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Attachment Security, Environmental Adversity, and Fast Life History Behavioral Profiles in Human Adolescents

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Keyword:	caregiver-child attachment, extrinsic and intrinsic mortality risks, fast and slow life history behavioral profiles
Abstract:	<p>One species-general life history (LH) principle posits that challenging childhood environments are coupled with a fast or faster LH strategy and associated behaviors, while secure and stable childhood environments foster behaviors conducive to a slow or slower LH strategy. This coupling between environments and LH strategies is based on the assumption that individuals' internal traits and states are independent of their external surroundings. In reality, individuals respond to external environmental conditions in alignment with their intrinsic vitality, encompassing both physical and mental states. The present study investigated attachment as an internal mental state, examining its role in mediating and moderating the association between external environmental adversity and fast LH strategies. A sample of 1169 adolescents (51% girls) from 9 countries was tracked over 8 years, starting from age 10. The results confirm both mediation and moderation and, for moderation, secure attachment nullified and insecure attachment maintained the environment-LH coupling.</p> <p>These findings suggest that attachment could act as a transformative factor, disrupting the contingent coupling between environmental adversity and a faster pace of life, consequently decelerating human LH.</p>

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Attachment Moderates Environmental Impact on LH 1

Attachment Security, Environmental Adversity, and Fast Life History Behavioral Profiles
in Human Adolescents

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Attachment Moderates Environmental Impact on LH 2

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Attachment Moderates Environmental Impact on LH 3

Attachment Security, Environmental Adversity, and Fast Life History Behavioral Profiles
in Human Adolescents

Abstract

One species-general life history (LH) principle posits that challenging childhood environments are coupled with a fast or faster LH strategy and associated behaviors, while secure and stable childhood environments foster behaviors conducive to a slow or slower LH strategy. This coupling between environments and LH strategies is based on the assumption that individuals' internal traits and states are independent of their external surroundings. In reality, individuals respond to external environmental conditions in alignment with their intrinsic vitality, encompassing both physical and mental states. The present study investigated attachment as an internal mental state, examining its role in mediating and moderating the association between external environmental adversity and fast LH strategies. A sample of 1169 adolescents (51% girls) from 9 countries was tracked over 10 years, starting from age 8. The results confirm both mediation and moderation and, for moderation, secure attachment nullified and insecure attachment maintained the environment-LH coupling. These findings suggest that attachment could act as an internal regulator, disrupting the contingent coupling between environmental adversity and a faster pace of life, consequently decelerating human LH.

Keywords: caregiver-child attachment, extrinsic and intrinsic mortality risks, fast and slow life history behavioral profiles

Attachment Moderates Environmental Impact on LH 4

Attachment Security, Environmental Adversity, and Fast Life History Behavioral Profiles
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Life history (LH) theory posits that adverse childhood environments marked by high and variable threats of death and disability, stemming from external factors like predation, accidents, violence, and infectious diseases, are associated with a fast or faster LH strategy (Ellis et al., 2009). This strategy prioritizes mating and reproduction over efforts to mitigate mortality and improve the living environment. Conversely, safe and stable childhood living environments lead to a slow or slower LH strategy and related behaviors (e.g., disease control effort; Chang et al., 2021) that aim at reducing and improving the external mortality conditions at the expense of delayed reproduction. Using different terminologies, Belsky et al. (1991) first identified this environment-LH contingency with human development (Also see Belsky, 2012; Belsky, 2019). However, alternative perspectives, such as internal LH models (Nettle et al., 2015; Nettle et al., 2013), propose that an individual's internal body state may play a role in shaping LH strategies or regulating the impact of the external environment on LH. Notably absent in existing internal models is the consideration of caregiver-child attachment—a crucial internal system evolved specifically to address extrinsic mortality threats (e.g., predation; Bowlby, 1969). The current study seeks to explore caregiver-child attachment as an internal mental state in the calibration and modulation of LH strategies. Similar to other internal models where early environments influence individuals' internal somatic state, determining LH, in our internal mental state model, attachment is hypothesized to mediate and moderate the effects of external environmental factors on LH strategies.

Intrinsic Somatic Models of LH

LH theory distinguishes between intrinsic and extrinsic components of morbidity and mortality (Williams, 1957). The intrinsic component refers to functional degradation

Attachment Moderates Environmental Impact on LH 5

stemming from decay of an individual's internal system (physiological and psychological functions). Aging-related wear and tear of the body and mind, degenerative diseases (e.g., heart and kidney problems), and unhealthy habits (e.g., smoking) exemplify intrinsic mortality risks (Carnes et al., 2006). Extrinsic morbidity and mortality refer to disability and death that befall an individual due to external and mostly uncontrollable factors such as predation, accidents, and infectious diseases. These two components of morbidity and mortality interact in bringing about an individual's eventual demise (Carnes et al., 2006), and the internal state and the external environment together determine LH strategies (e.g., Nettle et al., 2015; Nettle et al., 2013). Research on human and nonhuman animals has documented the interplay between intrinsic and extrinsic conditions. For example, trematoda parasite (external environment) causes deadly diseases (internal state) that make marine snails mature faster (faster LH, Lafferty, 1993), whereas great tits unaffected by parasite infestation engage in disease control effort and delay reproduction (slower LH, Oppliger et al., 1994). In humans, extrinsic adversities (e.g., socioeconomic deprivation) compromise the intrinsic somatic state (e.g., chronic illness and poor health) that calibrates faster LH such as an early age of pregnancy (Waynforth, 2012), early onset of menarche, tendency to engage in risky conduct (Hartman et al., 2017), and reckless sexual and aggressive behavior (Chang et al., 2019a; Ellis et al., 2021).

Attachment as an Internal Mental Regulator of LH

In these models, the intrinsic body state mediates extrinsic mortality conditions and calibrates LH either by initiating mortality-reduction strategies (e.g., disease control efforts) and slowing other aspects of life such as reproduction, or by accelerating reproduction and disregarding mortality threats. The resulting predicted adaptive LH tailors to the vitality status of the internal body state (Nettle et al., 2013) and represents adaptive strategies in managing mortality threats of the external environment (Clutton-Brock, 1984). Extending

Attachment Moderates Environmental Impact on LH 6

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3 these internal somatic models of LH calibration, we conceptualize the attachment system as a
4 possible internal mental state in organizing and modulating LH. Similar to how physical state
5 is involved in registering the external environment, the mental state of attachment mediates
6 and regulates the maternally socialized environment and formulates LH (Chisholm, 1996).
7
8 Mammalian species first experience the external environment through interactions with their
9 mothers or other primary caregivers (Bornstein, 2019). Through innumerable caregiver–child
10 interactions, the individual develops an internal working model as an internalized appraisal of
11 the environment and of the self (Bowlby, 1969) that subsequently guides, organizes, and
12 automates behavior (Zimmermann, 1999). Evolved to protect from predation (Bowlby, 1969),
13 attachment and the internal working model are especially involved in processing extrinsic
14 mortality information (Chisholm, 1996) and the individual’s ability to cope with mortality
15 threats (Lu et al., 2022). “Henceforward, the two working models each individual must have
16 are referred to respectively as his environmental model and his organismic model” (Bowlby,
17 1969, p. 82). Other early writings similarly refer to attachment and the internal working
18 model as “an organism’s capacity to interact effectively with its environment” (White, 1959,
19 p. 297), “the infant’s belief that its actions affect his environment” (Lewis & Goldberg, 1969,
20 p. 82), “broadly conceived competence” (Arend, Gove, & Sroufe, 1979, p. 951), and “the
21 ability to negotiate with the environment” (Cassidy, 1986, p. 331). Similar to other internal
22 LH models, attachment and the internal working model represent the internal mental state
23 (vis-à-vis the physical state) that provides cognitive and perceptual information (vis-à-vis
24 sensory and interoceptual information) concerning an individual’s cognitive (rather than
25 physical) status. Accordingly, attachment and its internal working model calibrate LH
26 strategies by attempting to reduce and outlive (slow LH) or disregard and outgrow (fast LH)
27 extrinsic mortality risks.
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Attachment Moderates Environmental Impact on LH 7

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3 Once formed, attachment operates outside consciousness (Chisholm, 1996; Main,
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5 1991). We propose two mechanisms to account for this operation. In one, attachment acts as
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7 an intermediary that conveys external information and engenders the species-general
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9 contingency between adverse environments and fast LH (Belsky et al., 1991; Chisholm,
10
11 1996; Del Giudice & Belsky, 2011). In the other, attachment as an internal mental regulator
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13 has the additional effect of breaking away from the external contingency and generates new
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15 pathways primarily in the slow LH direction of mortality reduction (Lu et al., 2021). In the
16
17 first mediation process, a child inherits the same extrinsic mortality conditions from his/her
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19 caregiver and is rendered the same effects through caregiving behavior and the caregiver's
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21 other LH manifestations. According to the pioneering work by Belsky et al. (1991) and other
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23 LH researchers (e.g., Chisholm, 1996; Del Giudice & Belsky, 2011; Simpson & Belsky,
24
25 2008), the actual environment and caregiver-mediated childhood experience should yield
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27 similar effects on LH calibration. Hence, attachment should (statistically) mediate the
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29 species-general coupling between the environment and LH. We postulate that a stable living
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31 environment is aligned with consistent caregiving, secure attachment, an internal working
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33 model that regards the world as predictable and the self as efficacious, and slow LH
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35 calibrations (Chisholm, 1993; 1996; Simpson & Belsky, 2008) aimed at mortality reduction.
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37 A secure internal working model inscribes the mortality-reduction mindset of slow LH that
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39 manifests through insight, planning, and control (Figuredo et al., 2018; Thompson, 2021). By
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41 contrast, fast LH strategies and a mortality-carefree mindset are associated with
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43 environmental harshness and unpredictability, neglectful and inconsistent caregiving, and an
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45 insecure internal working model rendering the individuals doubtful of their abilities and
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47 fearful and skeptical of the world (Belsky et al., 2010; Chen & Chang, 2012).

56 In the second regulatory (statistical moderation) process, the attachment system has
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58 the additional effect of buffering or underregistering rather than overregistering or amplifying
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Attachment Moderates Environmental Impact on LH 8

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3 environmental risks, and of undercalibrating rather than overcalibrating environmental
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5 adversities into fast LH strategies (Sung et al., 2016). The overall net effect of the attachment
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7 system is expected to attenuate the coupling between extrinsic mortality risks and fast LH
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9 strategies (Lu et al., 2022). Specifically, secure attachment should downregulate, and insecure
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11 attachment should maintain, the coupling between extrinsic mortality and fast LH. Therefore,
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13 the attachment system may direct children toward two separate developmental pathways. One
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15 is a slowing LH pathway wherein species-general coupling between extrinsic mortality and
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17 fast LH is downregulated by secure attachment and the related mortality-reduction effort. The
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19 other is a species-general LH pathway perpetuated by insecure attachment of individuals who
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21 continue to be shaped by environmental adversities into mortality-carefree fast LH strategists.
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26 Our theorizing (statistical mediation and moderation) about attachment is supported
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28 by the empirical literature, which has mainly examined retrospective measures of the
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30 childhood environment in relation to concurrent measures of adolescent and adult attachment.
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32 For example, a retrospective questionnaire measure of early environmental predictability was
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34 positively correlated with secure adult attachment, which itself was positively correlated with
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36 long-term (rather than short-term) intimate relationships (Hill et al., 1994). Another
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38 retrospective study yielded similar findings that childhood environmental unpredictability
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40 was positively correlated with insecure adult attachment, and the latter was positively
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42 correlated with intimate partner violence consisting of psychological aggression, physical
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44 assault, and sexual coercion (Barbaro & Shackelford, 2019). The same mediating effect was
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46 also reported in additional studies of relations between childhood adversity and fast LH
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48 profiles such as psychological distress, harmful drinking, and criminal thinking (Corcoran &
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50 McNulty, 2018; Le et al., 2018; Yang & Perkins, 2020). To a lesser extent, studies also show
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52 that attachment measures statistically moderate the relation between environmental adversity
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54 (family income-to-needs ratio, parental stress, maternal depression) and fast LH
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3 manifestations (early onset of menarche, aggressive behavioral problems, internalizing
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5 behavior; Sung et al., 2016; Tharner et al., 2012; Whittenburg et al., 2022).
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8 **Present Study**

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10 Here we tested the statistical mediating and moderating hypotheses about attachment
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12 in relation to environmental adversity and fast LH behavioral profiles (Figure 1) in a
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14 longitudinal and cross-cultural sample consisting of 1,169 adolescents and their primary
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16 caregivers from nine countries. Information about childhood environmental adversity, which
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18 was indicated by three proxies, namely unsafe neighborhoods, chaos in the home, and
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20 unpredictable life events, was obtained from the adolescents and one parent when the
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22 adolescents were 10 years old on average. However, data collection began when the children
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24 were 8 years old, and family environments remained stable throughout the subsequent data
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26 collection phases. Secure attachment was measured based on the adolescents' self-reports and
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28 reports from both parents when the adolescents were on average 14 years old. Fast LH
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30 behavioral profiles consisting of aggression, impulsivity, and risk taking were obtained from
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32 adolescents when they were 17 years old. Structural equation modeling was conducted to test
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34 relations among these variables with a focus on attachment as both a mediator and a
35
36 moderator. Attachment was hypothesized to mediate the species-general coupling between
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38 environmental adversity and fast LH behavioral profiles. In testing the statistical moderation
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40 of attachment, we expected an attenuated association between environmental adversity and
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42 fast LH behavioral profiles for higher levels of secure attachment and we expected the
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44 strength of the association to be unchanged at lower levels of secure attachment.
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51 **Method**

52 **Participants**

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54 Data for the present study were drawn from an ongoing longitudinal study that
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56 originally recruited children, their mothers, and their fathers in 2008 when the children were
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Attachment Moderates Environmental Impact on LH 10

8 years old on average. Families were sampled from 10 cities in nine countries: Shanghai, China ($n = 101$), Medellín, Colombia ($n = 100$), Naples, Italy ($n = 95$), Rome, Italy ($n = 99$), Zarqa, Jordan ($n = 112$), Kisumu, Kenya ($n = 95$), Manila, Philippines ($n = 100$), Trollhättan/Vänersborg, Sweden ($n = 95$), Chiang Mai, Thailand ($n = 100$), and Durham, North Carolina, United States ($n = 101$ European Americans, $n = 94$ African Americans, $n = 77$ Latin Americans). Participants were recruited from schools and communities. Most parents lived together (82%), and were biological parents (97%); nonresidential and non-biological parents also provided data. Sampling included families from each country's majority ethnic group, except in the United States, where we sampled equal proportions of White, Black, and Latino families. Families from different socioeconomic backgrounds were sampled in proportions representative of each recruitment area. The present sample consisted of 1,169 adolescents (51% girls), their mothers ($n = 1,150$), and their fathers ($n = 1,048$). In the last data collection wave of the present study, Time 3, the adolescents were 17 years of age on average ($M = 17.27$ years, $SD = .63$). They were 10 ($M = 10.29$ years, $SD = .65$) at Time 1 and 14 years old on average ($M = 14.28$ years, $SD = .63$) at Time 2 of the present study. At Time 3 of the present study, 78% of the initial sample at Time 1 were with the study eight years later. Participants who provided complete data across the eight years did not differ from the initial sample with respect to adolescent gender, parent marital status, education, and all the substantive variables used in the study. Adolescent age and gender did not vary across sites.

Interview Procedures

The primary data collection method for the present study was face-to-face interviews. Interviews lasted 1.5 to 2 hours at each of the three times of data collection and were conducted in participating adolescents' homes, schools, or at other locations chosen by the participants. Interviews and procedures were approved by the XX University Institutional

Attachment Moderates Environmental Impact on LH 11

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3 Review Board (IRB, protocol number 2032) and by the local IRBs at universities in each
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5 participating country. Mothers and fathers provided written informed consent, and
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7 adolescents provided assent. Family members were interviewed separately to ensure privacy.
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9 Measures used in the interviews were administered in the official language of each country,
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11 following forward- and back-translation of all instruments. For the present study, adult
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13 participants were given the choice of completing the measures in writing or orally, with the
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15 interviewer reading the questions aloud and recording the participants' responses (with a
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17 visual aid to ensure that participants understood the response scales). At Time 1, the
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19 adolescents, then children, were administered the measures orally, and for the two subsequent
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21 assessments they were given the option of completing the measures orally or in writing.
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23 Parents completed the questionnaire measures in writing. To thank them for their
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25 participation, adolescents were given small gifts or monetary compensation, parents were
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27 given modest financial compensation, families were entered into drawings for prizes, and
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29 modest financial contributions were made to adolescents' schools.
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Measures***Environmental Adversity Measured at Time 1 when Adolescents were 10 Years Old***

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38 In the empirical human LH literature, levels (harshness) and variations
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40 (unpredictability) of extrinsic morbidity and mortality are measured by sampling proxies
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42 from the current living environment that are believed to cue adverse environmental
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44 conditions of the ancestral past (Young et al., 2020). Environmental harshness and
45
46 unpredictability are both predictive of LH in the same direction (Lu et al., 2022), but cues of
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48 unpredictability appear to be stronger predictors than cues of harshness (Hartman et al.,
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50 2018). Thus, we sampled more unpredictability cues and combined the two kinds of cues to
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52 form a single construct of environmental adversity. Three indicators, unsafe neighborhood,
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54 chaos in the home, and unpredictable life events, form the environmental adversity construct.
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Attachment Moderates Environmental Impact on LH 12

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3 **Unsafe Neighborhoods.** Mothers and children separately reported on the 7-item
4 questionnaire measuring the perceived safety and livability of a neighborhood (Murray &
5 Greenberg, 2006; e.g., “My neighborhood is a dangerous place to live,” “My neighborhood is
6 a nice place to live” (reverse coded), and “I feel scared in my neighborhood”). Using a 4-
7 point scale ranging from 0 = “almost never true” to 3 = “almost always true,” the items were
8 measured or recoded in the direction of unsafe neighborhood. Internal consistency reliability
9 estimates were .86 for mother reporting and .77 for child reporting. The correlation between
10 the two ratings was .42. For the structural equation modeling and other analysis reported
11 later, the average of the two ratings was used as an indicator of environmental adversity.
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24 **Chaos in the Home.** We adopted 5 items from the Confusion, Hubbub, and Order
25 Scale (Matheny Jr et al., 1995) to measure confusion, chaos, and disorder in the home (e.g.,
26 “It’s a real zoo in our home,” “The atmosphere in our home is calm” (reverse coded), and
27 “You can’t hear yourself think in our home”). Mothers and children responded to these
28 questions on a 5-point scale ranging from 1 = “definitely untrue” to 5 = “definitely true.”
29 Internal consistency reliability estimates were .67 for mothers and .61 for children. The
30 correlation between the two ratings was .34. In subsequent analyses, the average of the two
31 ratings formed an indicator of environmental adversity.
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42 **Unpredictable Life Events.** Using the Social Readjustment Rating Scale (Holmes
43 & Rahe, 1967), mothers reported on whether 10 unpredictable negative life events happened
44 in the last 2 years in the family to which the child was likely to be exposed (e.g., “severe
45 and/or frequent illness,” “accidents and/or injuries,” and “death of other important person”).
46 The 10 items were summed to create a scale. Internal consistency reliability estimate was .65.
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Secure Attachment Measured at Time 2 When Adolescents were 14 Years Old

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56 Ratings from both parents and from the children provided three indicators of secure
57 attachment.
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Parent Ratings. We employed a single-item measure of secure attachment, similar to the widely used measure of adolescent and adult romantic attachment by Hazan and Shaver (1987). Hazan and Shaver (1987) adapted Ainsworth et al.'s (1978) verbal description of secure attachment to better suit the adult population. In our study, we utilized Ainsworth et al.'s (1978) original description, separately asking both parents to rate, on a 7-point scale ranging from "1 = not at all fit (0%)" to "7 = complete fit (100%)," the extent to which their child fits the description of secure attachment.

Child Rating. The Security Scale (Kerns et al., 1996; Tomich et al., 2000) originally has 15 but also uses 8 self-report items (Kerns et al., 2005; Pauletti et al., 2016). It adopts Harter's format to measure children's perceptions of a secure attachment relationship with a parent. We used 8 items to measure children's relationship with their mother or primary caregiver. Each item includes two statements, and participants first decide which statement better describes them and then rate the statement on two scales of "sort of true for me" or "really true for me." Sample items include "Some kids worry that their mom might not be there when they need her -- Other kids are sure their mom will be there when they need her," and "Some kids find it easy to trust their mom -- Other kids are not sure if they can trust their mom." The rating scale for each item was converted to 1 to 4, with higher scores indicating greater secure attachment. Internal consistency reliability estimate was .77.

Fast LH Behavioral Profiles Measured at Time 3 When Adolescents were 17 Years Old

Aggressive and exclusive sociality that is adaptive in a precarious environment to address immediate survival concerns aligns with fast pace of life (Chang et al., 2019b; Figueredo et al., 2018), and impulsivity and risk preference covary in predictable ways with fast LH traits (Sear, 2020). Thus, we used these three indicators to form the fast LH behavioral profiles construct.

Attachment Moderates Environmental Impact on LH 14

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3 **Aggression.** Fathers and mothers completed 20 items of the Child Behavior Checklist
4 (CBCL; Achenbach, 1991) to measure aggression (e.g., “argues a lot,” “gets in many fights,”
5 and “threatens people”). A 3-point scale ranging from 0 = “never” to 2 = “often” registers the
6 frequency an adolescent engaged in each of these behaviors. Internal consistency reliability
7 estimates were .88 and .87 for fathers and mothers, respectively. The correlation between the
8 two ratings was .56, well justifying averaging the two parental ratings to form the aggression
9 indicator.
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12 **Impulsivity.** Adolescents completed an 8-item scale of impulsivity selected from the
13 30-item Barratt Impulsiveness Scale (Patton et al., 1995; Steinberg et al., 2013). Sample
14 items include “I do not pay attention” and “I plan what I have to do (reverse coded).” The
15 items were rated on a 4-point scale ranging from 1 (*never true*) to 4 (*always true*). The
16 internal consistency reliability estimate was .67.
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19 **Risk Preference.** Following the literature (e.g., Duell et al., 2016), we adapted a self-
20 report measure of risk preference (Benthin et al., 1993). Adolescents were asked about the
21 following nine scenarios involving risky behavior: smoking cigarettes, drinking alcohol,
22 vandalizing property, going to dangerous places, riding in cars with drunk drivers, having
23 unprotected sex, stealing from stores, engaging in gang fights, and using weapons to threaten
24 someone. For each scenario, adolescents rated two questions on 4-point scales: “How would
25 you compare the benefits of this activity with the risks?” (1 = *the risks are far greater than*
26 *the benefits*; 4 = *the benefits are far greater than the risks*), “If something bad happened
27 because of this activity, how serious would it be?” (1 = *not at all serious*; 4 = *very serious*).
28 The average of the two ratings for the nine scenarios formed the construct, with a higher
29 score indicating a greater degree of risk preference. The internal consistency reliability
30 estimate was .88.
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33 **Analytic Strategy**

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Attachment Moderates Environmental Impact on LH 15

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3 Because we used latent constructs rather than directly observed variables, we
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5 conducted structural equation modeling using *Mplus* 7.0 (Muthén & Muthén, 1998-2012),
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7 and we used full information maximum likelihood estimation to account for missing data
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9 (Schafer & Graham, 2002). We adopted the following recommended cut-off values to assess
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11 model fit: chi-square to degrees of freedom ratio ($\chi^2/df < 5.0$; Kline, 1998), Comparative Fit
12
13 Index (CFI $\geq .90$; Marsh et al., 1988), Tucker-Lewis Index (TLI $\geq .90$; Marsh et al., 1988),
14
15 Root Mean Squared Error of Approximation (RMSEA ≤ 0.08 ; Browne & Cudeck, 1993),
16
17 Standardized Root Mean Square Residual (SRMR ≤ 0.08 ; Hu & Bentler, 1999), and
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19 minimum factor loading (loading $> .32$; Tabachnick & Fidell, 2013).
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24 When testing an interaction or moderation model, the two variables forming an
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26 interaction or moderation (environmental adversity and secure attachment) are typically
27
28 treated as correlated with unspecified causal directions. Because we also formulated a
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30 mediation hypothesis involving attachment as the mediator, in the model presented in Figure
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32 1, environmental adversity and secure attachment were specified as one leading to the other
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34 rather than as two correlates. Statistical estimation of the interaction or moderation effect
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36 remains the same whether the two main effect variables, environmental adversity and secure
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38 attachment, represent directional or nondirectional relations. Our moderation hypothesis
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40 concerns the directional association of environmental adversity leading to fast LH behavioral
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42 profiles just as when the interaction or moderation is formed by environmental adversity and
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44 secure attachment as two correlates. We computed the interaction construct by using the
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46 default approach of *Mplus* rather than manually pairing the indicators of the two constructs
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48 and multiplying them (Marsh et al., 2004). The *Mplus* default approach does not provide
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50 goodness-of-fit statistics (Maslowsky et al., 2015; Muthén & Muthén, 1998-2012). Instead,
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52 *Mplus* provides a measure, D, of relative fitness of the interaction model compared to the
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54 main-effect-only model without the interaction term. D is the difference of the log-likelihood
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Attachment Moderates Environmental Impact on LH 16

values of the two models ($D = -2 \times [(\log\text{-likelihood for the main effect model}) - (\log\text{-likelihood for the interaction model})]$; Muthén & Muthén, 1998-2012). D follows a chi-square distribution with DF being the difference in the number of estimated parameters between the two models, which, in the present case, was 1.

Results

Table 1 presents the M s, SD s, and correlations of all the variables used in the study. The correlations were based on different informants (i.e., adolescents, mothers, and fathers), over time lags of up to 8 years, and across diverse cultural groups. 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 expected directions, with indicators of environmental adversity (e.g., unpredictable life events obtained from mothers) longitudinally and significantly correlated with indicators of fast LH behavioral profiles (i.e., aggression, impulsivity, risk preference reported by adolescents). These indicators were also correlated with secure attachment in the expected directions. We also present the M s and SD s of the variables for the two genders in Table 2. Boys scored significantly higher than girls on two of the fast LH behavioral indicators. There were no directional or substantial differences in the zero-order correlations or structural relations between the two genders and across 10 cultural groups.

We initially examined and found support for measurement invariance across sites. The measurement model was identified by a confirmatory factor analysis in all 10 sites as the best fitting model with adequate measurement properties. Subsequent measurement invariance tests based on the alignment method (Asparouhov & Muthén, 2014) of *Mplus* revealed fewer than 4% noninvariant measurements which was far below the 20%-25% minimum noninvariance threshold (Muthén & Asparouhov, 2014). We then conducted the full structural equation modeling analysis and tested the mediation model without the

Attachment Moderates Environmental Impact on LH 17

interaction term. The goodness-of-fit statistics ($\chi^2/df = 4.99$, CFI = 0.96, TLI = 0.94, RMSEA = 0.070, SRMS = 0.056) of the model met the recommended cut-off values for adequate model fit. As shown in Figure 1, all parameter estimates were in the expected directions and were statistically significant. The factor loadings were adequate and were robust even though the indicators were obtained from different informants and some (e.g., proxies of environmental adversity) are not expected to be highly correlated in approximating diverse environmental conditions. Similarly, parameter estimates of the structural model were consistent with our hypotheses. Environmental adversity was negatively associated with secure attachment ($\beta = -.18$, $p < .001$) and positively predicted fast LH behavioral profile ($\beta = .35$, $p < .001$); secure attachment was negatively related to fast LH behavioral profiles ($\beta = -.49$, $p < .001$). The mediating effect of secure attachment between environmental adversity and fast LH behavioral profiles was significant ($\beta = .10$, 95% CI = [.01, .19]) based on a bootstrapping procedure with 2000 resamples and the maximum likelihood estimation. It represents 26% of the total effect ($\beta = -.44$, $p < .001$) of environmental adversity on fast LH behavioral profiles. These findings support our hypothesis that secure attachment mediates the relation between environmental adversity and fast LH behavioral profiles. Separately, we included family income on a 10-point scale equated across sites and years of education of each parent in the SEM analysis. The results concerning our variables of interest remained the same in terms of statistical significance and relation directionality.

We finally used the default approach of *Mplus* to test the moderation hypothesis by comparing the interaction or moderation model with the main-effect only or baseline model, which is our mediation model. The log-likelihood for the main-effect-only or baseline model was -9164.07; and that for the interaction model was = -9156.23; $D = 15.68$, $p < .001$. The statistically significant reduction of the log-likelihood value indicates substantial improvement in data fit by the hypothesized moderation model over the baseline model. For

Attachment Moderates Environmental Impact on LH 18

parameter estimation, the interaction between environmental adversity and attachment was significant ($\beta = -.46, p < .001$), supporting internal regulation by attachment of the external influence by environmental adversity on fast LH behavioral profiles. Figure 2 displays the simple slopes of environmental adversity on fast LH behavioral profiles at 1 *SD* ($\beta = .07, ns$) and -1 *SD* of secure attachment ($\beta = .33, p < .001$). Compared to the main effect ($\beta = .35, p < .001$), the first simple slope at higher levels of secure attachment was much reduced and nonsignificant, whereas the second simple slope at lower levels of secure attachment remained the same as the main effect. As predicted, secure attachment mainly attenuated or nullified the association of environmental adversity to fast LH behavioral profiles at higher levels of secure attachment, and the negative association was maintained but was not amplified at lower levels of secure attachment (i.e., insecure attachment).

Discussion

Belsky et al. (2010) first identified the effect of caregiver-child attachment on LH outcomes, while Sung et al. (2016) were the first to report the moderating effect of attachment on the relationship between environmental adversity and fast LH. From an internal (mental) state perspective (Nettle et al., 2013), our findings align with those of these pioneering studies. Caregiver-child attachment statistically mediated the longitudinal association between earlier environmental adversity and adolescent fast LH behavioral profiles in the same direction as the external environment. This finding supports the notion that some of the effect attributable to the child's living environment is transmitted to the child through caregiving behaviors and the caregiver's other LH manifestations, which are normally shaped by the same environment that the child inherits from the caregiver (Belsky et al., 1991; Chisholm, 1996). This finding also affirms the logic that internal state is in part caused by and exerts similar influence on LH as the external environment (Chang et al., 2019a). Secure attachment resulting from supportive family environment transmits the same

Attachment Moderates Environmental Impact on LH 19

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3 fitness enhancing effect on LH development as the supportive and stable environment.

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5 Dysfunctional parenting and insecure attachment that are caused by and in turn transmute
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7 environmental adversities into fast LH strategies perpetuate but do not intensify the species-
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9 general contingency between the living environment and LH strategies.
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12 The more significant finding is the statistical moderation of attachment. Consistent
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14 with our hypothesis, secure attachment primarily functions to downregulate or nullify the
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16 effects of the external environment on LH behavioral profiles, rather than insecure
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18 attachment upregulating or strengthening these effects. The evolutionary function of
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20 caregiving and parenting, which forms caregiver-child attachment, is to protect offspring
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22 from mortality threats (e.g., protection from predation; Bowlby, 1969), aligning with the
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24 mortality reduction function of slow LH. Parenting and the resulting attachment foster not
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26 only the knowledge and skills necessary to master the environment but also the associated
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28 mindset about the self in relation to the world. Established early in childhood as secure
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30 attachment and an efficacious internal working model, the internalization of the mental
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32 representation of the world as controllable and predictable, and of the self as capable and
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34 efficacious, potentially shifts species expectations about extrinsic mortality threats. Instead of
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36 perceiving extrinsic mortality threats as uncontrollable and inescapable, the parentally
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38 socialized mindset may view them as controllable and reducible. A pervasive belief in the
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40 controllability, dependability, and predictability of the external environment, combined with
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42 substantive knowledge, skills, and cognitive abilities to conquer nature, enables well-
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44 socialized human offspring to manage mortality threats in their living environment. Such an
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46 internal state effectively redirects the developmental trajectory from a species-general,
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48 adversity-contingent fast track, which disregards mortality and accelerates reproduction, to a
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50 slow pathway aimed at reducing extrinsic risks, delaying reproduction, and subsequently
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52 slowing LH.
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Attachment Moderates Environmental Impact on LH 20

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These findings also support the internal models of LH development (e.g., Nettle et al., 2013). Organisms actively regulate external effects through internal somatic and cognitive adjustments rather than responding passively to the environment. The somatic and mental statuses of individuals, responsible for the internal adjustment of external environmental effects, create phenotypic variations within species, which are the basis of human LH research. In the present study, individual differences in attachment and related internal working models enable individuals to respond to environmental adversities differently, accounting for observed variations in LH behavioral profiles. According to internal models in general and the attachment-specific internal model investigated here, extrinsic mortality risks may not uniformly affect age-specific populations but may respond to the mortality-reduction efforts and abilities of individuals. Extrinsic mortality risks can be rendered controllable depending on the intrinsic physical and cognitive attributes of individuals. This observation challenges the prediction of the species-general LH principle, which emphasizes extrinsic mortality risks causing indiscriminate casualties independent of individuals' survival abilities and efforts. While existing internal models are based on internal body states (Chang et al., 2019a), the present study includes mental states in intrinsic mortality–vitality determination. Just as a sound internal body state can influence responses to external threats, the internalized secure mental representation of the external environment in relation to the self may shift one's perception of extrinsic mortality threats from being uncontrollable and inescapable to being controllable and reducible.

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The present study has certain limitations. Most notably, the childhood environment variables were collected when the children were 10 years old. However, family environments remained stable throughout the data collection phases of the study that started when children were 8 years old on average. The items (e.g., "My neighborhood is a nice place to live." "The atmosphere in our home is calm.") reflect a consistent state of affairs over an extended period

Attachment Moderates Environmental Impact on LH 21

up to the time of the interviews reported in this study. Respondents were also asked to reflect on their past experiences. Thus, these variables effectively captured early or earlier childhood environments, potentially including more critical periods of LH development. We measured attachment during adolescence, but attachment, which is primarily formed during early childhood, remains relatively stable throughout life (Main, 1991). Finally, as suggested by one of the reviewers, race is highly relevant to LH processes (Rushton, 1996). Our multi-country data allow for comparative investigations across both racial and cultural dimensions, which future research may explore. Despite these and other limitations, our study represents one of the first theoretical and empirical attempts to conceptualize attachment as an internal state in slowing human LH, in addition to mediating the species-general environmental contingency on LH development.

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Attachment Moderates Environmental Impact on LH 29

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Table 1. Correlations, Means, and Standard Deviations of Variables Used in the Study

	1	2	3	4	5	6	7	8	9
Environmental adversity									
1. Unsafe Neighborhood	-								
2. Chaos in the Home	.67***	-							
3. Unpredictable Life Events	.54***	.55***	-						
Secure Attachment									
4. Father Rating	-.25***	-.40***	-.35***	-					
5. Mother Rating	-.05	-.12***	-.12***	.38***	-				
6. Child Rating	-.12***	-.19***	-.11***	.42***	.51***	-			
Fast LH Behavioral Profile									
7. Aggression	.20***	.28***	.19***	-.20***	-.20***	-.19***	-		
8. Impulsivity	.05	.16***	.10**	-.08†	-.16***	-.16***	.48***	-	
9. Risk Preference	.11**	.25***	.17***	-.16***	-.05	-.07†	.20***	.25***	-
<i>M</i>	0.64	2.24	1.44	6.00	6.08	3.23	0.23	2.00	1.53
<i>SD</i>	0.51	0.55	1.73	1.39	1.42	0.57	0.23	0.47	0.42

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Attachment Moderates Environmental Impact on LH 32

Table 2. *Gender Differences of Variables Used in the Study*

	Males		Females		<i>t</i> -test
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Environmental adversity					
1. Unsafe Neighborhood	0.62	0.50	0.67	0.51	-1.63
2. Chaos in the Home	2.25	0.53	2.24	0.57	0.38
3. Unpredictable Life Events	0.14	0.17	0.15	0.18	-0.71
Secure Attachment					
4. Father Rating	5.92	1.47	6.09	1.29	-1.65
5. Mother Rating	6.14	1.36	6.03	1.46	1.13
6. Child Rating	3.27	0.52	3.19	0.60	2.20*
Fast LH Behavioral Profile					
7. Aggression	0.22	0.23	0.24	0.24	-1.28
8. Impulsivity	2.03	0.43	1.97	0.50	1.98*
9. Risk Preference	1.61	0.42	1.45	0.40	5.72***

* $p < .05$, *** $p < .001$

Attachment Moderates Environmental Impact on LH 33

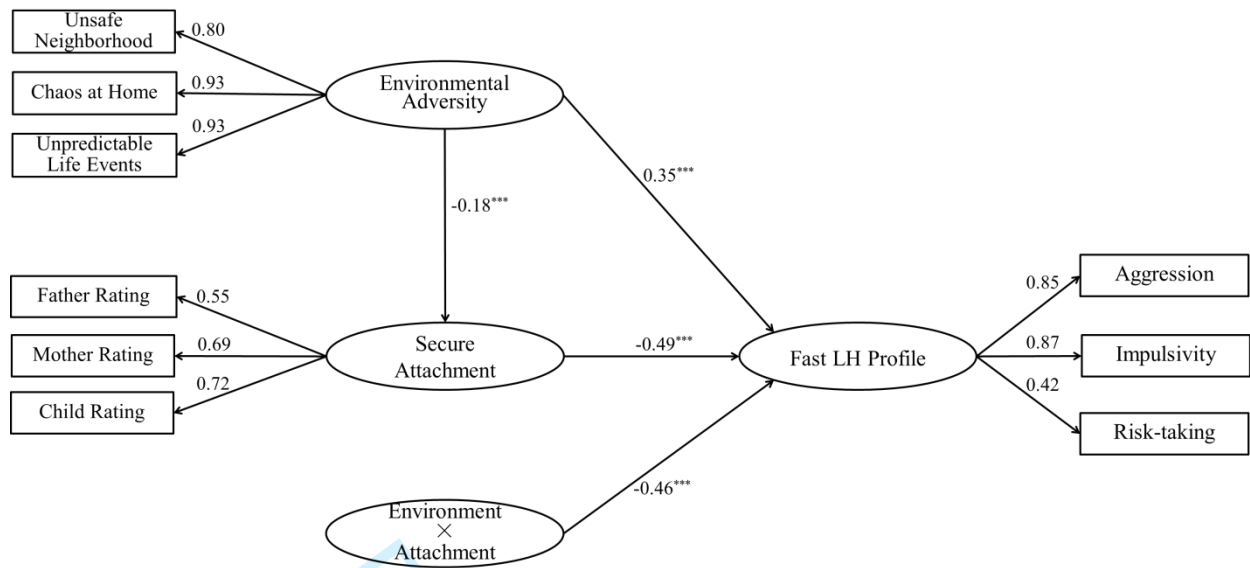


Figure 1. Childhood environmental adversity, secure attachment, and their interaction in relation to fast life history behavioral profile. *** $p < .001$.

Attachment Moderates Environmental Impact on LH 34

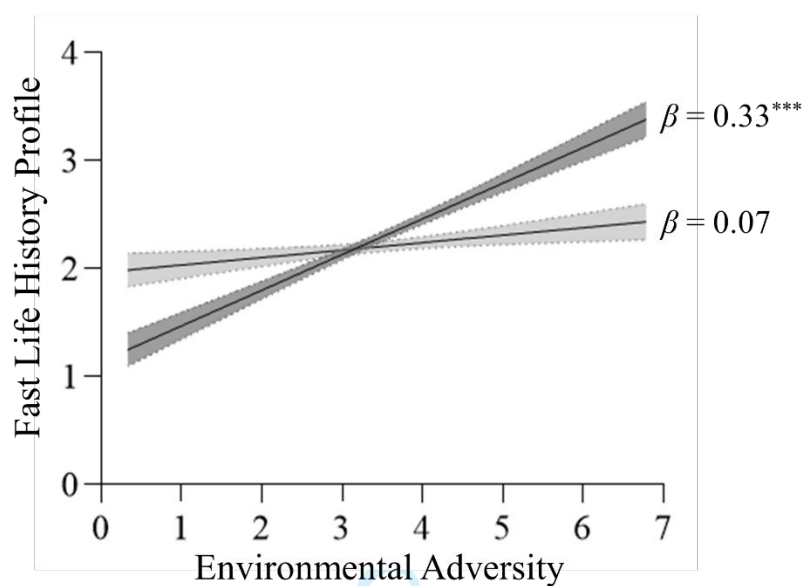


Figure 2. Simple slopes and 95% confidence bands of the regression of fast LH profile on childhood environmental adversity at 1 *SD* above (light) and 1 *SD* below (dark) the mean of secure attachment.