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Interactive Effects of Early-Life Income Harshness and Unpredictability on Children's Socioemotional and Academic Functioning in Kindergarten and Adolescence

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This research investigates whether and how two fundamental environmental factors—harshness and unpredictability—interact in regulating child and adolescent development, informed by life-history theory and drawing on data from the National Institute of Child Health & Human Development Study of Early Child Care and Youth Development (N = 1,364). Early life harshness was operationalized as the typical level of family income-to-needs based on six repeated measurements across the first 4.5 years of life and early life unpredictability as random variation using the same family income measurements. Results revealed that children functioned most competently in the social and academic domain as kindergarteners when exposed to low environmental harshness and low unpredictability and least competently when they experienced high harshness and low unpredictability. The same interaction pattern emerged in adolescence in forecasting cognitive-academic competence and sexual behavior. Findings are discussed in terms of how reliable and unreliable environmental cues shape developmental trajectories.

Keywords: environmental unpredictability, environmental harshness, life history, income

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Whether and how early developmental experiences and environmental exposures influence human development are issues of great interest to developmental scholars, parents, and policymakers alike. Much attention has been paid to both proximate and distal forces of influence. Indeed, it is widely appreciated that development is shaped by multiple and interacting factors and forces (Belsky, 1984; Bronfenbrenner, 1979; Conger, Ge, Elder, Lorenz, & Simons, 1994). Here we examine the harshness and unpredictability of family income relative to family size (i.e., income-to-needs ratio) across the first 4.5 years of life in predicting kindergarten and adolescent functioning, building on Ellis and associates' (2009) evolutionary analysis of fundamental factors shaping life history strategies in humans and animals. Drawing on data collected for other purposes, we specifically focus on the interaction of harshness and unpredictability, as the manner in which these sources of influence interact has heretofore not been carefully examined or has yielded inconsistent results.

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Life History Theory

Life history theory, a branch of evolutionary biology, seeks to explain how and why organisms allocate time and energy to different sets of competing life tasks, most notably, body maintenance (e.g., immune function, predation defenses), growth (acquisition of physical, social, and cognitive competencies), and reproduction (e.g., mating and parenting; e.g., Belsky, Steinberg, & Draper, 1991; Del Giudice, Gangestad, & Kaplan, 2015; Ellis, Figueredo, Brumbach, & Schlomer, 2009). Individuals must make trade-offs, often unconsciously, in terms of when, where, and how to invest their resources because energy and resources are finite. These trade-offs, which affect the rate of development—fast versus slow life history—and, thereby, reproductive behavior (i.e., mating, parenting) are presumed to make strategic sense (or at least once did) in terms of increasing the chance of dispersing genes in future generations given the conditions under which individuals develop.

According to life history theory, natural selection favors, at least to some extent, organisms capable of adjusting their development in response to prevailing and/or anticipated environmental conditions, as this should increase the chances of dispersing genes into the next generation (Belsky et al., 1991; Del Giudice et al., 2015; Ellis et al., 2009; Kaplan, & Gangestad, 2005). It is for this reason that psychosocial acceleration theory (Belsky et al., 1991) stipulates that experiences in first five to seven years are especially influential (Fawcett & Frankenhuis, 2015; Frankenhuis & Fraley, 2017; Panchanathan & Frankenhuis, 2016). Despite the fact that life history strategy is influenced by characteristics of individuality

(e.g., health, genetics), as well as the local ecology (e.g., morbidity/morality rates, Chisholm et al., 1993), the current inquiry only addresses the role of the early environment in putatively shaping development.

Fundamental Dimensions of the Environment

Developmental scholars have long investigated proximate and distal environmental influences on human development, often guided by Bronfenbrenner's (1979) bioecological perspective, Elder's (1998) life-course perspective, or Conger et al.'s (1994) family stress model, to name a few influential frameworks. Whatever the merits of these conceptual models and the empirical contributions they have stimulated, it remains true that none identify what might be regarded as fundamental dimensions of the environment that our species evolved to monitor during childhood to guide development—beyond perhaps the general concepts of stress and support. Recently, Ellis and colleagues (2009) addressed this lacuna, conducting a cross-species analysis of contextual factors regulating life history strategy, thereby identifying environmental harshness and unpredictability as two fundamental features of the developmental environment.

Harshness refers to rates of extrinsic factors associated with disability and death in a population. In Western societies, socioeconomic status (SES) is a key indicator of environmental harshness, as lower levels of SES are linearly related to nearly all forms of morbidity and mortality (e.g., Adler, Boyce, Chesney, Folkman, & Syme, 1993; Chen, Matthews, & Boyce, 2002). Early exposure to environmental harshness, indexed by low SES, is theorized to—and does—shift developmental-resource allocations toward faster life-history strategies (Ellis et al., 2009). In the current inquiry, harshness is operationalized as the typical level of repeatedly measured family income to needs across the first 4.5 years of life, thus ranging from low to high.

In contrast to harshness, *unpredictability* refers to stochastic variation in life-history-relevant environmental conditions (i.e., morbidity/mortality) over time. Recently, frequent changes in parental employment, residential relocations, and paternal transitions have been treated as indicators of unpredictability, proving predictive of less supportive parenting and/or more child behavior problems (e.g., Belsky, Schlomer, & Ellis, 2012; Ellis et al., 2009; Simpson, Griskevicius, Kuo, Sung, & Collins, 2012; Zachrisson & Dearing, 2015). In the current inquiry, we operationalize unpredictability in terms of random variation in repeatedly measured family income to needs across the first 4.5 years of life, thus ranging from low to high unpredictability.

By using the same data—on family income relative to family size—to index both environmental harshness and unpredictability (as well as their interaction), we position ourselves to illuminate distinctive effects of these environmental parameters highlighted by Ellis et al. (2009). In fact, proceeding in this manner precludes the possibility that any differential effects of harshness and unpredictability could be the result of measuring one construct with one set of information (e.g., harshness: income) and the other with different information (e.g., unpredictability: family transitions).

According to Ellis et al. (2009), environmental harshness and unpredictability are conceptually distinct dimensions that uniquely—and therefore additively—regulate life history strategy. Several empirical reports provide evidence to this effect, though these all reflect the concern just raised—different measurements bases for different constructs. Brumbach, Figueredo, and Ellis (2009) reported that adolescents' self-reported exposure to violence, considered an index of environmental harshness, and frequent changes or current inconsistencies in the childhood environment, considered an index of unpredictability, predicted adolescent and adult physical and mental health, social deviance (e.g., delinquency, drug use), and sexual attitudes and behavior. Greater unpredictability forecast poorer health in adolescence and adulthood and greater harshness predicted less sexual restraint and greater social deviance.

Belsky and associates (2012) also investigated whether and how harshness and unpredictability—in the first years of life—related to adolescent sexual behavior, drawing on data from the National Institute of Child Health & Human Development (NICHD) Study of Early Child Care and Youth Development. Environmental harshness, operationalized as mean level of repeatedly measured income-to-needs ratio across the first 5 years, did not predict adolescent functioning. Greater unpredictability, operationalized as the total number of residential changes, paternal transitions, and parental job changes during the same period, however, forecast more adolescent sexual behavior, which was interpreted as reflecting a faster life history.

In a third relevant study, Simpson and colleagues (2012) examined the effects of unpredictability (operationalized as in Belsky et al., 2012) and harshness (operationalized as SES from birth to age 16) on sexual and risk-taking behavior in young adulthood (at age 23), drawing on data from the Minnesota Longitudinal Study of Risk and Adaptation (MLSRA). Once again results indicated that unpredictability experienced during the first five years of life was the strongest predictor of both sexual behavior and risk-taking.

Two further investigations that drew on the same MLSRA data found that higher scores on Simpson et al. (2012)'s unpredictability composite also predicted more externalizing behavior and substance use (i.e., alcohol and marijuana) at age 16 (Doom, Vanzomeren-Dohm, & Simpson, 2016), more negative orientation toward the parental role, as well as less supportive parenting, at least in the case of fathers (Szepsenwol, Simpson, Griskevicius, & Raby, 2015). Harshness exerted much weaker effects, being only associated with greater adolescent substance use (Doom et al., 2016; Szepsenwol et al., 2015). Because all the harshness-and-unpredictability-related work just reviewed relied on different measurements to operationalize these two environmental constructs, it is impossible to know whether the differential predictive power detected within these studies was due to one actually being more influential than the other or because they were based on different measurements.

Limited Family Income as an Index of Environmental Harshness

As already indicated, the current investigation operationalizes environmental harshness using an index of family income-to-needs ratio, based on evidence that limited family economic resources are negatively associated with many indicators of child well-being (Brooks-Gunn & Duncan, 1997; Duncan, Yeung, Brooks-Gunn, & Smith, 1998; Gennetian, Castells, & Morris, 2010), including social adjustment (Qi & Kaiser, 2003; Mistry, Vandewater, Huston, & McLoyd, 2002), cognitive functioning (e.g., executive

functioning; Sarsour et al., 2011), and academic achievement (Dahl, & Lochner, 2012). Such results are often interpreted in terms of the family stress framework which stipulates that families with limited economic resources experience high levels of stress due to the constant struggle to pay bills and make ends meet. This psychological experience fosters high levels of parental distress which, in turn, promotes coercive family processes and problematic parenting (Conger, Conger, & Martin, 2010; Conger et al., 1994), thereby promoting conduct disorder (e.g., Deater-Deckard, Wang, Chen, & Bell, 2012) and undermining academic achievement (e.g., Dumont, Trautwein, Nagy, & Nagengast, 2014).

A second social-science perspective on economic disadvantage and child development, this one promulgated by economists (Becker & Tomes, 1986; Haveman & Wolfe, 1994), stipulates that parents with few financial resources can invest less in children's food, housing, stimulating learning materials and activities, high-quality child-care, safe neighborhoods and medical care; and that such compromised child rearing conditions undermine developmental well-being. Even if such economic theorizing stresses mediating family interactional processes less than does psychological thinking, the two approaches are by no means mutually exclusive. After all, each calls attention to developmental risks of children growing up under conditions of economic disadvantage. These perspectives and related evidence form the basis for conceptualizing limited income-to-needs ratio as an index of environmental harshness.

Income Instability and Child Development

Even as the theory and evidence already cited underscores the adverse developmental consequences of growing up under conditions of economic disadvantage (e.g., Brooks-Gunn & Duncan, 1997; Gennetian et al., 2010; Wagmiller, Lennon, Kuang, Alberti, & Aber, 2006), it is well appreciated that family income is often not stable; thus many children grow up in families that move in and out of poverty (Duncan et al., 1993). Research also links greater family income volatility to greater externalizing behavior (Dearing, McCartney, & Taylor, 2006; Yeung, Linver, & Brooks-Gunn, 2002; Zachrisson & Dearing, 2015) and internalizing problems during early childhood (Zachrisson & Dearing, 2015) and less positive social behavior in childhood and adolescence (Hill, 2016), typically operationalizing income volatility as variability around the personal mean of repeated income measurements (Moffitt & Gottschalk, 2002) or the ratio of the standard deviation of repeatedly measured income divided by mean income (i.e., coefficient of variation, Nichols & Zimmerman, 2008; Newman, 2006).

Relative to research on the effects of income, less is actually known about how changes/volatility in family income affect children, despite the work just cited (Hill, Morris, Gennetian, Wolf, & Tubbs, 2013). Although income instability can adversely affect child development, this may be more or less the case depending on a variety of factors (Hill et al., 2013). These include level of family income, the pattern of income changes over time (i.e., increasing, decreasing, changing erratically), whether change is anticipated (e.g., planned birth), and/or child age (e.g., first years of life, Belsky et al., 1991; pubertal transition, Graber, Brooks-Gunn, & Petersen, 1996), among other factors.

The Interaction of Environmental Harshness and Unpredictability

What should be clear at this point is that life-history thinking about environmental harshness and unpredictability is not inconsistent with much traditional social-science theory and research about family income, income stability and child development. Indeed, all perspectives under consideration imply that growing up in low-income families, especially those for which income fluctuates unpredictably, adversely affects child well-being. What has rarely been explored, however, is the interaction of these distinct income parameters-level of income and stability of income. Certainly, the aforementioned work by Belsky et al. (2012) failed to address this issue. And when Brumbach et al. (2009) examined the interaction in question, they did not detect any moderating effects. Thus, although the aforementioned research illuminated unique effects of harshness and unpredictability, it remains unclear both theoretically and empirically whether—and how—these two fundamental forces might operate together to influence human development.

One can easily imagine three possible ways income harshness (i.e., typical/average level) and unpredictability might interact (a) a dual-risk pattern whereby the adverse effects of high harshness and high unpredictability amplify each other so that children exposed to such early life conditions fare especially poorly developmentally; (b) a dual-benefit pattern whereby effects of low harshness and low unpredictability amplify each other so that children exposed to such early life conditions develop especially well; and (c) a buffering pattern whereby anticipated adverse effects of high harshness or unpredictability are attenuated due to the absence of problematic conditions in the case of the other environmental parameter (i.e., high harshness/low unpredictability; low harshness/high unpredictability). Notably, each of these three forms of interaction have been detected in prior research that is not informed by life history theory (e.g., dual-risk: Ge, Conger, & Elder, 2001; dual-benefit: Ditzen et al., 2008; buffering: Cohen & Wills, 1985). But one might also imagine a fourth way in which harshness and unpredictability could interact: the combination of low unpredictability and high harshness, resulting in predictable harshness and thus predictably low income in the current inquiry proving most damaging to children's well-being, perhaps fostering a fast life history.

We refrain from advancing any Harshness × Unpredictability hypotheses because in work directly informed by evolutionary thinking and focused on life-history-related outcomes, findings have proven inconsistent. As already noted, Brumbach and colleagues (2009) failed to discern any interaction of environmental harshness (i.e., violence exposure) and unpredictability (i.e., changes or inconsistencies in daily experiences) when predicting adolescent (mental and physical) health; Simpson et al. (2012) detected a dual-benefit effect in their aforementioned work when predicting sexual behavior; and, in still further contrast, Doom et al. (2016) documented a dual-risk pattern when predicting substance use at age 16! Clearly, more work is called for before any strong conclusions should be drawn. Thus, a central goal of the current work was to investigate whether and how effects of harshness are moderated by those of unpredictability.

The Current Study

The current study sought to evaluate effects of Harshness × Unpredictability interactions on various aspects of child and adolescent development. To create measures of both income harshness and unpredictability, we draw on the same NICHD study data on income-to-needs ratio across the first 4.5 years of life. Although harshness is operationalized in terms of mean level of the repeatedly measured ratio (as in Belsky et al., 2012), operationalizing unpredictability involved compositing residual variance after partialing out systematic time effects on the repeatedly measured ratio. This approach to operationalizing unpredictability, developed by Hoffman (2007), is frequently used to examine systematic change and differences in within-person variation in longitudinal data (e.g., Almeida, Piazza, & Stawski, 2009; Liu, Choi, Reddy, & Spaulding, 2011; Schneider et al., 2012) because it makes possible distinguishing systematic—and thus predictable—change, as in a steady increase or decrease in the income-to-needs ratio, from random variation in repeated measurements, even though both could have identical means and standard deviations.

When it comes to predicting child and adolescent development, we purposefully include constructs not routinely or necessarily regarded as reflections of a fast versus slow life history strategy, including, for example, teacher–child conflict, social skills, behavior problems, impulse control, depressive symptoms, and academic achievement; and this is for two reasons. As the preceding literature review makes clear, it is not only evolutionary-minded developmentalists studying sexual behavior, risk-taking, and future orientation who investigate effects of family income on children's development. And even though many of the outcomes studied by those focused on income unpredictability have not typically been investigated by those examining fast and slow life history strategies, it would not seem too much of a theoretical stretch to consider these at least somewhat reflective of these alternative developmental trajectories. Central to achieving academically and avoiding conflict with a teacher, to say nothing about being self-controlled, is the ability to regulate impulses, reflect on experience and delay gratification so as to function in ways that meet one's needs and desires, especially longer-term ones, while simultaneously taking into account those of others. Doing so would thus seem characteristic of a slow life-history strategy emphasizing, among other things, planning and a mutually beneficial social orientation. The opposite would seem to be true of a fast life history characterized by opportunistic-advantage taking rather than the reciprocal, mutually beneficial social orientation presumed to reflect a slow strategy (Belsky et al., 1991). This line of thinking would not seem inconsistent with Taborsky and Oliveira's (2012) definition of social competence as the ability to regulate one's social behavior to optimize his or her social relationship, which allows individuals to generate appropriate behavioral responses in their particular social contexts. Consider as well that individuals who commit crimes and are thus regarded as socially "maladaptive" from a mental health perspective have been reported to achieve greater reproductive success than others (e.g., having more mating partners and more offspring; Yao, Långström, Temrin, & Walum, 2014).

Finally, we should make clear that we focus on children's functioning in kindergarten and at age 15 to determine whether the forms that any detected Harshness × Unpredictability interaction effects might take early in life would prove evident a decade later. Notably, then, all outcomes selected when the study was originally designed are included in this report.

Method

Participants

The NICHD Study of Early Child Care and Youth Development recruited 1,364 families through hospital visits shortly after the birth of a child in 1991 at 10 U.S. locations; for detailed description of recruitment procedures, sampling plan, and sample characteristics, see NICHD Early Child Care Research Network (2005; information about this data set can be found at https://www.icpsr.umich.edu). In terms of demographic characteristics, 26% of the mothers had no more than a high school education at recruitment; 21% had household income below 100% of the poverty level (i.e., income-to-needs ratio <1.0) at enrollment; and 22% were minority (i.e., not non-Hispanic European American). The current article drew existing data from the NICHD SECCYD and conducted secondary data analyses, with no individual identifier linked to participants. Thus, this work was exempt for the IRB review according to the University of California, Davis, Office of Research IRB administration.

Not all families participated in or completed every wave of data collection. Missing data (ranging from 6.7% to 34.6%) was systematic. Considering age 15 risk taking, for example, cases with missing data had less educated mothers, $t(1,361) = -4.98$, $p < .01$, more parents not living together ($\chi^2(1) = 4.88$, $p = .03$, odds ratio = 1.42, 95% confidence interval: 1.02, 1.96), and lower household income, $t(643.23) = -2.90$, $p < .01$. Results of more detailed attrition analyses is available in the online supplemental materials (Supplemental Table S1).

The current analyses included all children (except for those whose information were completely missing) by using full information maximum likelihood (FIML) estimation (Enders & Bandalos, 2001), which resulted in a sample of 1,356 participants (FIML estimation was not applied to zero-inflated models). One advantage of FIML estimation is that data were assumed to be missing at random, which allows the missing data to be dependent on other variables in the dataset.

Measures

Early harshness and unpredictability predictors. We derived income-harshness and unpredictability scores from the repeatedly measured income-to-needs ratio, calculated when children were 1, 6, 15, 24, 36, and 54 months of age, based on detailed information about family finances provided by mothers. The income-to-needs ratio was created as an index of a family's income as a proportion of the official federal poverty line for a family of the same size. A higher income-to-needs ratio indicated greater financial resources per person in the household after adjusting for family size. A ratio of 1.0 indicates that family income equals the federal poverty threshold for a family of that size. Mean level of income to needs appeared relatively stable, yet also fluctuated across the six measurement occasions: 2.86 ($SD = 2.61$), 3.66 ($SD = 3.10$), 3.70 ($SD = 3.21$), 3.72 ($SD = 3.04$), 3.61 ($SD =$

3.05), and 3.59 (*SD* = 3.17), respectively. Notably, substantial variation characterized in the sample at every time point. For example, at enrollment, 21.1% of the families had ratios below 1.0, with the ratio below 2.0 for 41.4% of the families.

Kindergarten outcomes.

Teacher-child conflict. Teachers completed the seven-item Student-Teacher Relationship Scale (STRS; Pianta, 2001). The STRS measures teachers' perceptions of the quality of their relationship with specific children, with the Conflict subscale proving to be particularly informative (e.g., Birch, & Ladd, 1997). Responses to each item range from 1 to 5; a higher score reflects more conflict (Cronbach's alpha = .90).

Behavioral problems. Teachers completed the 100-item Teacher Report Form (TRF, Achenbach, 1991), which yields a measure of total behavior problems. Raw scores were converted into standard *T* scores, based on normative data for children of the same age (Achenbach & Rescorla, 2007).

Social skills. Teachers completed the 30-item Social Skills Rating System (SSRS; Gresham & Elliott, 1990), tapping social behavior, competence and adaptive functioning, ranging from 0 (*never*) to 2 (*very often*) and yielding three subscores: cooperation (α = .92), assertion (α = .86) and self-control (α = .87). The raw SSRS total score (range = 0 to 60) was transferred into a standardized score with a range of 49 to 130.

Academic skill. Academic skills were evaluated by teachers on a 5-point scale using a 28-item questionnaire pertaining to language, literacy, and mathematical thinking. All ratings were averaged to yield a total score (α = .96).

Adolescence measures.

Number of oral and sexual intercourse partners. Adolescents answered two questions about pertaining to number of different lifetime (a) oral-sex and (b) intercourse partners. Mean number of oral sex partners was 0.33 (*SD* = 0.92); mean number of sexual intercourse partners was 0.28 (*SD* = 0.89).

Nonsexual risk-taking behavior. Adolescents answered 36 questions drawn from instruments used in prior studies (Halpern-Felsher, Biehl, Kropp, & Rubinstein, 2004) tapping the extent to which, over the past year, they used alcohol, tobacco, or other drugs, behaved in ways that threatened their own safety, used or threatened to use a weapon, stole something, or harmed property. Responses were made on a 3-point scale, ranging from 0 (*never*) to 2 (*more than twice*), then summed and subjected to square-root transformation to reduce skew and kurtosis (α = .89).

Externalizing behavior. The 30-item subscale of 119-item Youth Self-Report (Achenbach & Rescorla, 2001) was used to index externalizing problems (α = .86).

Impulse control. Seven out of eight items included in the impulse-control subscale of the Weinberger Adjustment Inventory (WAI; Weinberger, & Schwartz, 1990) were administered by the NICHD SECCYD, reflecting the ability to control impulses. Adolescents reported on a 5-point scale, ranging from 1 (*false*) to 5 (*true*) the extent to which their behavior matched a series of statements (e.g., "I stop and think things through before I act"), with higher score indicating greater impulse control (α = .82).

Depressive symptoms. Adolescents completed the 10-item scale short form of Kovacs's (1992). Children's Depression Inventory (α = .81) concerning symptoms over the past two weeks. Square-root transformation was applied to total scores to reduce skew and kurtosis.

Future orientation. The eight-item Future Outlook Inventory (Cauffman & Woolard, 1999) was used to assess time perspective, or the ability to foresee short- and long-term consequences of actions (α = *.73).*

Cognitive-academic achievement. The Woodcock-Johnson Psycho-Educational Battery—revised (Woodcock & Johnson, 1989) is a wide-range, comprehensive set of individually administered tests. Cognitive ability was assessed with two subscales, Picture Vocabulary and Verbal Analogies. Achievement was assessed using the Passage Comprehension and Applied Problems subscales. All four scores were standardized and averaged to create a total score.

Data Analysis Plan

The first of three data-analytic steps involved parameterizing the harshness and unpredictability of family income to needs across time; the second involved using the two resulting indicators to forecast child and adolescent functioning; and the third involved a sensitivity analyses to evaluate the robustness of any documented results.

The preliminary analysis parameterized environmental harshness and unpredictability using the repeated measurements of income-to-needs ratio in the first 4.5 years. Environmental harshness was operationalized as the typical ratio of income-to-needs ratio across six measurement occasions from 1 to 54 months, and environmental unpredictability as the degree of random variability in the ratio across the same time period, after partialing out systematic (linear) change. To obtain individual-specific estimates of income-to-needs' harshness and unpredictability, we adopted Hoffman's (2007) model fitting procedure, first fitting multilevel growth-curve models (with each month serving as one unit of time) to determine whether there was systematic (linear) change in the income-to-needs ratio over time. Thus, we tested an intercept-only model and a linear-growth model, detecting a significant linear trend (β_{time} = 0.007, $p < .01$); this reflected the systematic increase in the sample's income-to-needs ratio over time.

After identifying a linear trend using growth curve modeling, we fitted a linear regression model to the income-to-needs ratio data for each child, with the repeatedly measured income-to-needs ratio modeled as a function of time (i.e., income-to-needs ratio was regressed on time, like growth-curve models). The estimated value at the 27th month, the midpoint of measurement, was used as an indicator of typical income-to-needs. The residual variance from the model (i.e., root-mean square error, which is the square root of the residual variance) was used as the index of unpredictability for each child's family, as greater residual variance reflects higher amount of fluctuations around the predicted trend, thus more unpredictability over time. We also tested for heterogeneity in the amount of within-person variation over time (i.e., heteroscedasticity), following Snijders and Bosker (1999, pp. 126–127). Results indicated that individuals differed in degree of unpredictability over time, $H(1225) = 6653.15$, $p < .001$, thus making the residual variance from the person-specific linear regression an appropriate indicator of income unpredictability.

Next, we reverse coded the income-to-needs ratio intercept so that higher values reflected greater harshness (i.e., less income to needs) and centered the predictors before creating the Income Harshness × Income Unpredictability interaction. Income-to-needs' harshness and unpredictability were substantially nega-

tively and significantly correlated, $r(1,256) = -.66$, $p < .01$. Multicollinearity diagnostics did not reveal problems using these (correlated) measures and their interaction (i.e., all VIF values below 3.0).

The primary regression analyses employed the environmental harshness and unpredictability parameters—and their interaction—to predict child functioning in kindergarten and adolescence. Because two outcomes had many zeros—number of oral-sex partner ($n_{[\text{partner number} = 0]} = 801$) and number of sex-intercourse partners ($n_{[\text{partner number} = 0]} = 826$)—they were analyzed using zero-inflated Poisson regression. Finally, because the environmental harshness and unpredictability predictors were residualized to account for linear change in the primary analyses, a sensitivity analysis was conducted in which the temporal dependency of the income-to-needs ratio was also taken into account.

Results

Descriptive information of the primary variables are presented in Table 1.

Results of the primary regression analyses are presented in Tables 2 and 3, with Table 3 displaying zero-inflated Poisson regressions on oral-sex and sex-intercourse partners. Because data plots did not reveal any nonlinear effects of income harshness, we only included the linear terms of harshness in the final regressions. Whenever significant Harshness × Unpredictability interactions emerged, a follow-up analysis was undertaken to illuminate the nature of the interaction. Thus, we divided the income-to-needs' unpredictability construct into thirds so that regions-of-significance tests could be conducted (see www.yourpersonality.net/interaction/ros3.pl).

Overall, higher levels of income-to-needs' harshness and unpredictability each uniquely predicted poorer developmental functioning in kindergarten and adolescence, though effects of harshness proved more extensive than unpredictability. When exposed to greater environmental harshness in early childhood, (a) kindergarteners displayed more behavioral problems, poorer social and academic skills and experienced more teacher–child conflict; and (b) adolescents exhibited less impulse control and more externalizing behavior, and achieved less academically while engaging in more nonsexual risk-taking behavior and having more oral-sex partners. Greater early life unpredictability also forecast more nonsexual risk-taking behavior and increased the likelihood of having at least one oral-sex partners.

Several of these main effects were qualified by significant interactions—in the case of (a) kindergarten behavioral problems, social skills, academic skills and, marginally, teacher–child conflicts and (b) adolescent cognitive-academic achievement and likelihood of having at least one, as well as more than one oral-sex partners (see Figures 1–6). Regions-of-significance tests (not applied to the oral-sex partner models) indicated that at age 5 and 15 children *functioned best when exposed to low environmental harshness and low unpredictability (i.e., dual benefit), yet performed worst when they experienced high harshness and low unpredictability early in life*. Kindergarteners and adolescents exposed to higher environmental unpredictability, as opposed to low-unpredictability, appeared less affected by level of income-to-needs' harshness. Differences between low-versus high-unpredictability groups were significant on both high and low ends of environmental harshness (see Table 4). When predicting presence/absence of oral-sex experience, the patterning of the interaction proved similar to the other interactions (see Figure 6).

Sensitivity Analyses

A series of sensitivity tests evaluated the robustness and reliability of the results. We thus repeated the regression analyses after modifying the operationalization of the core predictive constructs

Table 1
Descriptive Statistics

Variable	*n*	Min	Max	*M*	*SD*
Income-to-needs ratio					
INR, 1 month	1,273	.1	25.1	2.86	2.61
INR, 6 months	1,270	.1	27.9	3.67	3.10
INR, 15 months	1,234	.1	35.6	3.70	3.22
INR, 24 months	1,187	.1	27.3	3.72	3.04
INR, 36 months	1,208	.1	28.5	3.61	3.05
INR, 54 months	1,073	.1	57.0	3.59	3.17
Child function in kindergarten					
Behavioral problems	1,004	31.00	81.00	47.48	9.63
Social skills	993	49.00	130.00	103.47	14.05
Academic skills	991	1.00	5.00	3.00	.92
Teacher-child conflicts	1,006	7.00	34.00	10.60	5.36
Child function at age 15					
Impulse control	957	1.00	5.00	3.51	.90
Depressive symptoms	957	.00	18.00	2.01	2.34
Externalizing behavior	956	25.00	86.00	49.31	9.91
Non-sexual risk-taking	954	.00	53.00	6.16	5.67
Academic achievement[a]	892	50.25	147.25	106.05	13.07
Future orientation	952	1.00	4.00	2.62	.49
Oral-sex partners	948	0	5	.33	.92
Sex-intercourse partners	948	0	5	.28	.89

Note. Min = minimum score; Max = maximum score; INR = income-to-needs ratio.
[a] Academic-achievement is short for cognitive-academic achievement.

Table 2
Regression Analyses of the Effects of Environmental Harshness, Unpredictability, and the Harshness × Unpredictability Interaction on Kindergarten and Adolescence Functioning Based on Full Information Maximum Likelihood Estimation (N = 1,356)

Variable	Harshness[a]			Unpredictability[a]			Harshness[a] × Unpredictability[a]		
	Estimate (*SE*)	*t*	*p*	Estimate (*SE*)	*t*	*p*	Estimate (*SE*)	*t*	*p*
Kindergarten									
Behavioral problems	4.08 (.84)	4.86	.00**	−.50 (1.04)	−.48	.63	−2.45 (.93)	−2.64	.008**
Social skills	−8.16 (1.22)	−6.70	.00**	−.08 (1.52)	−.06	.96	5.20 (1.35)	3.86	.00**
Academic skills	−.75 (.08)	−9.86	.00**	.10 (.10)	1.08	.28	.35 (.08)	4.13	.00**
Teacher-child conflicts	1.43 (.47)	3.04	.002**	.11 (.59)	.18	.85	−.87 (.52)	−1.67	.09†
Adolescence									
Impulse control	−.40 (.08)	−4.99	.00**	−.16 (.10)	−1.55	.12	.004 (.09)	.05	.96
Depressive symptoms[b]	.12 (.09)	1.33	.18	.09 (.11)	.78	.44	.08 (.10)	.79	.43
Externalizing behavior	3.62 (.89)	4.05	.00**	2.01 (1.12)	1.80	.07†	.23 (.99)	.24	.81
Non-sexual risk-taking[b]	.72 (.10)	7.50	.00**	.39 (.12)	3.20	.001**	−.05 (.11)	−.50	.61
Academic achievement[c]	−14.50 (1.12)	−12.99	.00**	−2.08 (1.39)	−1.49	.14	5.91 (1.24)	4.77	.00**
Future orientation	−.08 (.04)	−1.77	.08†	−.05 (.06)	−.86	.39	.04 (.05)	.78	.44

[a] Harshness and unpredictability were sample-mean-centered. [b] Depressive symptoms and nonsexual risk-taking: Square-root-transformation was applied to these variables due to their non-normal distribution (i.e., skewness > 2 and/or kurtosis > 3). [c] Academic-achievement is short for cognitive-academic achievement.
† $p < .1$. ** $p < .01$.

in two ways: (a) by reverse coding mean income level to reflect income harshness across the first 4.5 years and (b) by applying the mean square successive difference (MSSD) method to income unpredictability after adjusting for different time intervals between measurement points (by dividing MSSD by the median time interval; Jahng, Wood, & Trull, 2008); for more details, see online supplemental materials.

The revised indices of income-to-needs harshness and unpredictability remained substantially negatively associated, $r(1,297) = -.62$, $p = .01$, and yielded mostly similar regression results to those already reported (Table 5). Although greater income harshness and unpredictability each forecast, once again, more problematic functioning, greater unpredictability in the sensitivity analysis also predicted better academic skills during kindergarten, something not detected in the original analysis. Even more important was that three of the four originally detected Harshness × Unpredictability interactions once more proved significant (kindergarten social skills, academic skills, and adolescent cognitive-academic competence)—and for the same reasons as originally detected: Under conditions low harshness and unpredictability, children functioned best, whereas under conditions of high harshness and low unpredictability they functioned most poorly.

Discussion

Here we investigated whether and how exposure to income-to-needs harshness and unpredictability interact early in life to predict child and adolescent functioning, drawing on diverse research traditions, including mainstream developmental psychology, evolutionary-developmental psychology, sociology, and economics. Recall it was this scholarly foundation that led us to focus on outcome measurements beyond those often studied in life-history-related inquiries. We thus extended prior work in multiple ways: (a) by relying on the same repeated measurements (of income relative to family needs) to operationalize both environmental harshness and unpredictability; (b) by operationalizing unpredictability as random variation in these repeated measure-

Table 3
Zero-Inflated Regression Analyses of the Effects of Environmental Harshness, Unpredictability, and the Harshness × Unpredictability Interaction on Adolescent Reproductive-Strategy Relevant Behavior (N = 934)

Adolescent behavior	Harshness[a]			Unpredictability[a]			Harshness[a] × Unpredictability[a]		
	Estimate (*SE*)	Wald χ^2	*p*	Estimate (*SE*)	Wald χ^2	*p*	Estimate (*SE*)	Wald χ^2	*p*
Number of oral-sex partners	.61 (.28)	4.84	.03*	.20 (.24)	.68	.41	.78 (.39)	3.99	.05*
Oral-sex partners (zero[b])	−1.56 (.39)	16.22	.00**	−.89 (.39)	5.13	.02*	1.71 (.84)	4.15	.04*
Number of sex-intercourse partners	.28 (.30)	.85	.36	.29 (.27)	1.16	.28	−.21 (.57)	.14	.71
Sex-intercourse partners (zero[b])	−2.45 (.44)	31.61	.00**	−.49 (.39)	1.53	.22	.42 (.54)	.58	.45

Note. The fact that neither of the categorical variables in this table follows the pattern of normal distribution—with majority values equal to zero—requires for zero-inflated regression model rather than the traditional OLS regression. The zero-inflated regression consists of two parts: the first model aimed at predicting the exact value of the dependent variables when such values does not equal to zero; the second part aimed at predicting the excessive zeros by fixing all non-zero values at one and use "one" as the reference group, just like the logistic model.
[a] Harshness and unpredictability were sample-mean-centered. [b] Zero refers to the logistic regression holding all non-zero values fixed and using nonzero values—one—as the reference group to predict likelihood of zero value.
* $p < .05$. ** $p < .01$.

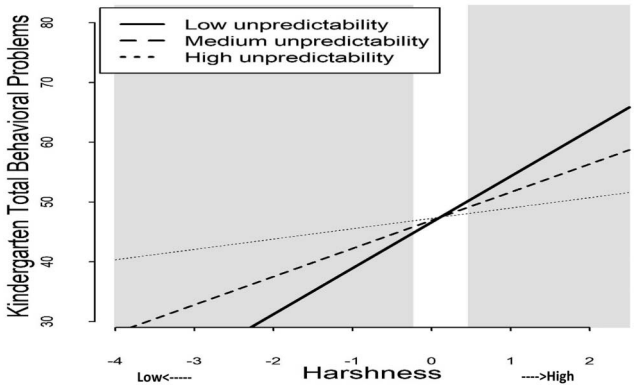

Figure 1. Environmental harshness and unpredictability interactions for teacher-reported kindergarten behavioral problems. The shaded areas represent the regions of significance (RoS). RoS = [X < −0.24 or X > 0.47].

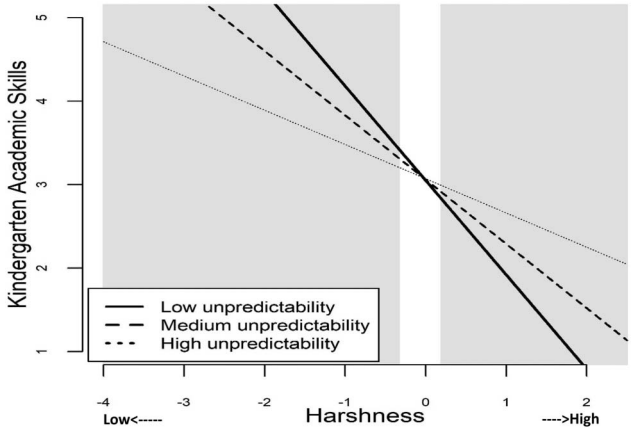

Figure 3. Environmental harshness and unpredictability interactions for kindergarten academic skills. The shaded areas represent the regions of significance (RoS). RoS = [X < −0.33 or X > 0.19].

ments; and (c) in finding that, in addition to uniquely predicting child and adolescent functioning (Brumbach et al., 2009; Belsky et al., 2012), income harshness and unpredictability interact with one another to do so.

It was respect to this latter focus that our findings most clearly extend the prior literature, in that the main effects detected which indicated that greater harshness and greater unpredictability each predicted poorer developmental functioning, as conceptualized from a mental health perspective, were generally consistent with prior research. Notably, though, our findings regarding the interaction of these the two core environmental parameters proved somewhat different from what others have reported. Whereas others have not detected any Harshness × Unpredictability interaction (Brumbach et al., 2009), or chronicled only dual-benefit (Simpson et al., 2012) or dual-risk effects (Doom et al., 2016), we observed that children exposed to high harshness and low unpredictability (i.e., predictable income harshness) functioned most poorly in childhood and adolescence, whereas those who experienced low harshness and low unpredictability functioned most competently (i.e., dual-benefit), at least in a mental health sense. Beyond main effects indicating that greater harshness and greater unpredictability proved related to more problematic functioning, recall the following Harshness × Unpredictability findings: Children and adolescents exhibited the least behavioral problems, most social/academic competence, and experienced the least conflict with teachers when environmental harshness and unpredictability were both low; but when exposed early in life to high harshness and low unpredictability children developed the most behavior problems, experienced more conflict with teachers, had the greatest likelihood of having an oral-sex partner, and manifested the least social and academic competence.

There are many reasons why our results proved different from Harshness × Unpredictability effects discerned by others, most notably (a) because we relied on the same repeated measurements of income-to-needs to operationalize both environmental harshness and unpredictability and (b) because of how we operationalized unpredictability. Rather than focusing on changes in residence, male presence and occupation of parents, as Belsky et al. (2012) and Simpson et al. (2012) did, or of consistency of child care, as Brumbach et al. (2009) did, we used an index of random variation in repeatedly measured income to needs. Recall that our

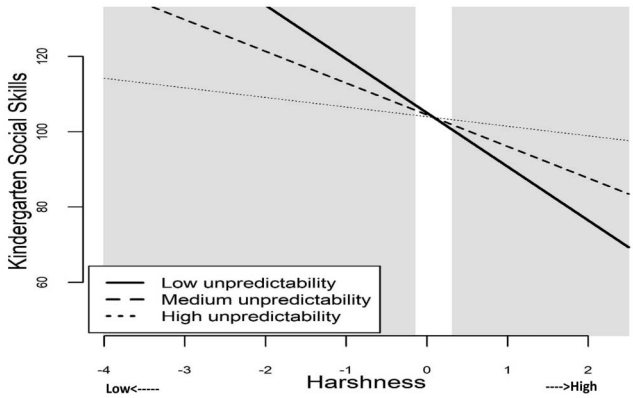

Figure 2. Environmental harshness and unpredictability interactions for teacher-reported kindergarten social skills. The shaded areas represent the regions of significance (RoS). RoS = [X< −0.15 or X > 0.32].

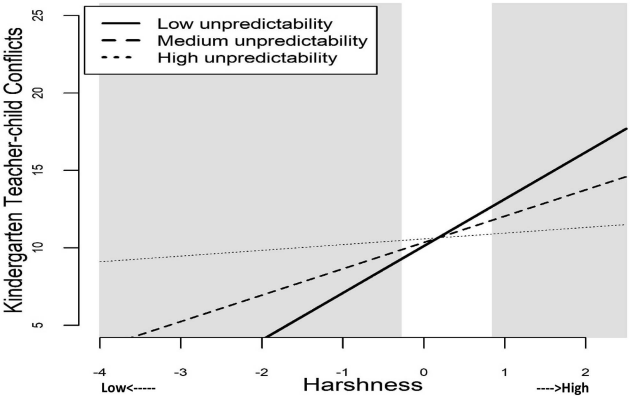

Figure 4. Environmental harshness and unpredictability interactions for kindergarten teacher-child conflicts. The shaded areas represent the regions of significance (RoS). RoS = [X < −0.28 or X > 0.85].

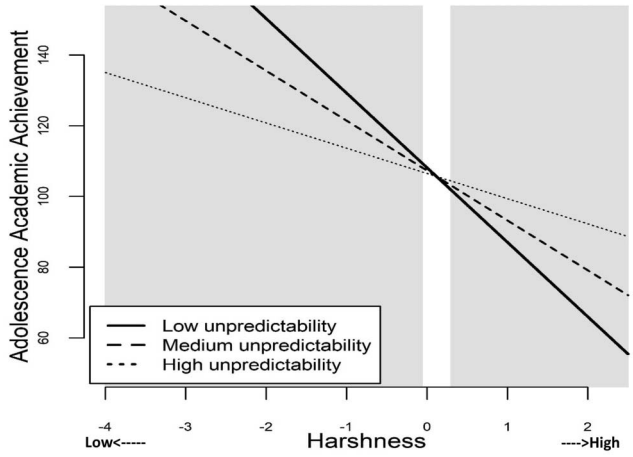

Figure 5. Environmental harshness and unpredictability interactions for adolescent cognitive-academic achievement. The shaded areas represent the regions of significance (RoS). RoS = [X< −0.06 or X > 0.30].

approach thus distinguished stochastic change from systematic and directional change. We would encourage others to follow this promising lead. Only when others do will we know how replicable and thus generalizable our detected interactive effects will be.

Our work also differed from some others in finding that greater harshness was associated with lower unpredictability. Whereas Belsky et al. (2012); Simpson et al. (2012); Doom et al. (2016); and Brumbach et al. (2009) all reported that greater harshness (indexed by low household income in the first three studies and exposure to violence in Brumbach et al., 2009) was associated with higher unpredictability (indexed by family instabilities in the first three studies and inconsistencies in child life in Brumbach et al., 2009), Szepsenwol et al. (2015) failed to detect a significant association in two substudies but discerned a significant positive correlation in the third substudy (using measures of SES as index of harshness and family instabilities as index of unpredictability). What such variation clearly suggests is that how these two core

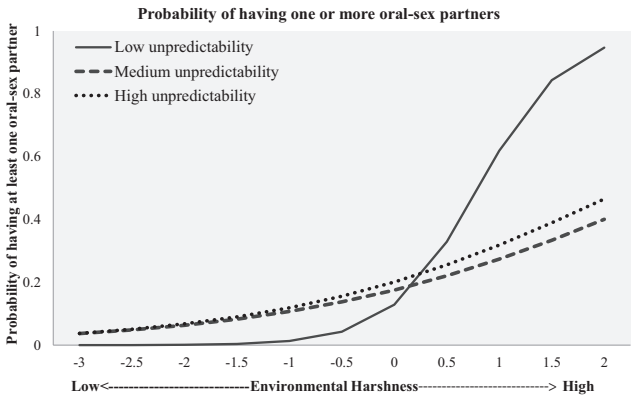

Figure 6. Environmental harshness and unpredictability interactions for probability of adolescence having one or more oral-sex partners. The vertical (Y) axis indicated probability of having one or more (i.e., at least one) oral-sex partners, the higher the Y value is, the higher the likelihood that adolescents have had oral sex with at least one person.

Table 4
Regions of Significance Analyses for the Effects of Environmental Harshness (Split in Terciles), Unpredictability, and Their Interaction on Childhood and Adolescence Functioning (N = 1,356)

Variable	Regions of significance
Kindergarten	
Behavioral problems	X < −.24 or X > .47
Social Skills	X < −.15 or X > .32
Academic skills	X < −.33 or X > .19
Teacher-child conflicts	X < −.28 or X > .85
Adolescence	
Cognitive-academic achievement	X < −.06 or X > .30

Note. Significant regions denoted regions (with regard to X values) that high-unpredictability and low-unpredictability group are significantly different ($p < .05$).

constructs of harshness and unpredictability are related appears to depend, perhaps not surprisingly, on how they are operationalized. One cannot discount the possibility, however, that sample make-up matters, too. Whereas Brumbach et al. (2009) drew on the nationally representative Longitudinal Study of Adolescent Health, Belsky et al. (2012) relied on the reasonably heterogeneous NICHD Study sample, just as we have, whereas others have relied on high-risk samples (Simpson et al., 2012; Szepsenwol et al., 2015).

On reflection, what makes all these Harshness × Unpredictability findings most intriguing is how consistent they seem to be with Frankenhuis and Panchanathan (2011a, 2011b; Panchanathan & Frankenhuis, 2016) novel thinking about environmental cue reliability. These evo-devo scholars theorized that when contextual conditions—such as family income—vary unpredictably (i.e., high unpredictability), they offer a less reliable estimate of current and future contextual conditions than when they prove predictable; as such, they serve as a less confident basis for committing to one or another life history strategy (e.g., development of problematic, coercive behavior in consistently harsh environment). According to these thinkers, the developing child should thus defer commitment to a particular developmental trajectory in the face of unpredictable environmental cues in order to reduce the chance of mis-calibrating development in a way that will lead to a poor fit with the current and future environment. Notably, then, it was children whose family economic environment provided predictable—thus providing reliable contextual cues—who developed most competently, in a mental health sense, perhaps reflecting a slow life history, or most poorly, perhaps reflecting a fast life history. In contrast, children who experienced an unpredictable family economic environment appeared less committed to one or another developmental trajectory, irrespective of whether the family environment was characterized by high or low harshness.

Perhaps if nothing else, what these findings make clear is the need to think not only about fundamental features of the environment and their unique effects, but about how such forces interact in shaping child, adolescent and even adult development. The fact that so much research on environmental effects relies on indices of cumulative contextual risk (for review, see Evans, Li, & Whipple, 2013) reflects the fact that developmentalists generally lack a theory about what features of the environment are more and less influential in shaping development, even as they appreciate that

Table 5
Sensitivity Analyses for Effects of Environmental Harshness, Unpredictability, and the Harshness × Unpredictability Interaction on Kindergarten and Adolescence Functioning Based on Full Information Maximum Likelihood Estimation (N = 1,356)

Variable	Harshness[a]			Unpredictability[a]			Harshness[a] × Unpredictability[a]		
	Estimate (*SE*)	*t*	*p*	Estimate (*SE*)	*t*	*p*	Estimate (*SE*)	*t*	*p*
Kindergarten									
Behavioral problems	2.59 (.58)	4.44	.00**	−.28 (.30)	−.91	.36	−.33 (.17)	−1.87	.06†
Social skills	−5.30 (.85)	−6.27	.00**	.12 (.44)	.26	.79	.65 (.25)	2.58	.01*
Academic skills	−.48 (.05)	−9.09	.00**	.06 (.02)	2.06	.04*	.05 (.02)	3.16	.00**
Teacher-child conflicts	.95 (.33)	2.90	.00**	.06 (.17)	.36	.72	−.05 (.10)	−.54	.59
Adolescence									
Impulse control	−.30 (.06)	−5.34	.00**	−.06 (.03)	−1.91	.06†	−.02 (.02)	−1.31	.19
Depressive symptoms[b]	.10 (.06)	1.63	.10	.06 (.03)	1.73	.08†	.03 (.02)	1.84	.07†
Externalizing behavior	3.08 (.62)	4.99	.00**	.88 (.32)	2.74	.01**	.34 (.18)	1.83	.07†
Non-sexual risk-taking[b]	.56 (.07)	8.39	.00**	.13 (.03)	3.82	.00**	.04 (.02)	1.80	.07†
Academic achievement[c]	−9.91 (.77)	−12.87	.00**	−.42 (.40)	−1.05	.29	.50 (.23)	2.18	.03*
Future orientation	−.05 (.03)	−1.74	.08†	−.02 (.02)	−1.21	.22	−.003 (.01)	−.31	.76

[a] Harshness and unpredictability were sample-mean-centered. [b] Depressive symptoms and nonsexual risk-taking: Square-root-transformation was applied to these variables due to their non-normal distribution (i.e., skewness > 2 and/or kurtosis > 3). [c] Academic-achievement is short for cognitive-academic achievement.
† $p < .10$. * $p < .05$. ** $p < .01$.

multiple factors and forces are at work—and no doubt interact with each other. Although Ellis et al. (2009) did not speculate about interactive effects, highlighting as they did unique and additive ones, the integration of their new fundamental-forces framework with developmentalists' appreciation of multiple, interacting influences holds, we believe, much promise for further understanding contextual determinants of human development.

Whatever the contributions of the research presented, it is not without limits. To begin with, the NICHD sample was neither nationally nor internationally representative and thus did not capture the full range of environmental conditions. Thus, even though family income in the study sample was substantially variable, the representation of extremely disadvantaged families was limited. Second, even though causal language (e.g., "effects", "influences") was used in this report, this observational study could not document cause-effect relations. Third, although the current article operationalized income changes as environmental unpredictability, it is appreciated that not all change is unpredictable and uncontrollable (e.g., intended job transition). Thus, the statistical technique for deriving income unpredictability in the current article cannot perfectly reflect the "unpredictable" component of family income. Nevertheless, we managed to statistically differentiate the systematic linear trend from the nonsystematic volatility, thereby capturing environmental unpredictability to a greater extent than would be the case had we just used a measure of change like standard deviation. The fourth limitation pertains to the number of repeated measurements we used to derive income unpredictability—just six occasions within the first 4.5 years. We advise future longitudinal studies interested in adopting the same approach to utilize more time points if possible. Another limit, which we actually regard as strength in planning this research, involved reliance on a single and repeated measure of the rearing environment, the income-to-needs ratio, to create indices of environmental harshness and unpredictability. Had we used other measurements, results could well have been different. Future investigators might adopt our approach, especially with regard to parameterizing unpredictability, to investigate interactive effects using repeated measures of stress, parenting, depression, and the like. Finally, we appreciate that much additional work is required to illuminate the proximate mechanisms by which income-related harshness and unpredictability gets conveyed to or experienced by the child (e.g., parental well-being, parenting).

References

Achenbach, T. M. (1991). *Manual for the Teacher's Report Form and 1991 profile*. Burlington, VT: Department of Psychiatry, University of Vermont.

Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for ASEBA school-age forms and profiles*. Burlington, VT: Research Center for Children, Youth, and Families, University of Vermont.

Achenbach, T. M., & Rescorla, L. (2007). *Multicultural understanding of child and adolescent psychopathology: Implications for mental health assessment*. New York, NY: Guilford Press.

Adler, N. E., Boyce, W. T., Chesney, M. A., Folkman, S., & Syme, S. L. (1993). Socioeconomic inequalities in health. No easy solution. *Journal of the American Medical Association, 269,* 3140–3145. http://dx.doi.org/10.1001/jama.1993.03500240084031

Almeida, D. M., Piazza, J. R., & Stawski, R. S. (2009). Interindividual differences and intraindividual variability in the cortisol awakening response: An examination of age and gender. *Psychology and Aging, 24,* 819–827. http://dx.doi.org/10.1037/a0017910

Becker, G. S., & Tomes, N. (1986). Human capital and the rise and fall of families. *Journal of Labor Economics, 4*(Part 2), S1–S39.

Belsky, J. (1984). The determinants of parenting: A process model. *Child Development, 55,* 83–96. http://dx.doi.org/10.2307/1129836

Belsky, J., Schlomer, G. L., & Ellis, B. J. (2012). Beyond cumulative risk: Distinguishing harshness and unpredictability as determinants of parenting and early life history strategy. *Developmental Psychology, 48,* 662–673. http://dx.doi.org/10.1037/a0024454

Belsky, J., Steinberg, L., & Draper, P. (1991). Childhood experience, interpersonal development, and reproductive strategy: And evolutionary theory of socialization. *Child Development, 62,* 647–670. http://dx.doi.org/10.2307/1131166

Birch, S. H., & Ladd, G. W. (1997). The teacher–child relationship and children's early school adjustment. *Journal of School Psychology, 35,* 61–79. http://dx.doi.org/10.1016/S0022-4405(96)00029-5

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press; http://www.jstor.org/stable/43852879

Brooks-Gunn, J., & Duncan, G. J. (1997). The effects of poverty on children. *The Future of Children, 7,* 55–71. http://dx.doi.org/10.2307/1602387

Brumbach, B. H., Figueredo, A. J., & Ellis, B. J. (2009). Effects of harsh and unpredictable environments in adolescence on development of life history strategies: A longitudinal test of an evolutionary model. *Human Nature, 20,* 25–51. http://dx.doi.org/10.1007/s12110-009-9059-3

Cauffman, E., & Woolard, J. (1999). *Future outlook inventory*. Unpublished manuscript.

Chen, E., Matthews, K. A., & Boyce, W. T. (2002). Socioeconomic differences in children's health: How and why do these relationships change with age? *Psychological Bulletin, 128,* 295–329. http://dx.doi.org/10.1037/0033-2909.128.2.295

Chisholm, J., Ellison, P. T., Evans, J., Lee, P. C., Lieberman, L. S., Pavlik, Z., . . . Worthman, C. M. (1993). Death, hope, and sex: life-history theory and the development of reproductive strategies. *Current Anthropology, 34,* 1–24. http://dx.doi.org/10.1086/204131

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98,* 310–357.

Conger, R. D., Conger, K. J., & Martin, M. J. (2010). Socioeconomic status, family processes, and individual development. *Journal of Marriage and Family, 72,* 685–704. http://dx.doi.org/10.1111/j.1741-3737.2010.00725.x

Conger, R. D., Ge, X., Elder, G. H., Jr., Lorenz, F. O., & Simons, R. L. (1994). Economic stress, coercive family process, and developmental problems of adolescents. *Child Development, 65,* 541–561. http://dx.doi.org/10.2307/1131401

Dahl, G. B., & Lochner, L. (2012). The impact of family income on child achievement: Evidence from the earned income tax credit. *The American Economic Review, 102,* 1927–1956. http://dx.doi.org/10.1257/aer.102.5.1927

Dearing, E., McCartney, K., & Taylor, B. A. (2006). Within-child associations between family income and externalizing and internalizing problems. *Developmental Psychology, 42,* 237–252. http://dx.doi.org/10.1037/0012-1649.42.2.237

Deater-Deckard, K., Wang, Z., Chen, N., & Bell, M. A. (2012). Maternal executive function, harsh parenting, and child conduct problems. *Journal of Child Psychology and Psychiatry, 53,* 1084–1091. http://dx.doi.org/10.1111/j.1469-7610.2012.02582.x

Del Giudice, M., Gangestad, S. W., & Kaplan, H. S. (2015). Life history theory and evolutionary psychology. In D. M. Buss (Ed.), *The handbook of evolutionary psychology* (2nd ed., pp. 88–114). New York, NY: Wiley. http://dx.doi.org/10.1002/9781119125563.evpsych102

Ditzen, B., Schmidt, S., Strauss, B., Nater, U. M., Ehlert, U., & Heinrichs, M. (2008). Adult attachment and social support interact to reduce psychological but not cortisol responses to stress. *Journal of Psychosomatic Research, 64,* 479–486. http://dx.doi.org/10.1016/j.jpsychores.2007.11.011

Doom, J. R., Vanzomeren-Dohm, A. A., & Simpson, J. A. (2016). Early unpredictability predicts increased adolescent externalizing behaviors and substance use: A life history perspective. *Development and Psychopathology, 28,* 1505–1516. http://dx.doi.org/10.1017/S0954579415001169

Dumont, H., Trautwein, U., Nagy, G., & Nagengast, B. (2014). Quality of parental homework involvement: Predictors and reciprocal relations with academic functioning in the reading domain. *Journal of Educational Psychology, 106,* 144–161. http://dx.doi.org/10.1037/a0034100

Duncan, G. J., Gustafsson, B., Hauser, R., Schmauss, G., Messinger, H., Muffels, R., . . . Ray, J. C. (1993). Poverty dynamics in eight countries. *Journal of Population Economics, 6,* 215–234. http://dx.doi.org/10.1007/BF00163068

Duncan, G. J., Yeung, W. J., Brooks-Gunn, J., & Smith, J. R. (1998). How much does childhood poverty affect the life chances of children? *American Sociological Review, 63,* 406–423. http://dx.doi.org/10.2307/2657556

Elder, G. H., Jr. (1998). The life course as developmental theory. *Child Development, 69,* 1–12. http://dx.doi.org/10.1111/j.1467-8624.1998.tb06128.x

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk: The impact of harsh versus unpredictable environments on the evolution and development of life history strategies. *Human Nature, 20,* 204–268. http://dx.doi.org/10.1007/s12110-009-9063-7

Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural equation modeling, 8,* 430–457. http://dx.doi.org/10.1207/S15328007SEM0803_5

Evans, G. W., Li, D., & Whipple, S. S. (2013). Cumulative risk and child development. *Psychological Bulletin, 139,* 1342–1396. http://dx.doi.org/10.1037/a0031808

Fawcett, T. W., & Frankenhuis, W. E. (2015). Adaptive explanations for sensitive windows in development. *Frontiers in Zoology, 12*(1, Suppl. 1), S3. http://dx.doi.org/10.1186/1742-9994-12-S1-S3

Frankenhuis, W. E., & Fraley, R. C. (2017). What do evolutionary models teach us about sensitive periods in psychological development? *European Psychologist, 22,* 141–150. http://dx.doi.org/10.1027/1016-9040/a000265

Frankenhuis, W. E., & Panchanathan, K. (2011a). Individual differences in developmental plasticity may result from stochastic sampling. *Perspectives on Psychological Science, 6,* 336–347. http://dx.doi.org/10.1177/1745691611412602

Frankenhuis, W. E., & Panchanathan, K. (2011b). Balancing sampling and specialization: An adaptationist model of incremental development. *Proceedings of the Royal Society of London B: Biological Sciences, 278,* 3558–3565. http://dx.doi.org/10.1098/rspb.2011.0055

Ge, X., Conger, R. D., & Elder, G. H., Jr. (2001). Pubertal transition, stressful life events, and the emergence of gender differences in adolescent depressive symptoms. *Developmental Psychology, 37,* 404–417. http://dx.doi.org/10.1037/0012-1649.37.3.404

Gennetian, L. A., Castells, N., & Morris, P. (2010). Meeting the basic needs of children: Does income matter? *Children and Youth Services Review, 32,* 1138–1148. http://dx.doi.org/10.1016/j.childyouth.2010.03.004

Graber, J. A., Brooks-Gunn, J. E., & Petersen, A. C. (1996). *Transitions through adolescence: Interpersonal domains and context*. Hillsdale, NJ: Erlbaum, Inc. Retrieved from http://PsycNET.apa.org/record/1996-98208-000

Gresham, F. M., & Elliott, S. N. (1990). *Social skills rating system (SSRS)*. Circle Pines, MN: American Guidance Service.

Halpern-Felsher, B. L., Biehl, M., Kropp, R. Y., & Rubinstein, M. L. (2004). Perceived risks and benefits of smoking: Differences among adolescents with different smoking experiences and intentions. *Preventive Medicine: An International Journal Devoted to Practice and Theory, 39,* 559–567. http://dx.doi.org/10.1016/j.ypmed.2004.02.017

Haveman, R., & Wolfe, B. (1994). *Succeeding generations: On the effects of investments in children*. New York, NY: Russell Sage Foundation.

Hill, H. (2016, June 13–14). *Income dynamics during childhood: Trends and implications*. Paper presented at the 2016 APPAM International Conference, London, UK. Retrieved from https://appam.confex.com/appam/int16/webprogram/Paper15643.html

Hill, H. D., Morris, P., Gennetian, L. A., Wolf, S., & Tubbs, C. (2013). The consequences of income instability for children's well-being. *Child Development Perspectives, 7,* 85–90. http://dx.doi.org/10.1111/cdep.12018

Hoffman, L. (2007). Multilevel models for examining individual differences in within-person variation and covariation over time. *Multivariate Behavioral Research, 42,* 609–629. http://dx.doi.org/10.1080/00273170701710072

Jahng, S., Wood, P. K., & Trull, T. J. (2008). Analysis of affective instability in ecological momentary assessment: Indices using successive difference and group comparison via multilevel modeling. *Psychological Methods, 13,* 354–375. http://dx.doi.org/10.1037/a0014173

Kaplan, H. S., & Gangestad, S. W. (2005). Life history theory and evolutionary psychology. In D. M. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 68–95). New York, NY: Wiley. http://dx.doi.org/10.1002/9780470939376.ch2

Kovacs, M. (1992). *Children's Depression Inventory: Manual*. North Tonawanda, NY: Multi-Health Systems.

Liu, N. H., Choi, K. H., Reddy, F., & Spaulding, W. D. (2011). Heterogeneity and the longitudinal recovery of functioning during inpatient psychiatric rehabilitation for treatment-refractory severe mental illness. *American Journal of Psychiatric Rehabilitation, 14,* 55–75. http://dx.doi.org/10.1080/15487768.2011.546293

Mistry, R. S., Vandewater, E. A., Huston, A. C., & McLoyd, V. C. (2002). Economic well-being and children's social adjustment: The role of family process in an ethnically diverse low-income sample. *Child Development, 73,* 935–951. http://dx.doi.org/10.1111/1467-8624.00448

Moffitt, R. A., & Gottschalk, P. (2002). Trends in the transitory variance of earnings in the United States. *The Economic Journal, 112*(478), C68–C73. http://dx.doi.org/10.1111/1468-0297.00025

National Institute of Child Health & Human Development Early Child Care Research Network. (2005). *Child care and child development: Results of the NICHD Study of Early Child Care and Youth Development*. New York, NY: Guilford Press.

Newman, C. (2006). *The income volatility see-saw: Implications for school lunch* (No. 7237). Washington, DC: Economic Research Service, United States Department of Agriculture. Retrieved from http://purl.umn.edu/7237

Nichols, A., & Zimmerman, S. (2008). *Measuring trends in income variability*. Washington, DC: The Urban Institute. Retrieved from https://www.urban.org/sites/default/files/publication/31811/411688-measuring-trends-in-income-variability.pdf

Panchanathan, K., & Frankenhuis, W. E. (2016). The evolution of sensitive periods in a model of incremental development. *Proceedings of the Royal Society of London B: Biological Sciences, 283,* 20152439. http://dx.doi.org/10.1098/rspb.2015.2439

Pianta, R. C. (2001). *Student–Teacher Relationship Scale: Professional manual*. Lutz, FL: Psychological Assessment Resources.

Qi, C. H., & Kaiser, A. P. (2003). Behavior problems of preschool children from low-income families review of the literature. *Topics in Early Childhood Special Education, 23,* 188–216. http://dx.doi.org/10.1177/02711214030230040201

Sarsour, K., Sheridan, M., Jutte, D., Nuru-Jeter, A., Hinshaw, S., & Boyce, W. T. (2011). Family socioeconomic status and child executive functions: The roles of language, home environment, and single parenthood. *Journal of the International Neuropsychological Society, 17,* 120–132. http://dx.doi.org/10.1017/S1355617710001335

Schneider, S., Junghaenel, D. U., Keefe, F. J., Schwartz, J. E., Stone, A. A., & Broderick, J. E. (2012). Individual differences in the day-to-day variability of pain, fatigue, and well-being in patients with rheumatic disease: Associations with psychological variables. *Pain, 153,* 813–822. http://dx.doi.org/10.1016/j.pain.2012.01.001

Simpson, J. A., Griskevicius, V., Kuo, S. I., Sung, S., & Collins, W. A. (2012). Evolution, stress, and sensitive periods: The influence of unpredictability in early versus late childhood on sex and risky behavior. *Developmental Psychology, 48,* 674–686. http://dx.doi.org/10.1037/a0027293

Snijders, T. A. B., & Bosker, R. (1999). *Multilevel analysis*. Thousand Oaks, CA: Sage.

Szepsenwol, O., Simpson, J. A., Griskevicius, V., & Raby, K. L. (2015). The effect of unpredictable early childhood environments on parenting in adulthood. *Journal of Personality and Social Psychology, 109,* 1045–1067. http://dx.doi.org/10.1037/pspi0000032

Taborsky, B., & Oliveira, R. F. (2012). Social competence: An evolutionary approach. *Trends in Ecology & Evolution, 27,* 679–688. http://dx.doi.org/10.1016/j.tree.2012.09.003

Wagmiller, R. L., Jr., Lennon, M. C., Kuang, L., Alberti, P. M., & Aber, J. L. (2006). The dynamics of economic disadvantage and children's life chances. *American Sociological Review, 71,* 847–866. http://dx.doi.org/10.1177/000312240607100507

Weinberger, D. A., & Schwartz, G. E. (1990). Distress and restraint as superordinate dimensions of self-reported adjustment: A typological perspective. *Journal of Personality, 58,* 381–417. http://dx.doi.org/10.1111/j.1467-6494.1990.tb00235.x

Woodcock, R. W., & Johnson, M. B. (1989). *Woodcock-Johnson Tests of Achievement*. Allen, TX: DLM Teaching Resources.

Yao, S., Långström, N., Temrin, H., & Walum, H. (2014). Criminal offending as part of an alternative reproductive strategy: Investigating evolutionary hypotheses using Swedish total population data. *Evolution and Human Behavior, 35,* 481–488. http://dx.doi.org/10.1016/j.evolhumbehav.2014.06.007

Yeung, W. J., Linver, M. R., & Brooks-Gunn, J. (2002). How money matters for young children's development: Parental investment and family processes. *Child Development, 73,* 1861–1879. http://dx.doi.org/10.1111/1467-8624.t01-1-00511

Zachrisson, H. D., & Dearing, E. (2015). Family income dynamics, early childhood education and care, and early child behavior problems in Norway. *Child Development, 86,* 425–440. http://dx.doi.org/10.1111/cdev.12306

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