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Household Chaos and Children's Cognitive and Socio-Emotional Development in Early Childhood: Does Childcare Play a Buffering Role?

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Abstract

Evidence suggests that household chaos is associated with less optimal child outcomes. Yet, there is an increasing indication that children's experiences in childcare may buffer them against the detrimental effects of such environments. Our study aims were to test: (1) whether children's experiences in childcare mitigated relations between household chaos and children's cognitive and social development, and (2) whether these (conditional) chaos effects were mediated by links between chaos and executive functioning. Using data from *The Family Life Project* ($n = 1,235$)—a population-based sample of families from low-income, rural contexts—our findings indicated that household disorganization in early childhood was predictive of worse cognitive and social

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outcomes at approximately age five. However, these relations were substantially attenuated for children attending greater childcare hours. Subsequent models indicated that the conditional associations between household disorganization and less optimal outcomes at age five were mediated by conditional links between disorganization and less optimal executive functioning.

Keywords

Childcare; Household Chaos; Executive Function; Social Development; Cognitive Development

Children growing up in low-income ecologies often face multiple risk factors that can have negative impacts on their cognitive and social development (Dearing, Berry, & Zaslow, 2008; Evans, 2004). In particular, children in families facing economic adversity are more likely to experience chaotic home environments, marked by high levels of disorganization and instability (Bradley & Corwyn, 2002; Vernon-Feagans, Garrett-Peters, DeMarco, & Bratsch-Hines, 2012). Notably, young children raised in such contexts also spend substantial amounts of time in settings outside of their homes, like childcare. In the U.S., approximately 43% children in poverty attend regular non-parental care by nine months of age (Capizzano & Adams, 2003). There is a growing indication that such childcare experiences may play a buffering role against the detrimental effects of high-risk contexts on children's development. Using data from a representative sample of children from two poor, rural regions of the US, the first aim of the present study was to consider whether links between early household chaos and children's subsequent cognitive and social development were mitigated by their early childcare experiences. Our second aim was to test the extent to which these (conditional) relations with children's broader cognitive and social outcomes were explained by links between these early experiences on children's development of executive functioning—a potentially key mechanism that shows notable growth across early childhood (Willoughby, Wirth, & Blair, 2012).

Low-Income Contexts, Chaos, & Development

Families experiencing material hardship often face a variety of stressors that can negatively impact the organization and predictability of children's day-to-day experiences at home (Evans & Wachs, 2010). In the sample considered in the present study, for example, parents from families that are near or below the poverty line are more likely to be employed in lower-paying, service-sector jobs. Such employment often entails irregular and inconsistent work hours that make it more difficult to establish regular, organized family routines (Vernon-Feagans, Garrett-Peters, et al., 2012). Low-income families also have less access to more spacious and higher quality living spaces. As such, on average, they tend to experience environments that are more densely populated, noisier, and disorganized (Evans, 2004; Evans & English, 2002). Children from low-income contexts are also more apt to face higher levels of household transience, as individuals join and leave the household (Vernon-Feagans et al., 2012). Collectively, these aspects of disorganization, unpredictability, and instability are often considered under the umbrella term *chaos* (Evans & Wachs, 2010).

There is considerable evidence that chaotic home environments are associated with less optimal cognitive and socio-emotional development in childhood. Based on findings from

studies using one of the most common measures of household chaos—the Chaos, Hubbub, and Order Scale (CHAOS; Matheney, Wachs, Ludwig, & Phillips, 1995)—higher levels of parent-rated household chaos in kindergarten have been linked with lower child IQ and worse conduct problems in first grade (Deater-Deckard, Mullineaux, Beekman, Petrill, Schatschneider, & Thompson, 2009). Similar associations are evident between self-reported household chaos in middle-childhood and children's subsequent levels academic achievement and problematic behavior at age 12 (Hanscombe, Haworth, Davis, Jaffee, & Plomin, 2011; Jaffee, Hanscombe, Haworth, Davis, & Plomin, 2012).

Links between chaos and cognition also extend to chaos measured as a function of its component parts—such as instability and disorganization. For instance, in prior work with the same sample of children as used in the present study, Vernon-Feagans and colleagues (Vernon-Feagans, Garrett-Peters, et al., 2012) measured household chaos using composite measures comprised of largely observer ratings of household instability and disorganization (see description in *Measures*), and found that higher levels of household disorganization (though not instability) in early childhood were predictive of lower levels of receptive and expressive vocabulary at the age of three. Similar relations are evident between household crowding and general measures of children's cognitive development in early childhood (Evans et al., 2010), and between household instability and behavior problems in adolescence (Marcynyszyn, Evans, & Eckenrode, 2008). Indeed, using long-term longitudinal data from the *Panel Study of Income Dynamics* (PSID), Dunifon, Duncan, and Brooks-Gunn (2001) found that household disorder and uncleanliness in childhood was predictive of children's lower levels of educational attainment and earnings upwards of 25 years later.

The mechanisms linking household chaos with less optimal developmental outcomes remain somewhat unclear. These relations are likely partially explained by the secondary effects of household chaos on parents' abilities to accurately read, interpret, and respond to their children's needs. Indeed, in prior work with the same data used in the present study, links between observed household chaos and children's emerging language abilities were partially explained by indirect effects of chaos on maternal sensitivity (Vernon-Feagans, Garrett-Peters, et al., 2012). Notably, there was also evidence of direct relations between household chaos and these language outcomes, after adjusting for maternal sensitivity and a wide array of potential confounds.

Such direct relations between chaos and children's development are consistent with theoretical work positing that household chaos has direct effects on children's abilities to regulate attention and arousal (Evans & Wachs, 2010). For instance, some have proposed that children raised in chaotic environments may adapt to these contexts by shifting their attention away from over-stimulating and unpredictable stimuli, essentially “tuning out” from the environment (Evans, 2006). In the short term, this may be an adaptive solution to down-regulate over-arousal. In the long term, however, it may also reduce their exposure to important aspects of socialization and, in turn, negatively affect children's cognitive and socio-emotional development. In particular, dyadic exchanges between young children and important adults are thought to support young children's abilities to maintain and volitionally control their attention (Conway & Stifter, 2012). As above, children facing more chaotic environments tend to experience fewer and lower quality interactions with caregivers

in the home (Vernon-Feagans, Garrett-Peters, et al., 2012). Further, when they do occur, the unpredictability and over-stimulation of these environments presumably render such exchanges comparatively less supportive.

Aspects of the environment that are not acutely overwhelming or unpredictable, per se, may have similar effects on children's abilities regulate attention and emotion. For instance, experimental work has shown that ambient noise as seemingly benign as the consistent din of a television playing in the background can have pronounced negative effects on toddlers' abilities to maintain sustained attention during typical play (Schmidt, Pempek, Kirkorian, Lund, & Anderson, 2008)—a building block to the development of more volitional aspects of executive attentional control (Blair, Berry, & Freidman, 2012; Posner & Rothbart, 2007). These findings are consistent with several studies showing links between chronic noise exposure and poorer attention with older children and adults (Evans, 2006).

Highly chaotic environments may affect children's language and early literacy development through similar mechanisms. Overstimulation—perhaps mediated through children's taxed attentional and executive systems—may challenge young children's ability to encode, process, and interpret linguistic information (Evans, Maxwell, & Heart, 1999). Although (to our knowledge) such indirect relations have yet to be tested empirically, several studies have noted moderate to strong links between better executive functioning and larger receptive vocabularies in early childhood (Blair & Razza, 2007; Hughes & Ensor, 2007).

As noted above, although direct associations are evident between household chaos and children's subsequent social development (e.g., externalizing problems), these relations may similarly be partially explained by links between household chaos and children's emerging executive-functioning abilities. Converging evidence across early childhood and beyond suggests that effective executive-functioning skills are associated with lower levels of externalizing-type behaviors (Hughes & Ensor, 2011; Schoemaker, Mulder, Dekovi, & Matthys, 2013).

Thus, taken together, theory and accumulating evidence suggests that household chaos is predictive of less optimal cognitive and social development. Although the mechanisms underlying these relations are less clear, links between household chaos and children's broader cognitive and social development may be partially explained by the negative relation between household chaos and children's emerging executive-functioning abilities.

Low-Income Contexts, Childcare, and Development

Notably, young children raised in high-risk contexts spend substantial amounts of time in environments outside of their homes in some sort of formal (i.e., center-based) or informal (e.g., home-based, neighbor, relative) non-parental childcare. A growing number of findings from large-scale longitudinal studies of children in context suggest that children's childcare experiences may play a buffering role against the detrimental effects of high-risk contexts on development. For example, consistent with a buffering hypothesis, Geoffroy and colleagues (2007) found that attending full-time, non-maternal care in the first year of life—broadly defined as any non-parental care—mitigated the link between low socio-economic status

(SES) and lower levels of receptive vocabulary at age four. Specifically, on average, children from low-SES contexts who did not attend childcare tended to show comparatively much lower receptive language skills than their more affluent peers. In contrast, low-SES children who attended full-time childcare tended to show receptive language skills that were indistinguishable from their high-SES counterparts. Further, there was some indication that childcare dosage may be critical. For instance, these conditional effects were descriptively similar, but much less pronounced and statistically non-significant for children attending only part-time childcare (<25 hours).

Using a different sample, this same research group provided evidence that childcare type may also play a meaningful role (Geoffroy et al., 2010). For instance, they found a similar buffering-type relation with respect to receptive vocabulary in kindergarten; however, this relation was only evident for those attending formal ‘center-based’ or ‘school-like’ childcare. Notably this conditionality differed somewhat across outcomes. For reading and math abilities, there was some indication of an ordinal relation, such that for children with mothers with low levels of educational attainment, those attending informal childcare fared better than those attending no childcare and those attending formal childcare performed better than either of these groups. As such, although the protective role of non-formal childcare has been largely mixed, there is at least some indication that formal center-based care may be a particularly salient protective factor for the cognitive development of children growing in up higher risk contexts.

Notably, these effects of childcare type may be partially explained by the fact that, on average, center-based tends to provide somewhat higher quality care than more informal arrangements—both with respect to indices of “process” quality (e.g., caregiver-child interactions) and some indices “structural” quality (e.g., predictable schedules, caregiver education; Dowsett, Huston, Imes, & Gennetian, 2008). Indeed, other works suggests that process quality may be a critical factor underlying the beneficial effects of childcare for children from higher risk contexts. For example, Dearing and colleagues (2009) found that greater exposure to high-quality childcare across early childhood (i.e., higher dosage) partially mitigated the link between low income contexts and lower levels of achievement. Similar findings are evident with respect to high-quality language environments in childcare. Using data from the same sample of children as the present study, Vernon-Feagans and colleagues (Vernon-Feagans, Bratsch-Hines, & FLP Key Investigators, 2013) found that high-quality teacher–child discourse in childcare bolstered the language development of those experiencing lower quality language environments at home.

There is also growing support for the buffering hypothesis in the context of children’s social development. Specifically, in contrast to some evidence suggesting that more extensive hours in childcare—that is, childcare *quantity*, irrespective of *quality*—may be associated with heightened levels of aggression (Belsky et al., 2007; Vandell et al., 2010), other work suggests that such relations may be quite different for children from high-risk contexts. Indeed, some findings suggest that the *direction* of the effects may differ. Attending greater hours of childcare may be beneficial for the social development of children from high-risk contexts.

Using a cumulative risk approach, Côté and colleagues (Côté, Borge, Geoffroy, Rutter, & Tremblay, 2008) reported that—quite similar to prototypical findings for middle- to upper-class families—attending non-maternal childcare (not differentiated by type or dose) in the first year of life was predictive of heightened levels of aggression in early childhood. However, this positive association was substantially attenuated for children from higher risk environments, with a descriptive indication that the effect reversed direction, such that non-maternal care was associated with *better* social outcomes for children with high levels of risk at home. Other work with low-income samples suggests that such buffering effects may be contingent on both dosage and childcare quality. For example, in low-income samples, more extensive hours in childcare have been linked to *lower* levels of internalizing and externalizing behavior—but, only when the quality of these childcare experience is high (Votruba-Drzal, Levine, & Chase-Lansdale, 2004). Although explicit measures of childcare quality were unavailable, using data from several welfare-reform experiments and a quasi-experimental instrumental variables approach, Crosby and colleagues (Crosby, Dowsett, Gennetian, & Huston, 2010) showed a quite similar effect with respect to exposure to center-based care. On average, children attending any center-based care—exclusively center-based-care or a mix of center-based and informal care—tended to show fewer externalizing problems than their peers receiving exclusively maternal care.

Although similar interaction effects have not been considered with respect to executive functioning (EF), there is good reason to expect similar relations. As above, high levels of chaos at home are theorized to undermine children's EF development in early childhood. On one hand, greater exposure to childcare may simply reduce children's exposure to chaos at home. There is also, however, reason to predict that aspects of childcare, such as children's interactions with sensitive and responsive caregivers—those whom effectively read, interpret, and respond to their children's needs—may actively support children's EF development. This may be particularly so for children from more chaotic homes who presumably need comparatively more support. Indeed, growing evidence from studies of parent-child interactions suggest that sensitive and responsive caregiving is predictive of more effective EF (Bernier, Carlson, & Whipple, 2010), even after accounting for children's prior EF abilities (Blair, Raver, & Berry, 2014).

Taken together, increasing evidence indicates that children's childcare experiences may buffer them against the developmental effects of high-risk environments. Although some work suggests that this may be particularly the case for those attending high-quality care (Dearing et al., 2009; Votruba-Drzal et al., 2004)—measured typically as having a sensitive and responsive caregiver—and “formal care” taking place in a childcare center (Crosby et al., 2010), variability with respect to study design, measures, and populations make it difficult to disentangle whether such conditional relations are driven by childcare exposure *writ large*, or whether they may be contingent on childcare quality and/or type.

The Present Study

In summary, accumulating evidence suggests that children from more chaotic home environments are at heightened risk from less optimal cognitive and social development in childhood. Yet, there is also an indication that links between higher-risk home environments

— typically measured using broad-scale distal indicators of risk (e.g., family income, maternal education)—may be attenuated for children attending childcare. This may be particularly the case for children attending high-quality childcare (Dearing et al., 2009; Votruba-Drzal et al., 2004) and/or center-based care (Geoffroy et al., 2010). The aim of the present study is to test the extent to which the predicted associations between levels of household chaos—characterized as disorganization and instability—and less optimal cognitive and social outcomes prior to school-entry are attenuated by children’s childcare experiences. Consistent with the idea of “moderated mediation” (Preacher, Rucker, & Hayes, 2007), a secondary aim was to test the extent to which the interactions between household chaos and childcare experiences in the prediction of age-five (~58 months of age) could be explained by similar interactive effects on children’s executive-functioning abilities (~48 months of age). That is, we hypothesized that childcare quantity and caregiver sensitivity (respectively) would interact with household chaos to predict executive functioning at 48 months, and through this relation, predict children’s cognitive and social outcomes at age 58 months. We considered the potential moderating role of center-based childcare to be exploratory. On one hand, center-based care has been linked with developmental supports (e.g., predictable schedules, better trained caregivers; Fuller, Kagan, Loeb, & Chang, 2004) and some evidence suggest buffering effects may be contingent on childcare being center-based (Crosby et al., 2010; Geoffroy et al., 2010). On the other, center-based care is also associated with potential challenges to children’s cognitive and social development (e.g., large peer groups; Morrissey, 2010), and the extant findings typically fail to adjust for the conflation of childcare type and quality.

Method

Participants

The Family Life Project (FLP) was designed to study young children and their families in two of the four major geographical areas of the United States with high poverty—Eastern North Carolina (NC) and Central Pennsylvania (PA). Sampling was based on a developmental epidemiological design in order to recruit a representative sample of 1,292 children (50% female) whose families resided in one of the six counties at the time of the child’s birth. Low-income families in both states and African American families in NC were over-sampled; sampling weights were included in all analyses to account for the sampling plan. Interested readers are referred to Vernon-Feagans and colleagues (Vernon-Feagans, Cox, & FLP Key Investigators, 2013) for exhaustive coverage of the sampling plan and demographics of the participating families.

The analytic sample comprises the 1,235 children who provided childcare data during at least one of the four points in which childcare data was collected between 7 and 36 months of age. Like the original sample, the analytic sample comprises predominantly low-income families. Mean family income-to-needs ratio was approximately 1.86 ($SD = 1.73$), where one represents the federal poverty threshold and income-to-needs ratios between one and two are typically considered ‘near poor’ or ‘working poor.’ Approximately, 34% of families were at or below the Federal poverty line. Although there was variability in maternal education, on average, participating mothers had approximately 14 years of schooling ($SD =$

2.82). Reflecting the two sites from which the populations were sampled, children from the rural Pennsylvania site were almost exclusively white (94%), whereas the NC site showed more racial heterogeneity (67% African American). The analytic sample did not differ from the original sample with respect to gender, race, family income-to-needs, or primary-caregiver education.

Procedures

The present study focused on data collected between infancy and approximately 58 months of age (hereafter, age five). Target children's primary caregivers (99.6% biological mothers) were interviewed during a home visit by a single research assistant when their children were approximately 2 months of age. Two research assistants conducted home visits twice, when their children were approximately 7, 24, and 36 months, and once when children were 15 months of age. During the home visits, research assistants conducted interviews with mothers and assessments with the target children. Observational measures of parenting behavior during a semi-structured parent-child play task were also videotaped during these visits when target children were approximately 7, 15, 24, and 36 months of age. Between the ages of 7 and 36 months, when children were in non-parental care for at least 10 hours per week, the interactions between the childcare caregiver and child were rated for caregiver quality by independent raters. During a home-visit when the target child was approximately 48 months of age, children were administered an executive functioning (EF) battery. When children were in approximately 5-years old, research assistants administered assessments of children's language, math and reading abilities and interviewed teachers regarding several aspects of children's behavior. If children did not attend childcare at age five (i.e., 10 hours in non-parental care), child assessments were conducted in the child's home. Teacher assessments of children's behavior are available only for children attending childcare at the age-five data-collection period (~67% of sample; see Missing Data).

Measures

Executive functions (EF)—At 48-months of age, children were administered a battery of six executive function tasks, collectively tapping inhibitory control, working memory, and attention shifting. The administration procedures and psychometric characteristics of these tasks are described in detail by Willoughby et al. (2012). As in prior work, we modeled EF as a single latent factor theorized to explain children's common abilities across the six EF tasks (robust FIML estimator; Mplus 5.21; Muthén & Muthén, 2009). This common-factor Confirmatory Factor Analytic (CFA) model fit the data reasonably well ($\chi^2 = 18.47$, $df = 9$, $p = .03$, CFI = .97, RMSEA = .03, SRMR = .03). There was statistically significant variability in children's latent EF abilities ($\phi = .114$, $p < .001$). Each of the loadings was in the theorized direction, statistically significant, and corresponded to standardized loadings ranging from .35 and .59.

Receptive vocabulary—When children were approximately five-years old, their receptive vocabularies were measured by raters using the Peabody Picture Vocabulary Test —4 (PPVT; Dunn & Dunn, 2007), a commonly utilized and validated measure of children's language development. Standardized scores were used; higher scores reflect more advanced

receptive vocabularies. The psychometric properties of the PPVT are well-established (Dunn & Dunn, 2007).

Academic achievement—Data on academic achievement were also collected at age-five using *W scores* from the Woodcock-Johnson Tests of Achievement III Applied Problems, Quantitative Concepts, and Letter-Word Identification subtests. The WJ III is a co-normed set of tests for measuring general scholastic aptitude, oral language, and academic achievement. The validity and reliability of the WJ III tests of achievement have been established elsewhere (Woodcock, McGrew, & Mather, 2001). We modeled academic achievement as a common factor, representing skills common across the three observed scales: Letter-Word ID, Quantitative Concepts, and Applied Problems. There was statistically significant variation in children's academic achievement levels ($\phi = 4.00$, $p < .001$). The standardized loadings ranged between .72 and .93.

Social problems—We modeled children's social problems as a latent factor comprising teachers' ratings across four scales from three measures of children's behavior problems and social competences. Specifically, we used the Conduct Problems and Peer Problems scales from *Strengths and Difficulties Questionnaire* (SDQ; Bourdon, Goodman, Rae, Simpson, & Koretz, 2005) as two indicators in the CFA. The former comprises the sum of 5 Likert-type items (0–2) tapping aggressive, angry, and antisocial behaviors; the latter comprises the sum of five Likert-type items (0–2) tapping the extent to which the child gets along with and is liked by other children. Stone and colleagues (Stone, Otten, Engels, Vermulst, & Janssens, 2010) provide a comprehensive review of the reliability and validity of the teacher-reported SDQ, which shows acceptable internal consistency ($\alpha = .70$) and test-retest reliability ($r = .77$) for these scales. The Emotion Regulation subscale of the *Social Competence Scale* (Dodge, Petit, & Bates, 1994) was also included as an observed indicator. This scale comprises five Likert-type items (1–6) in which children are rated with respect to the extent to which they accept disappointment effectively and control negative emotions. Finally, we included ratings on the Aggressive-Oppositional Behavior scale of the *Teacher Observation of Child Adaptation-Revised* (TOCA-R; Werthamer-Larsson, Kellam, & Wheeler, 1991). This scale comprises five Likert-type items (1–6) in which children are rated with respect behaviors representing aggression, defiance, and antisocial behavior. Both the Emotion-Regulation and the Aggressive-Oppositional Behavior scale show acceptable internal consistency reliability in their validation samples ($\alpha = .83$ and $.92$, respectively). Given item-wording similarities across the Aggressive-Oppositional scale and the Conduct Problems scale, the residual covariances of these two scales were freely estimated. Natural log transformations were adopted for the Conduct Problems and Aggressive-Oppositional Scales, to adjust for skew. A common-factor model fit the data well ($\chi^2 = 10.28$, $df = 1$, $p = .001$; RMSEA = .09, CFI = .99, SRMR = .02). There was statistically significant variability in the latent factor ($\phi = 3.03$, $p < .001$), and the (absolute) standardized factor loadings ranged from (.45 – .90). Higher ratings represent more problematic behavior.

Household chaos—Informed by prior validation work (Vernon-Feagans, Garrett-Peters, et al., 2012), factor analysis suggested two well-defined chaos factors from 10 indicators. The first index is proposed to reflect *household instability* and comprises five indicators

collected during interviews with the primary caregiver at the 2, 7, 15, 24, and 36-month visits. Specifically, we calculated, standardized and averaged the number of changes in the following indicators from one time point to the next: (1) times the child moved to another residence, (2) changes in the primary caregiver, (3) changes in the secondary caregiver, (4) different people in the household, and (5) household members moved into or out of the household over this period. The index is scaled such that higher ratings represent more household instability.

The second index is proposed to represent *household disorganization* and comprises five indicators. Four were collected during the 2-, 7-, 24-, and 36-month visits: household density, visit preparedness, household cleanliness, and neighborhood noise. At each visit, the number of household rooms was divided by the number of people in the home to create time-specific household density score. Ratings of visit preparedness, household cleanliness, and neighborhood noise were based on consensus ratings by two research assistants, using the post-visit inventory designed by the Fast Track study (Dodge et al., 1994). A final indicator—TV hours per day—was measured at 2, 7, 15, 24, and 36 months, based on primary-caregiver reports. Each indicator was averaged over time, standardized, and averaged across indicators to create the household disorganization composite. Higher ratings represent higher levels of disorganization.

Childcare quantity—Children's primary caregivers provided the average hours per week that the child attended childcare, when the child was 7-, 15-, 24-, and 36-months old. We operationalized childcare quantity as the average number of childcare hours per week, averaged across the four measurements between the ages of 7- and 36-months old. We divided childcare hours by ten, to reduce the required decimal places; the figures are on the original scale.

Caregiver responsivity—As traditional measures of childcare quality, such as the ECERS (Harms & Clifford, 1980) or the ORCE (NICHD ECCRN, 1996) were unavailable in these data, aspects of proximal quality were measured using independent ratings of caregivers' behavior toward the child, based on the Responsivity Scale of the Home Observation Measure of the Environment scale (HOME; Caldwell & Bradley, 1984). HOME scale observations were made when the child was 7-, 15-, 24- and 36-months old. The infant/toddler version was used at the 7- through 24-month observations. Informed by prior work (Caldwell & Bradley, 1984), we created a Caregiver Responsivity subscale, using 10 items tapping caregiver responsiveness and affection toward the child (e.g., caregiver holds child close; caregiver vocalizes to child; caregiver cuddles child, etc.). A similar strategy was adopted for seven items included in the preschool version of the measure. We hypothesized that a single latent factor explained observed caregiver responsivity across the items within a given time point. We fitted a longitudinal CFA model across the four time points, using a robust weighted least squares estimator (WLSMV; Mplus 5.2). The residual variances for common indicators were freely estimated over time, as were the covariances between the latent factors. The model fit the data well ($\chi^2 = 89.41$, $df = 73$, $p = .09$; CFI = .96, RMSEA = .02). All loadings were statistically significant and in the expected direction, with the

standardized loadings ranging from .54 to .85. These data were aggregated by estimating the factor scores at each time, standardizing, and averaging across time.

Childcare type—Childcare type was reported by the childcare caregiver and was designated as center- versus other-based care using dummy-codes at 7-, 15- 24-, and 36-months old. Center-based care represents formal care occurring in an organizational and physical structure designed expressly for childcare, regardless of auspice. Other-based care represents all other informal care settings (e.g., family day care, nanny, relative) and includes parent care. We aggregated these data as the number of spells—of the four time points measured—in which the child was reported to be in center-based care. Sensitivity checks of these operationalizations are provided in the online supplementary materials.

Control covariates—Informed by prior studies (Vandell et al., 2010) and/or evidence of modest empirical associations with our main predictors, we included a variety of child and family covariates in all regression models, in an attempt to reduce unobserved variables bias. These measures are described in detail in the online supplementary materials.

Infant traits: Child gender and race were dummy coded, such that male and African American children were each coded as 1. *Temperament:* Infant temperament was measured using the estimated factor scores from a CFA-based composite measure comprising three observer and parental reports. *Mental Development:* Infant mental development at seven months of age was measured using the Mental Development Index (MDI) scores on the Bayley Scales of Mental Development (Bayley, 1969). Higher scores represent more developmentally advanced abilities.

Maternal/family traits: At the age of two months, primary-caregiver reading ability was measured using the *KFAST* literacy screener (Kaufman & Kaufman, 1994). Higher scores indicate better reading skills. Positive parenting was based on the average of observer ratings of positive parenting during semi-structured play tasks conducted at 7, 15, 24, and 36 months of age (Cox, Paley, Burchinal, & Payne, 1999; Mills-Koonce et al., 2011). The primary caregiver's age at the birth of the target child, as well as her age when she had her first child, were included as covariates. Each was scaled in years. Dummy variables indicating receipt of Temporary Assistance to Needy Families (TANF), Supplementary Nutrition Assistance Program (SNAP) or Medicaid support (respectively) were also included in the model. For each, receipt of funding is coded as 1. *Research Site:* The NC site was dummy coded as 1.

Missing Data

Missing data were modest. For instance, 96% of children had data with respect to childcare quantity during at least one of the four measurement periods. Of these 1,235 children with at least one spell of childcare data, missing data with regard to childcare quantity ranged between 3% to 9% across the four measurement periods. Of those with a spell of childcare (i.e., 10 or more hours), missing data for estimated caregiver responsivity was 19% and missing data for those reporting center-based versus non-center-based care ranged from 23% to 31%. Approximately 9% of children were missing data on either of the two chaos

composites. Children not attending childcare at the 58-month assessment (~35% of children) are missing data for the social problems indicator, given that they are based on teacher reports. Notably, of the 30 variables tested as potential predictors of this missingness, only four showed any relation with missingness—all of them modest ($r < .15$). As these variables were also potential confounds with respect to selection bias, they were included in our control covariate model. To adjust for potential biases due to missing data, we used a robust FIML estimator in all analyses (Mplus, 5.21; Muthén & Muthén, 2009). To the extent to which the MAR assumption that missingness is *conditionally random* after adjusting for all of variables in the model is plausible, our estimates should not be biased by missingness (Enders, 2010).

Data-Analytic Plan

Our analytic plan consisted of two parts. Our first aim was to test whether the respective relations between household chaos and less optimal cognitive and social development in early childhood were mitigated by children's childcare experiences (quantity, type, caregiver responsivity). Specifically, in a taxonomy of models, we first regressed the given child outcome on the two household chaos composites (i.e., disorganization and instability), as well as a vector of control covariates. We subsequently introduced the main effects of the childcare quantity, type, and caregiver responsivity into the model. In series of separate models, we subsequently allowed the effect of household disorganization to vary as a function of childcare quantity, type, and caregiver responsivity by introducing these respective two-way interaction terms into the model. We then tested an identical series of interaction models between household instability and these childcare variables. We adjusted for false-discovery rates for families of analyses—for instance, the eight interactions between childcare quantity, the two household chaos composites, and four outcomes—by using Benjamini-Hochberg adjustments (marked “*p_{bh}*” Benjamini & Hochberg, 1995) calculated using the *multtest* package in *R* (Pollard, Gilbert, Ge, Taylor, & Dudoit, 2013). Finally, as a sensitivity check, we considered the extent to the respective caregiver responsivity and type effects were potentially conditional on childcare “dose” by testing two-way and three-way interactions between each of these variables, childcare quantity, and household chaos. We also tested a series of similar 2- and 3-way interactions testing the extent to which household chaos and/or childcare effects varied as a function of parental sensitivity. As no such relations were evident, we do not discuss them further. The most parsimonious “final” models from this set of analyses are displayed in Table 2 (see Supplementary Materials for full taxonomies of models).

All predictor variables were centered on their respective grand means. All models were fitted using the robust maximum likelihood estimator available in Mplus (Muthén & Muthén, 2009). All comparisons of nested models were based on Satorra-Bentler (S-B; Satorra & Bentler, 2001) adjusted likelihood ratio tests. Although classroom nesting was minimal (see Online Supplemental Material), Huber-White sandwich adjustments were made to account for any non-independence. Per convention, we probed statistically significant interactions at one standard deviation below (i.e., low chaos) and one standard deviation above (i.e., high chaos) the household chaos mean using tests of model constraints. Given the non-normal distribution of childcare hours, we probed these interactions at the 25th and 75th percentiles.

In subsequent models, we tested whether the respective relations between household chaos and the broader cognitive and behavioral outcomes at the age of five (conditional on childcare hours) were mediated by the conditional relation between household chaos and executive functioning by fitting mediation models similar to Figure 1. Specifically, in separate models we centered childcare hours as low (25th percentile) and high (75th percentile), so that the regression parameter for household chaos (i.e., path *a*) represented the simple slope for chaos (conditional on these respective levels of childcare hours, respectively). We then estimated the product of the fitted regression (i.e., $a * b$) parameters comprising conditional indirect pathway and bootstrapped a standard error to determine its statistical significance (1,000 iterations).

Results Preliminary Analyses

Children spent approximately 20.90 hours ($SD = 16.31$) in childcare per week, on average, between 7 and 36 months of age (Table 1). Just over a third of the children (35%) were in 10 or fewer hours of care per week, and approximately a third of the children (32%) were in 30 or more hours of childcare per week. On average, children tended to spend greater hours in childcare per week at older ages; rank-order stability was moderate to rather strong over this period ($r = .35$, $p < .001$ to $.61$, $p < .001$). Approximately 22% of the children attended at least two (of four) occasions in center-based care. Children spending more hours in childcare per week and those spending a greater proportion of their time in center-based care tended to less responsive caregivers, on average ($r = -.16$; $p < 0.001$ and $r = -.28$; $p < .001$, respectively). Although the associations were modest, children from more disorganized households also tended to attend fewer hours in childcare ($r = -.17$, $p < .001$), fewer spells in center-based care ($r = -.11$, $p < .001$) and experience less responsive caregiving (when they did attend; $r = -.22$, $p < .001$). Higher levels of household instability were modestly associated with experiencing less responsive care ($r = -.10$, $p < .001$).

The outcome variables all showed statistically significant inter-correlations in the expected directions, ranging from somewhat moderate (Table 1; $r = -.28$, $p < .001$) to rather strong ($r = .79$, $p < .001$). Across these outcomes, more responsive caregiving tended to be associated—albeit, modestly—with more optional cognitive and social development. Relations between childcare hours and type were much more inconsistent; however, there was some indications that greater hours in childcare ($r = .10$, $p = .01$) and greater spells in center-based care ($r = .15$, $p < .001$) were associated with more problematic social behavior.

Chaos, Childcare, and Early Childhood Cognitive and Social Development

Executive function—Preliminary models testing only the main-effects of household chaos and children's childcare experiences on executive functioning indicated a modest statistically significant negative relation between heightened levels of disorganization and less effective executive functioning. Household instability was not predictive of executive functioning, nor did any main-effect relations emerge for caregiver responsiveness, quantity, or type (see Table S2). However, subsequent models (Table 2, M1) indicated an interaction effect, such the relation between household disorganization and executive function was moderated by childcare quantity ($B = .03$, $p_{bh} = .04$, $R^2 = .01$). As shown in Figure 2, for children from highly disorganized homes (mean $+1$ SD), greater hours in childcare were

predictive of more effective executive functioning ($B_{high_disorg} = .04$; $S-B \chi^2 = 7.03$, $df = 1$, $p = .008$). This corresponded to a standardized simple slope of .21. In contrast, for those with low levels of disorganization, the relation between childcare quantity and executive functioning was not statistically significant ($B = -.002$, $p = .74$; $\beta = -.01$).

As indicated by the vertical distance between the two slopes for those attending 5 hours of childcare per week on average (25th percentile), higher levels of household disorganization were predictive of lower levels of executive functioning for those attending low hours of childcare ($B_{low_cc} = -.11$; $S-B \chi^2 = 12.14$, $df = 1$, $p < .001$). This corresponded to a standardized simple slope of approximately $-.26$. In contrast, the relation between household disorganization and executive functioning was attenuated to the point of statistical non-significance for those attending 35 hours of childcare per week, on average ($B_{hi_cc} = -.01$, $p = .97$; $\beta = -.01$).

There was no evidence of interactive effects between either of the two chaos variables with caregiver responsivity or type, nor was there any indication of higher-order interactions, such that effects of childcare type or caregiver responsivity varied both as a function of household chaos and childcare quantity (i.e., “dose”). Collectively, this model explained 44% of the variation in children’s executive-functioning abilities—approximately 7% of this total variation was explained by the household chaos and the childcare variables.

Receptive vocabulary—Preliminary models indicated a negative main-effect association for household disorganization; however, household instability was unrelated (see Table S3). Of the childcare variables, only caregiver responsivity was associated with receptive vocabulary, after adjusting for the control covariates. More responsive caregiving was predictive of better receptive vocabulary ($B = 1.79$, $p_{bh} = .03$, $\beta = .10$). Similar to the finding for executive functioning, subsequent models indicated a statistically significant interaction between household disorganization and childcare hours (Table 2, M2; $B = 1.49$, $p_{bh} = .02$; $R^2 = .01$).

As displayed in Figure 3, for children from highly disorganized homes, greater hours in childcare were predictive of better receptive vocabulary ($B_{high_disorg} = .92$; $S-B \chi^2 = 4.524$, $df = 1$, $p = .03$). This corresponded to a standardized simple slope of .10. In contrast, for those with low levels of disorganization, the relation between childcare quantity and receptive vocabulary was not statistically significant ($B_{low_disorg} = -.57$, $p = .28$; $\beta = -.06$).

The parallel interpretation of the interaction similarly indicated that higher levels of household disorganization were predictive of lower levels of receptive vocabulary for those attending low hours of childcare (5 hours; $B_{lo_cc} = -5.34$; $S-B \chi^2 = 13.93$, $df = 1$, $p < .001$; $\beta = -.22$), yet that the effect of disorganization was attenuated to the point of statistical non-significance in the context of full-time care (35 hours; $B_{hi_cc} = 1.32$, $p = .34$; $\beta = -.05$).

There was no evidence of interactive effects between either of the two chaos variables with caregiver responsivity or type, nor was there any indication of higher-order interactions. Collectively, this model explained 36% of the variation in children’s receptive vocabularies

—8% of this total variation was explained by the household chaos and the childcare variables.

Academic achievement—As shown in Table 2 (M3; see also Table S4), there was no evidence of interaction effects between either measures of household chaos and childcare quantity, or caregiver responsivity or type. Similarly, no higher-order interactions were evident. There was, however, some indication that, conditioning on all the other variables in the model, there was a modest main-effect association between higher levels of household disorganization and lower levels of academic achievement ($B = .54, p < .001; \beta = -.19$). Collectively, this model explained 39% of the variation in children's latent academic achievement levels; although only 3% of this total variation was accounted for by household disorganization.

Social problems—Preliminary models indicated a negative main-effect association for household instability, but not for household disorganization, after adjusting for the other covariates and childcare variables. Of the childcare variables, attending greater numbers of spells in center-based care was predictive of worse social problems, after adjusting for household instability and disorganization. No other childcare effects were evident (Table S5).

Subsequent models testing the interactive effects of the two measures of household chaos as a function of children's childcare experiences indicated that the relation between household disorganization and children's social problems was significantly moderated by childcare quantity (Table 2, M4; $B = -0.23, p_{bh} = .02; R^2 = .02$). For children from highly disorganized homes, greater hours in childcare were predictive of less problematic social behavior (Figure 4; $B_{high_disorg} = -.23; S-B \chi^2 = 8.55, df = 1, p = .003$). This corresponded to a standardized simple slope of $-.21$. In contrast, for those with low levels of disorganization, the relation was not statistically distinguishable from zero ($B_{low_disorg} = .09, p = .32; \beta = .08$).

The parallel interpretation of the interaction similarly indicated that higher levels of household disorganization were predictive of lower levels of receptive vocabulary for those attending low hours of childcare (5 hours; $B_{lo_cc} = .65, S-B \chi^2 = 7.61, df = 1, p = .006; \beta = .32$), yet that the effect of disorganization was attenuated to the point of statistical non-significance in the context of full-time care (35 hours; $B_{hi_cc} = -.15, p = .50; \beta = -.07$).

There was no evidence of interactive effects between either of the two chaos variables with caregiver responsivity or type, nor was there any indication of higher-order interactions. There were, however, main effects evident for household instability and childcare type in the "final" model. Controlling for the other variables in the model, children with greater levels of instability in their households between 2 and 35 months of age ($B = .38, p_{bh} < .001, \beta = .19$) and those who attended more spells in center-based care ($B = .25, p_{bh} < .001, \beta = .12$) tended to show higher levels of social problems at the age of five. Collectively, this model explained 22% of the variation in children's latent social problems—approximately 24% of this total variation was explained by the household chaos and the childcare variables.

Household Chaos*Childcare Hours→ Executive Functioning→ Pre-K Outcomes

In summary, two of the three age-five outcomes showed statistical interactions between household disorganization and childcare hours that were substantively very similar to the statistical interaction evident for children's 48-month executive functioning. To test whether the conditional relation between household disorganization and receptive vocabulary at the age of five was mediated by 48-month executive functioning *when childcare hours were low*, we centered childcare hours at the 25th percentile and estimated the 95% confidence interval for the product the regression parameters comprising the (conditional) indirect association. We subsequently fitted an identical model, but centered childcare hours on the 75th percentile of childcare hours, thus making the regression parameter linking household disorganization and executive functioning, *conditional on high hours of childcare*.

First, executive functioning at 48-months was positively associated with larger receptive vocabularies at the age of five ($B = 26.68$, $p < .001$; $\beta = .60$). In the context of low hours of care, there was a statistically significant negative indirect relation between household disorganization and receptive vocabulary via executive functioning ($B_{indirect} = -3.42$, $[-5.63, -1.51]$). On average, for children attending few hours in childcare, higher levels of household disorganization were predictive of less effective executive functioning. In turn, less effective executive functioning was predictive of less developed receptive vocabularies at the age of five. This indirect relation corresponded to a standardized conditional indirect association of $-.14$. In contrast, in the context of high hours of childcare, no indirect ($B_{indirect} = -.23$ $[-2.45, 1.99]$ or direct ($B = -.01$, $p = .84$) relations between household disorganization and receptive vocabulary were evident.

Virtually identical trends emerged across the remaining age-five outcomes. Executive functioning at 48-months was negatively associated with children's social problems at the age of five ($B = -1.98$, $p < .001$; $\beta = -.37$). Household disorganization showed a statistically significant positive indirect association with children's age-five social problems, in the context of low hours of childcare ($B = .23$, $[.08, .44]$, $\beta = .08$). For children attending low childcare hours, highly disorganized households were predictive of less effective executive functioning at 48-months of age and, in turn, greater social problems at the age of five. In contrast, for children who attended high hours of childcare, there were no indirect ($B_{indirect} = -.01$ $[-.23, .10]$ or direct ($B = -.05$, $p = .52$) relation between disorganization and social problems.

Although the negative relation between household disorganization and academic achievement was not moderated by any of the childcare variables, there was evidence of a statistically significant conditional indirect association between household disorganization and academic achievement via executive functioning. On average, more effective executive functioning at 48-months was associated with higher levels of academic achievement at the age of five ($B = 3.73$, $p < .001$; $\beta = .63$). In the context of low childcare hours, higher levels of household disorganization were predictive of less effective executive functioning and, in turn, lower levels of academic achievement at the age of five ($B_{indirect} = -.35$ $[-.65, -.07]$, $\beta = -.11$). There was no indirect relation, in the context of high childcare hours ($B_{indirect} = .13$ $[-.18, .43]$).

Discussion

Considerable evidence suggests that disorganization, unpredictability, and instability in the home—collectively, termed chaos—are predictive of less optimal social and cognitive development (Deater-Deckard et al., 2009; Hanscombe et al., 2011; Hughes & Ensor, 2009; Jaffee et al., 2012; Vernon-Feagans, Garrett-Peters, et al., 2012). However, a growing literature also suggests that children's early experiences in childcare may play a buffering role against the negative effects of high-risk contexts (Berry et al., 2014; Côté et al., 2008; Votruba-Drzal et al., 2004). The aims of the present study were to test whether relations between household chaos across infancy and early childhood and children's social and cognitive development at age five were mitigated by their experiences in childcare—quantity, type, and caregiver responsiveness. A second aim was to test whether the conditional relations between household chaos and these outcomes were explained by links between household chaos and less optimal executive functioning.

There was evidence of a fairly consistent interaction between household disorganization and children's hours in non-parental childcare, across multiple measures of children's cognitive and social development. For children experiencing low levels of disorganization at home across infancy and early childhood, greater hours of weekly childcare were largely unassociated with children's cognitive or social development. In contrast, for children experiencing highly disorganized households over this period, there was consistent evidence of a dose-response relation between greater hours of childcare per week and comparatively more optimal cognitive and social outcomes.

These findings add to a growing literature suggesting that the magnitude (and sometimes the direction) of the association between children's childcare experiences and their subsequent development may be quite different for children experiencing broader environmental risk factors (Côté et al., 2008; Crosby et al., 2010; Dearing et al., 2009; Votruba-Drzal et al., 2004). Critically, they also provide some support for the buffering hypothesis. For those attending little to no childcare, household disorganization was predictive of less effective executive functioning, smaller receptive vocabularies, and more problematic social behavior. However, consistent with the idea that children's childcare experiences may buffer them against the detrimental effects of chaos experienced at home, the respective associations between household disorganization and each of these outcomes was attenuated for those spending more time in childcare per week. Indeed, in each case, the effect of household disorganization was attenuated to the point of statistical non-significance for children attending full-time childcare (i.e., 35 hours per week).

Notably, building on prior work indicating that executive functioning abilities play an important role in children's broader cognitive (Blair & Razza, 2007) and social development (Hughes & Ensor, 2011), there was also consistent evidence that the respective conditional relations between household disorganization with children's subsequent receptive vocabulary and social problems were mediated by (conditional) links between household disorganization and executive functioning. In the context of low hours of childcare, high levels of household disorganization were predictive less effective executive functioning, and, in turn, smaller receptive vocabularies, lower levels of academic achievement, and more

problematic social behavior in at the age of five. Yet, in the context of higher childcare hours, no indirect associations were evident. That is, in theory, just as the substantively negative relation between household chaos and executive functioning might “spill over” and lead to less optimal social and cognitive outcomes for children attending fewer hours of childcare, the “protective” relation between greater hours in childcare and more optimal executive functioning for children from highly chaotic households appears to show secondary protective relations with children’s broader social and cognitive development.

Contrary to our hypotheses, links between caregiver responsivity and our outcomes were modest and inconsistent. Although zero-order correlations suggested that more responsive caregiving was associated with better cognitive and social outcomes, with the exception of receptive vocabulary, these relations dropped to statistical non-significance after adjusting for the effects of the other predictors. There was also no indication that the effects of caregiver responsivity were, perhaps, contingent on “dose,” as there was no evidence of higher-order interactions between caregiver responsivity and hours. These null relations were surprising. Ample prior evidence has linked higher quality childcare—often measured as the quality of caregiver–child interactions— with better cognitive outcomes across a wide developmental span (Vandell et al., 2010). Other work has shown “beneficial” relations between doses of high-quality care and young children’s social development (Votruba-Drzal et al., 2004).

This may be explained, in part, by our measure of caregiver responsivity. Traditional measures of childcare quality, such as the ORCE (NICHD ECCRN, 1996), were explicitly designed to measure caregiver sensitivity in the context of childcare settings. Although our aim was to tap very similar caregiver behaviors, our measure (HOME; Caldwell & Bradley, 1984) was originally designed for and validated in children’s own homes, rather than childcare. Collectively, our measure of caregiver responsivity may not capture the same aspects of childcare quality that have been found to be quite meaningful by others. Indeed, the inconsistency of our present findings with respect caregiver responsivity, as well as the typically modest effects established by more common indices of childcare quality, perhaps speak to a need to clarify the intersecting points of confluence in which several aspects of children’s experiences in childcare function together to support children’s development.

Our findings with respect to childcare type were also somewhat mixed and inconsistent. Like some prior work (Belsky et al., 2007), there was an indication that spending more spells in center-based care was associated with more problematic social behavior at the age of five. These relations were modest, yet were statistically significant after adjusting for childcare quantity and caregiver responsivity, and there was no evidence that the effects of childcare type were moderated by either. Similarly, there was no evidence that the effect of childcare type was conditional on children’s level of chaos in the home. Given that childcare type was not predictive of executive functioning, these relations did not appear to be explained by indirect relations via executive functioning. Although the differences in the operationalizations of center-based care make it difficult to make direct comparisons, this is somewhat contrary to some prior work suggesting that the effect of attending pre-kindergarten on less optimal social outcomes may be less pronounced for children from higher risk contexts (Magnuson, Ruhm, & Waldfogel, 2007).

As raised by others (NICHD ECCRN, 2003), the fact that the (conditional) associations between childcare quantity and childcare type with these outcomes were robust—irrespective of caregiver responsiveness—leaves the mechanisms linking these childcare experiences and children's subsequent development somewhat unclear. On one hand, there are likely other aspects of children's experiences in childcare that were not measured in the present study. For instance, caregiver language quality has been linked to more optimal cognitive development in early childhood and prekindergarten—further, similar to the present findings, these relations are particularly pronounced for children with lower quality language environments at home (Vernon-Feagans, Bratsch-Hines, et al., 2013). Structure and predictability of the classroom context (i.e., lack of chaos) likely also play a role in mitigating the negative effects of household chaos on children's development. Measures of classroom chaos were unfortunately unavailable in these data. Given the assumption that childcare in this sample is comparatively less chaotic than are the home environments of children from highly chaotic household, the present interaction may actually reflect a dose-response relation between household chaos and these outcomes. Children spending more time in childcare are presumably receiving smaller doses of chaos at home. As such, the interaction might be better understood as the reduction of a home effect, rather than as a positive effect of childcare, per se. This, however, remains a question to be addressed directly.

Although there was a good deal of consistency with respect to the findings for household disorganization, relations between our second measure of chaos—household instability—and these outcomes were limited and inconsistent. This was unexpected, as we theorized that the movement of family members in and out of the household would serve as a broad stressor impacting adult-child relationships, as well making the psychosocial environment less predictable. Although similar null associations have been noted elsewhere (Berry, et al., 2014), the cause of the asymmetry in the findings across our two measures of chaos is unclear. One possibility is that the cumulative crowding, din, and general disorganization of the household that comprise the household disorganization scale are better markers of the types of proximal chaos that children experience consistently on a day-to-day basis over extended periods of time. In contrast, movements in an out of the household are comparatively rarer events. For instance, less than 5% of children experienced a change in their primary caregiver between birth and 36 months of age. Thus, the vast majority of children had at least one constant primary adult in their lives across this period—perhaps, a protective factor against the transience of other household members. Given that some work suggests links between instability and the behavior problems in adolescence (Marcynyszyn et al., 2008), clarifying the unique roles of varying domains of household chaos in early childhood remains a pressing area of future research.

The present findings were robust after conditioning on several covariates potentially linked to both children's childcare experiences and household chaos, with the childcare and household chaos variables explaining between 1% and 5% unique variation in these outcomes. Perhaps most notably, we also conditioned on parenting quality. Similar to prior work (NICHD ECCRN, 2003) parenting quality consistently predicted better developmental outcomes, irrespective of children's childcare experiences or environmental risk. Young children's experiences of household chaos and childcare were nonetheless associated with

several developmental outcomes, often with magnitudes similar to those for parenting. For instance, a standard deviation difference in parental sensitivity was uniquely associated with a .26 standard deviation difference in executive functioning. For those attending limited hours of childcare (i.e., 5 per week), the standardized effect of household disorganization was $-.29$. These unique relations between household chaos and children's cognitive and social development are consistent with the theoretical literature on environmental chaos, which posits that chaos likely has direct effects on children's abilities to regulate attention and modulate arousal (Evans & Wachs, 2010). Notably, despite our control model, the potential endogeneity inherent in our design precludes us from making any causal inferences.

Informed by theory and the limited extant empirical data (Hughes & Ensor, 2009), we hypothesized that the over-arousing and unpredictable nature of household chaos may make it more difficult for young children to develop the abilities to maintain and volitionally shift attention in infancy and early toddlerhood—developmental processes thought to play an important role in children's emerging executive functioning capabilities in early childhood (Blair et al., 2012; Conway & Stifter, 2012). Although our findings suggest (conditional) links between household chaos and executive functioning, the mechanisms underlying these associations remain largely unclear. Clarifying the psychological and physiological processes by which environmental chaos “gets under the skin” to impact executive functioning, as well as development more broadly, remain important questions for future work.

Despite these limitations, our findings suggest that links between children's experiences of highly disorganized contexts in the first three years of life and their subsequent development of less optimal cognitive and social development may differ markedly for children with varying levels of childcare exposure. Specifically, they were consistent with the idea that attending greater hours of childcare may mitigate the (substantively) negative relations between household disorganization and an array of cognitive and social outcomes. Further, they suggest these conditional relations may be explained by the way greater hours in childcare minimize the negative effects of household disorganization on executive functioning—an important mechanism underlying broader indices of cognition and social adjustment.

Given the non-experimental nature of our design, implications for policy should be considered cautiously. However, when weighed as an additional piece of evidence in a growing research base (McCartney & Berry, 2009), collectively, this work suggests that the beneficial effects of full-time early childhood education may be most pronounced for children experiencing broader contextual risks and, as such, may serve as a critical leverage point for closing cognitive and social disparities caused by these risks. More generally, these findings highlight the importance of considering development in the context of the multiple ecologies that children experience in early childhood.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Research Highlights

- Longitudinal relations between household chaos and children's subsequent social and cognitive outcomes at age-five are conditional on early childcare exposure.
- Spending greater amounts of time in childcare attenuates the 'detrimental' association between household chaos and several social and cognitive outcomes.
- These attenuated relations may be explained by the role that childcare exposure plays in mitigating the detrimental effect of household chaos on executive functioning.
- The respective effects of caregiver responsiveness and childcare type were somewhat mixed across outcomes, yet largely consistent with the extant literature.

Figure 1.

Exemplar path diagram displaying the indirect pathway linking household disorganization—conditional on childcare hours—with the distal age-five outcome, via 48-month executive functioning. The bold pathway represents the indirect relation of interest. The respective pathways linking household disorganization with executive functioning and the distal outcome are made conditional by re-centering childcare hours at the 25th and 75th percentiles (in separate models).

Figure 2.

Fitted relation between childcare hours and 48-month executive functioning, conditional on high (mean+1) and low (mean-1) levels of cumulative household disorganization (2 –36 months; $n = 1,235$).

Figure 3. Fitted relation between childcare hours and age-five receptive vocabulary functioning, conditional on high (mean+1) and low (mean-1) levels of cumulative household disorganization (2-36 months; $n = 1,235$).

Figure 4.

Fitted relation between childcare hours and age-five social problems, conditional on high (mean+1) and low (mean-1) levels of cumulative household disorganization (2-36 months; $n = 1,235$).

Note: The y axis equals 2 standard deviations in each figure.

Table 1
Zero-order correlations between the outcomes and main predictors (maximum likelihood; $n = 1,235$)

	PROB	EF	ACHV	PPVT	Home Dis.	Home Instab.	CC Qual	CC Quant	Mean (SD)	Min.	Max.
PROB	–								0.00 (1.69)	–2.00	5.71
EF	– 0.42***								0.00 (0.33)	–1.02	0.87
ACHV	– 0.34***	0.79***							0.00 (1.74)	–6.95	4.82
PPVT	– 0.28***	0.75***	0.73***						94.50 (15.90)	43.00	138.00
Home Dis.	0.22***	–0.4***	– 0.45***	– 0.40***					0.00 (.65)	–1.66	2.16
Home Instab.	0.19***	– 0.27***	– 0.27***	– 0.22***	0.38***				0.00 (.72)	–1.12	3.87
CC Qual	– 0.17***	0.33***	0.23***	0.30***	– 0.22***	– 0.10***			0.00 (.89)	–2.74	1.75
CC Hours	0.10**	–0.03	0.01	–0.06	– 0.17***	–0.01	– 0.16***		20.9 (16.31)	0.00	115.00
CC Spell	0.15***	–0.04	–0.02	–0.09	– 0.11***	–0.05	– 0.28***	0.48***	0.72 (1.17)	0.00	4.00

PROB = latent social problems; EF = latent executive function; ACHV = latent academic achievement; PPVT = Peabody Picture Vocabulary Test; Home Dis. = Cumulative household disorganization; Home Instab. = Cumulative household instability; CC qual = Caregiver responsiveness; CC Hours = Average Weekly hours of childcare; CC Spells = Spells of center-based care compared to any other type of care;

**
 $p < .01$,

 $p < .001$

Table 2

Final models from taxonomies of (robust maximum likelihood) multiple regression models testing whether children's childcare experiences moderate the association between early household chaos and their subsequent cognitive and social development (n = 1,235).

	M1:EF	M2:PPVT	M3:ACHV	M4:PROB
	<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>
Home Dis.	−0.06~	−3.23 ***	−0.54 ***	0.23
Home Instab.	−0.03	0.19	−0.09	0.38 ***
CC Hours	0.02	0.17	0.06	−0.07
CC Qual	0.04	1.79 *	0.06	0.05
CC_Spell	0.01	−0.16	0.04	0.25 ***
Home Dis * CC Hours	0.03 *	1.15 *		−0.23 **
Control Covariates				
+ Parenting	0.17 ***	5.84 ***	0.68 ***	−0.47 *
Income-to-Need	−0.01	0.11	−0.01	0.01
Mat Ed.	0.00	0.19	0.02	−0.03
In School	0.03	−1.54	0.04	0.07
Mat Literacy	0.01 *	0.76 ***	0.10 ***	0.03
Work Hours	0.00	0.02	0.00	0.01
# Children	−0.03	−0.84	−0.04	0.04
Age 1 st Birth	0.01	−0.07	0.06 ***	−0.02
Age TC Birth	−0.15	−15.75 *	−2.22 *	0.02
TANF	−0.06	0.27	−0.05	−0.10
SNAP	0.02	0.01	0.25	0.01
Medicaid	0.03	0.47	0.07	−0.09
Pub. Housing	−0.06	−0.84	0.02	0.06
Temperament	0.11	4.87	2.83 *	−1.79
MDI	0.00	0.11	0.01	−0.02
Site (NC = 1)	−0.14 ***	−4.20 **	−0.46 ***	−0.16
Child weight	0.01	1.27~	0.26 ***	−0.05
Male	−0.15 ***	−0.77~	−0.25	0.80 ***
African American	−0.12 *	−4.74 **	−0.41 *	0.69 **
<i>R</i> ²	.45	.36	.39	.22

EF = latent executive function; PPVT = Receptive Vocabulary; ACHV = latent academic achievement; PROB = latent social problems;; Home Dis. = Cumulative household disorganization; Home Instab. = Cumulative household instability; CC qual = Caregiver responsiveness; CC Hours = Average Weekly hours of childcare; CC Spells = Spells of center-based care compared to any other type of care; + Parenting = Observed positive parenting (Mean 7–35 months); Income-to-Need = Income-to-need ratio (7 months); Mat Ed. = Maternal education (years, 2 months); In School = Mother attends school (0–1, 2 months); Mat Literacy = Maternal functional literacy (2 months); Work Hours = Hours per week of work (2-months); # Children = Mother's number of biological children (2 months); Age 1st Birth = Maternal age at first birth; Age TC Birth = Maternal age at target

child's birth; TANF = receives Temporary Assistance for Needy Families (0–1; 2 months); SNAP = receives Supplemental Nutrition Assistance Program (0–1; 2 months); Medicaid = receives Medicaid (0–1; 2 months); Pub. Housing = receives public housing (0–1; 2 months); Temperament = child temperament (7 months); MDI = Standardized score on Bayley MDI scale; Site = research site (NC = 1); Child weight = child weight (kgs, 2 months). p-values for variables of substantive interest are adjusted for repeated testing.

*
p < .05,

**
p < .01,

p < .001

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