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From Environment to Mating Competition and Super-K in a Predominantly Urban Sample of Young Adults

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Abstract

Recent research suggests human life history strategy (LHS) may be subsumed by multiple dimensions, including mating competition and Super-K, rather than one. In this study, we test whether a two-dimensional structure best fit data from a predominantly urban sample of young adults ages 18–24. We also test whether latent life history dimensions are associated with environmental harshness and unpredictability as predicted by life history theory. Results provide evidence that a two-dimensional model best fit the data. Furthermore, a moderate inverse residual correlation between mating competition and Super-K was found, consistent with a life history trade-off. Our findings suggest that parental socioeconomic status may enhance investment in mating competition, that harshness might persist into young adulthood as an important correlate of LHS, and that unpredictability may not have significant effects in young adulthood. These findings further support the contention that human LHS is multidimensional and environmental effects on LHS are more complex than previously suggested. The model presented provides a parsimonious explanation of an array of human behaviors and traits and can be used to inform public health initiatives, particularly with respect to the potential impact of environmental interventions.

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[3]·For 30/day binge drinking, categories were 0, 1, 2, 3, 4, 5, and 6 or more. For drinks/week, they were 0, 1, 2, 3–9, and 10 or more. For 30/day tobacco use, they were 0, 1–29, and 30. This variable was bimodal, with most participants endorsing no days or 30 days—only 10% endorsed the counts in between. For tobacco/week, the categories were 0, 1–2, and 3 or more. For tobacco/day, they were 0, 1, and 2 or more. For 30 day/cannabis, they were 0, 1–10, and 11 or more.

Keywords

life history theory; human life history strategy; mating competition; mating effort; K-factor; psychosocial acceleration; psychometrics

Evolutionary life history theory (LHT) originally explained *between*-species variation in maturational and reproductive traits that define the life course, such as developmental tempo, reproductive timing, offspring number, body size, and longevity (Stearns, 1976). During the past 30 years, LHT has been extended to explain variation *within* humans, first to observable biological variables (e.g., pubertal timing) and later to psychosocial traits (Belsky, Steinberg, & Draper, 1991; Chisholm, 1999; Draper & Harpending, 1982). More recently, Figueredo and colleagues developed a psychometric approach to the study of human life history that is rooted in the notion that evolution by natural selection produced clusters of coadapted psychosocial traits that function as coherent reproductive strategies (Figueredo et al., 2006, 2014). In this view, adaptations that allocate resources between somatic (e.g., bodily maintenance) and reproductive effort and also between mating effort and parental/nepotistic effort are executed in coordinated fashion, producing reproductively coherent phenotypes in terms of personality, psychosocial characteristics, and outward behaviors. The term *fast* life history strategy (LHS) has been used to denote scores on traits and behaviors that cohere with early reproduction and mating effort, while *slow* LHS represents scores that cohere with somatic and parental effort.

Many discussions of human LHS have assumed a *single* fast-to-slow dimension and consistent with this; a number of psychometric studies have found that a second-order K-factor subsumed indicators including planning and control, social contact and support, attachment, religiosity, and altruism (for a review, see Olderbak, Gladden, Wolf, & Figueredo, 2014). LHS has also recently been broadened to a third-order Super-K factor that subsumes the second-order K-factor, along with covitality (i.e., health and mental health) and the general factor of personality (which encompasses the Big Five; Olderbak et al., 2014). These findings suggest that on some level, a single source might give rise to the covariation among a suite of life history indicators.

Despite evidence of a K dimension and some consensus that there is a fast–slow life history continuum within humans (e.g., relating to developmental tempo; Belsky et al., 1991; Chisholm et al., 1993); it is not clear that a single dimension subsumes the wider documented variation in human life history traits (Cop-ping, Campbell, & Muncer, 2014a; Richardson, Sanning, et al., 2016). In particular, it is not clear that a single higher order K dimension subsumes mating competition (e.g., mating effort, dominance seeking, and risk-taking). According to LHT, the finite nature of resources induces phenotypic trade-offs (see Mace, 2000; Stearns, 1989) such that investments in somatic and parental effort occur at the expense of mating competition (Figueredo et al., 2006). This does not necessarily imply that these aspects of human LHS reflect a single factor. Indeed, some research indicates that although K-factors have subsumed neuroticism and health, altruism, conscientiousness, parental investment, and earning potential (Figueredo, Vasquez, Brum-bach, & Schneider, 2007), they have not also subsumed mating effort (Gladden, Figueredo, & Jacobs, 2009;

Olderbak & Figueredo, 2012; but see Figueredo et al., 2005). Recently, Olderbak, Gladden, Wolf, and Figueredo (2014) also found that mating effort did not reflect four of five K-factors subsuming five different measures of LHS (i.e., Super K-1, Arizona Life History Battery, Mini-K, and High-K Strategy Scale, but not Super K-2).

Consistent with the above, Hampson, Andrews, Barckley, Gerrard, and Gibbons (2016) reported that a life history dimension subsuming risky sex and substance use in Grade 10 was only slightly and negatively related to a dimension that subsumed sociability, health, and mental health 1-year post high school. Similar, Brumbach, Figueredo, and Ellis (2009) found two uncorrelated social deviance (impulsivity, substance use, delinquency, and Machiavellianism) and slow LHS (health, resource accruing potential and sexual restrictedness) dimensions of young adult LHS. Importantly, however, sexual restrictedness had only a small effect ($\beta = .23$) on sexual behavior and the structural model also did not fit according to current standards (e.g., the comparative fit index [CFI] was observed at .83, well below the standard threshold of .95; for discussion of fit indices, see model fit). This evidence of misfit is consistent with an omitted effect of social deviance on sexual behavior; future research could test alternative models that include this specification. Richardson, Chen, et al. (2014) and Richardson, Chen, et al. (2016) reported similar evidence that a factor subsuming delinquency, substance use, and number of sexual partners did not also subsume indicators of covitality. Other research has suggested that mating effort might be subsumed by latent variables named psychopathic and aggressive attitudes (Figueredo, Gladden, & Hohman, 2011) or perhaps the Dark Triad (Jonason, Li, Webster, & Schmitt, 2009). Taken together, the findings reviewed suggest that human LHS is likely multidimensional and mating competition might be unique from the K dimension that has subsumed aspects of somatic and parental effort.

Stemming from the above, Richardson, Sanning, et al. (2016) recently tested the possibility that human LHS is two-dimensional using a nationally representative middle adulthood sample and a broad selection of life history indicators. The authors found that indeed, two independent dimensions subsumed middle adult life history indicators—mating competition and Super-K. Mating competition subsumed life history indicators such as risk-taking, aggression, substance use, number of sex partners, and disagreeableness, while Super-K subsumed indicators such as social contact/support, pair-bonding, health and positive affect, agreeableness, conscientiousness, openness, extroversion, education, and emotional stability. These findings suggest that LHS is not only multidimensional at the first-order level of traits such as conscientiousness (as described in Figueredo et al., 2015), *but also* at higher order levels. In other words, while there might be a within humans fast–slow life history continuum, there may be no single LHS dimension that can be scored to capture life history speed.

More research is needed to confirm the two-dimensional structure found by Richardson, Sanning, et al. (2016) and test whether it extends to other developmental stages. This is crucial because LHT has been increasingly used in evolutionary studies of human variation as well as applied areas of research and theory. As examples of the latter, LHT has recently been to psychopathology (e.g., Del Giudice, 2014a; Del Giudice & Ellis, 2016), risk-taking propensity and externalizing behaviors (e.g., Ellis et al., 2012; Richardson & Hardesty,

2012; Richardson et al., 2014; Richardson, Castellano, Stone, & Sanning, 2016; Richardson, Chen, et al., 2016; Richardson, Dai, et al., 2016; Wang, Kruger, & Wilke, 2009), public health (e.g., Kruger, 2011), medicine (e.g., Nesse et al., 2010), and criminology and criminal justice (e.g., Boutwell, Nedelec, Lewis, Barnes, & Beaver, 2015). Many researchers who want to measure LHS are interested in the theory because of its potential to shed light on the covariance among broad array of traits and behaviors. One big payoff, from an applied perspective, is that if we can map LHT onto human variation, the theory can be leveraged to elucidate how broad arrays of reproductively relevant traits and behaviors relate to environment throughout development.

To achieve this payoff, we must first determine whether it is more useful to model latent variables that underlie suites of life history indicators or to instead focus on the individual indicators. While latent variables have the potential to provide parsimony and simplify our view of human variation, they also have the potential—particularly from a realist perspective—to impede scientific progress if they are not themselves good proxies for one or more real psychological mechanisms (for further discussion, see Richardson, Sanning, et al., 2016). We must first address the following question to determine whether it is useful to model dimensions of LHS: How many dimensions are plausible? To answer this question, we must establish which higher order structure, if any, fits the life history indicator data. We must also test whether latent variables that are found relate to environmental conditions as predicted by LHT, or in other words, assess the validity of latent LHS constructs through their linkage to external criteria.

Current Study

In this study, we test whether the two-dimensional structure documented by Richardson, Sanning, et al. (2016) also fits data from a predominantly urban sample of young adults ages 18–24. We also test whether the two latent variables—mating competition and Super-K—are associated with environmental harshness and unpredictability as predicted by LHT. As described in Richardson, Sanning, et al. (2016), the utility of the psychometric approach to human LHS is largely a function of the ability of factors to explain the dependence among life history indicators as well as their associations with aspects of environment. This study addresses these issues directly to shed additional light on the utility of the psychometric approach. It also builds upon prior research (e.g., Richardson, Sanning, et al., 2016) by using a more extensive selection of indicators of mating competition, environmental harshness, and environmental unpredictability, as well as more proximate measures of harshness and unpredictability. We used more proximate measures of harshness and unpredictability because most life history research has assumed that childhood conditions are most robustly associated with LHS. Few studies, however, have examined the magnitude of these associations later in development. Finally, this study follows Richardson, Sanning, et al. (2016) by including multiple aspects of environment so as to estimate their relative importance.

Method

Data

This study received institutional review board approval (both at the Johns Hopkins Bloomberg School of Public Health and the University of Cincinnati). All participants provided written consent before participating. The data were from a purposive sample of 126 HIV negative, never married, 18- to 24-year-old ($\bar{x}$ = 21.3, SD = 1.9) women (n = 70) and men (n = 56; sample demographics, see Table 1). Quota sampling was used to balance the sample on age, biological sex, and race. Participants were sampled from an urban city with high sexually transmitted infection and HIV, drug use, and crime prevalence, and also surrounding counties marked by fewer risk outcomes. Females were oversampled in an effort to offset attrition due to pregnancy. Inclusion criteria were being aged 18–24 years, never married, HIV negative,[1] proficient in English reading and writing, and not currently pregnant (females). Participants were recruited through local newspaper and online social media advertisements, public flyers, and peer referrals (from enrolled participants). The data supporting these analyses were collected at baseline of a larger parent study.

Instruments

We used LHT to select 11 indicators of young adult LHS and 3 retrospective indicators of childhood and recent environmental conditions. We selected a broad set of indicators that have been observed to reflect LHS in prior research (see Olderbak et al., 2014, for a review) and also chose environmental components that have been previously studied (for a review, see Ellis, Figueredo, Brumbach, & Schlomer, 2009). Based on the literature to date, we note the hypothesized valence of each LHS indicator loading on mating competition and Super-K in Table 2. We used numerous standardized and validated scales to measure most of our LHS indicators. A full list of the items and scales used is presented in Table 3 along with their corresponding construct labels, item contents, response options, and citations to validation studies. Detailed information about the items used to construct the environmental components is displayed in Table 4.

Below we describe all indicators used to measure young adult LHS and index environmental conditions. Because this study used established indicators of LHS, we do not provide a detailed theoretical rationale for the inclusion of each one in this report. Instead, we provide citations to reviews of life history measures or other publications in which the use of each indicator is substantiated. We also do not present psychometrics associated with each indicator in this section. Because our sample size was fairly small relative to the number of parameters we planned to estimate (i.e., less than the minimum 10:1 ratio often recommended for structural equation modeling [SEM] studies; Bentler & Chou, 1987), we assessed items for unidimensionality and computed scores for use in our structural models. These procedures are described in Analyses section, and the psychometric properties of our indicators are presented in Results section and in Tables 3 and 4.

[1]The larger parent study was designed to examine youth risk-taking and decision-making from biosocial perspectives. Because decision-making was a primary focus, participants were screened for HIV, stroke, epilepsy, traumatic brain injury, and other conditions that can compromise brain function. During an in-person screening visit, a trained test administrator conducted an HIV rapid test to verify self-reported negative HIV status—all participants tested negative.

Indicators of young adult LHS

Super-K.—To locate latent Super-K, we used measures of life history domains including health and symptoms of depression (Figueredo & Rushton, 2009; Olderbak et al., 2014; Richardson, Sanning, et al., 2016), harm avoidance (Del Giu-dice, 2014b), agreeableness (Dunkel & Decker, 2010; Figueredo, Vasquez, Brumbach, & Schneider, 2004, 2007; Olderbak et al., 2014; Richardson, Sanning, et al., 2016), valuing of children,[2] and liability to substance use (Richardson & Hardesty, 2012; Richardson, Chen, et al., 2014; Richardson, Chen, et al., 2016; Richardson, Dai, et al., 2016; Richardson, Sanning, et al., 2016). As a reminder, the specific items and scales we used to measure these domains, along with item contents, response options, and citations to validation studies are presented in Table 3.

Mating competition.—We located latent mating competition using measures of life history domains including sensation seeking and reward responsiveness (Copping, Campbell, & Muncer, 2013, 2014b), attitudes toward risk (Ellis et al., 2012; Figueredo et al., 2005; Richardson, Sanning, et al., 2016), delinquency (Boutwell et al., 2015; Brumbach, Figueredo, & Ellis, 2009; Richardson et al., 2014; Richardson, Chen, et al., 2016), liability to substance use (Richardson et al., 2014; Richardson, Chen, et al., 2016; Richardson & Hardesty, 2012; Richardson, Sanning, et al., 2016), harm avoidance (Del Giu-dice, 2014b; Richardson, Sanning, et al., 2016), and agreeableness (Dunkel & Decker, 2010; Figueredo et al., 2004, 2007; Olderbak et al., 2014; Richardson, Sanning, et al., 2016). We also included an item that assessed total number of same and opposite sex partners in the past year (Brumbach et al., 2009; Ellis et al., 2009; Richardson et al., 2014; Richardson, Chen, et al., 2016, Richardson, Sanning, et al., 2016; see Table 3 for more information).

Environment

Unpredictability.—Environmental unpredictability was indexed by summing 9 items similar to those previously used to form this construct (see, e.g., Brumbach et al., 2009; Simpson, Gris-kevicius, Kuo, Sung, & Collins, 2012). The items were drawn from the Life Events Scale (see Table 3; D'Imperio, Dubow, & Ippolito, 2000) and assessed past 12-month experience of events such as family moving to a new home or apartment; parental separation or divorce, or one of the parents leaving the family; one of the parents losing their job; and the family's property wrecked or damaged due to fire, burglary, or disaster. These items were categorical and participants endorsed "no" or "yes" on each. See Analyses section for a description of how we constructed the unpredictability index and Table 4 for information about internal consistency.

Harshness.—Environmental harshness was indexed with 16 items similar to those used in prior research (see Ellis et al., 2009; Simpson et al., 2012). The items were also drawn from the Life Events Scale (D'Imperio et al., 2000) and assessed experiences in the past 12 months such as seeing someone beaten, shot, or really hurt by someone; seeing or being around people shooting guns; being upset by neighborhood violence; and experienced the death of a family member, relative, or close friend. Participants endorsed "no" or "yes" on

[2]We used valuing of children as a hypothesized indicator of Super-K because we theorized that attribution of greater value to offspring should be a reliable precursor to greater parental investment (for related discussion, see Chisholm et al., 1993).

each item. See Analyses section for a description of how we constructed composite harshness.

Parental socioeconomic status (SES).—SES has been used in past research as an index of environmental harshness (i.e., extrinsic mortality; Ellis et al., 2009; Sheppard, Pearce, & Sear, 2015) as well as the degree of that extrasomatic resources are available to be invested in mating competition and/or parenting (Richardson, Sanning, et al., 2016). SES is traditionally indexed by forming a composite of indicators such as parental income, educational attainment, and occupational status (National Center for Education Statistics, 2012). In this study, we indexed parental SES using the highest degree earned by participants' mothers and fathers (ranging from "less than high school" to "doctoral") and an item assessing whether or not participants were eligible for or recipients of free or reduced cost lunch as minors. Below we describe how we constructed composite SES.

Analyses

We used exploratory factor analysis (EFA) to assess the valuing of children, delinquency, harm avoidance, liability to substance use, and agreeableness items for unidimensionality and compute scores for use in our structural models. We also scored several standardized scales (for scale descriptions and citations, see Table 2). For our EFA analyses, we used MPlus 7.11 and the robust weighted least squares (WLSMV) estimator, delta parameterization, and oblique rotations (Geomin). We used the WLSMV because we included categorical and ordinal Likert-type items. Following convention, we conducted all significance tests at the $p < .05$ level. Finally, we used principle components analysis (PCA) to form composite harshness and parent SES and summed over the unpredictability items to compute total unpredictability.

This study used SEM to test the structure of young adult life history indicators, along with the extent to which latent LHS variables explained associations between these indicators and aspects of environment. For our SEM analyses, we also used MPlus 7.11 and the WLSMV estimator because we needed to treat number of sex partners as ordinal. We considered treating this variable as a count but decided to treat it as ordinal because our models assumed a linear effect of mating competition on the number of partners and it did not seem plausible that a unit increase in mating competition would have the same meaning across the distribution of the number of partners (e.g., in moving participants from say, 0–1 vs. 20–21 partners). This approach was also reasonable because 92.7% of participants had six or fewer sexual partners and all counts greater than six were endorsed by only one or two participants. Thus, we recoded the original variable, which ranged from 0 to 25, into a new variable that ranged from 0 (no partners) to 6 (6 or more partners).

Goodness-of-fit criteria.—This study used a variety of fit indices in order to obtain a robust assessment of model fit. We considered the substantive meaningfulness of the model and regarded Tucker–Lewis index (TLI) and CFI greater than .95 (Byrne, 2001; Hu & Bentler, 1999), along with root mean square error of approximation (RMSEA) values of less than .05 (Browne & Cudeck, 1993), as evidence of acceptable fit to the data. We also

considered significant X^2 likelihood ratio statistics as evidence that the hypothesis of exact fit should be rejected (Bollen, 1989).

Hypothesized models.—We hypothesized a measurement model in which a two-dimensional structure (Super-K and mating competition) subsumed our life history indicators. We compared the fit of this model to one specifying a single Super-K factor that subsumed all the indicators. In addition, we hypothesized a full structural model in which latent Super-K and mating competition explained the effects of environmental harshness, unpredictability, and parental SES on their indicators. We tested our models and observed fit and modification indices for evidence of misfit suggesting we should reject the two-dimensional model. We also observed fit and modification indices for evidence suggesting that the latent variables did not fully explain the effects of environment on their indicators.

Results

Dimensionality of Scales

To assess our life history measures for unidimensionality, we used EFA to test measurement models for the valuing of children, delinquency, harm avoidance, liability to substance use, and agreeableness items. Fit indices for each model are displayed in Table 5. Consistent with prior research (Thompson, Davidson, & Williams, 1983), a three-factor solution fit the valuing of children items best. We termed the factors “purpose,” “burden,” and “community standing” (for item contents, see Table 2). Loadings ranged from β = .33 to .89 in magnitude across the factors (for all loadings, see Table 2) and higher scores implied lesser perceived purpose, lesser perceived burden, and lesser perception that children are critical to acceptance or standing in the community. We then saved scores on the three factors and applied PCA to them in order to construct composite valuing of children. A single component solution emerged and explained 62% of the variance in the three facets. Their loadings were observed at −.68, .90, and .78, respectively. Higher scores on the composite, therefore, implied greater perceived purpose, lesser sense of burden, and lesser perception that children are critical to acceptance or standing in the community (i.e., greater valuing of children).

Because we observed very low base rates on the delinquency items (60.3–98.6% endorsement of zeros across the items), we bucketed participants into “no instances of the behavior” and “one or more instances of the behavior” and then conducted our EFA. We dropped 2 items because only 1 person endorsed the first (delinquency last 12 months: breaking in) and only 2 endorsed the second (delinquency last 12 months: use weapon). A single-factor model fits the data reasonably well (see Table 5). Loadings ranged from β =.49 to .98, and we saved scores on latent delinquency for our SEM. Next, we factored the harm avoidance items and found that a two-factor solution best fit the data. We termed the first factor “confidence” and retained the label, “harm avoidance,” for the second. Loadings ranged from β = .54 to .94 across the factors, with higher scores implying greater confidence and harm avoidance. We saved scores on harm avoidance for our SEM. We did not include confidence because as far as we know, this construct has not been theoretically or

empirically linked to LHS. Moreover, due to sample size limitations, we were limited in the number of variables we could include in the model.

We fit a second-order factor model to the liability to substance use items. These items were counts and we recoded them into ordinal variables[3] for the same reasons as the number of sexual partners. This was also acceptable in this specific case because across the items, more than 70% of participants endorsed the first four counts and many of the higher counts were endorsed by only one participant. Moreover, 1 item was bimodal (30/day tobacco) and another exceeded the maximum for counts in MPlus (tobacco/week). In the model, daily, weekly, and past month alcohol use loaded on a first-order alcohol use factor. Similarly, daily, weekly, and past month nicotine use loaded on a first-order nicotine use factor. These two first-order factors and also the breadth in illicit substance use and past cannabis use items were then loaded onto second-order liability to substance use. Second-order factor loadings ranged from β = .67 to .77. We applied EFA to the agreeableness items and a single-factor model had an excellent fit to the data. Loadings ranged from β = .49 to .77. As mentioned previously, the other life history ¼domains were measured with scale scores or single items (for more information, see Table 2).

For the environmental components, we first applied PCA to environmental harshness, imposing a single component solution on the data, and found that it explained 38% of the variance in the items. We then used PCA to analyze the parent SES items and found that a single component explained 68% of the variance. Finally, we summed over the unpredictability items to compute total (composite) unpredictability because sources of unpredictability may not be systematically related.

Hypothesized Model I: Dimensionality of LHS

We tested the hypothesized two-factor model and it fit the data very well, $X^2 = 38.82$ [40], $p = .52$; CFI = 1.00; TLI = 1.00; RMSEA = .00. We set the metrics for the two factors by fixing the health loading on Super-K and the sensation seeking loading on mating competition to one. The effects of Super-K on its indicators were all statistically significant ($ps < .05$) except for the effect on liability to substance use ($p = .070$). Given that marginal p value for this loading, we constrained it to 0 to test the hypothesis that it was nil. We found that with this constraint imposed, model fit was significantly worse, $\Delta_X^2 = 4.45$ [1], $p = .035$. Thus, we proceeded by retaining and interpreting this loading along with the others. All significant effects of Super-K were larger than β (standardized) =.50 except for the effects on valuing of children (β = .27) and liability to substance use (β = −.20). The effects of mating competition on its indicators were all statistically significant except for the effect on harm avoidance ($p = .067$). Given that marginal p value for this loading, we constrained it to 0 and found that this constraint significantly worsened model fit, $\Delta_X^2 = 4.56$ [1], $p = .032$. Thus, we proceeded by retaining and interpreting this loading along with the others. All significant effects of mating competition were larger than β = .50. The correlation between Super-K and mating competition was observed at $r = -.55$ ($p < .001$). For the liability to substance use and harm avoidance indicators, which cross-loaded on Super-K and mating competition, the R^2 estimates were .43 and .20, respectively. Finally, we tested a single-factor model of life history indicators and found that it fits the data poorly, $X^2 = 94.83$ [44], p

< .001; CFI = .72; TLI = .65; RMSEA =.10, and significantly worse than Model I, Δ_X^2 = 38.91, p < .001. Thus, we accepted hypothesized Model I as the best reproducer of the associations among the indicators.

Hypothesized Model II: Associations With Environment

We next incorporated environmental variables into our final measurement model (Model I) and found that the result fit the data well, X^2 = 79.49 [67], p =.14; CFI = .95; TLI = .94; RMSEA = .04. The effects of Super-K and mating competition on their indicators mirrored those observed for Model I (see Table 6 and Figure 1). Consistent with Model I, the correlation between the residuals of the two life history dimension was observed at r = −.43 (p < .001). Parent SES had a moderate positive effect on mating competition (β =.31, p < .01) and no significant effect on Super-K. Harshness had a moderate positive effect (β = −.46, p < .001) on mating competition and a large negative effect on Super-K (β = −.56, p < .001). Unpredictability had no significant effect on the life history dimensions, although its effect on mating competition neared significance (β = .18, p = .09). A moderate positive correlation was observed between harshness and unpredictability (r =.45, p < .001), while a moderate negative correlation was observed between parent SES and harshness (r = −.34, p < .001). Parent SES and unpredictability were uncorrelated (p =.66) conditional on harshness.

No relatively large modification indices (MIs) were observed (all MIs < 5) for Model II suggesting that no areas of strain existed. Given this and the other observed fit information, we concluded that no covariances between our life history indicators or between our environmental components and the indicators had likely been omitted. This implied that the assumptions of local independence of the life history indicators conditional on mating competition and Super-K held. In addition, the assumption of local homogeneity held given the absence of paths from the environmental components to the indicators and the nonsignificant X^2 and other fit information (i.e., the latent LHS variables provided all the relevant information about their indicators). The first finding is consistent with the notion that the life history indicators share two underlying common causes. The latter is consistent with the notion that the life history dimensions mediated or otherwise explained any associations between environmental harshness, unpredictability, parent SES, and the life history indicators.

Discussion

Overview of Findings

Using SEM, this study tested the hypothesis that two dimensions subsumed life history indicators in a predominantly urban sample of young adults. We reproduced the two-dimensional structure suggested by Richardson et al. (2014) and documented by Richardson, Sanning, et al. (2016). The two dimensions—mating competition and Super-K—fully explained any associations among the life history indicators as well as their associations with environmental conditions. These findings suggest that mating competition and Super-K may function as underlying common causes that explain the covariance among a broad swath of life history parameters (e.g., number of sexual partners), psychosocial traits (e.g.,

sensation seeking and agreeableness), and behaviors (e.g., delinquency). Thus, it may be useful for evolutionary scientists, including those interested in informing public health efforts, to focus on the relationships between aspects of environment and these underlying factors. This kind of research may produce a more parsimonious picture of the linkage between environment and variation in human traits and behaviors, one that could inform the development of public policy initiatives that produce broad returns in terms of physical and mental health, risky behavior, and education. For instance, this work could shed new light on the etiology of comorbidity and inform efforts to prevent mental disorders. Our model and the one reported by Richardson, Sanning, et al. (2016) both suggest that holding harshness constant, higher parental SES has a *positive* mating competition mediated effect on risky behavior, but no effect on health or depression. Thus, it is possible that interventions that increase SES, but do not decrease harshness as a consequence, will increase risky behavior. Similar, interventions that decrease harshness but do not increase SES, if they are possible, would be expected to reduce internalizing symptoms without increasing risky behavior as a byproduct.

Dimensionality of Life History Indicators

We found that all indicators of mating competition functioned as theorized, with the exception of agreeableness. Those who scored higher on mating competition endorsed greater sensation seeking, less negative attitudes toward risk, greater responsivity to reward, less harm avoidance, more delinquent behavior, greater substance use, and larger numbers of sexual partners. There was a significant *positive* effect on agreeableness. This should be interpreted as an effect within levels of Super-K, or for those with the same scores on Super-K. Indeed, when Super-K and its unique indicators are removed from the model, the mating competition effect on agreeableness is no longer significant. Still, we expected significant negative effect on agreeableness on the basis of theory and past research (e.g., Richardson, Sanning, et al., 2016). Therefore, the current finding is surprising.

For Super-K, all indicators except harm avoidance reflected their factors as theorized. Also, the effect on substance use, although in the expected direction, was small. Those high on Super-K endorsed better health and fewer symptoms of depression, greater agreeableness, and greater valuing of children. To our knowledge, this is the first evidence that Super-K is associated with greater attribution of value to offspring prior to parenthood. Interestingly, higher levels on Super-K implied *less* harm avoidance. Perhaps this is due to the items used to measure harm avoidance. The content of the Character and Trait Inventory items in this subscale seem to tap into intolerance of ambiguity, discomfort in response to uncertainty, and/or anxiety (e.g., “I often feel tense and worried in unfamiliar situations, even when others feel there is little to worry about,’ and “It is extremely difficult for me to adjust to changes in my usual way of doing things because I get so tense’). Given that Super-K has reflected lesser environmental harshness and also subsumed social connectedness and support (Richardson, Sanning, et al., 2016), perhaps it should not be surprising that participants scoring highly on this factor feel less tense when faced with unfamiliar situations. Their external social environments have been relatively safe and thus they may feel secure in new situations. In contrast, the negative harm avoidance loading on mating competition might be attributable to low levels of sensitivity to threat. Consistent with this,

we found that mating competition subsumed aspects of reward sensitivity (e.g., reward dependence), and reward and threat sensitivity have been inversely related in past research (Richardson, Freedlander, Katz, Dai, & Chen, 2014). That is, those with high levels of mating competition may not find new situations unnerving because of internal characteristics that bias their attention toward cues to reward and away from cues to threat. This may enable them to better find and acquire new mates. Future work should confirm which forms of harm avoidance reflect mating competition and Super-K.

In combination with previous research, this study helps to characterize the dimensionality of life history indicators. LHS does not appear to be unidimensional—a single-factor model did not fit our data nor those examined in Richardson, Sanning, et al. (2016). Instead, there appear to be at least two unique factors—mating competition and Super-K. These findings are also consistent with the Brumbach et al.'s (2009) finding of two uncorrelated dimensions in young adulthood. Given that the two dimensions were independent or uncorrelated in other studies, and moderately correlated here, we contend that they should not be aggregated and interpreted as life history speed. Each unique dimension of LHS seems to require attention. Finally, although other studies suggest there may not be a direct trade-off between the two LHS dimensions, as LHT would have us believe, this study detected a moderate negative residual correlation that is consistent with a direct phenotypic trade-off. More research is needed to identify the conditions under which mating competition and Super-K are inversely related.

Combining the findings reported here and in Richardson, Sanning, et al. (2016), we conclude that although the nature of the trade-off between the two LHS dimensions is not yet resolved, it seems that mating competition clearly manifests as sensation seeking, risk-taking, and behaviors that can enhance fitness in the short term but are costly in the long term. Consistent with LHT, mating competition also manifests as greater numbers of sexual partners, which would have likely led to greater quantities of offspring prior to the advent of modern birth control and the demographic transition (for related discussions of fertility and the demographic transition, see Sear, 2015; Sear & Coall, 2011). We also conclude that Super-K clearly manifests as facets of connectedness to peers, intimate partners, and offspring, as well as covitality. These findings suggest the human life history continuum is composed of unique mating competition and Super K dimensions that subsume mating effort and somatic and parental effort, respectively. We note that these findings should not be seen as limiting human life history to two dimensions of investment. Much more work is needed to determine how many dimensions are plausible and also whether trade-offs between them are occurring as suggested by LHT.

Associations With Environment

Our LHS dimensions explained the associations between life history indicators and aspects of environment. Greater harshness predicted higher levels of mating competition and lower levels of Super-K, unpredictability did not have significant effects on either dimension, and parental SES had a moderate positive effect on mating competition. Richardson, Sanning, et al. (2016) documented similar environmental effects in middle adulthood, except they detected an effect of unpredictability on Super-K. This study used more proximate (past 12-

month) measures of environmental harshness and unpredictability than past studies. The effects of harshness were larger than observed in past research, consistent either greater importance of proximate cues to harshness and/or an emerging gene–environment correlation. The effects of unpredictability were nonsignificant. This could be because later unpredictability is not as important as early unpredictability, consistent with psychosocial acceleration theory (e.g., Belsky et al., 1991) and recent evidence (Simpson et al., 2012). This could also be partly due to the fact that some of our young adults were no longer living with their parents (about 38%) and some of the unpredictability items tapped aspects of parental experiences or behavior.

We also found a parental SES effect on mating competition similar to that reported in Richardson, Sanning, et al. (2016), consistent with gene–environment correlation and/or a reliable influence of access to resources on life history dimensions. It is important to note that some past research (e.g., Simpson et al., 2012) used SES as the only index of harshness. Our findings suggest that the SES effect on mating competition (or its indicators) may be more likely to emerge when more direct cues to extrinsic mortality (e.g., seeing someone shot) are controlled, while the association between SES and Super-K may be attributable to experienced harshness. This implies that relying on SES as the sole index of harshness is likely inadequate. Thus we suggest that in the future, researchers control for SES and also more direct indicators of environmental harshness. This may allow them to better disentangle the effects of SES and access to resources from the effects of cues to mortality risk.

Overall, these findings are consistent with LHT. Harshness had the expected effects on the two LHS dimensions and was associated with faster LHS overall. Unpredictability did not predict the LHS factors but this may be due to a restriction of its effects to childhood. Parental SES had what might be seen as a surprising effect on mating competition, but this effect was also found by Richardson, Sanning, et al. (2016) and is consistent with evidence of elevated risk-taking in samples of affluent youth (Luthar & Barkin, 2012). It is also consistent with evidence that greater access to resources is associated with higher levels on *r* and also K strategies between species (Sibly & Brown, 2007, 2009). The idea is that with greater access to resources, organisms can increase their play in all reproductive games. In the case of within-human variation, it seems that higher SES may be directly related to greater mating competition and also indirectly related to higher Super-K through decreased experience of cues to harshness (e.g., seeing someone shot).

Limitations

This study is limited by the use of self-report data, and it is widely recognized that such data can be affected by error in the retrieval processes associated with memory and self-presentation bias. This limitation applies most significantly to the retrospective measure of SES. However, the measure we used is the standard in the field and this limitation should also apply less young adults compared with middle adults given the smaller time lag since childhood. Second, causal inferences based on the results presented here should remain tentative given that past studies have shown that the influence of genetic factors is ubiquitous (Turkheimer, 2000). Future research can use genetic information to address this limitation.

Finally, we used environmental measures and several life history indicators (e.g., number of sexual partners and valuing of children) that can be seen as helpful in establishing the validity of our latent constructs. Future studies should test whether mating competition and Super-K are related to additional criteria such as pubertal timing, first birth, parental investment, and longevity. For mating competition, specifically, effects on indicators such as mate poaching, intrasexual competitiveness, attitudes toward partner infidelity, and perceptions of infidelity risk should also be tested. Future studies should also examine the stability of mating competition and Super-K over time.

Strengths/Contributions

One major contribution of this study is the heterogeneous sample of youth, representing many demographic characteristics (e.g., parental SES, current educational attainment, age, race, and ethnicity). The data set is rich in variables and constructs to support analyses like these. This study reproduced the two-dimensional structure of LHS indicators documented by Richardson, Sanning, et al. (2016) in this unique and heterogeneous sample of young adults. It also helped to better establish the identity of the mating competition factor using a more extensive selection of indicators as well as more extensive and proximate measures of environmental harshness and unpredictability. The latter casts light on the possible role of environment in LHS development. Finally, our inclusion of multiple aspects of environment allowed us to produce a nuanced view of their associations with young adult LHS.

Conclusion

Taken together, our results reinforce the Richardson, Sanning, et al.'s (2016) finding that human LHS at least two-dimensional. In this study, a moderate inverse residual correlation was observed between mating competition and Super-K, consistent with a direct trade-off between these two dimensions of LHS. Moreover, we have shown that SES may enhance investment in mating competition, that harshness might persist into young adulthood as an important correlate of LHS, and that unpredictability may not have significant effects in young adulthood. These findings reinforce the contention that human LHS is multidimensional and environmental effects on LHS are more complex than previously suggested. They also provide a parsimonious model of an array of human behaviors and traits that can be used to inform public health initiatives, particularly with respect to the potential impact of environmental interventions that target harshness versus SES.

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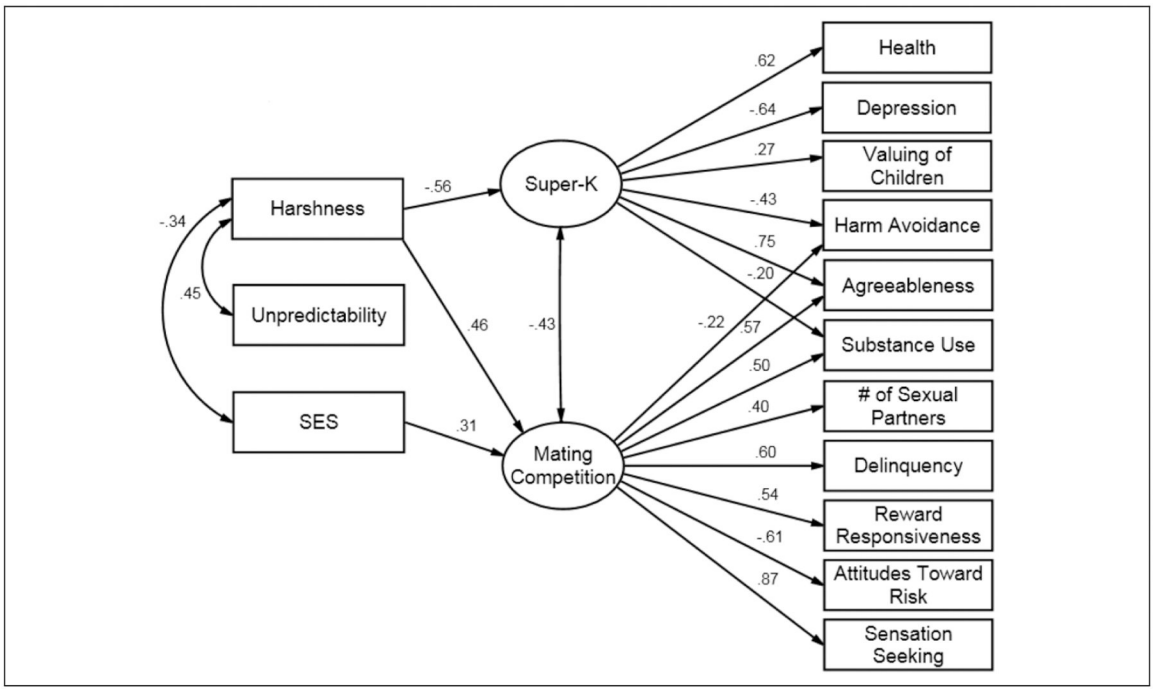

Figure 1.
Final full structural equation modeling: life history dimensions and their associations with aspects of environment.

Table 1.

Sample Demographics.

Variable	*n*	Percentage
Age (years)		
18	18	14.29
19	16	12.70
20	25	19.84
21	20	15.87
22	15	11.90
23	20	15.87
24	12	9.52
Sex		
Female	70	55.60
Male	56	44.40
Race		
American Indian/Alaska Native	1	0.80
Asian	6	4.80
Black/African American	66	52.38
White	52	41.27
Other specified/Indigenous Siberian	1	0.79
Hispanic		
Yes	5	3.97
No	121	96.80
Current school enrollment		
Full-time student	58	46.03
Part-time student	16	12.7
Not currently enrolled	52	41.27
Highest degree		
No degree/less than high school	9	7.14
GED	12	9.52
High school diploma	78	61.9
Associate’s degree	9	7.14
Bachelor’s degree	18	14.29
Post-bachelor’s degree	0	0.0
Received free or reduced lunch as a minor		
Yes	68	53.97
Father’s highest degree earned		
Less than high school	13	10.32
High school diploma	44	34.92
GED®	5	3.97
Trade school certificate	5	3.97
Associates degree/Associate of Arts	7	5.56

Variable	*n*	Percentage
Bachelors or equivalent 4-year degree	16	12.7
Masters degree	18	14.29
Doctoral degree	12	9.52
Missing	6	4.76
Mother's highest degree earned		
Less than high school	5	3.97
High school diploma	40	31.75
GED®	7	5.56
Trade school certificate	3	2.38
Associates degree/Associate of Arts	16	12.7
Bachelors or equivalent 4-year degree	22	17.46
Masters degree	26	20.63
Doctoral degree	5	3.97
Missing	2	1.59
Currently live at home with the parents/adults who raised you		
Yes	78	61.90

Source. Adapted from Dariotis and Johnson (2015).

Table 2.

Valence of Hypothesized Loadings on Mating Competition and Super-K.

Life History Indicator/Domain	Super-K	Mating Competition
Health	+	
Depression	−	
Valuing of children	+	
Agreeableness	+	−
Harm avoidance	+	−
Substance use	−	+
Number of sexual partners		+
Delinquency		+
Reward responsiveness		+
Attitudes toward risk (negative)		−
Sensation seeking		+

Table 3.

Life History Strategy Indicator Information.

Factor/Index	# Items (Score)	Content	Loading/α f1	f2	f3
Valuing of children (derived from the valuing of children scale: Arnold et al., 1975; Hoffman, Thornton, & Manis, 1978; Thomson, Davidson, & Williams, 1983) Scale: 4 points ("*agree a lot*" to "*disagree a lot*")	9	Children limit you in what you want to do and where you want to go.		.44	
		Having children gives a person a special incentive to succeed in life.	.62		
		Having children causes many disagreements and problems between the father and the mother.		.67	
		Having children makes a stronger bond between husband and wife.	.71		
		Raising children is a heavy financial burden for most people.		.73	
		One of the highest purposes of life is to have children.	.60		
		When you have children, you have to give up a lot of other things that you enjoy.	.52	.33	
		A person with children is looked up to in the community more than a person without children.			.89
		A young couple is not fully accepted in the community until they have children.			.82
Attitudes toward risk (Franken, Gibson, & Rowland, 1992)	34	Scored as described in Franken, Gibson, and Rowland (1992).		α = .94	
Reward responsiveness (Behavioral Inhibition Scale/Behavioral Activation Scale [BIS/BAS] subscale: Carver & White, 1994) Scale: 4 points ("*very true for me*" to "*very false for me*," reverse coded)	5 (sum)	When I'm doing well at something I love I keep at it. When I get something I want, I feel excited and energized.		α = .77	
		When I see an opportunity for something I like, I get excited right away.			
		When good things happen to me, it changes the way that I think and feel a lot.			
		It would excite me to win a contest.			
Depressive symptoms (Center for Epidemiologic Studies Depression Scale : Radloff, 1977)	20	Scored as described in Radloff (1997).			
Delinquency (adapted from Add-Health 1995 Items; see Harris, Duncan, & Boisjoly, 2002) Scale: 5 points ("*never*" to "*five or more times*")	8	Delinquency last 12 months: damage property	.87		
		Delinquency last 12 months: shoplift	.98		
		Delinquency last 12 months: hurt someone	.94		
		Delinquency last 12 months: steal car	.63		
		Delinquency last 12 months: steal property > US$50	.62		
		Delinquency last 12 months: steal property < US$50	.92		
		Delinquency last 12 months: group fight	.49		
		Delinquency last 12 months: public disturbance	.57		

Factor/Index	# Items (Score)	Content	Loading/α f1	f2	f3
Perceived health scale: 5 points (“very *poor*” to “*excellent*”)		How would to rate your overall health at the present time?			
Harm avoidance (subscale of the Temperament and Character Inventory: Cloninger, Przybeck, Svrakic, & Wetzel, 1994) Scale: 2 points (“*no*” and “*yes*”)	9	I usually am confident that everything will go well, even in situations that worry most people.	.94		
		I often feel tense and worried in unfamiliar situations, even when others feel there is little to worry about.		.87	
		I have less energy and get tired more quickly than most people.		.77	
		I often avoid meeting strangers because I lack confidence with people I do not know.		.66	
		If I am embarrassed or humiliated, I get over it very quickly.	.54		
		It is extremely difficult for me to adjust to changes in my usual way of doing things because I get so tense.		.87	
		I nearly always stay relaxed and carefree, even when nearly everyone else is fearful.	.72		
		I often feel tense and worried in unfamiliar situations, even when others feel there is no danger at all.		.92	
		I am usually confident that I can easily do things that most people would consider dangerous.	.56		
Substance use	8	Last 30 days: binge drinking (range = 0–15)	.87		
		Average # drinks in a typical week (0–30)	.80		
		Average # drinks per day (0–10)	.87		
		Last 30 days: tobacco use (0–30)		.99	
		Average tobacco use in a typical week (0–140)		.92	
		Average tobacco use per day (0–20)		.98	
		Loadings on second-order factor liability factor (for discussion, see Results section, first paragraph)			
		Alcohol	.67		
		Nicotine	.71		
		Last 30 days: cannabis use (0–30)	.77		
		Total number of types of illicit drugs ever used (0–8, sum; stimulants, opioids, inhalants, hallucinogens, 3,4- methylenedioxymethamphetamine, sedatives, bath salts, cannabis)	.71		
Friendliness (subscale from the Profile of Mood States Scale: McNair, Lorr, & Droppleman, 1981; Shacham, 1983)	6	Friendly	.77		
		Considerate	.74		
		Sympathetic	.49		
Scale: 5 points (“*not at all*” to (“*extremely*”)		Helpful	.71		

Factor/Index	# Items (Score)	Content	Loading/α		
			f1	f2	f3
		Good natured	.67		
		Trusting	.60		
Number of sex partners past 12 months		Thinking about the last 12 months, with how many different people have you had sex? Range = 0–25.			
Sensation seeking (Zuckerman Sensation Seeking Scale: Zuckerman, Eysenck, & Eysenck, 1978)	40	The scale consists of four subscales (Boredom Susceptibility, Thrill and adventure seeking, Experience seeking, and Disinhibition) composed of 10-items each. Summed over “true” scores. Range = 0–40.		α = .94	

Table 4.

Environmental Components.

Factor/Index	# Items	Content	Loading/α	% Var.
Harshness (D'Imperio, Dubow, & Ippolito, 2000)	11	Family member died	.38	37
		Another close relative or friend died	.46	
		Seen someone beaten, shot, or really hurt by someone	.79	
		Close family member arrested or put in jail	.62	
		Someone other than a family member beaten, attacked, or really hurt	.69	
		Seen or been around people shooting guns	.64	
		Family member robbed or attacked	.75	
		Upset by neighborhood violence	.63	
		Family member beaten, attacked, or really hurt by another family member	.53	
		Very crowded where you live	.46	
		Had to hide someplace because of shootings in neighborhood	.59	
Unpredictability (sum) (D'Imperio et al., 2000)	9	Family moved to a new home or apartment	α = .66	
		Parental separation or divorce, or one of parents left the family		
		Best friend moved away		
		Changed schools		
		Close family member had a mental illness or a serious emotional problem		
		Different people moved in and out of the home		
		One of parents lost job		
		Family's property wrecked or damaged due to fire, burglary, or disaster		
		Had to take care of self for long periods of time without adults around		
Socioeconomic status		Bio father's highest degree earned	.88	68
		Bio mother's highest degree earned	.84	
		Poverty: free or reduced cost lunch	.75	

Table 5.

Model Fit Information.

Model	Action	*#fs*	*df*	χ^2	CFI	TLI	RMSEA (90% Confidence Interval)
Assessments of scale unidimensionality							
Value of children (1)		1	27	126.351*	0.518	0.357	.171 [.141, .202]
Value of children (2)	+ Factor	2	19	35.995*	0.918	0.844	.084 [.040, .126]
Value of children (3)	+ Factor	3	12	14.085	0.990	0.970	.037 [.000, .102]
Delinquency		1	20	45.359*	0.964	0.950	.100 [.062, .139]
Substance use		3	13	19.972	0.995	0.992	.065 [.000, .119]
Agreeableness		1	9	8.832	1.000	1.001	.000 [.000, .099]
Harm avoidance (1)		1	27	117.987*	0.809	0.746	.164 [.134, .194]
Harm avoidance (2)	+ Factor	2	19	14.387	1.000	1.018	.000 [.000, .056]
Measurement model and full SEM							
Model I (two-factor model)		2	40	38.816	1.000	1.009	.000 [.000, .060]
Single-factor model		1	44	94.827*	0.716	0.645	.097 [.070, .124]
Model II (full SEM)		2	67	79.493	0.953	0.937	.039 [.000, .069]

Note. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; + = added factor or parameter. − = removed factor or parameter; *fs* = factors; SEM = structural equation modeling.

*$P = .05$.

Table 6.

Final SEM Unstandardized and Standardized Effects.

Variable			*b*	*SE*	*p**	β
Health	←	Super-K	1.000	0.000	_	.623
Harm avoidance	←	Super-K	−0.670	0.261	.010	−.425
Agreeableness	←	Super-K	1.432	0.376	<.001	.750
Depression	←	Super-K	−13.193	3.305	<.001	−.644
Substance use	←	Super-K	−0.324	0.168	.054	−.198
Value of children	←	Super-K	0.669	0.310	.031	.266
Sensation seeking	←	Mating competition	1.000	0.000	—	.865
Attitudes toward risk	←	Mating competition	−0.035	0.006	<.001	−.612
Reward dependence	←	Mating competition	0.050	0.009	<.001	.538
Delinquency	←	Mating competition	0.065	0.014	<.001	.597
Number of sex partners	←	Mating competition	0.063	0.018	<.001	.399
Substance use	←	Mating competition	0.060	0.015	<.001	.504
Harm avoidance	←	Mating competition	−0.025	0.015	.094	−.217
Agreeableness	←	Mating competition	0.078	0.019	<.001	.565
Super-K	←	Harshness	−0.258	0.059	<.001	−.562
Super-K	←	Unpredictability	0.002	0.026	.930	.009
Super-K	←	SES	−0.062	0.057	.277	−.134
Mating competition	←	Harshness	2.897	0.628	<.001	.459
Mating competition	←	Unpredictability	0.651	0.393	.097	.184
Mating competition	←	SES	1.943	0.673	.004	.305
Mating competition	↔	Super-K	−0.872	0.308	.005	−.427
Harshness	↔	SES	−0.337	0.114	<.003	−.336
Unpredictability	↔	SES	0.074	0.170	.664	.041
Unpredictability	↔	Harshness	0.816	0.159	<.001	.452

Note. For loadings used to set the metric of factors, we used the tests of standardized effect significance. SEM = structural equation modeling.

* $p = .05$.