Development and Psychopathology (2022), **34**, 705–717
doi:10.1017/S0954579421001607

CAMBRIDGE UNIVERSITY PRESS

Special Issue Article

Perceptions of childhood unpredictability, delay discounting, risk-taking, and adult externalizing behaviors: A life-history approach

Jose L. Martinez[1], Connor Hasty[1], Danielle Morabito[1], Heather M. Maranges[2], Norman B. Schmidt[1] and Jon K. Maner[1]

[1]Department of Psychology, Florida State University, Tallahassee, FL, USA and [2]Program for Leadership and Character and Department of Psychology, Wake Forest University, Winston-Salem, NC, USA

Abstract

Guided by principles from life-history theory, theories of adaptive calibration provide an overarching theoretical framework for understanding the developmental roots of impulsivity and externalizing psychopathology. The current research provides evidence for robust associations between perceptions of childhood unpredictability, delay discounting (Studies 1a and 1b), and adult externalizing traits and behaviors (Study 2). Both associations were observed while controlling for perceptions of the harshness of childhood environments, as well as a range of demographic characteristics. The association with externalizing traits and behavior was observed over and above current mood and depressive symptoms. Study 2 also replicated a previously documented association between changes in maternal employment, residence, and cohabitation during childhood and externalizing behavior and, furthermore, suggested that this association was mediated by perceptions of unpredictability. These studies provided no evidence for links between perceived childhood unpredictability and basic forms of risk-taking (Studies 1a and 1c). This research adds to a growing body of work leveraging principles from life-history theory to demonstrate links between childhood experiences, impulsivity, and potentially debilitating forms of mental illness. This work also highlights the value of assessing people's perceptions of their childhood environments.

Keywords: child adversity; decision-making; development; evolutionary psychology; life history theory

(Received 30 July 2021; revised 18 November 2021; accepted 19 November 2021; First Published online 18 January 2022)

Humans are remarkably flexible. People consistently respond to contingencies in their environment in ways that help them reap the benefits and avoid the perils of their immediate ecology. Guided by principles from life-history theory, theories of adaptive calibration suggest that human psychological and behavioral systems have been designed through evolution to adapt developmentally to key challenges and opportunities afforded by their local ecologies (Belsky, 2012; Boyce & Ellis, 2005; Del Giudice, 2009; West-Eberhard, 2003). Two crucial ecological affordances that influence a range of cognitive, behavioral, and neuroendocrinological processes involve the extent to which the environment is unpredictable (i.e., characterized by uncertainty or instability due to stochastic changes in the environment) and/or harsh (i.e., characterized by a lack of essential resources, leading to high risk of mortality and morbidity, e.g., Ellis et al., 2009). Exposure to unpredictable and/or harsh environments, particularly early in childhood, has been implicated in a range of adult outcomes in domains as far-reaching as parenting, economic decisions, morality, and health (e.g., Maner et al., 2017; Maranges et al., 2021; Mittal & Griskevicius, 2014; Szepsenwol et al., 2015).

In the current work, we used life-history theory as a guiding conceptual framework to provide insight into the developmental origins of impulsivity and adult externalizing behavior. In doing so, we focused on assessing people's perceptions of their childhood environment, and carefully disentangled the potential roles of environmental harshness versus unpredictability. The current study tested the primary hypothesis that perceptions of unpredictable environments in childhood, in particular, would be associated with high levels of impulsivity and externalizing traits and behavior in adulthood.

Adaptive calibration: Principles from a life-history theory perspective

Many unhealthy forms of adult behavior have been linked with exposure to adverse experiences in childhood (e.g., Bradley & Corwyn, 2002). Despite the consistency of such findings, we lack an understanding of exactly which features of childhood environments contribute to adverse adult outcomes. It is difficult to determine with precision the specific factors that underlie adult mental health problems because childhood environments are complex, multifaceted, and co-occur with a variety of variables linked with risk for poor mental and physical health (e.g., single parenthood, poverty; Chen & Miller, 2013).

Evolutionary-developmental models (e.g., adaptive calibration; Del Giudice et al., 2011), guided by principles from life-history theory (Belsky et al., 1991; Kaplan & Gangestad, 2005), provide an overarching theoretical framework for understanding effects of childhood ecological variables on behavior throughout the

Corresponding author: Jon K. Maner, email: maner@psy.fsu.edu
Cite this article: Martinez, J. L., *et al.* (2022). Perceptions of childhood unpredictability, delay discounting, risk-taking, and adult externalizing behaviors: A life-history approach. *Development and Psychopathology* **34**: 705–717, https://doi.org/10.1017/S0954579421001607

lifespan. Adaptive calibration models view some negative health outcomes as arising from processes designed to help people adapt functionally to the environments in which they live (see Ellis & Del Giudice, 2014). This perspective suggests that psychological, behavioral, and neuroendocrinological processes become calibrated to ecological affordances encountered early in development (Boyce & Ellis, 2005; Del Giudice et al., 2011; Ellis & Del Giudice, 2014, 2019). Moreover, the developmental mechanisms that drive early childhood calibration are presumed to be adaptive: people adapt their behavior and physiology in ways that, on average, are likely to maximize reproductive fitness given contingencies in the current environment (Cabeza De Baca et al., 2016; McDade, 2003; Pepper & Nettle, 2017). Crucially, early childhood may involve a developmental "critical period" in which particular patterns of behavior are initially solidified and later maintained throughout development (Simpson et al., 2012). Indeed, once adopted in childhood, those behavioral patterns often persist throughout the lifespan even when such behaviors may prove debilitating in adulthood.

Life-history theory assumes that developmental processes guide the way people manage fundamental tradeoffs associated with human life (Belsky, 2012, 2019). Those include tradeoffs between devoting effort to immediate reproduction versus long-term somatic growth and development, between mating and parenting, and more generally, between focusing on immediate versus long-term rewards (Kaplan & Gangestad, 2005). Adaptive calibration models assume that exposure to particular types of environments early in development causes people to navigate those tradeoffs in ways that make the most of limited bioenergetic resources (Belsky et al., 1991; Ellis et al., 2009). The way people strategically navigate those tradeoffs is often characterized as existing on a continuum from fast (accelerated reproduction and a focus on short-term gains) to slow (slower reproductive timing and a focus on long-term growth and development).

A burgeoning body of research suggests that the way people manage those tradeoffs – and more specifically whether they adopt a fast versus slow life-history strategy – is influenced by the level of unpredictability and harshness in their early developmental environments (e.g., Brumbach et al., 2009). Unpredictability refers to the extent to which an environment entails unstable or uncertain fluctuations in the presence of stressors and/or the availability of resources, due to stochastic changes in the environment. Harshness refers to rates of morbidity and mortality in an organism's environment, based largely on a lack of resources by which to survive; for humans, harshness is often indexed using measures of socioeconomic status (SES) because SES is associated in linear fashion to the scarcity versus abundance of essential resources (Belsky et al., 1991; Simpson et al., 2012).

Previous investigations have tended to find that unpredictability, in particular, underlies a developmental trajectory marked by accelerated reproductive timing, as well as behaviors reflecting prioritization of short-term rewards, impulsivity, and risk-taking (a "fast life history") (Griskevicius, Tybur et al., 2011; Griskevicius et al., 2013; Simpson et al., 2012; Young et al., 2018). Unpredictability may have a stronger influence than harshness on development because unpredictable stressors may be more difficult to adapt to than harsh but predictable stressors (Ellis et al., 2009). Harsh but stable environments may be relatively less threatening because the stability of the environment likely affords opportunities to develop strategies that, when applied on a consistent basis, allow people to avoid threats otherwise associated with resource scarcity. Exposure to unpredictable environments, in contrast, provides cues that the availability of social and material resources is unstable, as is the possibility of encountering social or ecological stressors. Consequently, high levels of unpredictability are likely to evoke in children a fundamental lack of perceived control, and that lack of perceived control may continue to affect behavior into adulthood (Mittal & Griskevicius, 2014). From a functionalist perspective, exposure to highly unpredictable environments during childhood cues an uncertain future, and so it may be adaptive to invest primarily in short-term (rather than long-term) reproductive pursuits. Adopting an accelerated reproductive strategy, on average, helps organisms reap short-term genetic benefits in an uncertain environment in which long-term investment of resources may offer little reproductive payoff. Exposure to more predictable environments in childhood instead cues a relatively certain future and may lead one to expect a fruitful return on investment in long-term growth and relationships. Thus, models of adaptive calibration imply that exposure to relatively unpredictable versus predictable childhood environments gives rise to prioritization of short-term versus long-term rewards (i.e., a "fast" vs. "slow" life-history strategy).

The crux of reproductive success in sexually reproducing species (including humans) is success in mating, so the logic of life-history theory applies most straightforwardly to mating behavior. Indeed, exposure to unpredictability in childhood is associated with younger age of menarche, sexual debut, first birth, first marriage, as well as the adoption of an overall mating strategy focused on gaining direct genetic benefits from multiple partners (Belsky et al., 2007; Chisholm et al., 2005; Ellis, 2004; Ellis et al., 2012; Griskevicius, Delton et al., 2011; Hartman et al., 2018; Maranges & Strickhouser, 2021; Xu et al., 2018). Childhood unpredictability is also linked with a more general prioritization of short-term social and material rewards and an overall orientation toward impulsivity and risk-taking (Griskevicius, Tybur et al., 2011; Griskevicius et al., 2013; Simpson et al., 2012; White et al., 2013). Childhood unpredictability has been linked to economic decisions that reflect common forms of risk-taking (Griskevicius et al., 2013); a tendency to display dysregulated eating habits and, ultimately, obesity (Maner et al., 2017); and a lack of investment in developing high quality, long-term relationships (Maranges et al., 2021).

It is important to note again that although outcomes associated with high levels of childhood unpredictability often, though not always (see Frankenhuis & Nettle, 2020; Mittal et al., 2015; Young et al., 2018), entail negative outcomes for the individual, such outcomes are assumed to reflect underlying adaptations to environmental contingencies. That is, while the proximate consequences of behaviors stemming from unpredictability may produce destructive or undesirable outcomes, the developmental processes that underlie those behaviors are assumed to be adaptive (i.e., in a reproductive sense). From this perspective, it is not the case that slow life-history strategies are inherently better or more adaptive than fast life-history strategies; both slow and fast strategies are well-calibrated to the environments in which they develop.

Childhood unpredictability, delay discounting, risk-taking, and externalizing symptoms

Given the hypothesized link between childhood unpredictability and impulsivity, one would expect childhood unpredictability to contribute to patterns of decision-making and behavior that reflect prioritization of short-term gains over long-term gains, despite the possibility of negative long-term consequences. An important

https://doi.org/10.1017/S0954579421001607 Published online by Cambridge University Press

dimension of decision-making involves temporal preferences and delay discounting (also known as temporal discounting or delay of gratification; Adams & Nettle, 2009; Griskevicius et al., 2011; Pepper & Nettle, 2013). Delay discounting tasks (DDTs) involve choosing between sooner, albeit smaller rewards or later, larger rewards. Delaying immediate gratification in favor of larger, delayed rewards traditionally is viewed as a rational choice. In real-world decisions, however, if an individual forgoes the immediate reward, the delayed (i.e., future) reward is not always guaranteed. Models of adaptive calibration would thus suggest that individuals exposed to high levels of unpredictability in their childhood environments might opt for immediate rewards despite the possibility of larger rewards in the future. Such individuals might adopt a "take what you can now" approach, given that the future may be uncertain. Conversely, life-history models would predict that individuals exposed to lower levels of unpredictability in their childhood environments might opt for delayed, larger rewards because the certainty associated with time may calibrate individuals to "wait (or delay)" in anticipation of a more certain future (e.g., Griskevicius et al., 2011).

Previous research also suggests a link between childhood unpredictability (and fast life-history strategies) and risky decision-making (e.g., Griskevicius et al., 2011, 2013), another important component of decision-making. Risky decision-making entails choosing between relatively safer choices versus those that involve the uncertain possibility of negative outcomes (e.g., receiving $10 for sure vs. taking an uncertain chance of receiving $25). Individuals exposed to high levels of unpredictability in their childhood environments might opt to engage in excessive risk-taking because risk-avoidance might result in a lack of sufficient short-term gains to ensure that one will be competitive on the immediate mating market. Conversely, individuals exposed to low levels of childhood unpredictability might avoid excessive risk-taking because the relative certainty of a long-term future implies a high likelihood of accumulating sufficient gains over time to ensure reproductive success.

In addition to assessing delay discounting and risk-taking, we also assessed the tendency to engage in forms of externalizing behavior (e.g., aggression, substance use, lack of inhibitory control), which entail prioritization of short-term gains despite the potential for negative long-term consequences (Patrick et al., 2013; see also Krueger et al., 2002). Existing studies provide evidence for a link between childhood unpredictability and externalizing symptomatology. For example, among preschoolers, sources of unpredictability such as unstable attention from caregivers have been linked to forms of externalizing behavior including defiance, hostility, and relational aggression toward teachers and parents (Davies et al., 2019).

Relying on data from the Minnesota Longitudinal Study of Risk and Adaptation, Doom et al. (2016) demonstrated that unpredictability experienced by children prior to age 5 was associated with adolescent and adult externalizing behaviors. Moreover, that association was stronger than the association with those same family disruptions measured at ages 6–16 (see also Richardson et al., 2014). Their assessment of unpredictability involved the frequency of changes in mothers' residence, cohabitation, and employment, in addition to coder ratings of the disruptiveness of those events in the home. In contrast, harshness (operationalized as childhood SES) was unrelated to those same outcomes. Similarly, analysis of the longitudinal NICHD Study of Early Child Care and Youth Development suggests that unpredictability exerts a stronger influence on externalizing behavior (and other risk-related outcomes) than harshness does and, moreover, that changes in family structure (paternal transitions), in particular, may underlie a developmental trajectory reflecting a fast life-history strategy (Hartman et al., 2018). Other work has documented links between childhood unpredictability and aggression in adults, such as intimate partner violence (Barbaro & Shackelford, 2019; Figueredo et al., 2012; Szepsenwol et al., 2019). The link between childhood unpredictability, life-history strategies, and externalizing behavior has been observed cross-culturally in adolescents, although that work has also suggested relationships between externalizing behavior and harshness (Chang et al., 2019; see also Chang & Lu, 2018). Notably, some studies have documented links between adverse child environments and aggression, but have not distinguished unpredictability from harshness (Rucas et al., 2012; Simmons et al., 2019; see also Cohen, 1990). In sum, studies have documented links between sources of unpredictability experienced in childhood and externalizing behavior in preschoolers, adolescents, and adults.

The current research

The current work tested hypothesized links between childhood unpredictability, delay discounting, risk-taking, and externalizing behavior in adults. First, we assessed participants' tendency to discount larger future gains in favor of smaller, short-term gains using a DDT (Studies 1a and 1b). Second, we assessed a tendency to engage in risk-taking using two well-validated decision-making tasks (Studies 1a and 1c). Third, we assessed participants' tendency to engage in forms of adult externalizing behavior (Study 2).

The current work advances the literature in part by directly assessing people's perceptions of unpredictability. In assessing childhood unpredictability, previous studies have often relied on assessments of whether people were exposed to particular types of stressors (e.g., changes in family structure, residential changes, maternal depression). This approach is valuable because it provides opportunities to isolate which stressors might exert the largest effects on developmental outcomes. Yet existing measures tend to focus on whether people were exposed to particular stressors during childhood, or the overall level of disruption resulting from those stressors, not the degree to which such stressors influenced perceptions of unpredictably across time and situations. For example, having one's parents divorce could result in substantial feelings of unpredictability when, for example, the divorce is associated with high levels of conflict over an extended period of time. However, some divorces are relatively amiable and result in regimented family interactions and schedules (Steinbach & Augustijn, 2021) that could plausibly produce feelings of certainty rather than unpredictability (Thirot & Buckner, 1991).

One key question, then, pertains to whether people perceive their environment as unpredictable, uncertain, and uncontrollable. Relative to other species, humans process their experiences through complex layers of cognition and appraisal (Lazarus, 1991). The stress and coping literature, for example, provides compelling evidence that the way people appraise potentially stressful events plays a crucial role in whether they perceive the event as stressful (e.g., Gross, 1998). Moreover, appraisals of stress influence people's responses and the ways in which they adapt and cope (Taylor & Stanton, 2007; Tomaka et al., 1993). Thus, whether people perceive aspects of their environment as unpredictable, uncertain, or uncontrollable may play a key role in shaping developmental outcomes reflecting fast versus slow life-history strategies. Few previous studies have sought to assess whether, over and above environmental sources of unpredictability, perceptions

https://doi.org/10.1017/S0954579421001607 Published online by Cambridge University Press

of unpredictability are linked with developmental outcomes. One previous study, however, showed that measures of subjective unpredictability were more strongly related to aggression than were measures of objective stressors (i.e., potential sources of unpredictability; Barbaro & Shackelford, 2019).

Our research team extended previous research (Mittal et al., 2015; Young et al., 2018) by developing and validating measures of perceived unpredictability and harshness (Maranges et al., 2021). We used those measures in the current research to predict delay discounting (Studies 1a and 1b), risk-taking (Studies 1a and 1c), and externalizing behavior (Study 2). We also assessed whether such relationships would hold over and above environmental sources of unpredictability (changes in maternal employment, residence, and cohabitation; Study 2). We included the measure of perceived harshness to assess whether associations would be specific to unpredictability versus generalizing to harshness. We also controlled for a range of demographic traits (sex, race, ethnicity, current and childhood income, age) to assess whether any associations with unpredictability would hold over and above potential demographic confounds.

Beyond testing for main effects of childhood unpredictability, we also explored the possibility of interactions between unpredictability and harshness. Unpredictability may have particularly potent effects when experienced under harsh conditions. The high levels of harshness typically experienced by people living in poverty entail stressors such as food insecurity, exposure to crime, poor living conditions, and lack of access to health care, all of which underlie high levels of morbidity and mortality (Chen & Miller, 2013). Experiencing such stressors on an unpredictable basis might be especially likely to potentiate the adoption of a fast life-history strategy marked by accelerated reproduction and a focus on reaping immediate rewards from the environment (Ellis & Del Giudice, 2019). When harshness is low, in contrast, resources are more abundant and the environment is relatively safer, and thus unpredictable stressors may be relatively less dire. Consequently, when harshness is low, even unpredictable stressors may have less of an impact on development. Consistent with this possibility, some evidence suggests that childhood unpredictability may be more strongly associated with adult externalizing behavior when harshness is high than when harshness is low (Doom et al., 2016).

Finally, sex differences in impulsivity, risk-taking, and externalizing spectrum behaviors are sometimes observed, with men displaying higher levels than women (e.g., Martel, 2013). Therefore, we explored the possibility that participant sex might moderate any observed effects of unpredictability.

Studies 1a–1c: Perceived unpredictability, delay discounting, and risk-taking

Studies 1a–1c assessed relationships among perceived childhood unpredictability (and/or harshness) and behavioral measures of delay discounting and risk-taking. Study 1a included the 5-trial adjusted DDT (Koffarnus & Bickel, 2014), the Balloon Analogue Risk Task (BART; Lejuez et al., 2002), and the Iowa Gambling Task (IGT; Bechara et al., 1994). We saw no significant relationships between childhood unpredictability (or harshness) and scores on the BART or IGT; Study 1b provided an opportunity to replicate findings for the DDT. Study 1c allowed us to replicate the null findings for the BART. Results for the BART and IGT from Study 1a and all results for Study 1c are provided in Supplemental Materials. Thus, the main text focuses on the DDT from Studies 1a and 1b (a preregistered study). The preregistration for Study 1b, as well as data and syntax for all of our studies, can be found here: https://osf.io/g79fm/?view_only=4414bab0662a464488eabbb50917afe7

Participants

Study 1a. Four hundred-eighteen undergraduates participated online in exchange for course credit. Based on a priori exclusion criteria, 69 participants were excluded because they failed at least one of three attention checks. Three-hundred forty-nine participants remained. A number of participants encountered problems moving from task to task in Inquisit (Inquisit 6 2019). Consequently, only 181 participants completed the DDT. Participant demographic characteristics for Studies 1a/1b are reported in Supplemental Materials.

Study 1b. The preregistered sample size for study 1b was determined by performing an a priori power analysis in G*Power using the association between unpredictability and delay discounting in study 1a ($f^2 = .0384$). Results indicated that, for a multiple regression analysis including 3 predictors, a minimum of 341 participants would be necessary to achieve conservative power of 0.95. We recruited 537 workers from Amazon's Mechanical Turk Prime (MTurk Prime). Based on preregistered criteria, 51 participants were excluded because they failed at least one of three attention checks. Of the remaining 486 participants, 341 completed the DDT; the 145 who did not experienced software errors when transferring from Qualtrics to Inquisit, similar to participants in Study 1a.

Measures

Perceived childhood unpredictability. Building on measures from previous work (Mittal et al., 2015; Young et al., 2018) our team developed and validated a measure of perceived childhood unpredictability with four studies that confirmed the intended factor structure, and demonstrated convergent, discriminant, and predictive validity (Maranges et al., 2021, under review). The resulting scale includes 15 items that assess perceptions of unpredictability in family (e.g., I never knew whether my parents would be there to pick me up from school), school (e.g., I often did not know what to expect from other students at school), and neighborhood contexts (e.g., When I left my house I was never quite certain what would happen in my neighborhood). All items assess perceptions of unpredictability, uncertainty, and/or instability. Participants respond regarding their experiences up to age 10 using 7-point scales (1 = *strongly disagree*, 7 = *strongly agree*). As reported in Maranges et al. (under review) the scale demonstrates good reliability, convergent validity (e.g., moderate correlations with ACEs, SES, impulsivity, and lack of perceived certainty and control), and discriminant validity (e.g., low correlations with age, sex, social desirability, personality traits such as extraversion). The measure also predicts biometric indices of life-history strategy including age of sexual debut, age of menarche (in females), age of first child, number of different sex partners, and number of children (Maranges et al., under review). Reliability was high in the current sample ($M = 2.32$, $SD = 1.20$, $\alpha = .93$).

Perceived childhood harshness. In addition to the measure of perceived childhood unpredictability, we also generated and validated a measure of perceived harshness. Eleven items assess harshness, as reflected in poverty and a lack of essential resources (e.g., My family rarely had enough money to go out for a nice dinner; My family was strained financially). Participants respond regarding their experiences up to age 10 using 7-point Likert scales (1=*strongly disagree*, 7=*strongly agree*). Like the unpredictability scale, and as

https://doi.org/10.1017/S0954579421001607 Published online by Cambridge University Press

Table 1. Correlations and descriptive statistics among Studies 1a and 1b variables

	Study 1a Mean (SD)	Study 1b Mean (SD)	Study 1a Min–Max	Study 1b Min–Max	Study 1a Skewness (Kurtosis)	Study1b Skewness (Kurtosis)	1.	2.	3.
1. Childhood unpredictability	2.36 (1.31)	2.92 (1.56)	1.00–6.33	1.00–7.00	1.25 (1.02)	.60 (−.71)	–	.57***	.18***
2. Childhood harshness	3.02 (1.59)	4.10 (1.66)	1.00–7.00	1.00–7.00	.78 (−.32)	.07 (−1.11)	.61***	–	.03
3. Delay discounting	.12 (.17)	.32 (1.57)	.00011–.82	.00011–9.79	1.81 (3.05)	6.07 (39.45)	.18**	.11	–

Note. Study 1a $N = 181$. Study 1b $N = 332$. Study 1a correlations are provided below the diagonal; Study 1b correlations are above the diagonal. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

reported in Maranges et al. (under review), the harshness scale demonstrates good reliability, convergent validity (e.g., strong correlation with SES, moderate correlations with ACEs and lack of perceived control), and discriminant validity (e.g., low correlations with age, sex, social desirability; Maranges et al., under review). Reliability was high in the current sample ($M = 3.02$, $SD = 1.59$, $\alpha = .95$).

Delay discounting. Participants completed five trials in which they chose between smaller immediate versus larger delayed rewards (e.g., $1 today vs. $10 next week). The delays were adjusted after each trial such that they varied depending on the previous choice of the participant. The dependent variable of interest is the discount rate, *k*. Larger *k* values indicate that participants were less willing to wait for a delayed, higher reward, and instead prioritized more immediate, lesser rewards. The DDT provides a well-validated measure of delay discounting (e.g., Friedel et al., 2016; Koffarnus & Bickel, 2014; Stein et al., 2018; Tucker et al., 2021). In both Studies 1a and 1b, we used a priori exclusion criteria to exclude participants whose *k* scores were 3SD above the mean (this criterion was preregistered in Study 1b).

Results

Study 1a

Descriptive statistics and correlations are reported in Table 1. Notably, childhood unpredictability (but not harshness) was significantly correlated with delay discounting such that individuals who reported experiencing more unpredictable childhood environments tended to prioritize more immediate, but smaller rewards over delayed, but larger rewards. Unpredictability and harshness were also significantly correlated with one another.

Hierarchical regression was used to examine the relationships between perceptions of childhood unpredictability and harshness, and delay discounting. In the first step, we simultaneously entered perceptions of childhood unpredictability and harshness. This allowed us to account for their overlap while assessing their associations with delay discounting. Then, in the second step, we entered demographic predictors (sex, race, ethnicity, current income, childhood income, and age) to assess the independent contribution of our predictors over and above those demographic covariates. Race was coded to compare Black/African American participants to non-Black/African American participants; Ethnicity was coded to compare Hispanic participants to non-Hispanic participants. Regression results are reported in Table 2.

In the first step, unpredictability (but not harshness) emerged as the only significant predictor of delay discounting (see Table 2) such that people who reported experiencing more unpredictable childhoods were more likely to discount future rewards and thus less likely to delay gratification in favor of more immediate, albeit lesser rewards. In the second step, unpredictability (but not harshness or any demographic variable) was a significant predictor of delay discounting (see Table 2).

Table 2. Hierarchical linear regression models predicting delay discounting in Studies 1a and 1b

	Study 1a				Study 1b			
	Beta	*t*	*p*	Part *r*	Beta	*t*	*p*	Part *r*
Step 1								
Unpredictability	**.23**	**2.44**	**.02**	**.18**	**.24**	**3.64**	**<.001**	**.20**
Harshness	−.02	−0.17	.86	−.01	−.11	−1.61	.11	−.09
Step 2								
Unpredictability	**.22**	**2.29**	**.02**	**.17**	**.25**	**3.59**	**<.001**	**.20**
Harshness	−.07	−0.55	.58	−.04	−.07	−0.79	.43	−.04
Sex	.04	0.55	.58	.04	−.05	−0.98	.33	−.06
Racial minority status	.11	1.32	.19	.10	.03	0.60	.55	.03
Ethnic minority status	.11	1.32	.19	.10	.04	0.63	.53	.04
Current income	.03	0.29	.77	.02	−.02	−0.27	.79	−.02
Childhood income	−.04	−0.31	.76	−.02	.06	0.76	.45	.04
Age	−.00	−0.02	.99	−.00	**.15**	**2.65**	**<.01**	**.15**

Note. Study 1a $N = 181$. Study 1b $N = 332$. Participant sex is coded 1=male, 0=female. Racial minority status compares Black/African American participants (coded 1) to other racial categories (coded 0). Ethnic minority status compares Hispanic (coded 1) to non-Hispanic (coded 0). Bold-faced values indicate significant associations.

In addition to the main effect of unpredictability, we also tested for the interaction between unpredictability and harshness. After centering both predictors, we added the interaction between those two variables to the model that included unpredictability, harshness, and all of the demographic factors. The interaction term was not significant ($B = .05$, $t = 0.54$, $p = .59$, *partial* $r = .04$). Thus, we found no evidence that the relation between unpredictability and delay discounting was moderated by perceived harshness.

In addition to possible moderating effect of harshness, we also explored possible moderating effects of participant sex. We added to the models described above an interaction term including participant sex and unpredictability (both centered prior to calculating the interaction). We found no evidence that the relation between unpredictability and delay discounting was moderated by participant sex ($B = .08$, $t = 1.01$, $p = .31$, *partial* $r = .08$).

Study 1b

Descriptive statistics and correlations are reported in Table 1. At the correlational level, unpredictability (but not harshness) was

https://doi.org/10.1017/S0954579421001607 Published online by Cambridge University Press

associated with delay discounting. Unpredictability and harshness were also significantly correlated with each other. Therefore, we used regression analyses to assess the independent association of each predictor with delay discounting (see Table 2).

We used the same (preregistered) analytic approach as in Study 1a. In the first step, we entered unpredictability and harshness simultaneously in a model predicting delay discounting. In the second step, we entered demographic predictors (sex, race, ethnicity, current and childhood income as measures of SES, and age). Race was coded to compare Black/African American to non-Black/African American participants. Ethnicity was coded to compare Hispanic to non-Hispanic participants. Regression results are reported in Table 2.

Unpredictability emerged as the strongest predictor of delay discounting. In step 1, unpredictability, but not harshness, was significantly associated with delay discounting. In step 2, unpredictability, but not harshness, again emerged as a strong and significant predictor of delay discounting. Participant age also emerged as a significant predictor of delay discounting such that older participants were more likely to discount future rewards. No other demographic variables were significant.

In addition to the main effect of unpredictability, we also tested for the interaction between unpredictability and harshness. After centering both predictors, we added their interaction to the model that included unpredictability, harshness, and all of the demographic factors. The interaction term was not significant ($B = -.08$, $t = -1.35$, $p = .18$, *partial* $r = -.08$) Thus, we found no evidence that the relation between unpredictability and delay discounting was moderated by perceived harshness.

In addition to the possible moderating effect of harshness, we also explored the possible moderating effects of participant sex. We added to the models described above an interaction term including participant sex and unpredictability (both centered prior to calculating the interaction). The interaction term was not significant ($B = -.03$, $t = -0.58$, $p = .56$, *partial* $r = -.03$). Thus, we found no evidence that the relation between unpredictability and delay discounting was moderated by participant sex.

Study 2 – Childhood unpredictability and adult externalizing behavior method

Participants

We collected data from 757 participants via the online platform MTurk Prime. Data collection took approximately 30–40 min and participants were compensated $4. Based on a priori exclusion criteria, we excluded participants who failed at least one attention check. This resulted in a sample of 643 participants. Demographic characteristics of the sample are reported in Supplemental Materials.

Measures

Childhood environment. We included the same measures of perceived childhood unpredictability and childhood harshness from Studies 1a–1c. In addition, we included retrospectively reported items from the Life Events Schedule (LES; Egeland et al., 1980) to assess changes in maternal employment, physical residence, and cohabitation (with romantic partners). These factors can reduce the stability of family environments and relationships between caregivers and children and thus serve as valid measures of environmental unpredictability (e.g., Doom et al., 2016; Simpson et al., 2012). Consistent with previous studies (Doom et al., 2016; Simpson et al., 2012), we created composite measures that incorporated assessments of both the raw frequency of those events and the level of disruption they caused (the latter used a 0-*no disruption* to 3-*severe disruption* scale) during childhood up to age 5. Measures of frequency and disruption for the three maternal variables were standardized and averaged to form a single composite.

Externalizing Spectrum Inventory. The Externalizing Spectrum Inventory (ESI-BF) (Patrick et al., 2013) assesses a range of traits and behaviors in the domain of deficient impulse control. Consistent with current clinical models, items cluster along three higher order dimensions reflecting general disinhibition, callous aggression, and substance use (Patrick et al., 2013; see also Kotov et al., 2017; Krueger et al., 2021). We used the 160-item brief form version of the ESI. The general disinhibition subscale includes 20 items involving individual facets of problematic impulsivity, irresponsibility, theft, fraud, alienation, boredom proneness, impatient urgency and lack of dependability and planful control. Sample items include: "I get in trouble for not considering the consequences of my actions"; "Others have told me they are concerned about my lack of self-control." The callous aggression subscale includes 19 items involving a tendency to lack empathy and honesty, show high levels of excitement-seeking, and display relational, physical, and destructive forms of aggression. Sample items include: "I enjoy pushing people around sometimes"; "I don't see any point in worrying if what I do hurts someone else." The substance use subscale includes 18 items tapping use and problems associated with alcohol, marijuana, and other drugs. Sample items include: "I've had urges to use marijuana that were hard to resist"; "I've gone on drinking binges." Participants responded to each item with a 0–3 scale (*false* = 0, *somewhat false* = 1, *somewhat true* = 2, and *true* = 3). As recommended by Patrick et al. (2013) we summed items to create composite measures of general disinhibition, callous aggression, and substance use. In addition to calculating scores on the three subscales, we also calculated a total score by averaging across all ESI subfacets. We report findings for the total score here in the main text. Analyses for the three ESI subscales are described briefly here and presented fully in Supplemental Materials.

Current mood and mental health. Some work suggests that retrospective reports of childhood adversity, unpredictability, and/or harshness may be influenced by current mood and mental health (e.g., Reuben et al., 2016). We therefore included as control variables the General Depression subscale of the IDAS (Watson et al., 2007) and the Emotional Stability/Neuroticism subscale of the TIPI (Gosling et al., 2003). The IDAS General Depression subscale contains 20 items assessing mood symptoms including lassitude, insomnia, change in appetite, irritability, and general well-being (e.g., "I felt depressed"). Ratings are made using a 5-point Likert scale (1 = *not at all* to 5 =*extremely*) with total scores ranging from 20 to 100. The TIPI Emotional Stability/Neuroticism subscale is represented by two items rated on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). One item is stated in a way that represents the positive pole, emotional stability ("calm, emotionally stable"), and the other is stated in a way that represents the negative pole, neuroticism ("anxious, easily upset"). The latter item was reverse-coded and the items were averaged such that higher composite scores reflected greater emotional stability.

https://doi.org/10.1017/S0954579421001607 Published online by Cambridge University Press

Table 3. Descriptive statistics and correlations among primary study variables in Study 2

	1	2	3	4	5	6	7	8	9
1. ESI total	—								
2. ESI disinhibition	.87***	—							
3. ESI callous aggression	.61***	.51***	—						
4. ESI substance use	.79***	.52***	.27***	—					
5. Childhood unpredictability	.31***	.31***	.19***	.16***	—				
6. Childhood harshness	.18***	.19***	.09*	.07	.53***	—			
7. Maternal changes	.12**	.13***	.06	.06	.43***	.26***	—		
8. General depression	.43***	.47***	.19***	.28***	.36***	.30***	.18***	—	
9. Emotional stability	−.34***	−.42***	−.11**	−.21***	−.29***	−.16***	−.13**	−.59***	—
Mean (SD)	103.49 (61.42)	12.86 (9.43)	8.66 (6.75)	20.25 (14.00)	2.11 (1.17)	3.28 (1.71)	−0.25 (0.71)	2.38 (0.78)	4.25 (1.50)
Min–Max	7–434	0–59	0–52	0–54	1.00–6.87	1.00–7.00	−0.79–4.44	1–4.95	1–7
Skewness	1.26	1.30	1.58	0.29	1.25	0.58	2.80	0.58	−0.04
Kurtosis	2.50	2.12	3.97	−0.94	0.92	−0.80	11.17	−0.17	−0.73

Note. ESI = Externalizing Spectrum Inventory; $N = 643$. *$p < .05$, **$p < .01$, ***$p < .001$.

Results

Descriptive statistics and correlations among all variables are reported in Table 3. Notably, at the bivariate level, childhood unpredictability and childhood harshness were both associated with all ESI measures, with the exception of a null association between harshness and substance use. Disruptive maternal changes were associated with the ESI total score and with disinhibition, but not with callous aggression and substance use. Measures of general depression and emotional stability were associated with all ESI measures, in opposite directions. Unpredictability, harshness, disruptive maternal changes, general depression, and emotional stability were all correlated with each another. Regression analyses allowed us to account for overlap among the predictor variables.

Hierarchical regression was used to test hypothesized associations between childhood unpredictability and adult externalizing behavior. Primary analyses focused on the ESI-BF total score. Supplemental analyses focusing on the ESI-BF subscales (general disinhibition, callous aggression, and substance abuse) are reported in Supplemental Materials. Predictors were entered hierarchically to isolate any association between childhood unpredictability and externalizing behavior. In the first step, we entered LES scores to predict externalizing behavior. In the second step, we included perceptions of childhood unpredictability and harshness. In the third step, we included individual differences in emotional stability/neuroticism and general depression. In the fourth and final step, we included demographic predictors (sex, race, ethnicity, current and childhood income as a measure of SES, and age) to assess whether any associations with unpredictability (and/or harshness) would be observed over those covariates. Race was coded to compare Black/African American to non-Black/African American participants. Ethnicity was coded to compare Hispanic to non-Hispanic participants. See Table 4.

Disruptive, maternal changes in early childhood, unpredictability, and harshness were all correlated with externalizing behavior. Once their overlap was taken into account in step 2 of the regression model, however, unpredictability was significantly and independently associated with externalizing behavior, but harshness and disruptive maternal changes were not. In step 3, unpredictability, general depression, and emotional stability were all significantly associated with externalizing behavior, but disruptive maternal changes and harshness were not.

Including demographic predictors in step 4 left the association between unpredictability and externalizing behaviors virtually unchanged. Unpredictability continued to predict externalizing behavior over and above disruptive maternal changes, harshness, and all demographic predictors. General depression, and emotional stability also predicted externalizing behavior. We also observed an association between externalizing behavior and participant sex such that men had higher externalizing scores than women did. No other demographic predictors were significant.

In addition to the main effect of unpredictability, we tested for the interaction between unpredictability and harshness. We added the centered interaction of those two variables to the model predicting ESI total scores. The interaction was nonsignificant ($B = -.04$, $t = -1.02$, $p = .31$, *partial* $r = -.04$). Thus, we found no evidence that the relation between unpredictability and externalizing behavior was moderated by perceived harshness. We also tested for the interaction between unpredictability and participant sex. We added the centered interaction of these two variables to the models predicting ESI total scores. The interaction was nonsignificant ($B = -.02$, $t = -0.62$, $p = .54$, *partial* $r = -.03$). Thus, we found no evidence that the relation between unpredictability and externalizing behavior was moderated by participant sex.

Finally, we ran a model (using the PROCESS macro in SPSS; Hayes, 2017) to explore the possibility that the association between maternal changes in childhood and adult externalizing behavior was statistically mediated by perceptions of unpredictability. The model included perceived harshness as a covariate. The indirect effect was significant, $Z = 8.17$, CI = 5.09–11.80. The direct effect was not significant, $p = .61$ (CI = −8.92–5.28), suggesting that the association was fully mediated by perceived unpredictability (see Figure 1).

General discussion

Findings from the current research suggest independent and robust relationships between perceptions of childhood unpredictability and both delay discounting and externalizing traits and

https://doi.org/10.1017/S0954579421001607 Published online by Cambridge University Press

Table 4. Regression analyses: Predictors of externalizing symptoms (ESI total score) in study 2

	Beta	*t*	*p*	Partial *r*
Step 1				
LES maternal changes	**.11**	**2.75**	**.01**	**.11**
Step 2				
LES maternal changes	−.03	−0.69	.49	−.03
Unpredictability	**.31**	**6.36**	**<.001**	**.25**
Harshness	.03	0.57	.57	.02
Step 3				
LES maternal changes	−.04	−1.09	.28	−.04
Unpredictability	**.19**	**4.13**	**<.001**	**.16**
Harshness	−.02	−0.49	.62	−.02
General depression	**.31**	**6.96**	**<.001**	**.27**
Emotional stability	**−.11**	**−2.46**	**.01**	**−.10**
Step 4				
LES maternal changes	−.04	−1.05	.30	−.04
Unpredictability	**.19**	**4.00**	**<.001**	**.16**
Harshness	−.06	−1.13	.26	−.05
General depression	**.31**	**6.91**	**<.001**	**.27**
Emotional stability	**−.14**	**−3.22**	**.001**	**−.13**
Gender	**.14**	**3.96**	**<.001**	**.16**
Racial minority status	−.07	−1.82	.07	−.07
Ethnic minority status	−.00	−0.02	.99	−.00
Current SES	.02	0.30	.76	.01
Childhood income	−.05	−0.82	.41	−.03
Age	.07	1.67	.10	.07

Note. $N = 643$. Participant gender is coded 1 = man, 0 = woman. Racial minority status compares Black/African American participants (coded 1) to other racial categories (coded 0). Ethnic minority status compares Hispanic (coded 1) to Non-Hispanic (coded 0).

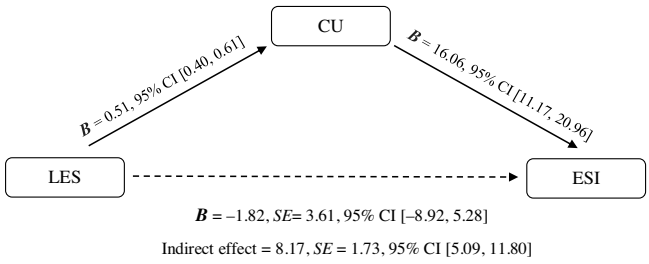

Figure 1. Childhood unpredictability as a mediator of the relationship between maternal changes in childhood and adult externalizing behavior. LES = Life Events Schedule; CU = perceived childhood unpredictability; ESI = Externalizing Spectrum Inventory. The solid lines represent significant pathways. The dotted line represents the nonsignificant direct effect of LES on ESI, after accounting for the indirect effect via CU.

behavior in adults. Those associations were observed over and above childhood harshness, consistent with work suggesting the relatively greater influence of childhood unpredictability (vs. harshness) on adult outcomes. Those associations were also observed over a range of demographic variables. Results of Study 2 suggest not only that perceptions of childhood unpredictability might contribute to externalizing behavior, but also that such perceptions might help explain the links between environmental unpredictability and adult outcomes reflecting a fast life-history strategy. Findings are consistent with models of adaptive calibration and contribute to a growing literature suggesting that exposure to particular types of childhood ecologies can have important effects on development and behavior throughout the lifespan.

Implications of the current research

In two studies (1a and 1b), we found evidence for a link between unpredictability and delay discounting such that individuals who perceived more unpredictability in their childhood environments displayed a tendency toward selecting more immediate, lesser rewards rather than delaying immediate gratification in favor of delayed, greater rewards. This association provides evidence for a cornerstone principle of adaptive calibration models guided by life-history theory: individuals who perceive themselves as experiencing stochastic or chaotic changes in their environment (i.e., high levels of unpredictability) tend to engage in behaviors that provide the most immediate benefit (i.e., prioritization of short-term gains), even if such behaviors may come with undesirable longer-term consequences.

In our supplemental analyses, which reflect findings from two different behavioral tasks (IGT and the BART), we report null associations between perceived unpredictability and general forms of risk-taking. Thus, our findings suggest that while childhood unpredictability might contribute to delay discounting, we saw no evidence for an association between unpredictability (or harshness) and performance on general risk-taking tasks. The different patterns of results may reflect the fact that while delay discounting has an inherent temporal component, some other forms of risk-taking, such as choosing a high risk-high reward option over a low risk-low reward option, do not. Childhood unpredictability might orient people toward prioritizing immediate and short-term rewards (over long-term rewards) rather than toward a more general propensity to prioritize larger (vs. smaller) rewards. Still, we only examined two laboratory risk-taking tasks, and thus more research is needed before drawing any conclusions about the association between childhood unpredictability and risk.

The association between perceptions of unpredictable childhood environments and adult externalizing behavior also fits with theories emphasizing the link between unpredictability and prioritization of short-term gains (e.g., Ellis & Del Giudice, 2019). The presence of an unpredictable environment may reduce the value of long-term future planning. If the future is uncertain, it may be more adaptive to reap maximum value from shorter-term pursuits. Adopting an accelerated reproductive strategy helps organisms reap immediate genetic benefits in an uncertain environment in which long-term investment of resources may offer little reproductive payoff (Belsky, 2012, 2019). Although this strategy is perhaps most straightforwardly manifested in mating-related outcomes (e.g., earlier sexual development and sexual debut), it is also manifested in more general patterns of behavior marked by adoption of a short-term time horizon and deprioritization of long-term outcomes (Griskevicius et al., 2011). Patterns of externalizing behavior are characterized by disinhibition, impulsivity, immediate gratification, and a lack of prioritization of long-term consequences. Thus, the pattern of externalizing tendencies among those exposed to early childhood unpredictability is consistent with the functional logic guiding fast life-history strategies. Such tendencies could help

https://doi.org/10.1017/S0954579421001607 Published online by Cambridge University Press

people reap from uncertain environments resources that aid in short-term pursuits related to survival, social affiliation, or mating.

Findings from Study 2 replicate previous evidence for the role of maternal changes as an important source of unpredictability (Doom et al., 2016; Simpson et al., 2012). The current work extends prior work by highlighting the potential mediating role played by perceptions of unpredictability. Although strong conclusions cannot be based on statistical tests of mediation alone, findings are consistent with the possibility that perceptions of unpredictability may explain the relationship between maternal changes in childhood and adult externalizing behavior. People process their environments using complex layers of perception and appraisal, and those psychological processes can serve as mechanisms that mediate the relationship between environmental variables and human behavior (e.g., Lazarus, 1991). Thus, while there is value to focusing on potential sources of unpredictability (e.g., maternal stress, changes in family structure, or parents' employment status), there is also value to directly assessing people's perceptions of unpredictability. The current work suggests that those perceptions may set the stage for developmental trajectories that prioritize short-term versus long-term pursuits.

This perspective fits with the broader literature on stress and coping, which emphasizes the important role perceptions of stress play in biological, social, and behavioral processes (Gross, 1998; Taylor & Stanton, 2007). For example, evidence suggests that perceptions of stress and the objective presence of environmental stressors both exert independent effects on human health and well-being and, moreover, effects of perceived stress versus environmental stressors may be mediated through different physiological pathways (Cohen et al., 1993; Tetrick & Larocco, 1987). Thus, research inspired by life-history theory would benefit from focusing on and distinguishing the role of *perceived* unpredictability from the presence of environmental factors that may serve as potential *sources* of unpredictability. Future work would also benefit from identifying which environmental stressors are most likely to evoke high perceptions of unpredictability. Some work, for example, suggests that changes in family structure might affect developmental trajectories more strongly than do changes in residence or parents' occupation (Hartman et al., 2018). The extent to which differential effects of particular stressors may be due to differences in perceived unpredictability, however, is unknown.

In addition to reflecting prioritization of short-term planning, the aggressive component of externalizing behavior may be functionally linked with status-striving. Across a range of species (including humans), aggression can serve as a means of asserting one's social dominance (Archer, 2006; Maner & Case, 2016). Although more prosocial (and less dangerous) strategies for attaining high social rank exist, those strategies often require a relatively long-term investment of energy and resources (e.g., earning prestige by mastering a skill; Maner, 2017). Aggression, in contrast, can serve as an effective short-term strategy for gaining social rank and ultimately increasing reproductive success (Wilson & Daly, 1997). People with an orientation toward prioritizing short-term, rather than long-term, gains might use tactics such as aggression or coercion that entail more immediate status payoffs. Thus, displaying a penchant for aggression may serve as an adaptive social rank-striving strategy for those calibrated to unpredictable environments who tend to adopt a short-term time horizon for social decision-making.

Although one might attain high social rank by acting aggressively, such behavior can undermine the quality of social-affiliative relationships. Aggression and other forms of externalizing behavior are not typically viewed as socially desirable and they may suggest that one is not a good bet for long-term cooperation or reciprocity. More broadly, focusing on the present and eschewing long-term gains may lead people exposed to unpredictable environments to invest themselves less in developing supportive, long-term relationships. Indeed, previous evidence suggests that exposure to unpredictable childhood environments is associated with lacking close, high-quality relationships with family, friends, and romantic partners (Maranges et al., 2021). Thus, although the social behavior of people adopting a fast life-history strategy may be adaptive given contingencies of the environment, that behavior nevertheless may undermine the quality of people's long-term social relationships.

While delay discounting and externalizing symptoms were associated with perceptions of childhood unpredictability, those same outcomes were not robustly associated with harshness. Harsh but stable environments may be relatively easier to contend with than unpredictable environments because the stability of the environment likely affords opportunities to develop strategies that, when applied on a consistent basis, allow people to avoid many of the perils otherwise associated with harshness. A wealth of research, for example, suggests that people living in low SES communities marked by a lack of resources tend to adopt high levels of long-term social interdependence (Fiske & Markus, 2012; Stephens et al., 2012). Enduring relationships provide lasting sources of social support that help people navigate times of hardship or crisis (e.g., Sugiyama, 2004). From this perspective, one might expect those from harsh but highly predictable environments to display a psychological orientation marked by long-term, rather than short-term, thinking, at least within the social sphere. The current work thus adds to a growing body of work suggesting that childhood unpredictability, more so than harshness, is associated with developmental outcomes characterizing a fast life-history strategy.

Although not the focus of the current investigation, the study afforded opportunities to explore potential interactions between unpredictability and harshness as well as unpredictability and sex. We found no evidence of moderation by participant sex. Nor did we see any consistent or robust evidence for interactions between perceptions of unpredictability and harshness. Nevertheless, given theories suggesting that unpredictability may exert stronger effects in environments that are also high in harshness, additional research is needed before drawing any firm conclusions about interactions between unpredictability and harshness.

Limitations and future directions

Limitations of this research provide valuable opportunities for future work. One limitation is that, although our samples included reasonably large numbers of participants, those samples included more women than men. Previous work suggests that men tend to display relatively higher levels of risk-taking and externalizing behavior than women do (e.g., Martel, 2013). The relatively smaller number of men in the current sample could have obscured possible sex differences in the links between those variables and childhood unpredictability; the current findings should be interpreted in light of this aspect of our participant samples.

A second limitation pertains to the retrospective nature of the perceived unpredictability and harshness measures. Despite the ease of assessing retrospective reports of perceived unpredictability and harshness, and although retrospective measures have been used by many other studies in this literature (e.g., Mittal et al., 2015; Young et al., 2018), such measures have drawbacks. For

https://doi.org/10.1017/S0954579421001607 Published online by Cambridge University Press

example, retrospective measures do not always predict outcomes in the same way that prospective measures do (see Baldwin et al., 2019; Newbury et al., 2018), and some work suggests that they may differentially predict psychopathology in adulthood. Moreover, retrospective reports may be influenced by extraneous factors such as current mental health, such that those with low levels of emotional stability or positive mood may overestimate the unpredictability and harshness of their childhood environments (Reuben et al., 2016). The association between perceived childhood unpredictability and externalizing behavior (Study 2) was observed over and above measures of emotional stability/neuroticism and current depressive symptoms, suggesting that the association cannot be easily explained by those factors. Nevertheless, future research would benefit from leveraging datasets that include non-retrospective measures of perceived unpredictability, as well as measures of objective stressors, to assess prospectively the extent to which perceptions of childhood unpredictability uniquely contribute to adult developmental outcomes.

A third limitation pertains to the timing of the developmental calibration processes implied by adaptive calibration models. Although the precise timing of developmental calibration is still uncertain, some evidence suggests that calibration to environmental unpredictability occurs in the first 5 (Simpson et al., 2012) or 10 (Mittal & Griskevicius, 2014) years of childhood. The measures used in the current studies do not allow for precise estimates of when developmental calibration occurs. The overarching question of developmental timing, and whether there is a critical period in which calibration to levels of unpredictability occurs (see Simpson et al., 2012), provides a number of valuable questions for future investigations.

Although the current work focused on associations between childhood unpredictability and patterns of externalizing behavior, we left unexplored the possible implications of those patterns for positive social outcomes such as status-striving (cf. Frankenhuis & Nettle, 2020; Frankenhuis et al., 2016). As noted earlier, some forms of externalizing behavior could serve as routes toward attaining high social rank. Future work would benefit from examining more closely the possibility that childhood unpredictability, and the externalizing behaviors that accompany it, are associated with status attainment in peer groups.

Not all people respond to harsh and unpredictable environments in the same way. Future work would benefit from assessing sources of resilience to adverse effects of childhood ecologies in order to identify factors that affect people's susceptibility to harsh and/or unpredictable environments (see Belsky & Pluess, 2009). Future investigations could profitably explore the hypothesis that perceptions of the environment (e.g., perceptions of unpredictability) might play a role in determining developmental responses to childhood stressors.

Finally, some work suggests that effects of childhood environments depend, in part, on the current state of the environment (Griskevicius, Delton, et al., 2011). Some work suggests, for example, that effects of exposure to unpredictable childhood environments are amplified in environments that entail currently high levels of unpredictability or instability (Young et al., 2018). Investigating possible interactions between childhood and current environments provides a number of important opportunities for future research.

Conclusion

Evolutionary-developmental models inspired and guided by life-history theory principles provide an overarching conceptual framework for understanding ways in which exposure to particular forms of ecological variables in childhood can influence developmental processes throughout the lifespan. Adaptive calibration models also provide a framework for understanding the ways with which people make decisions (Griskevicius et al., 2011, 2013; Simpson et al., 2012), and for understanding the structure and expression of a range of psychological disorders (Del Giudice, 2014, 2016). In contrast to models of toxic stress or allostatic load, adaptive calibration models conceptualize developmental outcomes as reflecting adaptive processes designed to maximize reproductive success given contingencies cued by one's early childhood environment. The current study joins others in this literature to suggest that childhood unpredictability may underlie forms of impulsivity reflected in prioritization of short-term rewards, impulsivity, and adult externalizing behaviors. The current work also highlights the importance of directly assessing perceptions of unpredictability. Perceptions of unpredictable childhood environments were robustly and independently associated with delay discounting and adult externalizing traits and behavior over and above measures of harshness, current mental health and mood, and a broad range of demographic covariates such as (childhood and current) income, race, sex, ethnicity, and age. Findings highlight the important role perceptions of instability and uncertainty may play in setting the stage for adult behaviors that satisfy immediate gratification at the expense of greater satisfaction in the long-term.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S0954579421001607

Conflicts of interest. None.

Funding statement. This research received no specific grant from any funding agency, commercial or not-for-profit sectors.

References

Adams, J., & Nettle, D. (2009). Time perspective, personality and smoking, body mass, and physical activity: An empirical study. *British Journal of Health Psychology*, *14*, 83–105. https://doi.org/10.1348/135910708X299664

Archer, J. (2006). Testosterone and human aggression: An evaluation of the challenge hypothesis. *Neuroscience and Biobehavioral Reviews*, *30*, 319–345. https://doi.org/10.1016/j.neubiorev.2004.12.007

Baldwin, J. R., Reuben, A., Newbury, J. B., & Danese, A. (2019). Agreement between prospective and retrospective measures of childhood maltreatment: A systematic review and meta-analysis. *JAMA Psychiatry*, *76*, 584–593. https://doi.org/10.1001/jamapsychiatry.2019.0097

Barbaro, N., & Shackelford, T. K. (2019). Environmental unpredictability in childhood is associated with anxious romantic attachment and intimate partner violence perpetration. *Journal of Interpersonal Violence*, *34*, 240–269. https://doi.org/10.1177/0886260516640548

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition*, *50*, 7–15. https://doi.org/10.1016/0010-0277(94)90018-3

Belsky, J. (2012). The development of human reproductive strategies: Progress and prospects. *Current Directions in Psychological Science*, *21*, 310–316. https://doi.org/10.1177/0963721412453588

Belsky, J. (2019). Early-life adversity accelerates child and adolescent development. *Current Directions in Psychological Science*, *28*, 241–246. https://doi.org/10.1177/0963721419837670

Belsky, J., & Pluess, M. (2009). Beyond diathesis stress: Differential susceptibility to environmental influences. *Psychological Bulletin*, *135*, 885–908. https://doi.org/10.1037/a0017376,

Belsky, J., Steinberg, L., & Draper, P. (1991). Childhood experience, interpersonal development, and reproductive strategy: An evolutionary theory of

socialization. *Child Development*, *62*, 647–670. https://doi.org/10.1111/j.1467-8624.1991.tb01558.x

Belsky, J., Steinberg, L., Houts, R. M., Friedman, S. L., DeHart, G., Cauffman, E. . . . the NICHD Early Child Care Research Network (2007). Family rearing antecedents of pubertal timing. *Child Development*, *78*, 1302–1321, https://doi.org/10.1111/j.1467-8624.2007.01067.x,

Boyce, W. T., & Ellis, B. J. (2005). Biological sensitivity to context: An evolutionary-developmental theory of the origins and functions of stress reactivity. *Development and Psychopathology*, *17*, 271–301, https://doi.org/10.10170S0954579405050145

Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual Review of Psychology*, *53*, 371–399. https://doi.org/10.1146/annurev.psych.53.100901.135233,

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. https://doi.org/10.1007/s12110-009-9059-3,

Cabeza De Baca, T. C., Wahl, R. A., Barnett, M. A., Figeuredo, A. J., & Ellis, B. J. (2016). Adversity, adaptive calibration, and health: The case of disadvantaged families. *Adaptive Human Behavior and Physiology*, *2*, 93–115. https://doi.org/10.1007/s40750-016-0042-z

Chang, L., & Lu, H. J. (2018). Resource and extrinsic risk in defining fast life histories of rural Chinese left-behind children. *Evolution and Human Behavior*, *39*, 59–66. https://doi.org/10.1016/j.evolhumbehav.2017.10.003

Chang, L., Lu, H. J., Lansford, J. E., Skinner, A. T., Bornstein, M. H., Steinberg, L. . . . Tapanya, S. (2019). Environmental harshness and unpredictability, life history, and social and academic behavior of adolescents in nine countries. *Developmental Psychology*, *55*, 890–903.

Chen, E., & Miller, G. E. (2013). Socioeconomic status and health: Mediating and moderating factors. *Annual Review of Clinical Psychology*, *9*, 723–749. https://doi.org/10.1146/annurev-clinpsy-050212-185634

Chisholm, J. S., Quinlivan, J. A., Petersen, R. W., & Coall, D. A. (2005). Early stress predicts age at menarche and first birth, adult attachment, and expected lifespan. *Human Nature*, *16*, 233–265. https://doi.org/10.1007/s12110-005-1009-0

Cohen, A. (1990). A cross-cultural study of the effects of environmental unpredictability on aggression in folktales. *American Anthropologist*, *92*, 474–479. https://doi.org/10.1525/aa.1990.92.2.02a00150

Cohen, S., Tyrrell, D. A. J., & Smith, A. P. (1993). Negative life events, perceived stress, negative affect, and susceptibility to the common cold. *Journal of Personality and Social Psychology*, *64*, 131–140. https://doi.org/10.1037//0022-3514.64.1.131

Davies, P. T., Thompson, M. J., Coe, J. L., Sturge-Apple, M. L., & Martin, M. J. (2019). Child response processes as mediators of the association between caregiver intimate relationship instability and children's externalizing symptoms. *Developmental Psychology*, *55*, 1244–1258. https://doi.org/10.1037/dev0000717

Del Giudice, M. (2009). Sex, attachment, and the development of reproductive systems. *Behavioral and Brain Sciences*, *32*, 1–21. https://doi.org/10.1017/S0140525X09000016

Del Giudice, M. (2014). An evolutionary life history framework for psychopathology. *Psychological Inquiry*, *25*, 261–300. https://doi.org/10.1080/1047840X.2014.884918

Del Giudice, M. (2016). The life history model of psychopathology explains the structure of psychiatric disorders and the emergence of the p factor: A simulation study. *Clinical Psychological Science*, *4*, 299–311. https://doi.org/10.1177/2167702615583628

Del Giudice, M., Ellis, B. J., & Shirtcliff, E. A. (2011). The adaptive calibration model of stress responsivity. *Neuroscience & Biobehavioral Reviews*, *35*, 1562–1592. https://doi.org/10.1016/j.neubiorev.2010.11.007

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. https://doi.org/10.1017/S0954579415001169

Egeland, B., Breitenbucher, M., & Rosenberg, D. (1980). Prospective study of the significance of life stress in the etiology of child abuse. *Journal of Consulting and Clinical Psychology*, *48*, 195–205. https://doi.org/10.1037/0022-006X.48.2.195

Ellis, B. J. (2004). Timing of pubertal maturation in girls: An integrated life history approach. *Psychological Bulletin*, *130*, 920–958. https://doi.org/10.1037/0033-2909.130.6.920

Ellis, B. J., & Del Giudice, M. (2014). Beyond allostatic load: Rethinking the role of stress in regulating human development. *Development and Psychopathology*, *26*, 1–20. https://doi.org/10.1017/S0954579413000849

Ellis, B. J., & Del Giudice, M. (2019). Developmental adaptation to stress: An evolutionary perspective. *Annual Review of Psychology*, *70*, 111–139. https://doi.org/10.1146/annurev-psych-122216-011732

Ellis, B. J., Figueredo, A. J., Brumach, 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. https://doi.org/10.1007/s12110-009-9063-7

Ellis, B. J., Schlomer, G. L., Tilley, E. H., & Butler, E. A. (2012). Impact of fathers on risky sexual behavior in daughters: A genetically and environmentally controlled sibling study. *Development and Psychopathology*, *24*, 317–332. https://doi.org/10.1017/S095457941100085X

Figueredo, A. J., Gladden, P. R., & Beck, C. J. A. (2012). *Intimate partner violence and life history strategy*. Oxford University Press.

Fiske, S. T., & Markus, H. R. (2012). A wide angle lens on the psychology of social class. In Fiske S. T., & Markus H. R. (Eds.), *Facing social class: Social psychology of social class*. Russell Sage New York, NY,

Frankenhuis, W. E., & Nettle, D. (2020). The strengths of people in poverty. *Current Directions in Psychological Science*, *29*, 16–21. https://doi.org/10.1177/0963721419881154

Frankenhuis, W. E., Panchanathan, K., & Nettle, D. (2016). Cognition in harsh and unpredictable environments. *Current Opinion in Psychology*, *7*, 76–80. https://doi.org/10.1016/j.copsyc.2015.08.011

Friedel, J. E., DeHart, W. B., Frye, C. C. J., Rung, J. M., & Odum, A. L. (2016). Discounting of qualitatively different delayed health outcomes in current and never smokers. *Experimental and Clinical Psychopharmacology*, *24*, 18–29. https://doi.org/10.1037/pha0000062

Gosling, S. D., Rentfrow, P. J., & Swann, W. B. Jr (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality*, *37*, 504–528, https://doi.org/10.1016/S0092-6566(03)00046-1,

Griskevicius, V., Ackerman, J. M., Cantú, S. M., Delton, A. W., Robertson, T. E., Simpson, J. A. . . . Tybur, J. M. (2013). When the economy falters, do people spend or save? Responses to resource scarcity depend on childhood environments. *Psychological Science*, *24*, 197–205. https://doi.org/10.1177/0956797612451471

Griskevicius, V., Delton, A. W., Robertson, T. E., & Tybur, J. M. (2011). Environmental contingency in life history strategies: The influence of mortality and socioeconomic status on reproductive timing. *Journal of Personality and Social Psychology*, *100*, 241–254. https://doi.org/10.1037/a0021082

Griskevicius, V., Tybur, J. M., Delton, A. W., & Robertson, T. E. (2011). The influence of mortality and socioeconomic status on risk and delayed rewards: A life history theory approach. *Journal of Personality and Social Psychology*, *100*, 1015–1026. https://doi.org/10.1037/a0022403,

Gross, J. J. (1998). Antecedent- and response-focused emotion regulation: Divergent consequences for experience, expression, and physiology. *Journal of Personality and Social Psychology*, *74*, 224–237. https://doi.org/10.1037//0022-3514.74.1.224

Hartman, S., Sung, S., Simpson, J. A., Schlomer, G. L., & Belsky, J. (2018). Decomposing environmental unpredictability in forecasting adolescent and young adult development: A two-sample study. *Developmental and Psychopathology*, *30*, 1321–1332. https://doi.org/10.1017/S0954579417001729

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Publications, https://doi.org/10.1111/jedm.12050

Inquisit 6. (2019). Retrieved from https://www.millisecond.com

Kaplan, H. S., & Gangestad, S. W. (2005). Life history theory and evolutionary psychology. In Buss D. M. (Eds.), *The handbook of evolutionary psychology*. John Wiley Hoboken, NJ: 68–95.

Koffarnus, M. N., & Bickel, W. K. (2014). A 5-trial adjusting delay discounting task: Accurate discount rates in less than one minute. *Experimental and*

Clinical Psychopharmacology, *22*, 222–228. https://doi.org/10.1037/a0035973

Kotov, R., Krueger, R. F., Watson, D., Achenbach, T. M., Althoff, R. R., Bagby, R. M. . . . **Zimmerman, M.** (2017). The hierarchical taxonomy of psychopathology (HiTOP): A dimensional alternative to traditional nosologies. *Journal of Abnormal Psychology*, *126*, 454. https://doi.org/10.1037/abn0000258

Krueger, R. F., Hicks, B. M., Patrick, C. J., Carlson, S. R., Iacono, W. G., & McGue, M. (2002). Etiologic connections among substance dependence, antisocial behavior, and personality: Modeling the externalizing spectrum. *Journal of Abnormal Psychology*, *111*, 411–424. https://doi.org/10.1037/0021-843X.111.3.411

Krueger, R. F., Hobbs, K. A., Conway, C. C., Dick, D. M., Dretsch, M. N., Eaton, N. R. . . . **HiTOP Utility Workgroup** (2021). Validity and utility of hierarchical taxonomy of psychopathology (HiTOP): II. Externalizing superspectrum. *World Psychiatry*, *20*, 171–193, https://doi.org/10.1002/wps.20844,

Lazarus, R. S. (1991). Progress on a cognitive-motivational-relational theory of emotion. *American Psychologist*, *46*, 819–834. https://doi.org/10.1037/0003-066X.46.8.819

Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L. . . . **Brown, R. A.** (2002). Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology: Applied*, *8*, 75–84. https://doi.org/10.1037//1076-898x.8.2.75

Maner, J. K. (2017). Dominance and prestige: A tale of two hierarchies. *Current Directions in Psychological Science*, *26*, 526–531. https://doi.org/10.1177/0963721417714323

Maner, J. K., & Case, C. R. (2016). Dominance and prestige: Dual strategies for navigating social hierarchies. In Olson J., & Zanna M. (Eds.), *Advances in Experimental Social Psychology*. Elsevier Academic Press San Diego, CA: 129–180. https://doi.org/10.1016/bs.aesp.2016.02.001

Maner, J. K., Dittmann, A., Meltzer, A. L., & McNulty, J. K. (2017). Implications of life history strategies for obesity. *Proceedings of the National Academy of Sciences of the United States of America*, *114*, 8517–8522. https://doi.org/10.1073/pnas.1620482114

Maranges, H., Hasty, C., Martinez, J. L., & Maner, J. K.. Adaptive calibration in early development: Brief measures of perceived childhood unpredictability and harshness (under review)

Maranges, H. M., Hasty, C., Maner, J. K., & Conway, P. (2021). The behavioral ecology of moral dilemmas: Childhood unpredictability, but not harshness, predicts less deontological and utilitarian responding. *Journal of Personality and Social Psychology*, *120*, 1696–1719. https://doi.org/10.1037/pspp0000368

Maranges, H. M., & Strickhouser, J. E. (2021). Does ecology or character matter? The contributions of childhood unpredictability, harshness, and temperament to life history strategies in adolescence. *Evolutionary Behavioral Sciences.* Advance online publication. https://doi.org/10.1037/ebs0000266

Martel, M. M. (2013). Sexual selection and sex differences in the prevalence of childhood externalizing and adolescent internalizing disorders. *Psychological Bulletin*, *139*, 1221–1259. https://doi.org/10.1037/a0032247

McDade, T. W. (2003). Life history theory and the immune system: Steps toward a human ecological immunity. *American Journal of Physical Anthropology*, *122*, 100–125. https://doi.org/10.1002/ajpa.10398

Mittal, C., & Griskevicius, V. (2014). Sense of control under uncertainty depends on people's childhood environment: A life history theory approach. *Journal of Personality and Social Psychology*, *107*, 621–637. https://doi.org/10.1037/a0037398

Mittal, C., Griskevicius, V., Simpson, J. A., Sung, S., & Young, E. S. (2015). Cognitive adaptations to stressful environments: When childhood adversity enhances adult executive function. *Journal of Personality and Social Psychology*, *109*, 604–621. https://doi.org/10.1037/pspi0000028

Newbury, J. B., Arseneault, L., Moffitt, T. E., Caspi, A., Danese, A., Baldwin, J. R. . . . **Fisher, H. L.** (2018). Measuring childhood maltreatment to predict early-adult psychopathology: Comparison of prospective informant-reports and retrospective self-reports. *Journal of Psychiatric Research*, *96*, 57–64. https://doi.org/10.1016/j.jpsychires.2017.09.020

Patrick, C. J., Kramer, M. D., Krueger, R. F., & Markon, K. E. (2013). Optimizing efficiency of psychopathology assessment through quantitative modeling: Development of a brief form of the Externalizing Spectrum Inventory. *Psychological Assessment*, *25*, 1332–1348. https://doi.org/10.1037/a0034864

Pepper, G. V., & Nettle, D. (2013). Death and the time of your life: Experiences of close bereavement are associated with steeper financial future discounting and earlier reproduction. *Evolution and Human Behavior*, *34*, 433–439. https://doi.org/10.1016/j.evolhumbehav.2013.08.004

Pepper, G. V., & Nettle, D. (2017). The behavioural constellation of deprivation: Causes and consequences. *Behavioral & Brain Sciences*, *40*, e314. https://doi.org/10.1017/S0140525X1600234X

Reuben, A., Moffitt, T. E., Caspi, A., Belsky, D. W., Harrington, H., Schroeder, F. . . . **Danese, A.** (2016). Lest we forget: Comparing retrospective and prospective assessments of adverse childhood experiences in the prediction of adult health. *Journal of Child Psychology and Psychiatry*, *57*, 1103–1112. https://doi.org/10.1111/jcpp.12621

Richardson, G. B., Chen, C. C., Dai, C. L., Hardesty, P. H., & Swoboda, C. M. (2014). Life history strategy and young adult substance use. *Evolutionary Psychology*, *12*, 932–957. https://doi.org/10.1177/147470491401200506

Rucas, S. L., Gurven, M., Winking, J., & Kaplan, H. (2012). Social aggression and resource conflict across the female life-course in the Bolivian Amazon. *Aggressive Behavior*, *38*, 194–207. https://doi.org/10.1002/ab.21420

Simmons, C., Rowan, Z., Knowles, A., Steinberg, L., Frick, P. J., & Cauffman, E. (2019). A life history approach to understanding juvenile offending and aggression. *Aggression and Violent Behavior*, *49*, 101317. https://doi.org/10.1016/j.avb.2019.07.012

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. https://doi.org/10.1037/a0027293

Stein, J. S., Heckman, B. W., Pope, D. A., Perry, E. S., Fong, G. T., Cummings, K. M. . . . **Bickel, W. K.** (2018). Delay discounting and e-cigarette use: An investigation in current, former, and never cigarette smokers. *Drug and Alcohol Dependence*, *191*, 165–173. https://doi.org/10.1016/j.drugalcdep.2018.06.034,

Steinbach, A., & Augustijn, L. (2021). Post-separation parenting time schedules in joint physical custody arrangements. *Journal of Marriage and Family Therapy*, *83*, 595–607. https://doi.org/10.1111/jomf.12746

Stephens, N. M., Fryberg, S. A., Markus, H. R., Johnson, C. S., & Covarrubias, R. (2012). Unseen disadvantage: How American universities' focus on independence undermines the academic performance of first-generation college students. *Journal of Personality and Social Psychology*, *102*, 1178–1197. https://doi.org/10.1037/a0027143

Sugiyama, L. S. (2004). Illness, injury, and disability among Shiwiar forager-horticulturalists: Implications of health-risk buffering for the evolution of human life history. *American Journal of Physical Anthropology*, *123*, 371–389. https://doi.org/10.1002/ajpa.10325

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. https://doi.org/10.1037/pspi0000032

Szepsenwol, O., Zamir, O., & Simpson, J. A. (2019). The effect of early-life harshness and unpredictability on intimate partner violence in adulthood: A life history perspective. *Journal of Social and Personal Relationships*, *36*, 1542–1556. https://doi.org/10.1177/0265407518806680

Taylor, S. E., & Stanton, A. L. (2007). Coping resources, coping processes, and mental health. *Annual Review of Clinical Psychology*, *3*, 377–401. https://doi.org/10.1146/annurev.clinpsy.3.022806.091520

Tetrick, L. E., & Larocco, J. M. (1987). Understanding, prediction, and control as moderators of the relationships between perceived stress, satisfaction, and psychological well-being. *Journal of Applied Psychology*, *72*, 538–543. https://doi.org/10.1037/0021-9010.72.4.538

Thirot, T. L., & Buckner, E. T. (1991). Multiple predictors of satisfactory post-divorce adjustment of single custodial parents. *Journal of Divorce & Remarriage*, *17*, 27–48. https://doi.org/10.1300/J087v17n01_03

Tomaka, J., Blaskovich, J., Kelsey, R. M., & Leitten, C. L. (1993). Subjective, physiological, and behavioral effects of threat and challenge appraisal.

Journal of Personality and Social Psychology, *65*, 248–260. https://doi.org/10.1037/0022-3514.65.2.248

Tucker, J. A., Lindstrom, K., Chandler, S. D., Bacon, J. P., & Cheong, J. (2021). Behavioral economic indicators of risky drinking among community-dwelling emerging adults. *Psychology of Addictive Behaviors*, *34*, 415–423. https://doi.org/10.1037/adb0000686

Watson, D., O'Hara, M. W., Simms, L. J., Kotov, R., Chmielewski, M., McDade-Montez, E. A.... **Stuart, S.** (2007). Development and validation of the Inventory of Depression and Anxiety Symptoms (IDAS). *Psychological Assessment*, *19*, 253–268. https://doi.org/10.1037/1040-3590.19.3.253

West-Eberhard, M. J. (2003). *Developmental plasticity and evolution*. Oxford University Press, New York, NY. https://doi.org/10.1093/oso/9780195122343.001.0001

White, A. E., Li, Y. J., Griskevicius, V., Neuberg, S. L., & Kenrick, D. T. (2013). Putting all your eggs in one basket: Life-history strategies, bet hedging, and diversification. *Psychological Science*, *24*, 715–722. https://doi.org/10.1177/0956797612461919

Wilson, M., & Daly, M. (1997). Life expectancy, economic inequality, homicide, and reproductive timing in Chicago neighborhoods. *British Medical Journal*, *314*, 1271–1274. https://doi.org/10.1136/bmj.314.7089.1271

Xu, Y., Norton, S., & Rahman, Q. (2018). Early life conditions, reproductive and sexuality-related life history outcomes among human males: A systematic review and meta-analysis. *Evolution and Human Behavior*, *39*, 40–51. https://doi.org/10.1016/j.evolhumbehav.2017.08.005

Young, E. S., Griskevicius, V., Simpson, J. A., Waters, T. E., & Mittal, C. (2018). Can an unpredictable childhood environment enhance working memory? Testing the sensitized-specialization hypothesis. *Journal of Personality and Social Psychology*, *114*, 891–908. https://doi.org/10.1037/pspi0000124