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Child attachment in adjusting the species-general contingency between environmental adversities and fast life history strategies

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Abstract

Extrinsic mortality risks calibrating fast life history (LH) represent a species-general principle that applies to almost all animals including humans. However, empirical research also finds exceptions to the LH principle. The present study proposes a maternal socialization hypothesis, whereby we argue that the more human-relevant attachment system adds to the LH principle by up- and down-regulating environmental harshness and unpredictability and their calibration of LH strategies. Based on a longitudinal sample of 259 rural Chinese adolescents and their primary caregivers, the results support the statistical moderating effect of caregiver–child attachment on the relation between childhood environmental adversities (harshness and unpredictability) and LH strategies. Our theorizing and findings point to an additional mechanism likely involved in the organization and possibly the slowdown of human LH.

Keywords: caregiver–child attachment; childhood environmental harshness and unpredictability; fast and slow human life history strategies; internal working models; risk aversion

Originally derived in biology from between-species, higher taxonomic observations, life history (LH) theory has been successfully used in developmental psychology to explain individual variations in development and behavior. One species-general LH principle is that high (harsh) and variable (unpredictable) mortality conditions especially from childhood living environment promote fast LH tradeoff strategies and related biobehavioral manifestations (Ellis et al., 2009). By contrast, a safe and stable childhood living environment engenders slow LH strategies and related behavior. Numerous empirical studies have been generated from, and support, this theoretical framework (see Wu et al., 2020, for a meta-analysis). Empirical research particularly supports the notion of a link between environmental harshness (e.g., low social economic status [SES], Belsky et al., 2012) and unpredictability (e.g., unpredictable life events, Chang et al., 2019) and subsequent fast LH behavioral outcomes (e.g., risk taking, Lu & Chang, 2019). However, in fields of social science other than LH research, evidence suggests that similar childhood adversities are also associated with behaviors that can be characterized as slow rather than fast LH. For example, in the literature of economics, low SES and experience of poverty are reported to be correlated with risk aversion (see Haushofer & Fehr, 2014, for a review). Separately from this discussion, one of the most influential areas of research in psychology, that of caregiver–child attachment research, demonstrates the power of attachment and its internal working model in organizing and formulating people's attention and orientation toward and interpretations and expectations of the external environment that especially includes harsh and unpredictable mortality conditions during the long evolutionary history (Bowlby 1969/1982; Chisholm, 1996; Main, 1991). An internalized pervasive belief and schema regarding the extent to which the external world and people around are deemed to be controllable, predictable, and dependable should have adaptive ramifications on how to approach extrinsic mortality factors. Reproducing early, fast, and plentifully to attempt to outgrow and escape uncontrollable mortality risks postreproductively conforms to the aforementioned species-general principle. However, as imbedded in the concept of internal working models, the attachment system proffers an alternative or additional adaptation, that of reducing extrinsic mortality risks or rendering them intrinsically controllable and therefore and consequently slowing the pace of LH.

Two additional observations or facts are worthy of remark. First, two-thirds of the human population across cultures and nations are securely attached (Van Ijzendoorn & Kroonenberg, 1988, Van Ijzendoorn et al., 1999), a number far greater than would be predicted by the extrinsic mortality conditions of the human environment of evolutionary adaptedness (Chisholm, 1996). Second, almost all aspects of human LH have slowed compared to their ancestral states (Smith & Tompkins, 1995). Putting all these otherwise disparate observations together, it appears that human LH may not have followed the species-general principle uniformly in adapting to harsh and unpredictable living environments, and secure attachment may provide an additional adaptation to environmental adversities. The purpose of the present study is to propose an alternative LH perspective, whereby we argue that, especially for humans and other primates, two forces may shape LH strategies, development, and behavior. The first of these is

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the ecological environment that frames individuals' development according to the species-general principle of LH research. The other is the attachment system as maternally socialized environment that shapes a person's LH development through one's internal regulatory system (Bowlby, 1969/1982). The two forces work mainly in the same direction to yield the findings reported in the aforementioned LH literature. However, as we theorize subsequently, when the two forces work in different directions, the attachment system should alleviate but may also aggravate ecological adversities and should attenuate but may also strengthen the contingent association of environmental harshness and unpredictability to fast LH. These situations should produce findings consistent with the social science literature and explain the prevalence of secure attachment in human populations.

Evolution of fast-slow LH tradeoff strategies

In running its intrinsic course from birth to death, life encounters many external obstacles (extrinsic mortality and morbidity risks) that in part result in an organism not being able to acquire sufficient resources (e.g., food and safety) to support all its intrinsic development needs. Tradeoffs occur between the different intrinsic needs that can be grouped into two investment strategies. One is to invest more on growth and development, as well as repair and maintenance, including learning and cognitive development and parenting or helping the next generation to learn and develop, all as preparations for reproduction. The other is to invest more in reproduction. The biobehavioral results (LH traits and LH-related traits [Del Giudice, 2020]) form a fast-slow LH trait continuum. Those on the trait continuum that represent slower and more invested growth and development are called slow LH strategies, and those that represent faster and less invested growth and development are called fast LH strategies (Ellis et al., 2009; Stearns, 1992). Parallel to the fast vs. slow pace of life is a cognitive and behavioral representation of time, with fast LH associated with a present orientation and shorter-time spans and slow LH associated with a future orientation and longer-term plans (Sear, 2020). Other bipolar behavioral traits include risk taking vs. risk averting, impulsivity and emotionality vs. planning, insight, and control, and an affiliative and altruistic sociality mindful of future cooperation, in contrast to an antagonistic and utilitarian social interactional style, aimed for immediate and self-focused survival goals (Chang et al., 2019; Figueredo et al., 2018).

These fast and slow LH strategies are largely shaped by safety conditions of the organism's living environment. Extrinsic safety risks inflict age specific mortality and morbidity independent of individuals' intrinsic life conditions (e.g., healthy) or survival efforts (e.g., working hard). The rate and variance at which extrinsic safety factors cause death and disability especially on the adult population are referred to as environmental harshness and unpredictability (Ellis et al., 2009). When these two dimensions are low as in a safe and controllable environment, the winning strategy is to maximize physical and mental development by acquiring energy and resources and accumulating knowledge and skills to enhance future resource-capturing and reproductive competitiveness. A safe environment fosters a larger population and increased intraspecific competition (MacArthur &Wilson, 1967). In response, organisms must develop their physical and mental capacities and must invest more in their offspring to keep up with increased competition. Environmental safety and stability also ensure a predictable future, which, in turn, ensures that investments in one's physical and mental capabilities will pay off.

Considered together, these interrelated factors stemming from safe environments predicate that slow or slower LH is the winning strategy (Chang & Lu, 2016). By contrast, in an unsafe and unpredictable environment causing casualties beyond the individual's survival efforts and abilities, the winning strategy is not to bet on trying to overcome environmental adversities through slow and invested development but to outgrow extrinsic mortality and morbidity by growing fast and reproducing early. Thus, the increased probability of escaping uncontrollable mortality risks post-reproductively means that fast or faster LH strategists out-survive slow or slower strategists in an unsafe and unpredictable environment. Evolution therefore tends to couple safe and stable living environments, especially in childhood, with slow LH strategies and couples unsafe and unpredictable childhood environments with fast LH strategies.

Mixed empirical evidence

The evolutionarily selected fast-slow LH strategies and the contingent coupling between the LH strategies and environmental safety conditions continue to regulate and organize current development and behavior (Del Giudice & Belsky, 2011). Within certain bounds, LH traits and strategies are plastic (Del Giudice & Belsky, 2011; Sear, 2020). They adaptively respond to cues of harshness and unpredictability from the present living environments and regulate behavior accordingly. In LH studies, environmental harshness has been indicated by low family income or socioeconomic status (e.g., Doom et al., 2016), income to needs ratio (e.g., Belsky et al., 2012), dangerous neighborhoods (e.g., Hampson et al., 2016), exposure to violence and drug and alcohol use (Brumbach et al., 2009), and exposure to illness, injury, and death (Szepsenwol et al., 2021). Environmental unpredictability has been indicated by such proxies as change of employment or residence, (e.g., Simpson et al., 2012; Zuo et al., 2018), chaos in the home (e.g., Del Giudice et al., 2012), income and occupation change (e.g., Belsky et al., 2012; Szepsenwol et al., 2021), and other precarious family conditions such as change in membership composition, death of family members, and caregiver depression (e.g., Ellis et al., 2021; Mell et al., 2018). Consistent with LH predictions, these proxies of environmental harshness and unpredictability are longitudinally correlated with corresponding LH strategies and LH-related traits. For example, indicators of harshness or unpredictability obtained before children are 10 years old positively predict aggression and other externalizing behavior during adolescence and young adulthood (Belsky et al., 2012; Chang et al., 2019; Doom et al., 2016; Ellis et al., 2021; Lu & Chang, 2019; Simpson et al., 2012). Similar longitudinal effects of childhood harshness and unpredictability are registered by additional fast LH-related outcomes such as academic underperformance (Chang & Lu, 2018), present orientation and social dysfunctions (Hartman et al., 2018), risk taking (Lu & Chang, 2019), risky sexual behavior (Ellis et al., 2021), number of sexual partners (Belsky et al., 2012), and a fast LH profile constructed by somatic and reproductive indicators (Mell et al., 2018). Overall, evidence from the LH research literature supports the species-general principle that environmental harshness and unpredictability have the same impact in calibrating fast LH.

However, nonevolutionary investigations of similar variables yield different findings. In economics studies, poverty or low SES, a pervasive measure of environmental harshness, is reported to be correlated with financial risk aversion rather than risk taking as would be predicted by LH research (see Haushofer & Fehr, 2014

for review). War time experience embodies both harshness and unpredictability. Based on a large sample of 5,000 households who were either exposed or not exposed to the Korean war five decades earlier when these participants were between 1 and 31 years old, a Korean study reports similar findings that, compared to those not exposed, those who were exposed to the war were more risk averse based on hypothetical lottery questions (Kim & Lee, 2014). Moreover, individuals who were exposed to the war when they were between 4 and 8 years old were the most risk averse and those who resided in areas more severely affected by the war were more risk averse (Kim & Lee, 2014). In additional examples of harshness and unpredictability, people who were exposed to a tsunami (Cassar et al., 2017), earthquake (de Blasio et al., 2020), or episodes of violence (Brown et al., 2019; Moya, 2018) were all found to be more financially risk averse. People who were exposed to violence were also more altruistic (Voors et al., 2012) and those who were poor scored higher on empathy (Stellar et al., 2012), prosociality (Amir et al., 2018), altruism (Miller et al., 2015; Piff et al., 2010), and ethical behavior (Piff et al., 2012), all of which are characteristic of slow but not fast LH. Some of the LH studies also do not fully support the link between childhood environmental adversity and fast LH. For example, economic harshness was not associated with earlier start of sexual activities (Nolin & Ziker, 2016), and harshness represented by reduced maternal capital was associated with delayed rather than accelerated menarche of daughters (Wells et al., 2019). In the data of Study of Early Child Care and Youth Development, childhood environmental harshness operationalized by income to needs ratio did not predict fast LH strategy represented by the number of sexual partners one had (Hartman et al., 2018). Unpredictability indicators such as household moves and parental job transition did not predict fast LH-related traits and behaviors such as age of first sex and externalizing behavior, although paternal transition was an across-the-board significant fast LH predictor (Hartman et al., 2018). Similarly, in the Minnesota Longitudinal Study of Risk and Adaptation, environmental harshness at age 0 to 16 and unpredictability at age 6 to16 failed to predict fast LH indicators at age 23, such as aggression and number of sexual partners, and environmental unpredictability also showed the opposite effect, predicting fewer delinquent or criminal behavior at 23 (Simpson et al., 2012).

Attachment in organizing LH strategies

We offer an explanation of the mixed findings that involves the attachment system. Mammalian species that undergo a period of childhood first experience the world through interactions with their mothers or primary caregivers. Through these innumerable interactions that help to form caregiver–child attachment, "the brain builds up working models of its environment" (Bowlby 1969/1982; p. 81). Caregiver–child attachment and the resulting internal working model set permanent or change-resistant expectations, orientations, and evaluations by which the growing child subsequently experiences and manages the outside world (Chisholm, 1993; 1996). Because the function of attachment is to provide protection from extrinsic risks (Bowlby, 1969/1982), the internal working model should be especially involved in processing extrinsic mortality information (Chisholm, 1996). As attachment is formed through caregiver–child interactions, especially for humans and other primates that live in groups, the internal working model is also relevant for managing conspecific relationships (Simpson & Belsky, 2008), which represent another

potential source of extrinsic mortality risks (i.e., intraspecific conflict and violence). According to Chisholm (1996) and other LH researchers (e.g., Belsky et al., 1991; Del Giudice & Belsky, 2011; Simpson & Belsky, 2008), effects rendered by the extrinsic mortality conditions of the child's living environment are transmitted to the child through caregiving behavior and the caregiver's LH manifestations, both of which are shaped by the environment the child inherits from the caregiver. Once organized, attachment operates outside consciousness as an intermediary, conveying external environmental information and engendering internal LH calibration (Chisholm, 1996). Specifically, it has been postulated in the literature that, for example, a stable environment is aligned with consistent caregiving, secure child attachment and an internal working model based on others being trustworthy and on the self being capable and in control, and with slow LH calibrations (Belsky et al., 1991; Chisholm, 1993; 1996; Del Giudice & Belsky, 2011). By contrast, environmental adversity (harshness and unpredictability) is aligned with insecure attachment that leads to fast LH strategies.

The above theorizing has received empirical support in the literature, which mainly examines retrospective measures of the childhood environment in relation to concurrent measures of adult attachment. For example, retrospective measures of environmental harshness (e.g., child abuse and neglect, Le et al., 2018; Yang & Perkins, 2020) and unpredictability (e.g., residence and parental employment changes, Barbaro & Shackelford, 2019; Szepsenwol et al., 2015) are positively correlated with adult insecure attachment, which is positively correlated with fast LH-related behavioral profiles such as harmful drinking, criminal thinking, intimate partner violence and sexual coercion, and disengaged parenting behavior. Other studies examine the direct or main effect of attachment or parenting behavior on LH-related outcomes. In these studies, insecure attachment or negative parenting (e.g., unresponsive parenting, maternal harshness, maternal insensitivity) are conceptualized as environmental harshness (Chua et al., 2020; Hartman et al., 2017; Suor et al., 2017; Warren & Barnett, 2020) or unpredictability (Brumbach et al., 2009; Ross & Hill, 2002; Sung et al., 2016) in independently predicting fast LH strategies. The theoretical rationale is that insecure attachment resulting from harsh and inconsistent parenting relates to the same dimensions of the ecological environment – harshness and unpredictability, and calibrates fast LH accordingly. More specifically, unsupportive parenting, as well as parental absence, indicates and is experienced by the child as environmental harshness (Warren & Barnett, 2020). Similarly, parental behavioral inconsistency or actual parental transition and change registers environmental unpredictability in shaping fast LH accordingly. As Belsky et al. (1991) states, "rearing context shapes life history, which is itself systematically related to patterns of pair bonding and parenting." (p. 649).

Thus, there are two schools of thoughts and findings regarding the role of attachment in shaping LH. In one, attachment and related parenting behavior register, mediate, and transmit environmental adversities in relation to LH strategies and, in the other, they represent a separate source of environmental adversities in calibrating LH. Integrating and extending this literature, we make two postulations. First, we argue that caregiving behavior registering environmental conditions is an approximate, not exact, process (Szepsenwol & Simpson, 2019). If the subsequent attachment system renders additional effects that deviate from the attachment-mediated environmental calibration of LH strategies, they are more likely to work in the direction of under-registering or buffering rather than over-registering or increasing

environmental risks, and in the direction of under-calibrating rather than over-calibrating environmental harshness and unpredictability into LH strategies. The overall net effect of the attachment system should be that of attenuating rather than strengthening the species-general contingent relation between extrinsic mortality risks and fast LH strategies. This is because one main function of parenting is to protect child from extrinsic risks such as predation (Bowlby, 1969/1982). This function makes parenting one of the most decisively slow LH traits (Kaplan, 1996). No matter how harsh or unpredictable the living environment a child inherits from his or her caregiver is, and regardless of how faithfully the caregiving the child receives registers the environmental adversity and manifests fast LH, the child should not be at more risk and should not develop a faster LH than he or she would if the child had not received protection and care from a caregiver. Because of the evolutionarily selected slow LH function of parenting, it is more likely, for example, that a mother overcomes (some) environmental adversity and provides a safe (safer) environment and (more) consistent and (more) responsive care to her (more) securely attached child (than predicted based on environmental conditions), thereby breaking, moderating, and down-regulating the species-general extrinsic mortality – fast LH contingency.

The above postulation presumes and predicates that caregiving behavior, especially maternal care, does not cause additional extrinsic risk or harm to a child over and beyond the permeated environmental or ecological risks. When it does, however, as in the case of aforementioned harsh and inconsistent parenting, the resulting attachment, most likely insecure, will add detrimentally to the existing environmental conditions in calibrating LH. If the ecological environment is also harsh and unpredictable, attachment and the related parenting should upregulate species-general harshness and unpredictability – fast LH contingency. Facing the same environmental harshness and unpredictability, the attachment system may therefore direct children onto two separate developmental pathways: (1) the upregulated species-general LH pathway, whereby childhood environmental harshness and unpredictability, which is fortified by harsh and inconsistent parenting, for example, are over-calibrated into faster LH strategies according to the species-general contingent coupling between environmental conditions and LH strategies and (2) the maternally-socialized LH pathway, whereby environmental adversity and its fast LH calibration are both alleviated, even if only slightly, to result in the attenuation of fast LH's contingent response to environmental adversities. The first pathway is typically taken by insecurely attached individuals who, in accordance with the species-general LH principle, continue to be shaped by environmental adversities into fast LH strategists. The second pathway is traversed by securely attached individuals who, because of a strong mother-guided internal working model, may resist and even reverse the impacts or detriments of childhood environmental adversities.

Present study

The two pathways form a stastistical moderating hypothesis about attachment, with the moderating effect moving in the direction of secure attachment nullifying or reducing the impact of environmental harshness and unpredictability on LH-related outcomes and insecure attachment maintaining or strengthening the adverse environmental impact. We tested the hypothesis and our LH theorizing on a longitudinal sample of 259 rural Chinese adolescents. Specifically, we hypothesized that childhood environmental harshness and unpredictability, obtained from the adolescents and their primary caregivers when the former were 7 years old on average (Wave 1), and secure attachment obtained from the adolescents in the following year (Wave 2) would be negatively associated with slow LH strategies, obtained from the adolescents when they were approximately 11 years of age (Wave 3 of the present study). We expected statistical moderating effects of secure attachment on the relations between childhood environmental adversities (harshness and unpredictability) and slow LH strategies. In testing the statistical moderation or interaction, we expected a stronger negative association between environmental adversities and slow LH strategies for lower levels of secure attachment and a more attenuated association at higher levels of secure attachment.

Method

Sample

A community sample was taken from four randomly selected rural townships of three counties in Henan Province, which registers the highest population density, highest rural population, and one of the lowest per capita incomes (National Bureau of Statistics (NBS), 2020). The sample consisted of 259 adolescents (137 males; $M_{age} = 10.99$, $SD = 0.77$) and their primary caregivers who were mostly mothers ($M_{age} = 33.54$, $SD = 4.96$). The present study reports three waves of data from a multiyear longitudinal study. The adolescents were 7-year-old children on average ($M_{age} = 6.97$, $SD = 0.74$) at Wave 1, were 8 years old on average ($M_{age} = 7.94$, $SD = 0.74$) at Wave 2, and were 11 on average at Wave 3 of the present study. Retention rate was 76%. Participants who provided complete data across the three data points did not differ from the initial sample on any of the measures used in the present study.

Procedures

At Wave 1 or initial data collection, two interviewers who were blind to the purpose of the study conducted face-to-face interviews with the participating children and their primary caregivers at the participants' homes. A participating child and the caregiver were interviewed separately to ensure privacy. The interview involved an interviewer reading standardized questions to a participant and recording his/her answers. At Wave 2, the same interview procedures involving the participating child and her primary caregiver were conducted at the participant's home. Of the Wave 2 measures, the present study included only the child attachment measure obtained from the children. At Wave of the present study, measures used in the present study were obtained from the participating adolescents through self-response questionnaires. Questionnaires were distributed to and obtained from the adolescents in the schools. For all three data collections, children were given small gifts, and adolescents and caregivers were given modest monetary compensation to thank them for their participation. The interview content and procedures and questionnaire content were approved by the Institutional Review Board of the concerning universities. Primary caregivers provided written informed consent, and children and adolescents provided assent.

Wave 1 measures: childhood environmental harshness
Environmental harshness is defined as the frequencies or rates at which extrinsic risks cause mortality and morbidity of age-specific but mainly adult populations (Ellis et al., 2009). The definition

ascribes importance to extrinsic mortality caused by external factors mostly independent of an individual's survival effort and ability. This is in contrast to intrinsic mortality due to the internal degenerative process of aging and senescence. In the empirical human LH literature, harshness is indicated by poor economic conditions, because the latter are normally related to various forms of externally caused mortality and morbidity (Belsky et al., 2012), and by the number of such external causalities and negative events one witnessed or experienced (Chang et al., 2019). Following the literature, we measured environmental harshness by the three indicators below.

Negative life events. Children were asked to recall and report the number of times they ever experienced such negative life events as "severe illness," "accidents or injuries," "death or injuries of important persons," and others, which were adapted from the Social Readjustment Rating Scale (Holmes & Rahe, 1967). The total number of recalled events was used to indicate the variable, which being the number of counts has no internal consistency reliability estimate.

Poor economic conditions. Caregivers responded to seven items about poor economic conditions in the home (e.g., "during my child's growing up, we would buy cheaper kind of the same products;" "we did not have enough money to pay all the bills during;" "we relied on government subsidies"). The items were rated on a 4-point scale (1–4: *almost never, sometimes, often, almost always*). Internal consistency reliability estimate was .80.

Perceived financial difficulties. Caregivers responded to six items we modified and adopted from the literature (e.g., Griskevicius et al., 2011; "when my child was growing up, our family experienced financial difficulties;" "our family was relatively wealthy compared to other families in the community"). The items were rated on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Items were reversely coded, if necessary, with higher score indicating higher financial difficulties. The internal consistency reliability estimate was 0.90.

Wave 1 measures: childhood environmental unpredictability
Environmental unpredictability is defined as the rates at which extrinsic mortality causing risks vary mainly temporally (Ellis et al., 2009). In the empirical human LH literature, it is measured by sampling proxies from the current living environment that are believed to cue unpredictable environmental conditions of the ancestral past (Young et al., 2020). Following the literature, the following three indicators are used to measure environmental unpredictability.

Life routine irregularities. Children responded to 12 items measuring irregularity in life routines (e.g., "my family does not sit at the same table to eat dinner;" "my parents may not be home when I go to bed;" "I do not know where my parents are"). The items were rated on a 4-point scale (1–4: *almost never, sometimes, often, almost always*). Internal consistency reliability estimate was .69.

Chaos in the home. Caregivers responded to 10 items which we adapted and modified from the Confusion, Hubbub, and Order Scale (Matheny Jr. et al., 1995) to measure confusion, chaos, and disorder in the home (e.g., "when the child was growing up, it was a real zoo in our home;" "we almost always seemed to be rushed;" "there was often a fuss going on at our home").

The statements were rated on a 4-point scale ranging from 1 (*not at all like our home*) to 4 (*very much like our home*) to describe the family's home environment when the child was growing up. Items were worded and reversely coded, if necessary, in the direction of chaos and disorder. The internal consistency reliability estimate was 0.73.

Change in the township. Using a 4-point scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*), caregivers responded to four items about changes in their township ("during my child's growing up, people moved in and out of the township;" "a lot of people left;" "there had been too many unexpected changes here;" "I don't know what was going on here"). Internal consistency reliability estimate was .53.

Wave 2 measures: secure attachment
The Inventory of Parent and Peer Attachment (IPPA, Armsden & Greenberg, 1987) is a widely used self-report measure of attachment in relation to parents (25 items) and peers (25 items) for older adolescents. A revised version, IPPA-R (Gullone & Robinson, 2005) is used for children. Both versions contain three subscales, trust, communication, and alienation, but it is advised to use the 25 items to measure a single construct of secure attachment (Armsden & Greenberg, 1987; Gullone & Robinson, 2005). We used the revised IPPA-R for children. Sample items include, "My primary caregiver can tell when I'm upset about something;" "when I talk about things with my caregiver, she listens to what I think;" and "I can count on my caregiver when I need to talk about a problem." The items were measured on a 5-point scale ranging from 1 (*almost never or never true*) to 5 (*almost always or always true*). Internal consistency reliability estimate was .86. The children were asked to indicate who the primary caregiver was. Among the responses, 93.25% were mothers, and 6.75% were fathers.

Wave 3 measures: slow LH strategies
Questionnaire measures of LH strategies used in psychology (e.g., Mini-K) have been criticized for not including LH traits (Sear, 2020). In addition to Mini-K, we used two LH-related traits, affiliative sociality, and risk aversion to measure slow LH strategies.

Affiliative sociality. There are two types of sociality aligned with fast-slow pace of life: an affiliative, altruistic, and mutualistic social interactional style that is mindful of future cooperation and long-term reciprocation, in contrast to an antagonistic, exclusive, and utilitarian sociality that is adaptive in a precarious environment to address immediate self-focused survival concerns rather than future conspecific cooperation (Chang et al., 2019; Figueredo et al., 2018). These two types of sociality are observed in other animals as well (Réale et al., 2000; Wolf et al., 2007). Affiliative sociality is thus a defensible slow LH-related trait that is also widely used in the literature (e.g., Figueredo et al., 2018). Adolescents responded to 12 items measuring affiliative sociality (e.g., "I like to help others;" "it is important to cooperate;" and "I care about people around me"). They were rated on a 4-point scale ranging from 1 (*totally not true of me*) to 4 (*totally true of me*). Internal consistency reliability estimate was .70.

Risk aversion. Risk proneness or risk aversion is one of few behavioral traits that "may covary in predictable ways with life history traits between individuals" (Sear, 2020, p. 514). So we chose risk aversion as another slow LH-related trait. Following the literature

Table 1. Means, standard deviations, and correlations of variables used in the study

	1	2	3	4	5	6	7	8	9	10	11	12	13
Childhood Environmental Harshness													
1. Negative Life Events	–												
2. Poor Economic Conditions	.32***	–											
3. Perceived Financial Difficulties	.17**	.51***	–										
Childhood Environmental Unpredictability													
4. Life Routine Irregularities	.15*	.13*	.14**	–									
5. Chaos in the Home	.27***	.28***	.16*	.13*	–								
6. Change in the Township	.23***	.20**	.20**	.43***	.17*	–							
7. Secure Attachment	−.13*	−.10	−.09	−.23***	−.15*	−.21**	–						
8. Trust	−.09	−.11	−.09	−.26***	−.10	−.18**	.91***	–					
9. Communication	−.14*	−.10	−.04	−.24***	−.16*	−.22***	.90***	.71***	–				
10. Alienation	−.10	−.03	−.12*	−.20**	−.12*	−.16**	.72***	.54***	.48***	–			
Slow Life History Strategies													
11. Affiliative Sociality	−.28***	−.17*	−.05	−.20**	−.14*	−.23***	.43***	.36***	.44***	.26***	–		
12. Risk Averse	−.25***	−.17*	−.20**	−.35***	−.24***	−.20**	.43***	.41***	.39***	.27***	.34***	–	
13. Mini-K	−.25***	−.15*	−.15*	−.18**	−.16*	−.15*	.25***	.19**	.26***	.18**	.24***	.29***	–
Mean	2.08	1.92	2.82	1.59	2.05	1.56	3.76	3.71	3.47	4.27	3.11	3.32	3.85
Standard Deviation	3.11	0.57	0.69	0.41	0.52	0.60	0.62	0.68	0.79	0.65	0.40	0.57	0.84

Note. *p* < .05, **p* < .01, ***p* < .001.

(Duell et al., 2016), we adapted the Benthin Risk Perception Scale (Benthin et al., 1993). We adopted 8 out of the original 11 risky activities that are deemed relevant to the rural Chinese adolescent population. These are smoking cigarettes, drinking alcohol, taking a ride by a drunk driver, vandalizing property, going to dangerous places, stealing from stores, engaging in gang fights, and using weapons to threaten someone. About each of the eight activities, adolescent respondents answered the following four questions on a 4-point scale: "How scary are the things that could happen?" (1 = *not scary at all;* 4 = *very scary*; reverse coded); "To what extent are you at risk of something bad happening?" (1 = *very much;* 4 = *not at all*); "How would you compare the benefits of this activity with the risks?" (1 = *the risks are far greater than the benefits;* 4 = *the benefits are far greater than the risks*); "If something bad happened because of this activity, how serious would it be?" (1 = *not at all serious;* 4 = *very serious*; reverse coded). The average of the four ratings over eight activities formed the construct, which we multiplied by −1 so that a higher score indicated risk aversion or a greater inclination not to take risk independent of the actual opportunity to do so (Duell et al., 2016). Cronbach's α internal consistency reliability estimate was 0.94.

Mini-K. The 20-item scale measures the behavioral and cognitive aspects of LH strategies on a single continuum in the direction of slow LH (e.g., "I often make plans in advance;" "I try to understand how I get into a situation and figure out how to handle it;" and "I would rather have one than several sexual relationships at a time;" Figueredo et al., 2006). It has been criticized for including items representing both sides of LH hypothesized relations (Sear, 2020). In this connection, we eliminated two items concerning parental support because they are conceptually similar to the attachment items. We also eliminated an item about one's children because none of our adolescent participants had children.

We changed one item about religious participation into school involvement because almost all of the participants are nonreligious. For a few items about romantic and sexual relations, we made sure the wording represents opinions and beliefs but not experience because the participants would not have had the experience. Adolescents responded to the Mini-K items on a 6-point scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). The internal consistency reliability estimate was .84.

Results

Table 1 presents the means, standard deviations, and correlations of all the variables used in the study. The correlations were based on different informants (i.e., children and caregivers) and over time lags of up to 5 years. They showed good convergent and discriminant validity with mono-trait measures more highly correlated with each other than with hetero-trait measures. Inter-trait correlations were also in the expected directions, with indicators of environmental harshness (e.g., poor economic conditions, and perceived financial difficulties, which were obtained from caregivers) and unpredictability (e.g., chaos in the home, and change in the township, also from caregivers) longitudinally and significantly correlated with indicators of slow LH strategies (i.e., affiliative sociality, risk aversion, and Mini-K, reported by the adolescents). These indicators were also correlated with caregiver–child attachment in the expected directions. We also present the means and *SDs* of the variables for the two genders in Table 2. Girls scored higher on slow LH indicators but the differences were not statistically significant. There were no directional or statistically significant differences in the zero-order correlations or structural relations between the two genders.

To test our hypotheses, we conducted structural equation modeling (SEM) tests using *Mplus* 7.0 (Muthén & Muthén

Table 2. Means and standard deviations of variables used in the study for the two genders

	Boys		Girls		
	Mean	SD	Mean	SD	t-test
Childhood Environmental Harshness					
1. Negative Life Event	2.23	3.58	1.92	2.47	0.82
2. Poor Economic Conditions	1.92	0.59	1.91	0.56	0.25
3. Perceived Financial Difficulties	2.80	0.71	2.84	0.68	−0.52
Childhood Environmental Unpredictability					
4. Life Routine Irregularities	1.61	0.41	1.56	0.40	1.06
5. Chaos in the Home	2.06	0.52	2.04	0.53	0.36
6. Change in the Township	1.53	0.58	1.59	0.61	−0.84
7. Secure Attachment	3.72	0.62	3.80	0.62	−0.93
8. Trust	3.66	0.69	3.76	0.68	−1.11
9. Communication	3.44	0.74	3.51	0.85	−0.73
10. Alienation	4.25	0.71	4.29	0.59	−0.41
Slow Life History Strategies					
11. Affiliative Sociality	3.07	0.41	3.16	0.38	−1.86†
12. Risk Averse	3.30	0.58	3.35	0.56	−0.66
13. Mini-K	3.80	0.87	3.90	0.80	−0.96

Note. †$p < .10$.

1998–2012) and using full information maximum likelihood estimation procedures to handle missing data (Schafer & Graham, 2002). Consistent with the literature, we used the following goodness of fit statistics and the recommended cut-off values to assess model fit: chi-square to degrees of freedom ratio ($\chi^2/df < 5.0$; Kline, 1998), Comparative Fit Index (CFI ≥ .90; Marsh et al., 1988), Tucker-Lewis Index (TLI ≥ .90; Marsh et al., 1988), Root Mean Squared Error of Approximation (RMSEA ≤ 0.08; Browne & Cudeck, 1993), Standardized Root Mean Square Residual (SRMR ≤ 0.08; Hu & Bentler, 1999). Minimum factor loading (loading > .32; Tabachnick & Fidell, 2013) and more stringent requirement (loading > .50; Bagozzi & Yi, 1988) were also adopted. We first tested the model in Figure 1 without the interaction terms. The goodness of fit statistics ($\chi^2/df = 1.89$, CFI = 0.95, TLI = 0.93, RMSEA = 0.060, SRMS = 0.051) of the model met the recommended cutoff values for adequate model fit.

We then included the two interaction constructs in the model, which is related to the hypothesized statistical moderating effect of secure attachment on the relation between the two childhood environmental constructs (harshness and unpredictability) and slow LH strategies. In computing the interaction constructs (by multiplying the indicators of each set of the two interacting constructs, i.e., harshness and slow LH, and unpredictability and slow LH), we used the M*plus* default approach rather than manually pairing indicators and multiplying them (Marsh et al., 2004). The M*plus* approach does not provide goodness-of-fit statistics (Maslowsky et al., 2015; Muthén & Muthén 1998–2012). Instead, M*plus* provides a measure, D, of relative fitness of the interaction model compared to the main-effect-only model without the interaction terms. D is the difference of the log-likelihood values of the two models (D = −2 × [(log-likelihood for the main effect model) − (log-likelihood for the interaction model)]; Muthén & Muthén 1998–2012). D follows chi-square distribution with *DF* being the difference in the number of estimated parameters between the

two models, which, in the present case, was 2. The log-likelihood for the main-effect-only or baseline model was −3668.19 and that for the interaction model was −3649.76, D = 36.86, *p* < .001, indicating that the interaction model showed substantial and statistically significant improvement in data fit over the baseline model. Parameter estimates are reported in Figure 1.

As shown in Figure 1, the interaction between unpredictability and secure attachment was significant (β =−.26, *p* < .001). The main effect of unpredictability was also significant (β =−.34, *p* < .001). We also calculated simple slopes, reported in Figure 2. The simple slopes of environmental unpredictability on slow LH at −1 SD (β =−.40, *p*< .001) and 1 SD (β =−.13, *p* = .092) of secure attachment conform to the predictions. As predicted, the negative association of environmental harshness to slow LH strategies was robust at lower levels of secure attachment (i.e., insecure attachment), whereas the negative association became greatly attenuated and nonsignificant at higher levels of secure attachment (i.e., secure attachment).

The interaction between harshness and attachment was not significant (β =−.10, *p* =.29). The main effect of harshness was significant (β =−.21, *p* =.04). However, when the interaction term (harshness by attachment), as well as all the other constructs, was entered into the model without the other interaction (unpredictability by attachment), the interaction involving harshness was significant (β =−.31, *p* = .008). Also reported in Figure 2, we calculated simple slopes based on the separate analysis without the unpredictability interaction. The negative effect of environmental unpredictability on slow LH strategies was robust (β =−.38, *p* < .001) at lower levels of secure attachment (−1 SD), and the negative effect was greatly attenuated and was nonsignificant (β =−.10, *p* = .21) at higher levels of secure attachment (+1 SD).

Finally, as shown in Figure 1, the factor loadings were overall adequate. The magnitudes were relatively moderate mainly because the indicators (e.g., cues of environmental harshness and unpredictability) are not expected to be highly correlated in approximating diverse environmental conditions. However, with almost all being .50 or above and with the average exceeding .60, these factor loadings met the minimum standard for adequate measurement models (Tabachnick & Fidell, 2013) and most of them also met more stringent statistical requirement (Bagozzi & Yi, 1988).

Discussion

The findings mostly support our theorizing that attachment regulates LH development. Secure attachment statistically moderated the negative longitudinal association between childhood environmental unpredictability and adolescent slow LH strategies. The statistical moderation is in the expected direction of either down- or upregulating the negative effect of environmental unpredictability depending on the attachment status. The negative environmental effect is upregulated or exacerbated with insecure attachment. With secure attachment, the environmental effect is down-regulated or greatly reduced. The same statistical moderation is borne out partially with environmental harshness; the interaction effect that was not significant when considered together with environmental unpredictability was statistically significant when considered alone. This numerical finding is consistent with existing attachment moderation studies where harshness was investigated by itself without the unpredictability construct. In these studies, environmental harshness (family income to needs ratio, exposure to community violence, parental stress, paternal
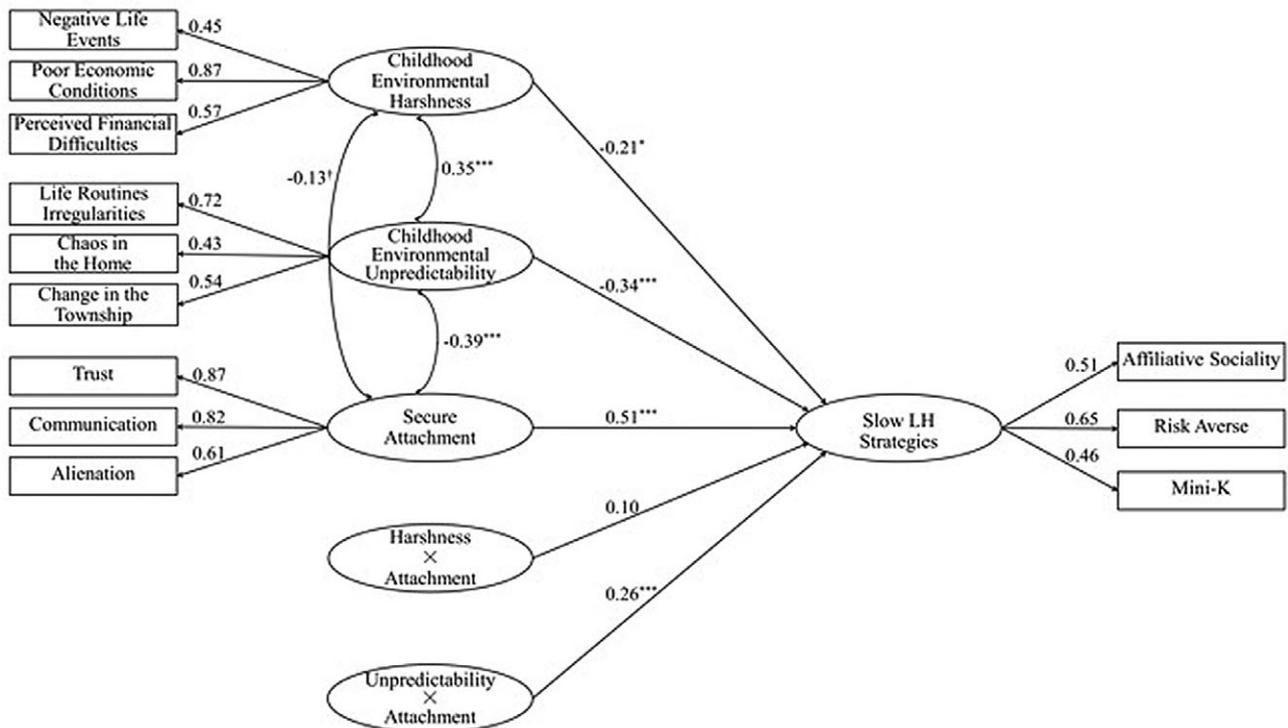
Figure 1. Childhood environmental harshness and unpredictability, secure attachment, and their interaction in relation to slow LH strategies. Note. $^†p < .10$, $^* p < .05$, $^{**} p < .01$, $^{***} p < .001$.
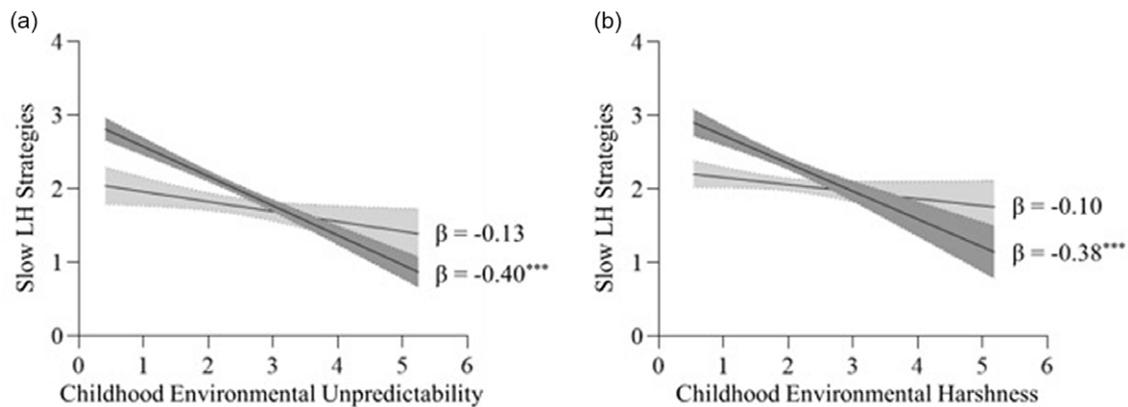

Figure 2. Simple slopes and 95% confidence bands of the regression of slow LH strategies on childhood environmental unpredictability (a) and harshness (b) at 1 SD above (light) and 1 SD below (darkened) the mean of secure attachment. Note. $^{***} p < .001$.

alcoholism) yielded a significant main effect and a significant interaction (with attachment) effect in relation to various LH manifestations (Barone et al., 2016; Edwards et al., 2006; Houston & Grych, 2016; Sung et al., 2016; Tharner et al., 2012). We are unaware of studies that examined both harshness and unpredictability together with attachment. Our findings also suggest that harshness and unpredictability, although conceptually distinct, are highly correlated ($r = .39$ in the present study) because they predict LH-related outcome variables in the same direction of fast LH (Ellis et al., 2009). Operationally, they are approximated by proxy indicators representing a cuing process that is also error-prone (Young et al., 2020). It seems clear, though, that, between the two constructs, unpredictability is a stronger predictor of LH. Two other studies reached similar conclusions (Hartman et al., 2018; Szepsenwol et al., 2015).

The present study is motivated by two remarkable facts. First, two-thirds of the modern human population are securely attached (Van Ijzendoorn & Kroonenberg, 1988; Van Ijzendoorn et al., 1999). This number is disproportionally higher than would be predicted by ancestral mortality conditions (Simpson & Belsky, 2008). Second, modern humans live at a pace nearly twice as slow as *Australopithecines* did over two million years ago, and almost all aspects of modern human LH have slowed relative to ancestral states (Smith & Tompkins, 1995). Following the species-general principle that extrinsic mortality risks shape fast LH, we should expect modern humans to continue to respond to ancestrally inherited extrinsic mortality conditions as fast LH strategists in much the same manner as *Australopithecines* did, and we should have far fewer securely attached individuals across cultures and nations. In reality, over the past two million years of evolution,

humans did not merely respond to, but have come to dominate, the ecological environment (Alexander, 1990). "Humans had in some unique fashion become so ecologically dominant that . . . .the real challenge in the human environment throughout history that affected the evolution of the intellect was not climate, weather, food shortages, or parasites—not even predators." (Alexander, 1990, p. 4). By listing most of the extrinsic mortality factors, Alexander (1990) essentially argued that humans have rendered extrinsic mortality risks intrinsically controllable through slow, not fast, LH strategies. Therefore, something other than, or in addition to, the species-general extrinsic-mortality-to-fast-LH contingency accounts for the slowdown in human LH.

The attachment system may provide a second mechanism in shaping and "shaking" human LH development. As demonstrated by the findings of the present study, it essentially slows human LH by channeling some of the would-be fast strategists who are exposed to environmental unpredictability, as well as harshness, onto a mother-guided or maternally socialized pathway of slow LH development. In doing so, the mechanism naturally increases the number of securely attached individuals, contributing to its higher distribution than the species-general principle would predict. The maternally socialized attachment system provides a child with cognitive structures to store and organize information and experience (from caregiver interactions or caregiver mediated environment) and formulate into internal working models to guide future attention to and interpretations of the external environment. The process is unconscious and the outcome that is permanent or change resistant represents self-perceived, internalized competence to control the external environment (Chisholm, 1996; Main, 1991). The ability to control the environment has been similarly presented in early writings on attachment as "an organism's capacity to interact effectively with its environment" (White, 1959, p. 297), "the belief that his actions affect his (sic) environment" (Lewis & Goldberg, 1969, p. 82), "the ability to negotiate with the environment" (Cassidy, 1986, p. 331), and "broadly conceived competence" and "resourceful, flexible, affectively positive environmental engagement" (Arend et al., 1979, p. 951). Within the LH framework, the internalized ability to control the environment or the pervasive belief that the world and people around it are dependable, controllable, and predictable characterize slow LH strategies such as insight, planning, and control (Figueredo et al., 2018) that reduce the pace of human LH possibly by rendering extrinsic mortality risks intrinsically controllable.

One specific extrinsic mortality risk targeted for reduction is predation. John Bowlby (1969/1982) insistently emphasized that "the function of attachment behavior is protection from predators (p.226)" and "in defining attachment behavior as the output of a safety-regulating system emphasis is placed on the important biological function attributed to it, namely that of protecting the mobile infant and growing child from a number of dangers, amongst which in man's environment of evolutionary adaptedness the danger of predation is likely to have been paramount" (p.375). Caregiver–child attachment also sets the cognitive foundation for the development of adult close relationships and social groups (Main, 1991; Smith et al., 1999), the evolutionary function of which includes protection against predation. "In all of them the organized social group serves at least one important function, that of protection from predators" (Bowlby, 1969/1982; p.63). Extrinsic mortality reduction is essential for the evolution of delayed maturity, long lifespan, and an array of distinctive human slow LH traits (Hill & Kaplan, 1999). By contributing to the decrease of one paramount extrinsic mortality, that of predation, the attachment

system is directly involved in the slowdown of human LH. By providing the mental representation for adult affiliative behavior (Main, 1991), child attachment also is potentially involved in healthcare provisioning of the sick and injured that significantly reduces extrinsic mortality in ancestral societies (Sugiyama, 2004). It is estimated that 90% of the adult population in prehistory hunting-gathering societies suffer a disability lasting 14 days or longer who will not have survived without healthcare and food provisioning from fellow tribal members. Most of the disabilities are caused by acute conditions, which are more likely to represent extrinsic mortality factors, but not chronic conditions that are more likely to be intrinsic and degenerative causes of death (Sugiyama, 2004). Fincher and Thornhill (2012) documented similar evidence of enhanced in-group sociality, cooperation, and solicitude in relation to behavioral control of pathogen and infectious diseases that represent another extrinsic mortality threat in human LH evolution. In sum, child attachment is potentially involved in reducing extrinsic mortality risks or rendering them intrinsically controllable and contributes to the slowdown of human LH by breaking the species-general extrinsic-mortality-to-fast-LH contingency and providing an additional maternally socialized slow LH pathway.

There are several limitations. One concerns the child age (8 years of age) and assessment method (questionnaire) at and by which we measured child attachment. Future and more ideal studies should use the *Strange Situation* paradigm to best assess attachment in much younger children because almost no other method can be as effective (while not violating research ethics) in cuing extrinsic mortality risks (Bowlby, 1969/1982) as the experimentally manipulated separation from the attachment figure. Whereas the present study provides initial and preliminary information about attachment security in relation to LH, the four classifications from the strange situation paradigm (i.e., secure, ambivalent, avoidant, and disorganized attachment typologies) will enable more detailed and insightful understanding of the expected function of attachment in organizing and possibly slowing human LH. In this regard, future studies should also examine potential gender differences in attachment and its involvement in LH calibration and attachment re-organization (Del Giudice, 2009). We did not investigate or find gender differences in part because the unidimensional questionnaire measurement of attachment is not as sensitive to gender differences as the detailed typology method. Future LH studies could also examine the perspective, as well as the operationalization, of mother-offspring conflict of interest. Paternal interest represented by the child (patrigenes) fundamentally represents fast LH strategies (e.g., mate desertion with no paternal investment), whereas the mother's counteract through child socialization represents slow LH manipulation. Thus, mother–child conflict of interest stems from and boils down to that between fast (paternal interest) and slow (maternal interest) LH strategies. Further research could view secure caregiver–child attachment as the result of successful postnatal maternal manipulation, whereby a mother counteracts the father's fast LH interest by entering his child representative on a slow or slower LH ontogeny.

LH research in psychology, similar to the present study, has been criticized, mainly by biological researchers, for making assumptions about and attempting to investigate within-species LH trait variations and, more specifically, for using self-response questionnaires, such as the Mini-K that is used in the present study, to measure putative individual differences in LH strategies (Međedović, 2020; Sear, 2020; Stearns & Rodrigues, 2020;

Zietsch & Sidari, 2020). To an extent, the present study bears some blame in this regard and can be improved in all these areas of criticism. However, LH research in psychology should also try to develop its own unique theoretical and methodological approach. Assuming, measuring, and testing latent trait variations by asking direct questions of the unique (speaking) human animal research participants represents an effective approach. We also endeavored to exclude items from the Mini-K that may involve constructs at both sides of our hypothesized relations, and we augmented the LH strategy construct with two additional behavioral traits—affiliative sociality and risk aversion. The last attempt also addresses the potential criticism that LH strategy should comprise LH traits (Sear, 2020) or LH-related traits (Del Giudice, 2020). Despite these and other limitations, we contend that our study represents the first attempt to conceptualize fast and slow LH strategies in relation to both external environmental conditions and internal attachment development. The results support our hypothesis that child attachment would statistically moderate the species-general contingent relationship between childhood adversities (harshness and unpredictability) and LH strategies.

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