect interaction effects. Beyond these limitations, this study adds to the extant literature base arguing that early environmental chaos serves as a risk for low-income children's physical and mental health.

Conclusions

The current study expands on past empirical work by testing multiple components of the ecobiodevelopmental model (Shonkoff, 2010; Shonkoff & Garner, 2012) concerning hypothesized links between environmental chaos and child well-being. Our findings support the idea that environmental chaos is detrimental during the first years of life with chaotic housing environments predicting deficits in early health and basic developmental milestones. In contrast, neighborhood disorder and relationship instability were more potent predictors of children's mental health as they entered elementary school. The intensity of chaos was associated with less healthy development across multiple periods and domains of functioning.

By employing a within-group design focused on environmental chaos among low-income families in high-poverty, urban neighborhoods, the present study yields important implications. The findings in this study may be useful to both practitioners and policy-makers, helping to inform early childhood and family programming; federal, state, and local housing and community programs; and low-income family subsidies. Such programs and policies may seek improve the maintenance of the housing stock in low-income communities; to enhance the levels of safety and community involvement in urban neighborhoods; and to increase couples' abilities to sustain stable, healthy relationships. Targeting programs and policies to specific populations and developmental windows may help to shield against the negative effects of environmental chaos and to promote the healthy development of low-income children.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The project reported here was supported by grants from the MacArthur Foundation (10-96266-00USP) and the William T. Grant Foundation (11617) to Rebekah Levine Coley, Tama Leventhal, and Linda M. Burton. We also acknowledge core support to the *Three-City Study* from the National Institute of Child Health and Human Development through grants HD36093 and HD25936, as well as the support of many government agencies and private foundations.

References

Achenbach, TM. Manual for the Child Behavior Checklist/4–18 and 1991 Profile. Burlington, VT: University of Vermont, Department of Psychiatry; 1991.

Achenbach, TM. Manual for the Child Behavior Checklist/2–3 and 1992 Profile. Burlington, VT: University of Vermont, Department of Psychiatry; 1992.

Achenbach, TM.; Rescorla, LA. Manual for the ASEBA School-Age Forms and Profiles: An Integrated System of Multi-informant Assessment. Burlington, VT: University of Vermont, Department of Psychiatry; 2001.

Ackerman BP, Brown ED, D'Eramo KS, Izard CE. Maternal relationship instability and the school behavior of children from disadvantaged families. Developmental Psychology. 2002; 38:694–704.10.1037/0012-1649.38.5.694 [PubMed: 12220048]

Ackerman BP, Kogos J, Youngstrom E, Schoff K, Izard C. Family instability and the problem behaviors of children from economically disadvantaged families. Developmental Psychology. 1999; 35(1):258–268.10.1037/0012-1649.35.1.258 [PubMed: 9923480]

Advisory Committee on Infant Mortality. Low birth weight report and recommendations. Washington, DC: U.S. Department of Health and Human Services; 2001.

Annie E. Casey Foundation. 2011 Kids Count Data Book. Baltimore, MD: Author; 2011. America's children, America's challenge: Promoting opportunity for the next generation.

Bachman H, Coley RL, Carrano J. Maternal relationship instability influences on children's emotional and behavioral functioning in low-income families. Journal of Abnormal Child Psychology. 2011; 39:1149–1161.10.1007/s10802-011-9535-1 [PubMed: 21728032]

Bachman H, Coley RL, Carrano J. Low-income mothers' patterns of partnership instability and adolescents' socioemotional well-being. Journal of Family Psychology. 2012; 26:263–273.10.1037/a0027427 [PubMed: 22369464]

Barker, DJP. Fetal and infant origins of adult disease. London, UK: BMJ Publishing Group; 1992.

Barker, DJP. Mothers, babies, and disease in later life. 2. London, UK: BMJ Publishing Group; 1995.

Blair C. School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. American Psychologist. 2002; 57(2):111–127.10.1037/0003-066X.57.2.111 [PubMed: 11899554]

Blair C, Raver CC, Granger D, Mills-Koonce R, Hibel L. The Family Life Project Key Investigators. Allostasis and allostatic load in the context of poverty in early childhood. Development and Psychopathology. 2011; 23:845–857.10.1017/S0954579411000344 [PubMed: 21756436]

Bowling A. Just one question: If one question works, why ask several? Journal of Epidemiology and Community Health. 2005; 59:342–345.10.1136/jech.2004.021204 [PubMed: 15831678]

Boyce WT, Chesney M, Alkon A, Tschann JM, Adams S, Chesterman B, Wara D. Psychobiologic reactivity to stress and childhood respiratory illnesses: Results of two prospective studies. Psychosomatic Medicine. 2005; 57:411–422.10.1097/00006842-199509000-00001 [PubMed: 8552730]

Boyce WT, Jemerin JM. Psychobiological differences in childhood stress response. I. Patterns of illness and susceptibility. Developmental and Behavioral Pediatrics. 1990; 11(2):86–95.10.1097/00004703-199004000-00010

Bradley, RH. Environment and parenting. In: Bornstein, MH., editor. Handbook of parenting. 2. Vol. 2. Mahwah, NJ: Erlbaum; 2002. p. 281-314.

Bradley RH, Caldwell BM. Home Observation for Measurement of the Environment: A revision of the preschool scale. American Journal of Mental Deficiency. 1979; 84(3):235–244. [PubMed: 93417]

Bronfenbrenner U, Evans GE. Developmental science in the 21st century: Emerging theoretical models, research designs, and empirical findings. Social Development. 2000; 9:115–125.

Bronfenbrenner, U.; Morris, PA. The ecology of developmental process. In: Damon, W.; Lerner, RM., editors. Handbook of child psychology: Vol 1. Theoretical models of human development. 5. New York, NY: Wiley; 1998. p. 993-1028.

Busaker A, Kasehagen L. Association of residential mobility and child health: An analysis of the National Survey of Children's Health. Maternal and Child Health Journal. 2012; 16(1):78–87.10.1007/s10995-012-0997-8

Caughy MO, O'Campo PJ. Neighborhood poverty, social capital, and the cognitive development of African American preschoolers. American Journal of Community Psychology. 2006; 37(1/2):141–154.10.1007/s10464-005-9001-8 [PubMed: 16680542]

Cavanagh SE, Huston AC. Family instability and children's early problem behavior. Social Forces. 2006; 85:551–581.10.1353/sof.2006.0120

Coldwell J, Pike A, Dunn J. Household chaos – links with parenting and child behavior. Journal of Child Psychology and Psychiatry. 2006; 47(11):1116–1122.10.1111/j.1469-7610.2006.01655.x [PubMed: 17076750]

Coley RL, Kull MA, Leventhal T, Lynch AD. Profiles of housing and neighborhood contexts among low-income families: Links with children's well-being. Cityscape: A Journal of Policy Development and Research. 2014; 16(1):37–61.

Coley RL, Leventhal T, Lynch AD, Kull MA. Relations between housing characteristics and the well-being of low-income children and adolescents. Developmental Psychology. 2013; 49(9):1775–1789.10.1037/a0031033 [PubMed: 23244408]

Corpaci F, Wachs TD. Does parental mood or efficacy mediate the influence of environmental chaos upon parenting behavior? Merrill-Palmer Quarterly. 2002; 48(2):182–201.10.1353/mpq.2002.0006

Cutts DB, Meyers AF, Black MB, Casey PH, Chilton M, Cook JT, Frank DA. Housing insecurity and the health of very young children. American Journal of Public Health. 2011; 101(8):1508–1514.10.2105/AJPH.2011.300139 [PubMed: 21680929]

Deater-Deckard K, Mullineaux PY, Beekman C, Petrill SA, Schatschneider C, Thompson LA. Conduct problems, IQ, and household chaos: A longitudinal multi-informant study. The Journal of Child Psychology and Psychiatry. 2009; 50(10):1301–1308.10.1111/j.1469-7610.2009.02108.x

Derogatis, LR. BSI 18: The Brief Symptom Inventory 18: Administration, scoring and procedures manual. Minneapolis, MN: National Computer Systems; 2000.

Elliott DS, Wilson WJ, Huizinga D, Sampson RJ, Elliott A, Rankin B. The effects of neighborhood disadvantage on adolescent development. Journal of Research in Crime and Delinquency. 1996; 33(4):389–426.10.1177/0022427896033004002

Escalona SK. Babies at double hazard: Early development of infants at biologic and social risk. Pediatrics. 1982; 70(5):670–679. [PubMed: 7133816]

Evans GW. The environment of child poverty. American Psychologist. 2004; 59(2):77–92.10.1037/0003-066X.59.2.77 [PubMed: 14992634]

Evans GW, Boxhill L, Pinkava M. Poverty and maternal responsiveness: The role of maternal stress and social resources. International Journal of Behavioral Development. 2008; 32(3):232–237.10.1177/0165025408089272

Evans GW, Gonnella C, Marcynyszyn LA, Gentile L, Salpekar N. The role of chaos in poverty and children's socioemotional adjustment. Psychological Science. 2005; 16(7):560–565.10.1111/j.0956-7976.2005.01575.x [PubMed: 16008790]

Evans GW, Kantrowitz E. Socioeconomic status and health: The potential role of environmental risk exposure. Annual Review of Public Health. 2002; 25:303–331.10.1146/annurev.publhealth.23.112001.112349

Evans GW, Kim P. Childhood poverty and young adults' allostatic load: The mediating role of childhood cumulative risk exposure. Psychological Science. 2012; 23(9):979–983.10.1177/0956797612441218 [PubMed: 22825357]

Evans GW, Kim P. Child poverty, chronic stress, self-regulation, and coping. Child Development Perspectives. 2013; 7(1):43–48.10.1111/cdep.12013

Evans GW, Maxwell LE, Hart B. Parental language and verbal responsiveness to children in crowded homes. Developmental Psychology. 1999; 35(4):1020–1023.10.1037/0012-1649.35.4.1020 [PubMed: 10442870]

Evans GW, Saltzman H, Cooperman JL. Housing quality and children's socioemotional health. Environment and Behavior. 2001; 33(3):389–399.10.1177/00139160121973043

Farver JM, Natera LX, Frosch DL. Effects of community violence on inner-city preschoolers and their families. Journal of Applied Developmental Psychology. 1999; 20(1):143–158. doi:0.1016/S0193-3973(99)80008-2.

Fomby P, Cherlin AJ. Family instability and child well-being. American Sociological Review. 2007; 72:181–204.10.1177/000312240707200203 [PubMed: 21918579]

Gollenberg AL, Lynch CD, Jackson LW, McGuinness BM, Small ME. Concurrent validity of the parent-completed Ages and Stages Questionnaire, 2nd Ed. with the Bayley Scales of Infant Development II in a low risk sample. Child: Care, Health and Development. 2010; 36(4):485–490. doi:0.1111/j.1365-2214.2009.01041.x.

Gunnar M, Quevedo K. The neurobiology of stress and development. Annual Review of Psychology. 2007; 58:145–173.10.1146/annurev.psych.58.110405.085605

Holden, GW.; Vittrup, B.; Rosen, LH. Families, parenting, and discipline. In: Underwood, MK.; Rosen, LH., editors. Social development: Relationships in infancy, childhood, and adolescence. New York, NY: Guilford Press; 2011. p. 127-152.

Honaker J, King G. What to do about missing values in time-series cross-section data. American Journal of Political Science. 2010; 54(2):561–81.10.1111/j.1540-5907.2010.00447.x

Jackson AP. The effects of family and neighborhood characteristics on the behavioral and cognitive development of poor black children: A longitudinal study. American Journal of Community Psychology. 2003; 32(1/2):175–187.10.1023/A:1025615427939 [PubMed: 14570445]

Jaffee SR, Hanscombe KB, Haworth CMA, Davis OSP, Plomin R. Chaotic homes and children's disruptive behavior: A longitudinal cross-lagged twin study. Psychological Science. 2012; 23(6): 643–650.10.1177/0956797611431693 [PubMed: 22547656]

Johnson AD, Martin A, Brooks-Gunn J, Petrill SA. Order in the house! Associations among household chaos, the home literacy environment, maternal reading ability, and children's early reading. Merrill Palmer Quarterly. 2008; 54(4):445–472.10.1353/mpq.0.0009 [PubMed: 19526070]

Kalmar M, Boronkai J. Interplay of biological and social-environmental factors in the developmental outcome of prematurely born children from infancy to seven years. International Journal of Disability, Development, and Education. 1991; 38(3):247–270.10.1080/0156655910380304

Kamp Dush CM, Schmeer KK, Taylor M. Chaos as a social determinant of child health: Reciprocal associations? Social Science & Medicine. 2013; 95:69–76.10.1016/j.socscimed.2013.01.038 [PubMed: 23541250]

Kohen DE, Leventhal T, Dahinten S, McIntosh CN. Neighborhood disadvantage: Pathways of effects for young children. Child Development. 2008; 79(1):156–169.10.1111/j.1467-8624.2007.01117.x [PubMed: 18269515]

Kotchick BA, Dorsey S, Heller L. Predictors of parenting among African American single mothers: Personal and contextual factors. Journal of Marriage and Family. 2005; 67:448–460.10.1111/j. 0022-2445.2005.00127.x

Kull MA, Coley RL, Lynch AD. The roles of instability and housing in low-income families' residential mobility. Manuscript under review.

Magnuson K, Berger LM. Family structure states and transitions: Associations with children's well-being during middle childhood. Journal of Marriage and Family. 2009; 71:575–591.10.1111/j. 1741-3737.2009.00620.x [PubMed: 20228952]

Martin A, Razza R, Brooks-Gunn J. Specifying the links between household chaos and preschool children's development. Early Child Development and Care. 2012; 182(10):1247–1263.10.1080/03004430.2011.605522 [PubMed: 22919120]

Masten, A.; Gewirtz, AH. Vulnerability and resilience in early child development. In: McCartney, K.; Phillips, D., editors. Blackwell handbook of early childhood development. Malden, MA: Blackwell; 2006. p. 44-61.

Matheny AP, Wachs TD, Ludwig JL, Phillips K. Bringing order out of chaos: Psychometric characteristics of the Confusion, Hubbub, and Order Scale. Journal of Applied Developmental Psychology. 1995; 16:429–44.10.1016/0193-3973(95)90028-4

Meaney MJ. Epigenetics and the biological definition of gene x environment interactions. Child Development. 2010; 81(1):41–79.10.1111/j.1467-8624.2009.01381.x [PubMed: 20331654]

Mendez JL, Fantuzzo J, Cicchetti D. Profiles of social competence among low-income African American preschool children. Child Development. 2002; 73(4):1085–1100.10.1111/1467-8624.00459 [PubMed: 12146735]

National Research Council and Institute of Medicine. From neurons to neighborhoods: The science of early childhood development. Washington, DC: National Academy Press; 2000.

Newman SJ. Does housing matter for poor families? A critical summary of research and issues still to be resolved. Journal of Policy Analysis and Management. 2008; 27(4):895–925.10.1002/pam. 20381

Osborne C, McLanahan S. Partnership instability and child well-being. Journal of Marriage and Family. 2007; 69:1065–1083.10.1111/j.1741-3737.2007.00431.x

Paat Y. Influences of mother and neighborhood on children's behavioral outcomes. Children, Youth and Environments. 2010; 20(1):91–122.

Roche K, Leventhal T. Beyond neighborhood poverty: Family management, neighborhood disorder, and adolescents' early sexual onset. Journal of Family Psychology. 2009; 23(6):819–827.10.1037/a0016554 [PubMed: 20001140]

Roy AL, McCoy DC, Raver CC. Instability versus quality: Residential mobility, neighborhood poverty, and children's self-regulation. Developmental Psychology. 2014; 50:1891–1896.10.1037/a0036984 [PubMed: 24842459]

Schofield TJ, Conger RD, Conger KJ, Martin MJ, Brody G, Simons R, Cutrona C. Neighborhood disorder and children's antisocial behavior: The protective effect of family support among Mexican American and African American families. American Journal of Community Psychology. 2011; 50(1–2):101–113.10.1007/s10464-011-9481-7 [PubMed: 22089092]

Shonkoff J. Building a new biodevelopmental framework to guide the future of early childhood policy. Child Development. 2010; 81(1):357–367.10.1111/j.1467-8624.2009.01399.x [PubMed: 20331672]

Shonkoff JP, Boyce WT, McEwan BS. Neuroscience, molecular biology, and the childhood roots of health disparities: Building a new framework for health promotion and disease prevention. Journal of the American Medical Association. 2009; 301(21):2252–2259.10.1001/jama.2009.754 [PubMed: 19491187]

Shonkoff JP, Garner AS. The lifelong effects of early childhood adversity and toxic stress. Pediatrics. 2012; 129(1):e232–e246.10.1542/peds.2011-2663 [PubMed: 22201156]

Squires, JK.; Potter, L.; Bricker, DD. The ASQ user's guide. Baltimore, MD: Paul H. Brookes; 1999.

Supplee LH, Unikel EB, Shaw DS. Physical environmental adversity and the protective role of maternal monitoring in relation to early child conduct problems. Journal of Applied Developmental Psychology. 2007; 28:166–183.10.1016/j.appdev.2006.12.001 [PubMed: 18311323]

Vaden-Kiernan M, D'Elio MA, O'Brien RW, Tarullo LB, Zill N, Hubbell-McKay R. Neighborhoods as a developmental context: A multilevel analysis of neighborhood effects on Head Start families and children. American Journal of Community Psychology. 2010; 45:49–67.10.1007/s10464-009-9279-z [PubMed: 20066488]

Valiente C, Lemery-Chalfant K, Reiser M. Pathways to problem behaviors: Chaotic homes, parent and child effortful control, and parenting. Social Development. 2007; 16(2):249–268.10.1111/j.1467-9507.2007.00383.x

Vernon-Feagans L, Cox M. The Family Life Project Key Investigators. The Family Life Project: An epidemiological and developmental study of young children living in poor rural communities. Monographs of the Society for Research in Child Development. 2013; 78(5):1–150.10.1111/mono.12046 [PubMed: 24147448]

Vernon-Feagans L, Garrett-Peters P, Willoughby M, Mills-Koonce R. The Family Life Project Key Investigators. Chaos, poverty, and parenting: Predictors of early language development. Early Childhood Research Quarterly. 2012; 27:339–351.10.1016/j.ecresq.2011.11.001 [PubMed: 23049162]

Winston, PW.; Angel, RJ.; Burton, LM.; Chase-Lansdale, PL.; Cherlin, AJ.; Moffitt, RA.; Wilson, WJ. Welfare, children, and families: Overview and design. Baltimore, MD: Johns Hopkins University; 1999.

Ziol-Guest K, McKenna C. Early childhood housing instability and school readiness. Child Development. 2014; 85(1):103–113.10.1111/cdev.12105 [PubMed: 23534607]

Highlights

- This study assessed key tenets from the ecobiodevelopmental model concerning the role of environmental chaos in children's development.
- The domains, timing, and intensity of chaos were all predictive of children's mental and physical health.
- Maternal distress served as a mediator between environmental chaos and children's mental health functioning.
- Environmental chaos effects were not buffered by parental functioning or lack of biological vulnerability.

Table 1

Sample Descriptives

	Wave 1		Wave 2		Wave 3	
	***M*/%**	***SD***	***M*/%**	***SD***	***M*/%**	***SD***
Child Functioning						
Poor Health			1.81	0.87	1.81	0.87
Developmental Delays			0.65	1.01		
Internalizing Problems					50.32	10.52
Externalizing Problems					52.84	10.31
Total Problems					51.64	10.83
Environmental Chaos						
Housing Disorder	1.52	1.37	1.34	1.40	1.96	1.21
Neighborhood Disorder	1.84	0.62	1.76	0.61	1.68	0.61
Relationship Instability	0.08	0.40	0.24	0.53	0.57	0.89
Residential Instability	0.76	1.10	1.39	1.44	2.69	2.31
Chaos Intensity	1.05	0.48	1.18	0.57	1.73	0.74
Family Functioning						
Maternal Distress	1.47	1.05	1.39	1.10	1.21	1.11
Maternal Sensitivity	0.87	0.24	0.81	0.27	0.68	0.33
Covariates						
Child Age (Months)	12.70	6.87				
Child Gender (Male)	0.48					
Low Birth Weight	0.06					
Maternal Employment	0.38					
TANF Receipt	0.40					
White	0.06					
African American	0.41					
Hispanic	0.53					
Less than High School	0.35					
High School Education	0.27					
More than High School	0.38					

	Wave 1		Wave 2		Wave 3	
	***M*/%**	***SD***	***M*/%**	***SD***	***M*/%**	***SD***
Income to Needs	0.85	0.55				
Boston	0.33					
Chicago	0.33					
San Antonio	0.33					

Table 2

Domains of Environmental Chaos and Children's Functioning

	Child Functioning Wave 2				Child Functioning Wave 3							
	Poor Health		Delays		Poor Health		Externalizing		Internalizing		Total Problems	
	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)
Main Effects Model												
Housing Disorder	−0.06	(0.07)	0.30	(0.11)**	0.19	(0.08)*	0.70	(1.48)	0.49	(1.07)	0.78	(1.35)
Neighborhood Disorder	0.11	(0.08)+	−0.06	(0.06)	0.12	(0.07)+	2.37	(0.64)**	2.58	(1.55)+	3.58	(1.04)**
Relationship Instability	0.06	(0.09)	−0.01	(0.08)	−0.02	(0.09)	1.62	(1.02)	2.66	(0.94)**	2.49	(1.01)*
Residential Instability	−0.01	(0.08)	−0.05	(0.08)	0.06	(0.09)	0.97	(1.08)	0.20	(1.20)	0.73	(1.23)
Covariates												
Child Age	0.00	(0.01)	0.00	(0.01)	0.00	(0.01)	0.15	(0.12)	0.22	(0.19)	0.13	(0.18)
Child Gender (Male)	0.06	(0.18)	0.35	(0.11)**	0.00	(0.24)	1.05	(1.51)	−1.17	(1.60)	−0.20	(1.15)
Low Birth Weight	0.55	(0.32)+	0.52	(0.23)*	0.52	(0.23)*	1.08	(2.63)	0.06	(1.78)	1.30	(3.03)
Maternal Employment	−0.14	(0.17)	−0.08	(0.11)	0.15	(0.12)	−4.60	(2.36)+	−2.60	(2.03)	−3.77	(2.28)
TANF Receipt	0.01	(0.14)	−0.06	(0.18)	−0.21	(0.11)+	1.10	(0.96)	−2.54	(0.97)**	−0.73	(1.11)+
White	−0.02	(0.34)	0.26	(0.33)	−0.08	(0.24)	−2.25	(3.23)	−2.21	(2.96)	−1.25	(3.32)
Black	0.13	(0.11)	0.22	(0.07)*	−0.12	(0.10)	−0.50	(1.56)	1.81	(1.13)	0.91	(1.21)
Less than High School	0.11	(0.10)	0.35	(0.18)*	0.06	(0.16)	0.87	(1.38)	2.50	(0.89)**	0.56	(1.02)
More than High School	0.07	(0.11)	0.26	(0.16)	−0.16	(0.11)	1.14	(2.07)	3.22	(1.21)**	1.68	(1.37)
Income to Needs	−0.03	(0.15)	−0.17	(0.08)*	−0.17	(0.16)	1.65	(1.50)	−0.76	(1.28)	0.93	(1.40)
Boston	−0.13	(0.10)	0.27	(0.09)**	−0.07	(0.08)	−1.58	(0.97)	0.26	(1.25)	−0.13	(1.10)
San Antonio	−0.17	(0.09)	−0.04	(0.06)	−0.05	(0.08)	−1.80	(0.95)+	−0.98	(1.52)	−0.61	(1.18)
Constant	1.94	(0.07)**	0.60	(0.06)**	1.87	(0.07)**	54.25	(0.64)**	50.75	(0.85)**	52.12	(0.72)**
Mediation Model												
Housing Disorder	−0.08	(0.06)	0.27	(0.09)**	0.17	(0.08)*	−0.10	(1.37)	−0.51	(1.17)	−0.20	(1.33)
Neighborhood Disorder	0.11	(0.06)+	−0.05	(0.05)	0.10	(0.07)	1.99	(0.65)**	2.08	(1.63)	3.10	(1.16)**
Relationship Instability	0.05	(0.10)	−0.00	(0.12)	−0.04	(0.09)	0.97	(1.08)	1.85	(1.08)+	1.69	(1.19)

	Child Functioning Wave 2				Child Functioning Wave 3							
	Poor Health		Delays		Poor Health		Externalizing		Internalizing		Total Problems	
	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)
Residential Instability	−0.02	(0.08)	−0.05	(0.08)	0.05	(0.09)	0.71	(1.10)	−0.17	(1.20)	0.39	(1.24)
Maternal Distress	0.04	(0.06)	−0.01	(0.09)	0.09	(0.10)	2.32	(0.79)**	3.06	(1.04)**	2.95	(0.91)**
Maternal Sensitivity	−0.08	(0.06)	−0.19	(0.10)+	−0.06	(0.12)	−2.40	(1.04)*	−2.63	(1.06)*	−2.76	(1.17)*

Note.

** $p < 0.01$

* $p < 0.05$

+ $p < 0.10$

In models predicting Wave 2 functioning, chaos and stability variables were derived from waves 1–2 contexts; in models predicting Wave 3 functioning, chaos and stability variables were derived from waves 1–3 contexts. Coefficients for covariates in mediation models not shown.

Table 3

Timing of Environmental Chaos and Children's Functioning

	Child Functioning Wave 2				Child Functioning Wave 3							
	Poor Health		Delays		Poor Health		Externalizing		Internalizing		Total Problems	
	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)
Main Effects Model												
Wave 1 Chaos	0.19	(0.16)	0.06	(0.23)	0.18	(0.15)	1.66	(1.66)	1.26	(2.33)	3.07	(1.78)$^{+}$
Wave 2 Chaos	−0.09	(0.11)	0.16	(0.20)	0.13	(0.15)	0.25	(1.35)	0.52	(1.57)	0.01	(1.20)
Wave 3 Chaos					0.06	(0.17)	3.76	(1.35)**	3.67	(1.34)**	4.34	(1.34)**
Mediation Model												
Wave 1 Chaos	0.17	(0.15)	0.07	(0.22)	0.17	(0.16)	1.24	(1.67)	0.84	(2.48)	2.56	(1.93)
Wave 2 Chaos	−0.09	(0.11)	0.13	(0.11)	0.10	(0.14)	−0.09	(1.53)	−0.31	(1.58)	−0.56	(1.30)
Wave 3 Chaos					0.03	(0.17)	2.39	(1.36)$^{+}$	2.21	(1.40)	2.83	(1.45)$^{+}$
Wave 1 Maternal Distress	−0.06	(0.06)	0.03	(0.08)	0.07	(0.12)	−1.05	(0.77)	0.41	(0.59)	−0.55	(0.76)
Wave 2 Maternal Distress	0.09	(0.07)	−0.04	(0.10)	0.06	(0.10)	0.35	(0.51)	0.14	(0.69)	0.81	(0.62)
Wave 3 Maternal Distress					−0.03	(0.11)	3.23	(1.08)**	2.61	(0.52)**	2.87	(0.74)**
Wave 1 Maternal Sensitivity	0.01	(0.03)	0.01	(0.06)	0.02	(0.03)	−1.22	(0.48)*	−0.96	(0.46)*	−1.18	(0.40)**
Wave 2 Maternal Sensitivity	−0.08	(0.05)	−0.24	(0.17)	−0.07	(0.07)	−1.17	(0.75)	−0.74	(0.77)	−1.20	(0.94)
Wave 3 Maternal Sensitivity					−0.02	(0.07)	0.12	(1.16)	−0.90	(0.86)	−0.40	(1.13)

Note.

$^{**}p < 0.01$

$^{*}p < 0.05$

$^{+}p < 0.10$

Coefficients for covariates not shown.

Table 4

Intensity of Environmental Chaos and Children's Functioning

	Child Functioning Wave 2				Child Functioning Wave 3							
	Poor Health		Delays		Poor Health		Externalizing		Internalizing		Total Problems	
	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)
Main Effects Model												
Chaos Intensity	0.03	(0.06)	0.15	(0.06)**	0.15	(0.07)*	1.76	(0.74)*	1.38	(0.90)	2.21	(0.84)**
Mediation Model												
Chaos Intensity	0.01	(0.07)	0.14	(0.07)*	0.12	(0.06)+	0.45	(0.97)	1.04	(0.74)	1.30	(0.92)+
Maternal Distress	0.04	(0.07)	−0.01	(0.08)	0.10	(0.09)	2.55	(0.54)**	3.39	(0.91)**	3.31	(0.76)**
Maternal Sensitivity	−0.07	(0.06)	−0.22	(0.14)	−0.06	(0.14)	−2.39	(1.05)**	−2.76	(1.02)**	−2.83	(1.21)*

Note.

** $p < 0.01$

* $p < 0.05$

+ $p < 0.10$

In models predicting Wave 2 functioning, chaos and stability variables were derived from waves 1–2 contexts; in models predicting Wave 3 functioning, chaos and stability variables were derived from waves 1–3 contexts. Coefficients for covariates not shown.

Table 5

Environmental Chaos Predicting Maternal Distress and Sensitivity

	Maternal Psychological Distress				Maternal Sensitivity			
	Waves 1–2		Waves 1–3		Waves 1–2		Waves 1–3	
	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)	Coef	(*SE*)
Domains of Chaos								
Housing Disorder	0.16	(0.08)+	0.22	(0.08)**	−0.16	(0.16)	−0.13	(0.13)
Neighborhood Disorder	0.09	(0.07)	0.15	(0.05)**	0.03	(0.07)	−0.01	(0.08)
Relationship Instability	0.10	(0.08)	0.14	(0.08)+	0.00	(0.07)	0.03	(0.06)
Residential Instability	0.20	(0.09)*	0.20	(0.09)*	−0.00	(0.08)	−0.06	(0.07)
Timing of Chaos								
Wave 1 Chaos	0.31	(0.15)*	0.20	(0.14)	0.12	(0.10)	−0.03	(0.09)
Wave 2 Chaos	0.23	(0.09)*	0.19	(0.09)*	−0.04	(0.08)	−0.09	(0.10)
Wave 3Chaos			0.32	(0.10)**			−0.02	(0.12)
Intensity of Chaos								
Chaos Intensity	0.20	(0.05)**	0.23	(0.04)**	−0.08	(0.06)	−0.06	(0.05)

Note.

** $p < 0.01$

* $p < 0.05$

+ $p < 0.10$

In domain and intensity models predicting Waves 1–2 parenting, chaos variables were derived from Waves 1–2; in models predicting Waves 1–3 parenting, chaos variables were derived from Waves 1–3. In timing models, chaos predicted concurrent parenting, adjusting for additional developmental periods. Coefficients for covariates not shown.