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Testing the empirical integration of threat-deprivation and harshness-unpredictability dimensional models of adversity

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Abstract

Recent dimensional models of adversity informed by a neurobiological deficit framework highlights threat and deprivation as core dimensions, whereas models informed by an evolutionary, adaptational and functional framework calls attention to harshness and unpredictability. This report seeks to evaluate an integrative model of threat, deprivation, and unpredictability, drawing on the Fragile Families Study. Confirmatory factor analysis of presumed multiple indicators of each construct reveals an adequate three-factor structure of adversity. Theory-based targeted predictions of the developmental sequelae of each dimension also received empirical support, with deprivation linked to health problems and cognitive ability; threat linked to aggression; and unpredictability to substance use and sexual risk-taking. These findings lend credibility to utility of the three-dimensional integrative framework of adversity. It could thus inform development of dimensional measures of risk assessment and exploration of multidimensional adversity profiles, sensitive to individual differences in lived experiences, supporting patient-centered, strength-based approaches to services.

Keywords: adaptation; dimensional adversity; evolutionary-developmental; integrative model; risk factors

Understanding early life adversity is critical to mitigating its well-documented negative effects on the development of children (Cicchetti, 2016; Dunn et al., 2018; Lupien, et al., 2009; McLaughlin, et al., 2010; Wilson et al., 2009; Yoshikawa, et al., 2012). Traditionally, adversity has often been treated categorically (i.e., present/absent), with risk factors assumed to exert additive effects, such that exposure to more risks undermines normative development more than exposure to fewer risks (Appleyard, et al., 2005; Cicchetti, 2010; Hostinar & Gunnar, 2013; Masten, et al., 2015). This widely utilized approach to studying effects of early life adversity is known as *cumulative-risk* (Evans et al., 2013) – or, more recently, ACEs (Adverse Childhood Experiences; Danese & McEwen, 2012; Felitti et al., 1998).

While these approaches to conceptualizing adversity and investigating its effects have proven useful in predicting variation in diverse features of development (e.g., neurobiology, cognition, problem behavior; Evans et al., 2013; Nusslock & Miller, 2016; Pechtel & Pizzagalli, 2011; Repetti, et al., 2011; Sturge-Apple et al., 2011; Taylor, et al., 2011), it is ever more appreciated that these paradigms are limited (Widaman, in press). Conceptually, these deficit-oriented models regard exposure to any adversity as potentially undermining the well-being of children (i.e., Daskalakis et al., 2013), when the Darwinian process of natural selection may have shaped human development to respond in strategic and beneficial ways (Belsky, et al., 1991).

Methodologically, various risk factors are typically assigned equal weight, thereby failing to recognize that some may be more influential than others (e.g., see Ettekal, et al., 2019). More importantly, the categorical parameterization of adversity in these frameworks has little capacity to account for the timing, intensity and/or duration (i.e., severity) of early-life experiences and exposures presumed to harm the developing child (McLaughlin & Sheridan, 2016).

In recent years, alternative dimensional models have emerged in an effort to address these – and other – limitations. Dimensional models of adversity are based on the view that different individual risk conditions share underlying characteristics that can – and should – be measured continuously (Ellis, et al., 2009; McLaughlin & Sheridan, 2016; McLaughlin, et al., 2014; Sheridan & McLaughlin, 2014). In so doing, they allow for treating different risks similarly, while capturing the severity gradient of risk. Central to the dimensional approach is the presumption that while some adverse exposures may have broad, across-the-board developmental effects, as more or less presumed by cumulative-risk and ACEs frameworks, most exert more particular, targeted and specific effects (Kuhlman et al., 2017; McLaughlin et al., 2014; McLaughlin et al., 2020).

The current report aims to integrate and expand two separate dimensional models – the neurobiological threat-deprivation framework and the evolutionary-adaptive harshness-unpredictability framework – within a single three-dimensional model of adversity. To evaluate the utility of joining these independently developed models we draw on data from the *Fragile Families and Child Wellbeing Study* (*FFCW*; Reichman, et al., 2001).

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More specifically, we first evaluate the fit of a three-dimensional model and then test hypotheses linking each dimension with the particular aspects of development they are hypothesized to influence (e.g., cognition, risk taking). Before doing so, we (a) review the two foundational dimensional models in order to highlight conceptual similarities – and differences – that serve as the basis for their integration; (b) discuss briefly the conceptual and operational definitions of the adversity dimensions under consideration; and then (c) provide the conceptual and empirical foundations for the dimension-outcome predictions that will be tested.

Dimensional models of adversity

The dimensional models of adversity on which this report is based – and builds – can be distinguished in terms of their scholarly foundations. McLaughlin and associates' (2014) *threat-deprivation model* is neurobiologically based (McLaughlin et al., 2014), whereas Ellis and associates' (2009) *harshness-unpredictability* one is grounded in evolutionary-developmental thinking. More specifically, the former framework is focused on understanding of brain mechanisms linking adversity exposures involving threat and deprivation with different psychological and behavioral phenotypes, including psychopathology (McLaughlin et al., 2014; Sheridan & McLaughlin, 2014). The evolutionary-developmental (evo-devo) framework, in contrast, is based on the "why" of development rather than founded on the mechanistic concern for the "how" of development: Why does development operate the way it does? It calls attention to experiences of harshness and unpredictability, as well as energetic resources (Ellis et al., 2009), though the latter is only of secondary consideration in this report.

Unlike cumulative-risk, ACEs and other deficit-oriented approaches that exclude consideration of any developmental advantages that may be associated with exposure to adversity, both aforementioned dimensional frameworks call attention to developmental adaptation. Critically, though, they differ in how adaptation is conceptualized. *The threat-deprivation model* regards effects of these adverse conditions as fostering self-preservation and strategic coping in the immediate environment (Kundakovic & Champagne, 2015; McLaughlin & Lambert, 2017; McLaughlin et al., 2015), while recognizing that longer-term consequences may include maladaptation, compromised development and even diagnosable psychiatric disorders. It derives from a neurobiological analysis of experience-driven plasticity (McLaughlin et al., 2014; Sheridan & McLaughlin, 2014). The central tenet of this model is that different dimensions of adversity will exert distinctive influence on neural development and, thereby, phenotypic functioning.

The evolutionary-developmental model, related as it is to life history theory (Del Giudice, et al., 2016), is based on a Darwinian view of adaptation. That is, the consequences of adversity often, even if not always, constitute a strategic response to morbidity and mortality risks that, over the course of human history, have fostered reproductive success, that is, the passing on of genes to future generations, the ultimate goal of all living things. Thus, responses to adversity do not represent compromised, dysfunctional, dysregulated, or disordered development, even when they involve making the best of a bad situation and result in forms of thinking, feeling and behaving that are not socially desirable in modern society (Belsky et al., 1991; Belsky & Pluess, 2013; Ellis & Del Giudice, 2019). More specifically, forces that increase morbidity and mortality risks – stemming from

not just the immediate environment, but the broader one as well (e.g., neighborhood, society) – promote a fast rather than slow life history strategy. This is because such a developmental trajectory is presumed to have increased the likelihood of survival to reproductive age and, thereby, the passing on of genes to the next generation in human ancestral history (Ellis et al., 2009; Del Giudice, 2020; Del Giudice et al., 2016).

Indeed, even if this is no longer the case in the modern world, the presumption is that the developmental machinery for inducing fast-life history phenotypes – including advantage taking, discounting of the future, and accelerated sexual development, leading to more promiscuous mating, high fertility and limited parental investment – remains operative (Belsky, 2019; Belsky et al., 1991; Brumbach, et al., 2009; Ellis, 2004). This is all in contrast to slow life histories which involve quite the opposite developmental trajectories, ones presumed to be induced by safe, secure and supportive early-life experiences and exposures (Ellis et al., 2009). Notably, neither manner of developing in response to developmental conditions is considered inherently better or worse than the other. Both are strategic alternatives assumed to fit the developing organism to the present and probabilistic future environment in the service of reproductive success (Belsky, 2007; Belsky, et al., 2012; Ellis et al., 2009).

Important to appreciate is that the *slow* life history may also be induced by conditions of resource scarcity, that is, deprivation (Ellis et al., 2022). When energetic resources (e.g., nutrition) are limited, the developing organism privileges survival and maintenance rather than development, according to life history theory. This should result in slower growth, smaller body size, later sexual maturation and constrained reproductive potential (Ellis et al., 2009). Related to the threat-deprivation model is the fact that conservation of energetic resources may come at a cost of neurobiological complexity and maintenance of physical fitness (Ellis et al., 2022).

This brief summary of the dimensional models of adversity which are the focus of the research presented herein highlights significant conceptual differences between the two frameworks, including differential emphasis on the immediate vs. the broader and future environment, psychological adaptation vs. reproductive adaptation, and the how vs. the why of development. At the same time, it reveals no evidence of irrevocable contradictions that would preclude their integration. (For more extensive discussion of the models and this point, see Ellis et al., 2022).

Model dimensions

Having delineated major postulates of the dimensional models of adversity that are the focus of this report, attention is now turned to the specific dimensions highlighted by each of these models – to lay the groundwork for the specific predictions that are central to this empirical report.

The threat-deprivation model

Deprivation is broadly understood as developmentally insufficient expected species- and age-typical environmental complexity, with the primary emphasis on the lack (or presence) of cognitive and social-relational stimulation. As such, deprivation has been assessed on a continuum, ranging in severity from lack of cognitive and psychosocial stimulation to the extent of environmental enrichment. Consequently, a few widely used indicators of the lower end of the deprivation-enrichment continuum include neglect, institutional rearing and caregiver

emotional unavailability, whereas the higher end of that continuum may be exemplified by parental scaffolding and psychosocial stimulation, among other factors such as adequate linguistic input (Colich et al., 2020; Drury et al., 2012; Lambert, et al., 2017; McLaughlin et al., 2014, 2015; McLaughlin, et al., 2017; Miller et al., 2018; Miller, et al., 2021).

Threat is conceptualized as any aversive exposure that physically or psychologically harms or poses risk of harm to an individual or someone close to them. Therefore, threat is indexed by traumatic or violent events linked to serious injury or threat to life. Examples include experiencing or witnessing physical, sexual, or emotional abuse, as well as violence in the home, in childcare, in the classroom or in the peer group or the community (Colich et al., 2020; Lambert et al., 2017; McCoy, et al., 2015; McLaughlin et al., 2014, 2015; Miller et al., 2018, 2021; Sumner et al., 2019).

The harshness-unpredictability model

Environmental harshness represents external conditions associated with increased risk of morbidity and mortality, which may be conveyed via cues of resource scarcity, conspecific violence, and population-level epidemiological indicators of risk to safety and survival that evolution has sensitized the developing individual to detect (e.g., crime rate; Brumbach et al., 2009; Ellis et al., 2009). To this extent, dimensions of deprivation and threat identified under *the harshness-unpredictability framework* map on to the conceptually broader components of environmental harshness (Ellis et al., 2022). Indeed, whereas in the threat-deprivation view, poor caregiving quality and/or absence of a caregiver largely accounts for the absence of experience-expectant environmental input, the harshness-unpredictability framework considers the critical role of material resources, such as nutrition, shelter, and basic safety, in terms of survival and eventual reproductive success (Ellis & Del Giudice, 2019; Ellis et al., 2009). Thus, material deprivation reflecting harshness can be indexed by measures of economic insufficiency, such as low income-to-needs ratio, food insecurity, receipt of public assistance or neighborhood deprivation (Belsky et al., 2012; Dennison & Swisher, 2019; Mededović & Bulut, 2019; Nettle, 2010; Sturge-Apple et al., 2016).

Similarly, environmental cues of threat within the harshness-unpredictability framework extend beyond proximal experiences of violence recognized by the threat-deprivation model, to more distal contextual cues, as noted above. From the Darwinian adaptational viewpoint, the threat component of harshness has been operationalized as family dysfunction (i.e., harsh parenting, interparental conflict), thereby acknowledging the unique role that families play in conveying to children – but not necessarily consciously – what the future will be like, based on their own lived experiences in childhood and adulthood (Belsky, 2019; Belsky et al., 1991, 2012; Brumbach et al., 2009). At the same time, it incorporates broader indicators of epidemiological environmental quality as markers of increased morbidity and/or mortality, such as population-wide indicators of health, life expectancy, and crime rates (Brumbach et al., 2009; Ellis et al., 2009; Ellis et al., this issue).

Environmental unpredictability reflects the stochastic component of sensory input in the environment associated with elevated risk of morbidity and mortality (Belsky et al., 2012; Ellis et al., 2009; Kuhlman et al., 2017). In other words, the continuum of unpredictability may be captured by experiences characterized by high entropy rate and low autocorrelation (i.e., see Davis et al., 2017; Young, et al., 2020). At the household level, unpredictability is commonly operationalized as parental transitions (e.g., changes in family structure or marital status), changes in employment or economic status, residential mobility, as well as general lack of family routines, inconsistent parenting, parental relational instability, and household chaos (Baram et al., 2012; Davis et al., 2017; Glynn et al., 2019; Hartman et al., 2018; Sturge-Apple et al., 2017). Fluctuating family income has also been considered an index of unpredictability (Li & Belsky, 2022). Broader environmental conditions pointing to unpredictability include chaotic neighborhoods and change in societal economic conditions, among others (Coley, et al., 2015; Ross & McDuff, 2008; Young et al., 2020).

Developmental correlates of dimensional adversity

Both dimensional models of adversity have stimulated theory-testing research linking specific dimensions with particular developmental outcomes. Here we focus on developmental phenotypes that serve as outcomes for the empirical work we report: cognitive ability, physical health, aggressive behavior and risk-taking.

Cognitive ability has been linked to socio-cognitive deprivation within the threat-deprivation model (e.g., Sheridan, et al., 2017) and the broader resource scarcity component of environmental harshness within the life history approach (e.g., Nettle, 2010). The threat-deprivation literature elucidates neurobiological pathways by which socio-cognitive deprivation shapes the neural architecture of the brain – the how of development – via the over-pruning of synaptic connections and the underlying thinning in frontoparietal, default and visual network areas of the prefrontal cortex (McLaughlin et al., 2014, 2015; Sheridan & McLaughlin, 2014). These effects on the brain lead to deficits in cognitive control and executive functions, such as working memory, cognitive flexibility and cognitive inhibition, which collectively can manifest as cognitive and language delays as well as developmental disabilities (Lambert et al., 2017; McLaughlin & Lambert, 2017; Miller et al., 2018; Rosen et al., 2020). Considered within the evolutionary-developmental perspective, cognitive outcomes may be a marker of low embodied capital, shaping development of a slow life history (see Ellis et al., 2022), rather than as evidence of dysfunction or disorder (see Ellis et al., 2022).

Physical health is another feature of development commonly associated with early exposure to deprivation. Turning to the "how" of development, physiological indicators of poor health have been linked to nutritional deficits, as well as hyper- and hypo-physiological stress responsivity, depending on the duration, intensity, and developmental timing of deprivation experiences (Chen, et al., 2002; Cutuli et al., 2014; Shankar, et al., 2017; Yoshikawa et al., 2012). Although the threat-deprivation model does not explicitly address effects of deprivation on physical health, it subsumes earlier neurobiological models, such as allostatic load, which elucidate mechanisms by which early life adversity, including material deprivation, undermines physical health (McLaughlin & Sheridan, 2016). From the threat-deprivation standpoint, then, compromised health may be viewed as a cost associated with adaptive changes induced by exposure to adversity (Mclaughlin et al., 2020).

From the evo-devo perspective, exaggerated immune responsivity may be an adaptation to conditions of elevated environmental morbidity (McDade, 2003), with limited allocation of resources for physical health maintenance representing an adaptive trade-off (Hill, et al., 2016; Jasienska et al., 2017; Mededović & Bulut, 2019; Urlacher et al., 2018; Walker et al., 2006). Aligned with the slow life history trajectory, this trade-off involves redistribution of resource

allocation from growth to maintenance, with the goal of improving the odds of surviving and eventually reproducing.

Aggressive behavior is linked to exposure to heightened threat and harshness. From the evolutionary standpoint, aggressive, destructive, or oppositional behavior, accounting for 17–33% of childhood psychopathology (Danielson et al., 2021), may be conceived as functional in harsh environmental conditions, such as in use of violence in self-defense (i.e., see Belsky et al., 1991, 2012; Ellis et al., 2009; McLaughlin et al., 2014; Sheridan & McLaughlin, 2014). Given that hypervigilance to threat may be protective in contexts characterized by violence, whereas aggressive behavior may be critical to asserting dominance needed to secure access to energetic resources and reproductive partners, externalizing behavior is considered a marker of *fast* life history (Belsky, 2019; Belsky et al., 1991, 2012; Del Giudice, 2020; Ellis et al., 2009; Suor, et al., 2017). Neurobiological mechanisms supporting increased sensitivity to real or perceived threat in areas of attention, memory and emotional processing of environmental stimuli under conditions of threat encountered early in life are well-described by the threat-deprivation model and related biopsychosocial perspectives, again reflective of the how of development (Humphreys & Zeanah, 2015; Machlin et al., 2019; McLaughlin & Sheridan, 2016; McLaughlin et al., 2015, 2017; Miller et al., 2021; Sheridan et al., 2017).

More specifically, exposure to threat cues is hypothesized to trigger changes in amygdala-prefrontal cortex connectivity and cortical thinning in the ventromedial area of the prefrontal cortex. Restructuring of emotional learning networks implicated in fear learning and appraisal of environmental cues increases propensity to interpret neutral or ambiguous stimuli as threatening (Briggs-Gowan et al., 2015; Lambert et al., 2017; McLaughlin et al., 2014; Miller et al., 2018). In turn, hypervigilance to perceived cues of threat, coupled with exaggerated physiological reactivity to stress and deficits in emotion regulation, are common correlates of behavioral problems, as highlighted in the threat-deprivation model (Jenness et al., 2021; Lambert et al., 2017; McLaughlin et al., 2014, 2017; Miller et al., 2018, 2021; Sheridan et al., 2017).

Risk-taking behavior, such as youth substance use and the early onset of sexual behavior, often with multiple partners, is presumed to reflect a *fast* life history and derive from early exposure to threat, harshness, and unpredictability (Belsky et al., 1991; Brumbach et al., 2009; Doom, et al., 2016; Ellis et al., 2009; Hartman et al., 2018; Simpson et al., 2012). Among possible mechanisms are cellular inflammation and up-regulation of the *Hypothalamic-Pituitary-Adrenal (HPA)*-axis, linked to disrupted caregiving (Drury et al., 2014; Kuhlman et al., 2017; Sturge-Apple et al., 2017). In turn, inflammation and elevated HPA axis reactivity mediate the relationship between exposure to early life unpredictability and difficulties with emotion regulation, impulsivity, delay of gratification, and long-term planning, with the downstream consequence of behavioral problems, such as substance use (Gassen et al., 2019; Sturge-Apple et al., 2017). Similarly, cellular indices of accelerated biological development (e.g., epigenetic clock, telomere erosion) are related to parental conflict, unemployment, family instability, parental substance problems, and neighborhood disorder (Coimbra et al., 2017; Price et al., 2013). These epigenetic and chromosomal markers of biological aging are associated with earlier pubertal timing and sexual risk-taking, such as early sexual debut and multiple sexual partners (Belsky & Shalev, 2016; Belsky, et al., 2010). Accordingly, exposure to unpredictability is thought to favor the *fast* life history, characterized by prioritization of immediate gratification over long-term planning and an emphasis on mating over parental investment, all at the cost of physical or

mental tenacity (Belsky et al., 2012; Brumbach et al., 2009; Ellis et al., 2009; Simpson et al., 2012).

In sum, the threat-deprivation and harshness-unpredictability frameworks are very much aligned when it comes to predicting developmental sequelae of exposure to harshness-threat, harshness-deprivation and unpredictability, as well as in the selection of many indicators of their adversity dimensions. Based on these commonalities, this report focuses on a parsimonious, three-dimensional model of adversity represented by threat-harshness, deprivation, and unpredictability (Ellis et al., 2022).

Current study

On the basis of the work reviewed, we draw on the *Fragile Families and Child Wellbeing (FFCW) Study* to measure threat-harshness, unpredictability, and deprivation in order to test specific predictions linking these exposures with particular developmental outcomes. Toward this end, we emphasize the following conceptual points that inform selection of indicators of each construct. First, each of the integrated dimensions are represented by proximal indicators (e.g., spanking) and more distal ones (e.g., neighborhood violence, environmental toxins). Second, threat and harshness are clearly overlapping even if not one and the same, though for purposes of this report the focus will be on overlap, resulting in reliance on terminology of threat-harshness throughout the remainder of this report. Third, all dimensions are conceptualized in bipolar terms (i.e., from "positive" to "negative", rather than from none to "negative"). Thus, for example, in order to represent the positive pole, deprivation will include sensitive-supportive care; threat-harshness will include parental warmth; and unpredictability will include consistency of caregiving and parents' relational stability.

With regard to predictions, we exclusively test the following dimension-specific exposure-outcome hypotheses following the creation of latent constructs representing each dimension: (1) greater deprivation will predict more developmental delays and physical health problems; (2) greater threat-harshness will predict more aggressive behavior; and (3) greater unpredictability will predict more risk-taking behavior, above and beyond the effects associated with aggression levels measured at an earlier timepoint. Adversity exposures were measured at around age 3 and hypothesized sequelae when children were 5 and 15 years of age.

Method

Data sources and characteristics

Empirical data for this investigation comes from *the Fragile Families and Child Wellbeing (FFCW) Study*, an ongoing longitudinal survey that follows a birth cohort of 5,000 children born between 1998 and 2000 across 20 U.S. cities sampled from medium sized urban, metropolitan, and large metropolitan areas (Reichman et al., 2001). The *FFCW Study* participants were selected via stratified, multistage random sampling from cities with populations over 200,000, grouped by political and labor market conditions. By design, unmarried mothers were oversampled, such that for each three children born to unwed mothers there was one child born to a married couple.

The *FFCW Study* is comprised of three components, the *Primary Caregiver (PCG) Core Study*, consisting of mother and father and/or caregiver surveys; the *In-Home Study*, which included caregiver surveys, standardized tests administered by the interviewers to children, and interviewer observations of focal

families' homes, parenting behavior, and parent–child relationship; and the *Child Care Centers and Teachers' Study*, which surveyed participating families' childcare providers and teachers. For the present report, the data come from the first two study components. Additionally, of the currently available six waves of data collection, spanning from pregnancy to when the child was 15 years old, the present study relied on the Wave 3 data to index dimensions of threat, deprivation, and unpredictability, collected when target children were around 3 years of age. Data on children's physical, cognitive, and behavioral development was sourced from Wave 4 when children were around 5 years old and Wave 6 when they were around 15 years of age.

Study sample

The total sample consisted of 3,253 children and their caregivers. Target children's gender was evenly split, with 51% boys and 49% girls. By age 15, 18% of children identified as White, 49% as Black, 25% as Hispanic or Latino, and 8% as Other or Mixed ethnicities. In terms of yearly household income, when children were 3 years of age, 28% of families earned $15,000 or less per year; another 27% earned less than $30,000, 28% between $30,000 and $60,000, and the remaining 17% more than $60,000. The majority of children were eutrophic (92% within normal range for weight and height); only 7% were identified as malnourished, underweight or stunted, and less than 1% as obese. Maternal age at childbirth varied, with 24% of mothers being under 19, 38% between 20 and 24, 32% between 25 and 34, and 6% being 35 or older. The majority of mothers were U.S. born (87%); 59% graduated from high school and/or attained higher education.

Measures

The a priori choice of indicators to index dimensions of threat, deprivation, and unpredictability – used as early-life predictors of later development – was theoretically based on ideas outlined in the introduction and/or prior empirical research. Indicators of each dimension are detailed below. Overall, the indicators used for this empirical investigation represented a mix of standardized assessments in their original, abridged, or adopted versions, as well as continuous scale and binary yes/no items (used to create sum scores) from the *FFCW PCG Core Study*.

Predictors

All predictor indicators were measured around three years of age.

Threat-Harshness. To capture this dimension, we relied on 13 indicators. Of these, four pertained to parenting behavior (spanking; physical abuse; psychological abuse; warmth/acceptance of child by parent); four to the interparental relationship (domestic violence; physical assault; psychological aggression; supportive relationship between parents); three to neighborhood characteristics (neighborhood violence; neighborhood safety; parent victim of neighborhood violence); and two to environmental risk of morbidity (parental health; exposure to environmental toxins).

Deprivation. Seventeen indicators were used to index deprivation. Of these, three reflected financial security of the household (income; assets; monthly rent or mortgage), six financial insecurity (financial hardship; length of welfare use; food insecurity; insufficient utilities; financial uncertainty; receipt of free meals by children and/or adults in household), three insufficient caregiving (parental depression; child neglect; number of hours child watches television), two engaged caregiving or scaffolding

(stimulating home environment; parental interaction/stimulation), and three as broader familial and extra-familial relational resources (parental relationship quality; availability of family/friends instrumental support; parental community involvement).

Unpredictability. Finally, to index unpredictability we used 12 indicators: four aimed to capture household composition changes (parental relationship status; change in parental relationships or living arrangements; number of serious relationships since child's birth; household composition reflective of relational ties & number of families living in the home); three changes in domicile and related areas of life (residential instability; unreliable transportation; regularity of child support payments); two of stability of child's living arrangements (how often child sees parent; who child lives with); and three indicative of irregular caregiving behavior (parental substance use interfering with work; coparenting issues-lack of agreement on parenting; coparenting issues-lack of trust in prudent parenting between child's caregivers).

Outcomes

Dependent developmental constructs were assessed in a variety of ways, including parent report, standardized testing, and interviewer observations. All outcome indicators were measured when children were five years old, with the exception of those related to risk behavior, which were assessed at age 15.

Child Physical Health was indexed by two indicators reflecting child's general health and asthma diagnosis. The general health was measured by a single item on a scale from *1 (excellent)* to *5 (poor)*. The asthma diagnosis was a sum score of three yes/no variables indicating whether a child was ever diagnosed with asthma.

Child Cognitive Ability was indexed by two indicators, the *Peabody Vocabulary Test Third Edition* (*PPVT-III*; Dunn & Dunn, 1997) standardized z-score, and the *Woodcock Johnson Letter-Word Identification Test* (*W-J Test 22*; Woodcock, et al., 2001) Passage Comprehension and Applied Problems standardized score. For both measures, higher scores represented higher cognitive ability.

Child Aggressive Behavior was assessed by means of the parent form of the CBCL 4–18 (Achenbach, 1991) subscales of *aggressive* and *delinquent* behavior. The aggressive subscale score was a sum of 18 items (Cronbach's $a = 0.74$) and the delinquent subscale score was a sum of nine items (Cronbach's $a = 0.56$), all on a scale from *0 (not true)* to *2 (very true)*.

Youth Risky Behavior was based on three items. The first two asked about age at first sexual intercourse and the number of sexual partners. The third was a sum score of three yes/no items that whether youth tried smoking, drinking, and/or other illicit drugs. All items were self-reported by youth.

Analytical plan

Analyses proceeded in three steps: (1) selection of indicators; (2) evaluation of the three-factorial measurement model; and (3) testing predictions linking specific adversity dimensions with specific developmental outcomes.

Selection of indicators. Before proceeding with this first step, data were examined for missingness and normality; scales were scored using the *User's Guides for the FFCW Study Public Data* (https://fragilefamilies.princeton.edu/sites/fragilefamilies); and intercorrelations of the resulting composite scores and individual indicator variables were examined. For each indicator pair that correlated at .85 or greater, one was removed to minimize redundancy (Bergqvist, et al., 2020). An exploratory factor analysis was used to identify and drop indicators loading on more than
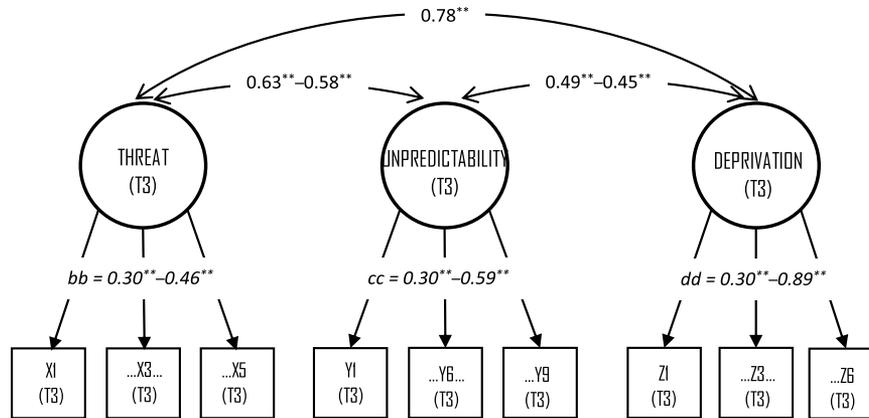
Figure 1. Robust fit indices for the integrative 3-factorial measurement model fit to *sample 1* (*n* = 1971): χ^2(135) = 663.00, *p* = .000, CFI = 0.87, RMSEA = .054 [.050; .058]; and *sample 2* (*n* = 1582): χ^2(135) = 744.83, *p* = .000, CFI = 0.85, RMSEA = .059 [.055; .063]. Coefficients are reported in standardized form; ***p < .001. Abbreviations: T3 = Time 3 (target child's age 3); X1 . . . X3 . . . X5 = placeholder for five indicators of threat; Y1 . . . Y6 . . . Y9 = placeholder for nine indicators of unpredictability; Z1 . . . Z3 . . . Z6 = placeholder for six indicators of deprivation; bb = a range of standardized loading coefficients for indicators of each of the three latent factors.

one factor with .20 or less difference in factor loadings (Hair et al., 2006). The final selection consisted of 13 indicators of threat-harshness, 17 indicators of deprivation, and 12 indicators of unpredictability. Detailed information on indicators used in this study can be provided upon request.

Three-factorial measurement model. In the next analytic step, indicator variables selected in the previous step were entered into a Confirmatory Factor Analysis (CFA) in which the three latent factors were allowed to covary. To meet the minimum level of factor loadings for interpretation of factor structure, all indicators with a standardized loading at or below .30 were dropped (Hair et al., 2006). The resulting factorial structure yielded, at age 3 years, five indicators of threat-harshness, six indicators of deprivation, and nine indicators of unpredictability. To test factor structure, the total sample (*N* = 3253) was split into two independent subsamples (*n* = 1671/1582). The three-factorial measurement model was fit to the first subsample data, then cross-validated by running a multi-sample CFA with the second subsample data (Immekus & Ingle, 2017). Results of these analyses informed the basis of the adversity-predictor constructs in the next phase of analysis.

Predictive model. The final analytic step involved two sub-steps. First, a measurement model of four latent outcome factors via a CFA, then specified a predictive model by adding predictive paths from the three latent predictor factors to the four latent outcome factors, using structural equation modeling (SEM). The measurement model of *latent outcome factors* was specified as follows: the latent factors of child physical health, cognitive ability, and aggression were each indexed by two indicators each, all measured at age 5 years; the latent risk-taking factor was indexed by three indicators, all measured at age 15 years. For each of the three latent factors measured at age 5, indicator factor loadings were constrained to equality.

In the second sub-step, theory-driven predictive paths based on the strongest hypothesized relations between each predictor and each outcome were tested by means of SEM. Thus, aggression was regressed on threat-harshness; cognitive ability and physical health on deprivation; and risk-taking on unpredictability, accounting for aggression at age 5 years. The latent predictor factors of threat-harshness, deprivation and unpredictability were allowed to covary, as were the latent outcomes of aggression, cognitive ability and physical health.

Analyses were carried out in R 4.1.0., package *lavaan* (Rosseel, 2012), using Maximum Likelihood estimation. All models were examined based on the Chi-square statistic, as well as robust CFI and RMSEA indices. The latter was considered more important when evaluating model fit, given the sensitivity of the Chi-square statistic to large sample sizes. Parameter estimates are reported in standardized form.

Results

The three-factorial measurement model testing

The three-factorial measurement model of threat-harshness, deprivation, and unpredictability depicted in Figure 1 showed acceptable fit, considering its a priori specification, model complexity and large sample size (Fabrigar, et al., 1999; Kim et al., 2016; Schumacker & Lomax, 2016). Robust fit indices for the model fit to the first sub-sample were as follows: χ^2(135) = 663.00, *p* < .001, CFI = .87, RMSEA = .054, 90% CI [.050, .058]. The final model featured 4 indicators of threat-harshness, seven indicators of deprivation, and seven of unpredictability. All indicator loadings were significant at *a*-level of .001 or below (see Table 1).

To test for latent-factor invariance, a series of Chi-square difference tests were used to evaluate measurement equivalence between the two randomly created subsamples. When testing for *configural invariance*, results of the multigroup CFA demonstrated comparable fit between the two groups, with the second subsample χ^2(135) = 744.83, *p* < .001, CFI = .85, RMSEA = .059, 90% CI [.055, .063]. *Weak invariance*, when the factor loadings between the two samples were constrained to equality, similarly held, χ^2_{diff}(15) = 10.49, *p* = .788. Likewise, no significant differences emerged between the two subsamples when evaluating *strong invariance*, with factor loadings and intercepts constrained to equality, χ^2_{diff}(30) = 30.20, *p* = .546; or factor loadings, intercepts, and covariances all held equal, χ^2_{diff}(33) = 31.83, *p* = .526. Finally, evidence proved consistent with *strict invariance*, when factor loadings, intercepts, covariances, and residuals proved equal, with a χ^2_{diff} (51) = 38.64, *p* = .898. The measurement equivalence of the three-factorial model observed between two independent subsamples generated by randomly splitting the full-sample data sample supports the three-factorial structure of the integrative dimensional model, at least in this high-risk sample.

Table 1. Indices of threat, deprivation, unpredictability, and latent child development outcome factor loadings, based on total sample ($N = 3253$) data

Latent construct indicators	Standardized estimate	Standard error
Threat (T3)		
Child experienced psychological abuse by parent/partner[a]	0.34**	0.01
Interparental physical violence[a]	0.50**	0.01
Neighborhood violence[a]	0.43**	0.01
Neighborhood safety[a]	−0.35**	0.01
Deprivation (T3)		
Physical/emotional neglect	0.33**	0.02
Parental depression	0.40**	0.03
Stimulating environment in the home	−0.37**	0.02
Parent/partner has access to instrumental support	−0.59**	0.02
Housing insufficiency-no utilities	0.44**	0.03
Food insecurity/hunger	0.54**	0.03
Financial uncertainty	0.32**	0.03
Unpredictability (T3)		
Residential instability	0.30**	0.02
Parent/partner's change in relational/live-in status	0.69**	0.02
Instability in father's payment of child support	0.77**	0.02
Reliable transportation	−0.56**	0.02
Coparenting issues – lack of agreement on parenting	0.65**	0.02
Stability of child's living arrangements (who child lives with)	−0.88**	0.02
Household composition	0.50**	0.02
Covariances		
Threat ↔ Unpredictability	0.57**	0.03
Threat ↔ Deprivation	0.74**	0.03
Deprivation ↔ Unpredictability	0.48**	0.02
Child physical health problems (T4)		
Child's general health status[c]	0.55**	0.01
Child's asthma diagnosis[c]	0.53**	0.01
Child's cognitive ability (T4)		
Child's PPVT score[d]	0.69**	0.02
Child's WWJS score[d]	0.68**	0.02
Child's aggression (T4)		
Child's aggressive behavior[e]	0.80**	0.02
Child's destructive behavior[e]	0.78**	0.02
Youth's risk-taking behaviors (T6)		
Youth's substance use	0.42**	0.02
Youth's age at first sexual intercourse	−0.98**	0.05
Number of sexual partners reported by youth	0.99**	0.02
Covariances		
Physical health problems ↔ Cognitive ability	−0.26**	0.05
Physical health problems ↔ Aggressive behavior	0.18**	0.03
Physical health problems ↔ Risk-taking behavior	0.08*	0.03
Cognitive ability ↔ Aggressive behavior	−0.18**	0.03
Cognitive ability ↔ Risk-taking behavior	−0.12**	0.03
Aggressive behavior ↔ Risk-taking behavior	0.13**	0.03

Note. Abbreviations: T3 = Time 3 (target child's age - 3); T4 = Time 4 (target child's age - 9); T6 = Time 6 (target child's age - 15). PPVT = Child's Peabody Picture Vocabulary Test; WJSS = Child's Woodcock Johnson Passage Comprehension and Applied Problems. All factor loadings were significant at $\alpha = 0.001$ level. Superscripts indicate equality constraints.
*$p < .05$.
**$p < .01$.
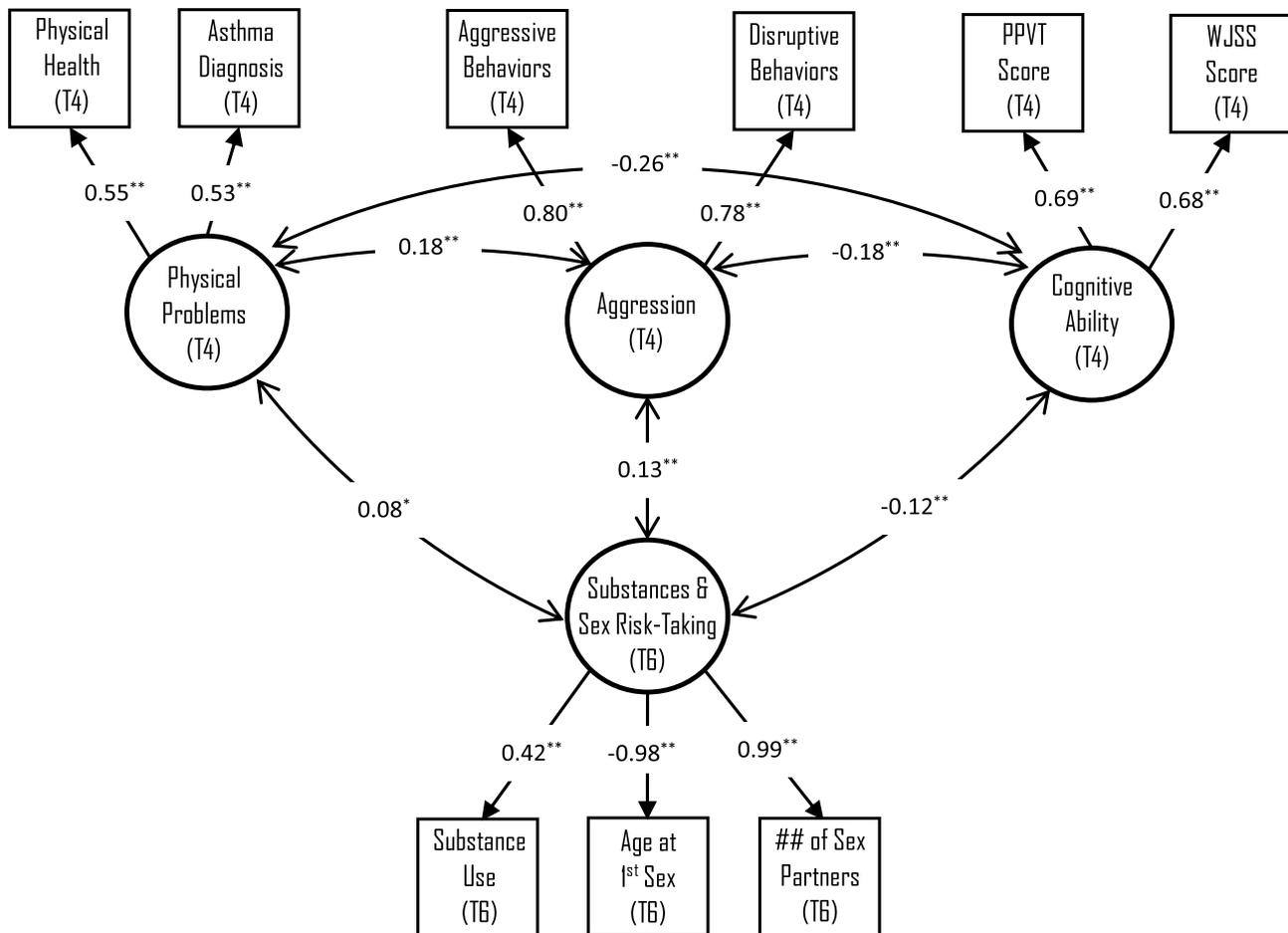
Figure 2. Robust fit indices for the multifactorial latent outcome measurement model, fitted to the whole sample ($N = 3253$): $\chi^2(24) = 92.33$, $p = .000$, CFI = 0.99, RMSEA = .031 [.025; .038]. Indicators of each latent factor at T4 are held equal. Coefficients are reported in standardized form; *$p < .05$, **$p < .001$. Abbreviations: T3 = Time 3 (target child's age 3), T4 = Time 4 (target child's age 9), T6 = Time 6 (target child's age 15); PPVT = Child's Peabody Picture Vocabulary Test; WJSS = Child's Woodcock Johnson Passage Comprehension and Applied Problems.

Before proceeding to testing the predictive model linking adversity dimension with developmental outcomes, we evaluated factor loadings and model fit for the latent outcome measurement model. A CFA model fitted to the whole sample demonstrated good fit, $\chi^2(24) = 92.33$, $p < .001$, CFI = .99, RMSEA = .031, 90% CI [.025, .038]. Figure 2 and Table 1 show that all indicator loadings were significant at a-level of .001 or below.
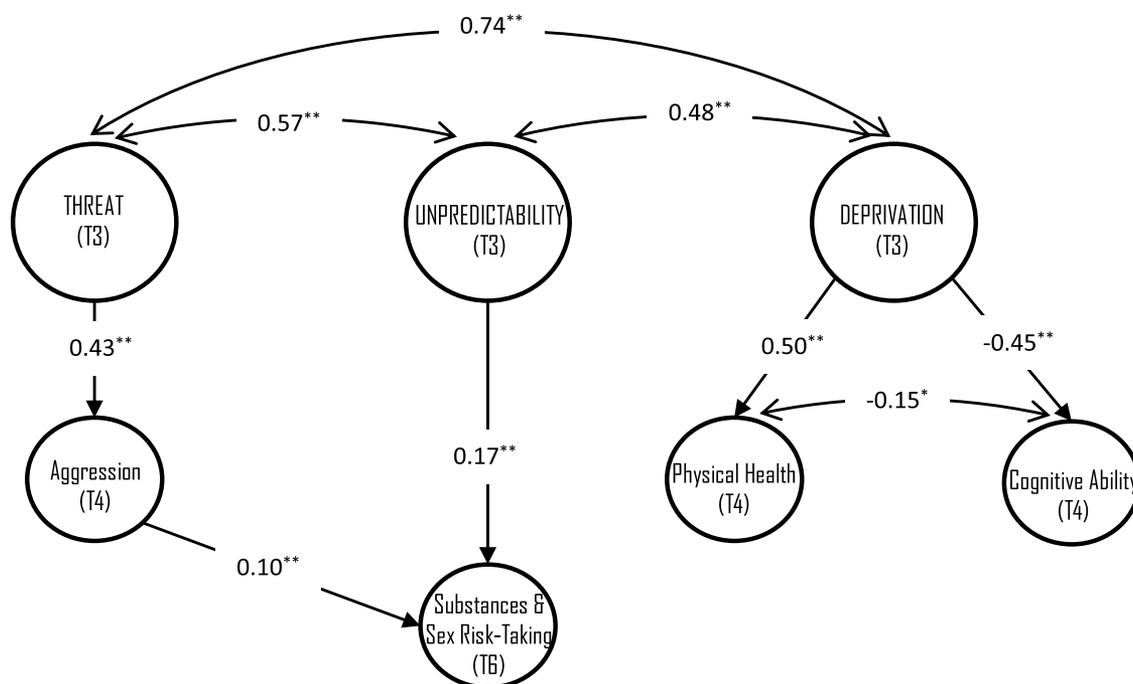
Testing predictive model

The predictive model in which latent constructs representing specified child outcomes measured at ages 5 and 15 years were regressed on latent constructs representing distinct dimensions of adversity measured at age 3 years. The model showed acceptable fit in the total sample, $\chi^2(318) = 2096.80$, $p < .001$, CFI = .89, RMSEA = .044, 90% CI [.043, .046]. Figure 3 demonstrates that all specified predictive paths were significant at a-level of .001 or below, with small effect sizes in the expected direction. Thus, greater exposure to deprivation at age 3 predicted, at age 5, more physical health problems, $b = 0.50$, $p = .000$, and lower cognitive functioning, $b = -0.45$, $p = .000$. At the same time, children who experienced more threat-harshness at age 3 exhibited more aggressive behavior by 5 years of age, $b = 0.43$, $p = .000$. Finally, as expected, children exposed to more unpredictable environmental

conditions at age 3 were more likely to use substances, showed earlier engagement in sexual activity, and had more sexual partners by age 15, $b = 0.17$, $p = .000$, after accounting for aggression at age 5, which independently predicted higher likelihood of substance use and sexual risk-taking at 15, $b = 0.10$, $p = .000$. Additionally, as is also depicted in Figure 3, children's physical health problems related to lower cognitive functioning, $b = -0.15$, $p = .023$.

Discussion

Given the emergence of recent dimensional models of childhood adversity, this study sought to empirically integrate the mechanistic threat-deprivation and the evolutionary harshness-unpredictability frameworks within a parsimonious threat-deprivation-unpredictability model, drawing on longitudinal data from the well-known *FFCW Study*. We endeavored to achieve this goal in two ways: (a) by proposing and evaluating a measurement model comprised of three separate, even if related dimensions of adversity and (b) by testing the fit of a theory- and evidence-derived predictive model linking each of the three dimensions with particular developmental phenotypes they were each hypothesized to most influence. Each goal is discussed in turn.

Figure 3. Robust indices for the 3-factorial predictive model fit to the whole sample (N = 3253): χ^2(318) = 2096.80, p = .000, CFI = 0.89, RMSEA = .044 [.043; .046]. Non-significant covariances are not shown. Coefficients are reported in standardized form; *p < .05; **p < .001. Abbreviations: T3 = Time 3 (target child's age 3), T4 = Time 4 (target child's age 9), T6 = Time 6 (target child's age 15).

Three-dimensional measurement model of childhood adversity

We hypothesized that multiple indicators of all three aforementioned adversity dimensions would fit a hypothesized measurement model with threat-harshness based on safety indicators (or lack thereof), deprivation on indicators of available resources and unpredictability on indicators of contextual instability. The task of operationalizing dimensions of adversity as latent constructs proved somewhat novel, as only one previous investigation has adopted this approach. It, too, relied on the *FFCW Study* to generate dimensions of threat and deprivation (Miller et al., 2021), while using many fewer indicators. We were unaware of this work as we conducted that reported herein.

Indicator assignment to the three latent constructs of adversity was based on both foundational models on which the present work is based. Where appropriate, both proximate indicators (e.g., unpredictability: coparenting issues) and distal (e.g., threat-harshness: neighborhood violence; exposure to environmental toxins) variables were included. Nevertheless, the decision-making process was challenging. For example, although various research groups relied on socioeconomic variables (e.g., maternal education, household income) as indices of deprivation experiences given the presumption that they reflect exposure to stimulating environments (e.g., Machlin et al., 2019; Sheridan et al., 2017, Suor et al., 2017, etc.), concerns have been raised about this practice. This is because dimensions of threat and deprivation may be difficult to disentangle in the context of poverty (Colich et al., 2020; Sumner et al., 2019). Issues also arose with regard to what indicators should be considered to reflect, where possible, the bipolarity of each continuum. For example, we chose to include maternal warmth and perceptions of neighborhood safety to reflect the positive pole of the threat-safety continuum, whereas indicators of

psychological aggression and neighborhood violence were chosen to reflect the negative pole of the same continuum.

Whatever the apparent merits of our decision making regarding what indicators went with which of the three dimensions – and we think that open-minded scholars could have honest disagreements on this score – what seems particularly important is that the hypothesized measurement model received empirical support. Recall, in fact, that this proved true even when the sample was randomly split in half. Thus, the three-dimensional model was twice confirmed. To be clear, however, this should not be read to imply that an alternative model based on a somewhat different array of indicators for each dimension would not fit the data.

It was not surprising that the dimensions themselves proved related to one another. Recall that levels of deprivation, threat-harshness and unpredictability were positively associated with each other, consistent with results of other investigators (Dong et al., 2004; Green et al., 2010; Frankenhuis & Dorsa, 2021; McLaughlin et al., 2020). Despite this, there would seem to be reasons to wonder whether there could be ecological niches in which the positive associations detected herein among the three latent adversity constructs might prove to be weaker – or even stronger. It could be of interest to see if this would be the case in contexts other than the USA and Western nations more generally, as some work suggests that the strength of association between deprivation and threat may vary, depending on the geographic locale (Frankenhuis & Dorsa, 2021).

Testing adversity predictions

The second goal of the study was to evaluate the predictive validity of the three-dimensional model by treating latent constructs reflecting each adversity dimension as specific predictors of select latent child-development outcome constructs. Recall that the

specific predictor-outcome associations evaluated herein were informed by both foundational dimensional models on which this study was based. Given that exposure to deprivation presupposes limited availability of material resources and cognitive stimulation, known to affect executive functioning (e.g., Rosen et al., 2020), it was hypothesized and confirmed that greater deprivation experienced in early childhood would forecast more limited cognitive capacity at the cusp of middle childhood. While investigation of the specific neurophysiological or other mechanisms mediating such an effect was beyond the scope of this investigation, our result is in line with the notion that the limited complexity of social and cognitive input constrains development of brain architecture (Sheridan et al., 2017). The result is also in line with life history theory, in that under conditions of material deprivation, particularly, limited nutrients, growth is traded off for maintenance and thus survival for reproduction, thereby favoring lower complexity of bodily systems (Ellis et al., 2009). The two foundational dimensional frameworks converge here in that brain development carries high energetic costs, particularly in early childhood (Kuzawa et al., 2014; Ellis et al., 2022). Also empirically confirmed was the prediction that greater deprivation would prove related to poorer physical health. Once again, the trade-off between growth and maintenance and thus between current survival and future reproduction help to explain this finding (Mell et al., 2018; Urlacher et al., 2018).

Because a *fast* life history is presumed to be favored in – and induced by – environmental contexts high on threat-harshness, the expectation was that such exposure would predict high levels of aggression/externalizing problems, which it did. And, interestingly, this prediction is not just in line with evolutionary analysis (Ellis et al., 2009, 2022). And this is because the threat-deprivation literature underscores links between violence exposure and neurophysiological adaptive response characterized by hypervigilance to threat and reduced self-control (Jenness et al., 2021; McLaughlin et al., 2014). Of course, for reasons other than those just outlined, developmental scholars have long linked family violence with heightened aggression (Dodge et al., 1990).

Considering the origins and character of a *fast* life history, in which conditions of environmental uncertainty are thought to preferentially support development geared toward earlier sexual maturation and increased fertility, exposure to early life unpredictability predicted, as hypothesized, sexual risk-taking (i.e., earlier age at first intercourse, more sexual partners by age 15), as well as other risky behaviors (i.e., substance use). Importantly, these predictions held even after accounting for earlier levels of externalizing behavior, a known mediator in the developmental cascades between early life stress, self-regulation, and later life risk-taking (e.g., Bornstein et al., 2010; Dishion & Snyder, 2016; Zucker et al., 2011). They are also consistent with other research inspired by evolutionary-developmental thinking because, as here, a fast life history is characterized by a limited capacity to delay gratification and the proclivity to value present rewards over future ones, among other psychological and behavioral tendencies that privilege mating over parental investment (Belsky et al., 2012; Brumbach et al., 2009; Simpson et al., 2012). But because life history thinking stipulates that this trade off proves strategic only when energetic resources are sufficient to promote growth and do not have to be husbanded in the service of survival (Ellis et al., 2009), there is reason to wonder whether the three adversity dimensions investigated in the current research would interact when it comes to predicting the phenotypes found herein to be associated with unpredictability. Addressing such possibilities

was beyond the scope of the current work but certainly merits attention in future research.

Conclusion and limitations

The work presented herein contributes to the field of developmental science by advancing and empirically testing – and finding support for – an integrative multidimensional model of adversity based on two reasonably well-established dimensional frameworks (Ellis et al., this issue). Whatever the real strengths of the current inquiry – including the effort to integrate empirically two separately developed dimensional frameworks, reliance on multiple indicators of adversity constructs and developmental outcomes, confirmatory evaluation of a measurement model, and the formal testing of a predictive model reliant on latent constructs of predictors and outcomes – it is not without limitations. To begin with, while it is not surprising that the high-risk *FFCW* sample had a large amount of missing data, often due to family attrition, this situation created many computational difficulties. While we regard decisions made in coping with this situation reasonable, it is indisputable that others might have handled data limitations differently; and this could have resulted in somewhat different findings. In light of this, it is critical to assert that we did not analyze the data in multiple ways, after exploring alternative decisions, until we arrived at results consistent with expectations. Nonetheless, it is important to validate the three-factorial CFA model with new data in future research.

Another limitation is that the three-dimensional measurement model of adversity was based on select indicators collected at one point in time, when the children were three years of age. Only future work can determine whether a model based on similar data collected at other ages would fit as well as our data did. Next, there is the issue of cohort effects, given that adversity was measured between 2001 and 2003. As there are grounds for believing that since that time the ecological landscape has changed even within the same communities and for families like those that are the focus herein – due to the Great Recession and COVID, to cite but two obvious reasons – we cannot be sure how replicable the measurement model we tested will prove to be. Changing family policies also matter in this regard, including, for example, the McKinney-Vento Act of 2001 (No, C. L. B., 2002; Act of 2001, Pub. L. No. 107-110, § 115. *Stat*, 1425), Medicaid expansion (aka Obamacare; The Patient Protection and Affordable Care Act of 2010, P.L. §§ 111–148), and Families First Prevention Services Act of 2018 (Bipartisan Budget Act of 2018, H.R. § 1892, 115th Congress. 2017–2018), to name a few particularly relevant to people of color and other underserved communities that were oversampled in the *FFCW Study*.

Despite these real limits, we believe that our effort has advanced the developmental-science ball down the field. While we did not seek to incorporate brain measurements in order to fully integrate the mechanistic "how" of development championed by threat-deprivation investigators (McLaughlin et al., 2014; McLaughlin & Sheridan 2016) with the "why" of development championed by evo-devo ones (Ellis et al., 2009), we believe we have succeeded in other ways of advancing the integration of these two generative frameworks. Much more empirical integration is called for, but it is clear that there exist many opportunities to pursue this worthy scholarly goal.

Conflicts of interest. None.

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