Adaptive Human Behavior and Physiology (2025) 11:5
https://doi.org/10.1007/s40750-025-00258-5

RESEARCH

Able But Unwilling: Intelligence is Associated with Earlier Puberty and Yet Slower Reproduction

Jose C. Yong[1] · Satoshi Kanazawa[2]

Received: 5 November 2024 / Revised: 17 February 2025 / Accepted: 20 February 2025

Abstract

Purpose Research using system integrity theory (SIT) has shown that more intelligent men have higher-quality semen, which is puzzling because although reproductive capability should predict fertility, more intelligent men have fewer children. The current research addresses this puzzle by highlighting the distinct obligate and facultative outcomes that emerge when SIT is integrated with life history theory (LHT) and evolutionary novelty theory (ENT). Specifically, we propose that SIT accounts for more rigidly obligate physiological traits whereas LHT encompasses both obligate traits *and* flexibly facultative behaviors and, thus, permits the ENT-driven expectation that brighter individuals would act in evolutionarily novel ways—e.g., slower reproduction despite possessing capacities for faster reproduction.

Methods We examined this logic using another obligate reproductive trait: the timing of puberty. Based on our proposed synthesis of SIT, LHT, and ENT, we tested the prediction that more intelligent people would experience puberty earlier and yet have sex later, engage in less sexual activity, and have fewer children using two nationally representative and generationally distinct samples from the NCDS and Add Health.

Results Data across both samples confirmed that higher intelligence predicted earlier puberty *and* indicators of slower reproduction over and above several potential confounds, thus constituting a robust validation of our propositions.

Conclusions Findings are discussed with regards to the importance of considering the interplay between obligate and facultative traits, particularly when opposing directions might occur due to evolutionarily novel preferences associated with intelligence, as well as in the context of evolutionary mismatch in modern settings. Future directions inspired by this novel synthesis are offered.

Keywords System integrity theory · Life history theory · Evolutionary novelty theory · Puberty timing · Reproductive behavior · Fertility

---

Extended author information available on the last page of the article

Introduction

Higher intelligence correlates with better cognitive processing, physical performance, height, physical attractiveness, symmetry, physical and mental health, and longevity (Arden et al., 2016; Calvin et al., 2011; Deary et al., 2010; Hope et al., 2015; Kanazawa & Kovar, 2004; Meincke et al., 2016; Pearce et al., 2005). A theory that has been proposed to explain these associations is *system integrity theory* (SIT), which posits that intelligence signals "a body that has generally been put together well, and which can respond well to stressful challenges from the environment" (Deary, 2010; p. 340). The proposed mechanism is that pleiotropic mutations exerting multiple effects on bodily systems create genetic correlations between them such that the lower the individual genotypic burden of such mutations, the higher the overall "quality" of the phenotype as indexed by higher levels of these traits across the board (Arden et al., 2009; G. F. Miller, 2000). Evidence of a genetic link between intelligence and lifespan (Arden et al., 2016) indicates selective effects that cluster intelligence with other desirable traits. For instance, healthier individuals survive longer than less healthy individuals, and people prefer healthier, attractive, and brighter individuals as mating partners (Kanazawa & Kovar, 2004; Maestripieri et al., 2017). The coming together of genes that underlie such traits lead to "system integrity" as a latent or general "fitness factor" capturing individual differences in phenotypic quality (see *F*-factor; G. F. Miller, 2000; Prokosch et al., 2005).

Using SIT, researchers have argued that intelligence would correlate with markers of reproductive capability and demonstrated that more intelligent men have higher-quality semen (Arden et al., 2009; but see DeLecce et al., 2020 for null findings). While this finding makes sense in terms of SIT, it presents a puzzle because more intelligent individuals (including men) tend to have fewer children (Hopcroft, 2006; Meisenberg, 2010; Reeve et al., 2018). A key tenet of evolutionary theory is that traits evolve to increase an organism's ability to deal with adaptive problems. By this logic, and also because the maintenance of evolved traits is metabolically costly (Isler & van Schaik, 2006; Pontzer & McGrosky, 2022), traits tend to be purposeful rather than random or wasteful (see teleonomy; Corning et al., 2023). Thus, possessing reproductively supportive traits would be expected to result in greater fertility. Indeed, studies show that, on average, men with higher sperm quality tend to have more (rather than fewer) children (Asklund et al., 2007; Bostofte et al., 1982) and also have descended from ancestors who had larger families (Patel et al., 2021). By having fewer children, more intelligent men appear not to be capitalizing on their reproductive endowments. Likewise, women with better quality eggs and reproductive systems in general tend to be more fecund, but more intelligent women, despite their higher reproductive potential, are less likely to have children (Kanazawa, 2014b). As such, a pertinent question is what the point of having higher-quality gametes or other reproductively advantageous traits would be if intelligent individuals are not using them to produce more offspring (Barbaro et al., 2019).

Synthesizing Theories on System Integrity, Life History, and Evolutionary Novelty

One way to clarify these patterns is to consider the interplay of obligate versus facultative traits through an integration of SIT with *life history theory* (LHT; Figueredo et al., 2006) and *evolutionary novelty theory* (ENT; Kanazawa, 2004). Whereas SIT concerns traits like intelligence and physiological features (e.g., strength, health, reproductive qualities) whose expressions are genetically determined (Kanazawa, 2014a) and people have little control over, LHT involves physiological *and* psychobehavioral traits which, when operating together, make life history strategies less predetermined and more flexible. Specifically, LHT stresses that organisms adjust their reproductive strategy to be faster (e.g., reproduce sooner, have more offspring) or slower (e.g., reproduce later, have fewer offspring) depending on environmental and developmental factors (Figueredo et al., 2006; Frankenhuis & Amir, 2022; Walasek et al., 2022). While physiological traits help to facilitate the preferred strategy, such as the speed of physical and sexual maturity (Ellis et al., 2009) which are obligate and thus rigid or automatic, other psychobehavioral traits like temporal orientation, impulsivity, risk appetite, and sociosexuality (Figueredo et al., 2006, 2012) are facultative and provide room for flexible adjustment and volitionality. Thus, although people can be physiologically equipped to pursue faster reproduction, the flexibility afforded by facultative traits may result in the pursuit of a slower one. Even if genes determine to some extent the expression of certain behaviors, there is a degree of choice within constraints. For instance, circadian rhythm—which influences whether one is a morning or evening person—has a heritability of around 0.50, meaning that roughly 50% of individual differences in "morningness versus eveningness" can be attributed to the influence of genetic factors while the remaining variance relates to shared (e.g., within-family) and non-shared environmental factors. Thus, while individuals can be predisposed toward different circadian phenotypes due to combinations of personal genetic and environmental factors working in concert, such individuals are not constrained by these determinants (Kanazawa & Perina, 2009). Indeed, "evening people" may not like having to awaken at 6am, but they can do so if their livelihoods depend on waking and going to work early. Likewise, although genes have an influence on life history variables like impulsivity and sociosexuality (Bailey et al., 2000), people ultimately still have more flexibility within these behavioral traits than the physiological ones (e.g., body size, gamete quality) they are rigidly endowed with.

ENT is pertinent for why more intelligent individuals may forgo their reproductive advantage to pursue slower reproduction. As the theory suggests that general intelligence evolved to solve evolutionarily novel problems for which there are no predesigned psychological adaptations (Kanazawa, 2004), more intelligent individuals are better able to recognize and handle evolutionarily novel entities and situations. Consequently, individuals with higher intelligence are more likely to acquire and espouse evolutionarily novel values and act in evolutionarily novel ways than less intelligent individuals. For instance, higher intelligence is associated with preferences for activities that were likely unusual or unavailable in ancestral settings, such as staying up at night (Kanazawa & Perina, 2009), listening to non-vocal instrumental music (Kanazawa & Perina, 2012; Račevska & Tadinac, 2019), and substance use (Kanazawa & Hellberg, 2010). More intelligent individuals also do less of what would be considered evolutionarily familiar and typically rewarding, including enjoying spending time with friends (Li & Kanazawa, 2016) or in the sunshine (Kanazawa et al., 2022), kissing and making love (Halpern et al., 2000), and having children (Kanazawa, 2014b). When taken in conjunction with LHT, more intelligent individuals—despite possessing capabilities for reproduction sooner—may exhibit preferences that produce higher-quality offspring at a slower rate. In particular, intelligence is associated with learning (Kaplan et al., 2000), ambitiousness (Dunkel et al., 2021), cautiousness, and future orientation (Liu et al., 2023; Sternberg, 2017), which tend to shift preferences toward self-development (i.e., somatic investment) over reproduction, resulting in delayed or reduced sexual activity (e.g., investing more time in studies than in dating) and subsequently having fewer children (Ellis et al., 2009; Figueredo et al., 2006; Kaplan et al., 2000).

Another reason why the conflict between obligate and facultative traits among intelligent individuals revealed by our model should be examined is because studies often fail to find a direct relationship between intelligence and life history speed using psychometric scales such as the Mini-*K*, Arizona Life History Battery, and related instruments (e.g., Woodley, 2011; Figueredo et al., 2014; Woodley of Menie & Madison, 2015). As there might be opposing effects which nullify any associations between intelligence and life history strategy unless the interactional nature of physiology and behavior is delineated, a test of our proposed mechanisms is necessary to shed light on the evolutionary peculiarities of intelligent individuals and guide the design of future research that seeks to capture the reproductive strategies of such individuals more appropriately.

The Current Study

To examine this synthesis of SIT, LHT, and ENT, the current study focused on another reproductively relevant physiological trait: *puberty timing*. Puberty is the process of physical and hormonal changes that transform a child's body into an adult body capable of reproduction (Wood et al., 2019). If SIT is correct, more intelligent individuals would be anticipated to experience earlier puberty as such reproductively facilitative traits are expected to congregate. The LHT and ENT perspectives would, however, predict that more intelligent individuals would enact behaviors associated with a slower strategy despite the affordance to have sex and reproduce earlier, such as later sexual debut, engaging in less sexual activity, and having fewer children.

We also considered the potential confounding influence of variables whose implications for our variables of interest have been documented. These include physical developmental aspects such as nutrition (Sigman & Whaley, 1998) and health (Kirkegaard et al., 2020; Lawlor et al., 2005) given their role in the maturation of bodily functions supporting puberty (Villamor & Jansen, 2016) and cognition (Ivanovic et al., 2004; Zamroziewicz et al., 2017). Another highly pertinent factor is education because of how intertwined it is with intelligence (Mayer, 2000). Furthermore, puberty is a period of intense learning of numerous important skills (Fuhrmann et al., 2015; Larsen & Luna, 2018) and prolonged schooling could be indicative of more intelligent individuals' predispositions toward extended learning to obtain those skills (Brant et al., 2013).

To facilitate this investigation, two large and publicly available datasets, the National Child Development Study (NCDS) and the National Longitudinal Study of Adolescent to Adult Health (Add Health), will be used. Confirming that brighter individuals sexually mature earlier (SIT prediction) and yet pursue aspects of slower reproductive strategy (LHT × ENT prediction) over two nationally representative samples while controlling for several potential confounds will provide a robust test of the proposed logic, contribute an important validation of the theories involved, and demonstrate how distinct evolutionary mechanisms dynamically manifest.

Study 1: National Child Development Study (United Kingdom)

Data

The NCDS is a large, ongoing, and prospectively longitudinal study that has followed a *population* (not a sample) of British respondents since birth for over 60 years. The study included *all* babies (n = 17,419) born in Great Britain (England, Wales, and Scotland) during one week (3–9 March 1958). The respondents were subsequently reinterviewed in 1965 (Sweep 1 at age 7; n = 15,496), 1969 (Sweep 2 at age 11; n = 18,285), 1974 (Sweep 3 at age 16; n = 14,469), 1981 (Sweep 4 at age 23; n = 12, 537), 1991 (Sweep 5 at age 33; n = 11,469), 1999–2000 (Sweep 6 at age 41–42; n = 11,419), 2004–2005 (Sweep 7 at age 46–47; n = 9,534), 2008–2009 (Sweep 8 at age 50–51; n = 9,790), and 2013 (Sweep 9 at age 55; n = 9,137). In each sweep, personal interviews and questionnaires were administered to the respondents, as well as to their parents, teachers, and doctors during childhood and to their partners and children in adulthood. Virtually all (97.8%) of the NCDS respondents are Caucasian. The Centre for Longitudinal Studies of University College London now conducts the NCDS and the data are publicly and freely available to registered users of the UK Data Service (https://ukdataservice.ac.uk/).

Dependent Variables

Puberty The NCDS measured girls' puberty with five indicators at age 16: age of menarche reported by parents (91.8% mothers) and age of menarche, pubic hair development, axillary (armpit) hair development (1 = absent, 2 = sparse, 3 = intermediate, 4 = adult), and breast development (1 = absent, 2 = intermediate, 3 = adult) reported by a doctor during a medical examination. We subjected these five indicators of puberty to a principal component analysis, and all five indicators extracted a single principal component with high factor loadings (menarche by parent = −0.626; menarche by doctor = −0.665; pubic hair = 0.774; axillary hair = 0.744, breasts = 0.715).

The NCDS measured boys' puberty with three indicators at age 16: age when voice broke reported by parents (1 = before 11 years, 2 = 11 years, 3 = 12 years, 4 = 13 years, 5 = 14 years, 6 = 15 or 16 years, 7 = not yet broken) and pubic and axillary hair development reported by a doctor during a medical examination. A principal component analysis on these three indicators of puberty resulted in a single principal component with high factor loadings (voice change = −0.559; pubic hair = 0.842, axillary hair = 0.861).

Reproductive Behavior The NCDS measured respondents' onset of reproductive behavior in adulthood with three indicators at age 33: age at first cohabitation for one month or longer, age at first marriage, and age at first child. In addition, the number of biological children that respondents have had in early adulthood at ages 23 and 33 were also recorded.

Independent Variable

General Intelligence The NCDS has possibly the strongest measure of childhood general intelligence of all large-scale surveys. The respondents took multiple cognitive tests at ages 7 (4 tests), 11 (5 tests), and 16 (2 tests). At 7, the respondents took the Copying Designs Test, Draw-a-Man Test, Southgate Group Reading Test, and Problem Arithmetic Test. At 11, they took the Verbal General Ability Test, Nonverbal General Ability Test, Reading Comprehension Test, Mathematical Test, and Copying Designs Test. At 16, they took the Reading Comprehension Test and Mathematics Comprehension Test. We performed a principal component analysis at each age to compute the general intelligence score for each age, and all cognitive test scores at each age extracted a single principal component with reasonably high loadings (age 7: Copying Designs = 0.671, Draw-a-Man = 0.696, Southgate Group Reading = 0.780, and Problem Arithmetic = 0.762; age 11: Verbal General Ability = 0.920, Nonverbal General Ability = 0.885, Reading Comprehension = 0.864, Mathematical = 0.903, and Copying Designs = 0.486; age 16: Reading Comprehension = 0.909, and Mathematics Comprehension = 0.909). The general intelligence scores at each age were then converted into the standard IQ metric with a mean of 100 and a standard deviation of 15. A second-order principal component analysis was performed with the IQ scores at three different ages to compute the overall childhood general intelligence score, resulting in a single principal component with very high loadings (Age 7 = 0.867; Age 11 = 0.947; Age 16 = 0.919). We used the childhood general intelligence score in the standard IQ metric as the independent variable.

Control Variables

Education was measured by a six-point ordinal scale of educational achievement level (0 = No qualification; 1 = CSE 2–5/NVQ 1; 2 = O levels/NVQ 2; 3 = A levels/NVQ 3; 4 = Higher qualification/NVQ 4; 5 = Degree/NVQ 5–6). Nutritional status was measured by the body-mass index (BMI). The NCDS measured the general health of the respondent only in adulthood (age 23 onward) and thus was not included.

Results

Puberty Both age and race were almost constant among NCDS respondents as they were all born during one week in March 1958 and 97.8% were Caucasian. Net of education and nutritional status, childhood general intelligence has a significantly positive association with puberty, both among girls (unstandardized coefficient = 0.005, standard error = 0.002, standardized coefficient = 0.074, $p = 0.009$) and boys (unstandardized coefficient = 0.005, standard error = 0.002, standardized coefficient = 0.076, $p = 0.008$), indicating that both boys and girls who were more intelligent underwent puberty earlier than less intelligent children did.

Reproductive Behavior When the outcome measure was reproductive behavior, however, the effect of childhood general intelligence was sometimes (though not always) entirely mediated by education and nutritional status. Without the inclusion of confounds, general intelligence was significantly positively associated with all three indicators of the start of reproductive behavior for both NCDS women (cohabitation: $r = 0.202$, $p < 0.001$; marriage: $r = 0.242$, $p < 0.001$; child: $r = 0.347$, $p < 0.001$) and NCDS men (cohabitation: $r = 0.133$, $p < 0.001$; marriage: $r = 0.180$, $p < 0.001$; child: $r = 0.260$, $p < 0.001$), demonstrating that more intelligent men and women started their reproductive behavior at later ages than less intelligent adults did. Likewise, general intelligence was significantly negatively associated with the number of biological children women had at age 23 ($r = -0.335$, $p < 0.001$) and 33 ($r = -0.201$, $p < 0.001$). The results were the same, albeit slightly smaller in magnitude, among men at age 23 ($r = -0.207$, $p < 0.001$) and 33 ($r = -0.089$, $p < 0.001$).

After controlling for education and nutrition, childhood general intelligence for NCDS women was no longer significantly associated with the age of first cohabitation (unstandardized coefficient = 0.008, standard error = 0.006, standardized coefficient = 0.034, $p = 0.179$), and only marginally significantly positively associated with the age of first marriage (unstandardized coefficient = 0.024, standard error = 0.014, standardized coefficient = 0.089, $p = 0.085$). However, childhood general intelligence was still significantly positively associated with the age at first child (unstandardized coefficient = 0.039, standard error = 0.008, standardized coefficient = 0.134, $p < 0.001$), and significantly negatively associated with the number of children before 23 (unstandardized coefficient = −0.014, standard error = 0.004, $p < 0.001$) and before 33 (unstandardized coefficient = −0.007, standard error = 0.001, $p < 0.001$). In all equations, education was always significantly (ps < 0.001) associated with delayed or decreased reproduction.

Similarly, among NCDS men, net of education and nutritional status, childhood general intelligence was no longer significantly associated with the age of first cohabitation (unstandardized coefficient = 0.011, standard error = 0.007, standardized coefficient = 0.044, $p = 0.109$) or the age of first marriage (unstandardized coefficient = 0.019, standard error = 0.013, standardized coefficient = 0.080, $p = 0.130$). However, childhood general intelligence was still significantly positively associated with the age of first child (unstandardized coefficient = 0.044, standard error = 0.008, standardized coefficient = 0.168, $p < 0.001$) and significantly negatively associated with the number of children before 23 (unstandardized coefficient = −0.018, standard error = 0.005, $p < 0.001$) but not 33 (unstandardized coefficient = −0.003, standard error = 0.003, $p = 0.247$). As with women, education was at least marginally significantly associated with delayed or decreased reproduction among men.

To graphically illustrate the proposed interplay between intelligence, obligate physiology, and facultative behavior, Fig. 1 presents the association between childhood general intelligence, earlier puberty (obligate), and age at first child (facultative) among the NCDS girls/women (Panel 1) and boys/men (Panel 2). Figure 1a shows that there was a monotonically negative association between childhood general intelligence and the age of menarche, recorded by a doctor during a medical examination. The brightest girls, with IQs above 125, on average underwent menarche at age 12.60 years, whereas the least bright girls, with IQs below 75, on average underwent menarche at age 13.24 years. Despite the fact that more

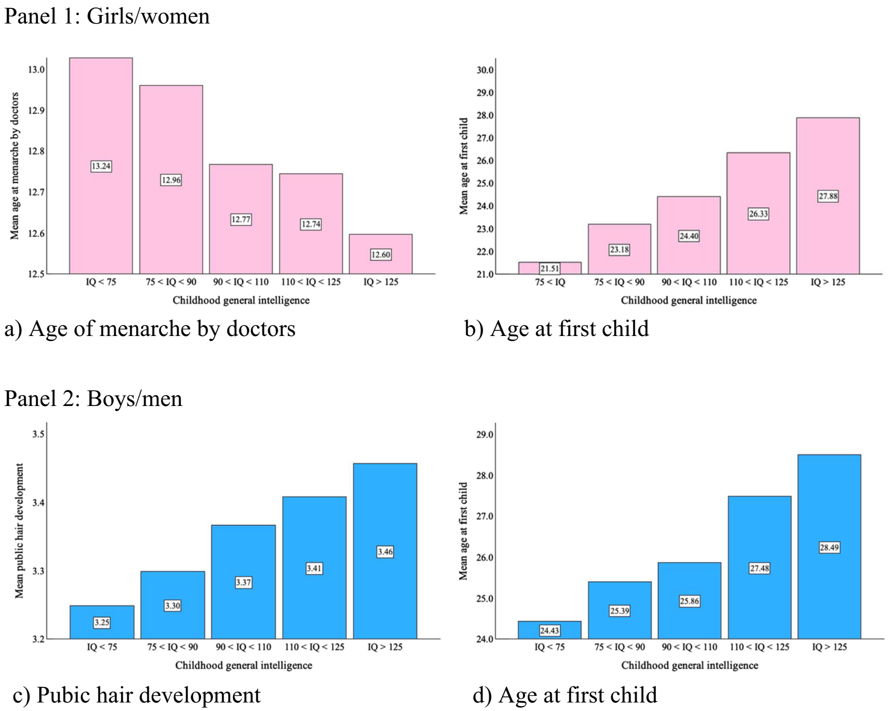

Fig. 1 Association between childhood general intelligence and the timing of puberty (obligate) and of reproductive behavior (facultative) among girls/women (Panel 1) and boys/men (Panel 2), National Child Development Study (United Kingdom)

intelligent girls underwent puberty earlier than less intelligent girls, Fig. 1b shows that the former started their reproductive careers later than the latter. On average, the brightest women had their first child at 27.88 years, whereas the least bright women did so on average at 21.51 years.

The pattern was identical among the NCDS boys/men. Figure 1c shows a monotonically positive association between childhood general intelligence and puberty, measured by pubic hair development recorded by a doctor during a medical examination. The brightest boys, with IQs above 125, on average scored 3.46 on a four-point scale (where 3 = intermediate and 4 = adult) whereas the least bright boys, with IQs below 75, on average scored 3.25. Once again, despite the fact that more intelligent boys underwent puberty earlier than less intelligent boys did, Fig. 1d shows that the former started their reproductive careers later than the latter did. The brightest men on average had their first child at 28.49 years, whereas the least bright men did so on average at 24.43 years.

Discussion

Consistent with our prediction derived from SIT, more intelligent NCDS girls and boys underwent puberty much earlier than their less intelligent counterparts did, because the timing of puberty is an indicator of general system integrity and genetic health and is also less controllable by the individual. In contrast, and once again consistent with our prediction derived from LHT and ENT, more intelligent women and men began their reproductive careers much later than less intelligent women and men did, because the timing of reproduction—when to have their first child—is more controllable by the individuals, and more intelligent individuals are more likely to engage in evolutionarily novel behavior that our ancestors did not routinely engage in, like *not* reproducing when they are fully capable of doing so.

The association between intelligence and puberty held despite controlling for education and nutrition. However, intelligence no longer predicted some of our indicators of reproductive behavior onset when these anticipated confounds were controlled, which is unsurprising in light of their known links with intelligence (e.g., Ivanovic et al., 2004; Mayer, 2000). Especially for education to which intelligence is causally upstream (Deary et al., 2007), such a strong overlap may exist that there is sometimes little variance left for intelligence to explain—indeed, these variables have been shown to completely mediate one another in other studies (e.g., Anderson et al., 2020). Nevertheless, intelligence still uniquely predicted later age at first child and having fewer children for both men and women, which are arguably our most valid indicators of delayed reproduction and, ultimately, low fertility. These findings also reflect decreasing levels of predictability as we move up the hierarchy of the sciences from more fundamental explanations (e.g., biology, physiology) to more complex ones (e.g., psychology, behavior; Simonton, 2015).

Our analyses of the NCDS data confirmed our prediction that SIT better explains the more obligate outcomes of general system integrity and genetic health, while LHT and ENT jointly better explain the more facultative aspects of reproductive decisions and behavior. However, the NCDS data are specific to one society (the

United Kingdom) and one cohort (all born during March 1958). Furthermore, the NCDS data did not include information on respondents' health status, which was one of our identified potential confounds. To see if our conclusions from our analyses of the NCDS are generalizable, we tested our predictions with the Add Health dataset which surveyed respondents from another society (the United States) in a later generation (born during the late 1970s and early 1980s). In addition, the Add Health's use of alternative intelligence, puberty, reproductive behavior, and health measures, allowed us to test our predictions using similar but distinct variables.

Study 2: National Longitudinal Study of Adolescent to Adult Health (United States)

Data

Add Health is a prospectively longitudinal study of a nationally representative sample of American youths, initially sampled when they were in junior high and high school in 1994–1995 (Wave I, $n=20{,}745$, mean age = 15.6) and reinterviewed in 1996 (Wave II, $n=14{,}738$, mean age = 16.2), in 2001–2002 (Wave III, $n=15{,}197$, mean age = 22.0), in 2007–2008 (Wave IV, $n=15{,}701$, mean age = 29.1), and in 2016–2018 (Wave V, $n=12{,}300$, mean age = 38.0). See additional details of sampling and study design at http://www.cpc.unc.edu/projects/addhealth/design. Certified researchers may obtain replication data and materials from the Carolina Population Center by contacting addheath-contracts@unc.edu and signing a one-year no-fee contract for replication purposes only.

Dependent Variables

Puberty Add Health measured girls' puberty with four indicators at age 16 (three sex-specific and one unisex): breast development (1 = My breasts are about the same size as when I was in grade school, 2 = My breasts are a little bigger than when I was in grade school, 3 = My breasts are somewhat bigger than when I was in grade school, 4 = My breasts are a lot bigger than when I was in grade school, 5 = My breasts are a whole a lot bigger than when I was in grade school; they are as developed as a grown woman's breasts), body curviness (1 = My body is about as curvy as when I was in grade school, 2 = My body is a little more curvy than when I was in grade school, 3 = My body is somewhat more curvy than when I was in grade school, 4 = My body is a lot more curvy than when I was in grade school, 5 = My body is a whole lot more curvy than when I was in grade school), age at menarche, and physical development compared to girls of their age (1 = I look younger than most, 2 = I look younger than some; 3 = I look about average, 4 = I look older than some; 5 = I look older than most). We subjected these four indicators of puberty to a principal component analysis, and all indicators extracted a single principal component with high factor loadings (breasts = 0.817; curves = 0.808; menarche = –0.365, physical development = 0.662).

Add Health measured boys' puberty with four indicators at age 16 (three sex-specific and one unisex): axillary hair development (1 = I have no hair at all, 2 = I have a little hair, 3 = I have some hair, but not a lot; it has spread out since it first started growing and is thicker, 4 = I have a lot of hair that is thick, 5 = I have a whole lot of hair that is very thick, as much hair as a grown man), facial hair development (1 = I have a few scattered hairs, but the growth is not thick, 2 = The hair is somewhat thick, but you can still see a lot of skin under it, 3 = The hair is thick; you can't see much skin under it, 4 = The hair is very thick, like a grown man's facial hair), voice change (1 = No, it is about the same as when I was in grade school, 2 = Yes, it is a little lower than when I was in grade school, 3 = Yes, it is somewhat lower than when I was in grade school, 4 = Yes, it is a lot lower than when I was in grade school, 5 = Yes, it is a whole lot lower than when I was in grade school; it is as low as an adult man's voice), and physical development (1 = I look younger than most, 2 = I look younger than some; 3 = I look about average, 4 = I look older than some; 5 = I look older than most). These four indicators of puberty were subjected to a principal component analysis, from which a single principal component was extracted with high factor loadings (axillary hair = 0.767, facial hair = 0.731, voice change = 0.698, physical development = 0.708). We analyzed the puberty latent factor (with a mean of 0 and a standard deviation of 1) with ordinary least squares (OLS) regression.

Reproductive Behavior Add Health measured respondents' reproductive behavior in adulthood with five indicators: age at first vaginal intercourse, number of heterosexual sex partners before age 18, whether they are currently cohabiting at age 22, whether they are currently legally married at age 22, and total number of biological children at age 29.

We analyzed the age at first vaginal intercourse with OLS regression. Because the number of heterosexual sex partners before 18 was highly positively skewed (women: skewness = 7.255, kurtosis = 85.370; men: skewness = 11.500, kurtosis = 244.244), we subjected the data to a natural logarithmic transformation before analyzing it with OLS regression. The skewness was significantly reduced with the transformation (women: skewness = −0.701, kurtosis = −1.393; men: skewness = −0.629, kurtosis = −1.484). We analyzed whether Add Health respondents were currently cohabiting or currently legally married with binary logistic regression. Because the number of biological children at 29 was a count measure with overdispersion (women: mean = 1.12, variance = 1.47; men: mean = 0.78, variance = 1.21), we analyzed it with negative binomial regression (Hilbe, 2011).

Independent Variable

General Intelligence Add Health measured respondents' intelligence with the Peabody Picture Vocabulary Test (PPVT). The raw scores (0–87) were age-standardized and converted to the IQ metric with a mean of 100 and a standard deviation of 15. The PPVT is properly a measure of verbal intelligence, not general intelligence. However, verbal intelligence is known to be highly correlated with (and thus heavily load on) general intelligence. For instance, Miner's (1957) extensive review of 36 studies shows that the median correlation between vocabulary and general intelligence was 0.83, while Wolfle (1980) reported that the correlation between a full-scale IQ test (Army General Classification Test) and the General Social Surveys (GSS) synonyms measure was 0.71. As a result, the GSS synonyms measure and other such instances of verbal intelligence have been used widely by intelligence researchers to assess trends in general intelligence (Alwin & McCammon, 1999; Glenn, 1999; Huang & Hauser, 1998; Wilson & Gove, 1999).

Control Variables

Unlike the NCDS respondents, Add Health respondents were not homogeneous in race and age. They included all races in the United States, and the age difference between the youngest and the oldest respondents was nine years, which made a huge difference for puberty and the onset of reproductive behavior. We therefore controlled for race (with four dummies for black, Asian, Native American, and, for Wave V only, Pacific Islander, with whites as the reference category in all cases)[1] and age.

Education was measured as the number of years of formal schooling at age 22 on a 13-point ordinal scale from 1 = 8th grade or less to 13 = completed post-baccalaureate profession education at age 29, and on a 16-point ordinal scale from 1 = 8th grade or less to 16 = completed a post-baccalaureate professional education. Nutritional status was measured with the BMI. Self-described health was measured on a five-point ordinal scale: 1 = poor, 2 = fair, 3 = good, 4 = very good, and 5 = excellent. Both nutritional status and self-described health were measured at the same time as the dependent variable.

Results

Puberty Net of education, nutritional status, and health, as well as age and race, childhood general intelligence was still significantly positively associated with puberty, both among girls (unstandardized coefficient = 0.011, standard error = 0.001, standardized coefficient = 0.162, $p < 0.001$) and boys (unstandardized coefficient = 0.009, standard error = 0.001, standardized coefficient = 0.140, $p < 0.001$). Thus, both more intelligent Add Health girls and more intelligent Add Health boys underwent puberty at earlier ages than their less intelligent counterparts did.

Reproductive Behavior As with the NCDS data in Study 1, the effect of childhood general intelligence on reproductive behavior was sometimes mediated by education, nutritional status, and health. Before controlling for our anticipated confounds,

[1] To further illustrate how these patterns appear across race, an analysis of the two major races (white and black) in the sample is provided in the supplemental materials.

net of race and age, more intelligent Add Health women had their first vaginal intercourse later (unstandardized coefficient = 0.019, standard error = 0.003, standardized coefficient = 0.081, $p < 0.001$), had fewer heterosexual sex partners before 18 (unstandardized coefficient = −0.018, standard error = 0.004, standardized coefficient = −0.055, $p < 0.001$), were less likely to be currently cohabiting at 22 (unstandardized coefficient = −0.009, standard error = 0.002, odds associated with a one standard deviation increase in general intelligence = 0.874, $p < 0.001$), were less likely to be currently legally married at 22 (unstandardized coefficient = −0.011, standard error = 0.002, odds associated with a one standard deviation increase in general intelligence = 0.848, $p < 0.001$), and had fewer children at 29 (unstandardized coefficient = −0.018, standard error = 0.001, $p < 0.001$). There are currently no widely accepted measures of standardized coefficients or effect sizes in generalized linear models like negative binomial regression (Hilbe, 2009; pp. 99–102).

The results prior to controlling for education, nutrition, and health were identical for Add Health men. Net of race and age, more intelligent Add Health men had their first vaginal intercourse later (unstandardized coefficient = 0.031, standard error = 0.004, standardized coefficient = 0.126, $p < 0.001$), had fewer heterosexual sex partners before 18 (standardized coefficient = −0.033, standard error = 0.005, standardized coefficient = −0.100, $p < 0.001$), were less likely to be currently cohabiting at 22 (standardized coefficient = −0.007, standard error = 0.002, odds associated with a one standard deviation increase in general intelligence = 0.900, $p = 0.005$), were less likely to be currently legally married at 22 (unstandardized coefficient = −0.009, standard error = 0.002, odds associated with a one standard deviation increase in general intelligence = 0.874, $p < 0.001$), and had fewer children at 29 (unstandardized coefficient = −0.015, standard error = 0.002, $p < 0.001$).

After controlling for education, nutrition, and health, however, childhood intelligence for Add Health women was not significantly associated with the age of first vaginal intercourse (unstandardized coefficient = -3.976^{-4}, standard error = 0.003, standardized coefficient = −0.002, $p = 0.899$), was significantly *positively* associated (contrary to prediction) with the number of heterosexual sex partners before 18 (unstandardized coefficient = 0.010, standard error = 0.004, standardized coefficient = 0.032, $p = 0.021$), while education was significantly negatively associated with it, was not significantly associated with whether the respondent was currently cohabiting at age 22 (unstandardized coefficient = 0.001, standard error = 0.002, odds associated with a one standard deviation increase in general intelligence = 1.015, $p = 0.689$), or currently married at 22 (unstandardized coefficient = −0.003, standard error = 0.002, odds associated with a one standard deviation increase in general intelligence = 0.956, $p = 0.253$). However, it was significantly negatively associated with the total number of biological children at 29 ($b = -0.007$, standard error = 0.001, $p < 0.001$).

For Add Health men, net of education, nutrition, and health, childhood general intelligence was still significantly positively associated with the age of first vaginal intercourse (unstandardized coefficient = 0.013, standard error = 0.004, standardized coefficient = 0.053, $p < 0.001$) and significantly negatively associated with the number of heterosexual sex partners before 18 (unstandardized coefficient = −0.012, standard error = 0.005, standardized coefficient = −0.037, $p = 0.012$). However, it was no longer significantly associated with whether the respondent was currently cohabitating at 22 (unstandardized coefficient = 0.001, standard error = 0.003, odds associated with a one standard deviation increase in general intelligence = 1.015, $p = 0.694$) or currently married at 22 (unstandardized coefficient = −0.002, standard error = 0.003, odds associated with a one standard deviation increase in general intelligence = 0.970, $p = 0.467$). However, childhood general intelligence was still significantly negatively associated with the total number of biological children at 29 ($b = -0.006$, standard error = 0.002, $p < 0.001$). For either women or men, education was not always significantly associated with reproductive behavior.

Once again, for illustrative purposes, Fig. 2 presents the association between childhood general intelligence, earlier puberty (obligate), and number of biological children (facultative) among Add Health girls/women (Panel 1) and boys/men (Panel 2). Figure 2a shows a monotonically positive association between childhood general intelligence and breast development at 16. The brightest girls, with IQs above 125, on average scored 3.54 while the least bright girls, with IQs below 75, on average scored 3.14 on the scale between 3 = My breasts are somewhat bigger than when I was in grade school and 4 = My breasts are a lot bigger than when I was in grade school. However, despite the fact that more intelligent girls underwent

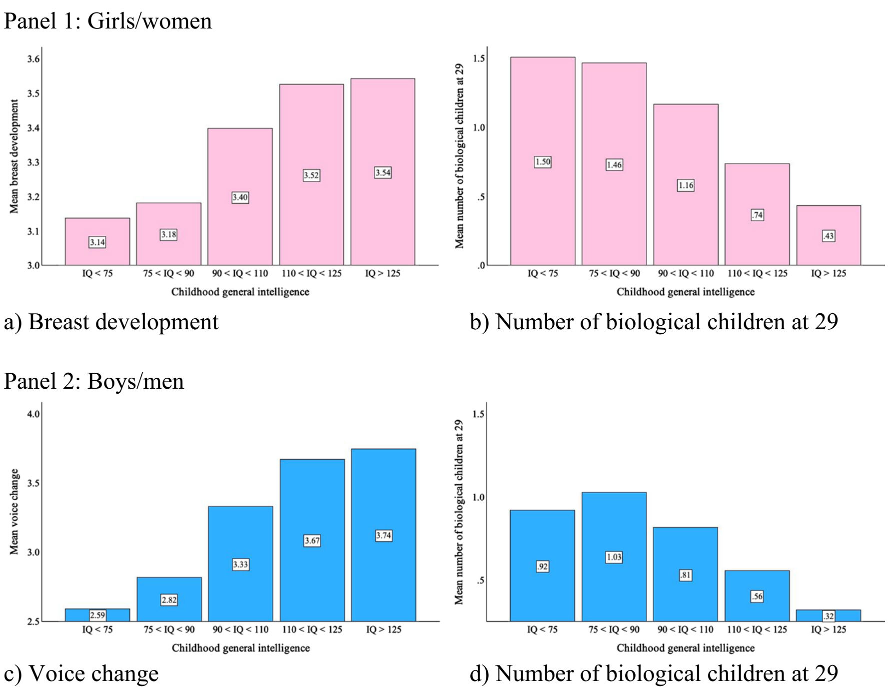

Fig. 2 Association between childhood general intelligence and the timing of puberty (obligate) and of reproductive behavior (facultative) among girls/women (Panel 1) and boys/men (Panel 2), National Longitudinal Study of Adolescent to Adult Health (United States)

puberty earlier than less intelligent girls did, Fig. 2b shows that the former had fewer biological children before 29 than the latter. More specifically, the brightest women on average had 0.43 children whereas the least bright women on average had 1.50 children.

The pattern is identical among Add Health boys/men. Figure 2c shows a monotonically positive association between childhood general intelligence and puberty, measured by voice change at 16. The brightest boys, with IQs above 125, on average scored 3.74 on a five-point scale where 2 = Yes, it is a little lower than when I was in grade school, 3 = Yes, it is somewhat lower than when I was in grade school, and 4 = Yes, it is a lot lower than when I was in grade school, whereas the least bright boys, with IQs below 75, on average scored 2.59. Once again, despite the fact that more intelligent boys underwent puberty earlier than less intelligent boys did, Fig. 2d shows that the former achieved lower reproductive success than the latter did. While the association was not quite monotonic, it nonetheless shows a generally negative association, where the brightest men on average had 0.32 children before 29, whereas the least bright men on average had 0.92 and the second least bright men on average had 1.03.

Discussion

The results with the Add Health data in Study 2 replicated the results with the NCDS data in Study 1, therefore reflecting convergent evidence using nationally and generationally distinct respondents as well as alternative measures. As with the NCDS, and consistent with our prediction derived from SIT, more intelligent girls and boys underwent puberty much earlier than less intelligent girls and boys did, because the more rigid aspect of puberty timing indicates general system integrity and genetic health. In contrast, and again consistent with our prediction derived from LHT and ENT, more intelligent women and men began their reproductive careers much later and achieved lower fertility than less intelligent women and men did, because the timing of the commencement of reproductive careers—when to start having sexual activities—and the extent of fertility—how many biological children to have—are much more flexibly determined by the individual. Similar to the NCDS data, more intelligent Add Health individuals were more likely to engage in evolutionarily novel behavior that our ancestors did not routinely engage in, like not engaging in sexual and reproductive behavior when they are fully biologically capable of doing so.

Taking into account confounding variables, Study 2 similarly found that the relationship between intelligence and puberty held net of controls, but the relationship between intelligence and reproductive behavior sometimes disappeared when controls were adjusted for. The direction of the association between intelligence and number of sexual partners before 18 for women was also reversed, thus revealing the complex psychosocial effects of education, nutrition, and health in relation to our variables of interest. Nevertheless, intelligence continued to independently predict having fewer children for both men and women, as well as delayed sexual experience and fewer sex partners for men, once more demonstrating its ability to predict reproductive behavior over and above confounds.

In sum, our analyses of both the NCDS data in Study 1 and the Add Health data in Study 2 confirmed our prediction that SIT better explains puberty timing, which is an obligate consequence of general system integrity and genetic health, whereas LHT and ENT jointly better explained reproductive decisions and behavior which are more facultative. The convergence of evidence using multiple measures from two separate nationally representative samples, separated by an ocean and a quarter of a century, and net of potential confounds increase our confidence in our conclusions.

General Discussion

Evolution involves the workings of several mechanisms in tandem as organisms strive to survive and reproduce. We identified three such mechanisms described by SIT, LHT, and ENT, each emphasizing distinct evolutionary forces occurring in specific contexts. Motivated by the paradox that intelligence predicts better semen quality (Arden et al., 2009) but also reduced fertility (Reeve et al., 2018), we proposed that SIT would predict the clustering of intelligence with obligate physiological traits (e.g., physical and reproductive health) whereas LHT stresses some facultative flexibility (e.g., adjustable behaviors according to reproductive preferences) which allows the expectations of ENT (i.e., intelligence driving evolutionarily novel preferences) of brighter individuals opting for slower reproduction to play out. To test the validity of our logic, we sought data sources that provided information on another physiological trait, puberty timing, and reproductive decisions such as preferences for sexual activity and number of children. Evidence from two nationally and generationally distinct samples confirmed that higher intelligence correlated with earlier puberty *and* indicators of slower reproduction including later sexual debut and fewer offspring. Moreover, we were able to achieve a degree of confidence in our model by confirming our predicted effects while accounting for a few potential confounds. Although some of the effects pertaining to facultative reproductive behavior disappeared, our results still showed that intelligence continued predicting puberty and several reproductive behavioral outcomes beyond the confounding effects of education, nutritional status, and health, thus constituting a robust test of our unification of SIT, LHT, and ENT and establishing the centrality of intelligence to our theorized mechanisms.

Our study advances a way to understand why and how people might act in often evolutionarily paradoxical ways. When organisms are endowed with certain qualities like better physical and reproductive capabilities, they typically proceed to translate those qualities into increased survival and reproductive success. According to LHT, the pursuit of adaptive goals is facilitated by a suite of traits comprising components that are both obligate (physiological) and facultative (preferences and behavior; Ellis et al., 2009). However, these dynamics become less straightforward when intelligence comes in because more intelligent individuals have evolutionarily novel tendencies (Kanazawa, 2004) which express themselves via routes that allow for more flexibility and control. Thus, a person may possess physiological and behavioral traits that do not always cohere and may even operate in opposite ways, especially when they are more intelligent. A key contribution of the current paper therefore rests in demonstrating how initially contrasting mechanisms, such as those described by SIT and ENT, can be accommodated under additional frameworks like LHT. In so doing, we highlight the importance of considering how obligate and facultative mechanisms interact in future analyses of evolved traits while adding to the literature on how outcomes that appear evolutionarily contradictory at first are ultimately still underscored by deep evolutionary logic (see Yong & Li, 2022).

The current findings constitute an important validation of ENT (Kanazawa, 2004), which illuminates the role of general intelligence in the acquisition and espousal of evolutionarily novel preferences and values (e.g., Kanazawa & Hellberg, 2010; Kanazawa & Perina, 2009, 2012; Kanazawa et al., 2022; Kanazawa, 2014b; Li & Kanazawa, 2016). This perspective carries significant implications for understanding where our species is headed, particularly in terms of global fertility, evolutionary mismatch, and the Flynn (1999) effect. Fertility is known to be declining at a disconcerting rate in many countries (Jarzebski et al., 2021), and preferences for slower reproduction have been raised as one reason for this decline (Yong et al., 2024). At the same time, humans are residing in environments that are increasingly mismatched from those our ancestors evolved to live in due to a growing reliance on and preference for cultural and technological inventions which create increasingly artificial or unnatural settings (Rolston III, 2017). Part of this immersion in unnatural environments could be spurred by preferences for evolutionarily novel stimuli as intelligence generally increases in the population over time (Flynn, 1999), which in turn drives an ever-increasing willingness to engage in evolutionarily novel behaviors and slower reproduction. Indeed, a growing number of people are giving up on traditional pursuits such as marriage and preferring to have pets rather than children or live in virtually augmented worlds (Guo et al., 2021; Yong et al., 2024). Thus, the current perspective may, at least in part, explain some of the difficulties faced by governments in motivating citizens to reproduce, because people with increasingly higher IQs in increasingly evolutionarily novel environments are preferring not to have sex or have children even if they have the means to do so.

Limitations

A limitation of the current research is that the data are correlational. Given the nature of our investigation, a randomized controlled experiment would not be feasible as intelligence cannot be manipulated. However, the use of prospectively longitudinal data with two independent large population samples is the next most viable alternative. Moreover, although the NCDS respondents were almost entirely Caucasian and may raise concerns regarding generalizability, the Add Health data included respondents from different racial groups and the results still held despite controlling for race.

Some psychologists and behavioral scientists might contend that our data coming solely from the two WEIRD (Western, Educated, Industrialized, Rich, and Democratic) nations that are most frequently studied—the United States and the United Kingdom—presents a limitation, as they believe that the exclusive reliance on WEIRD data might limit generalizability of findings to the rest of humanity (Henrich et al., 2010). However, as Kanazawa (2024) has recently argued, WEIRD societies actually represent the *best* locations to test any evolutionary psychological theories because individuals in such societies face the least social, cultural, institutional, and economic constraints on their behavior and are therefore freest to express their evolved human nature and tendencies. For example, and with regard to the current investigation specifically, girls and women in highly patriarchal and religiously restrictive societies would not be able to freely initiate sexual and reproductive activities at their chosen time or in their chosen manner no matter what their genetic tendencies and individual life history strategies might be. This is most evident in the fact that the World Values Surveys, which typically ask an *identical* set of questions to respondents from all nations in the world, routinely omit *all* questions about sexual behavior in Muslim nations, so our hypotheses above could not be tested in such societies. American and British women (and men) are among the freest to choose to engage in sexual and reproductive behavior on their own chosen schedule and following their own life history strategies.

Doubts may also exist over the validity of the theories and constructs used in our proposed model. For instance, some researchers have argued that puberty timing is not a clean marker of investment in current versus future reproduction which calls into question its relevance to life history development (Del Giudice, in press), though to be very precise we are viewing puberty not only in terms of reproductive pace but also as a marker of reproductive capability. Moreover, the application of LHT to human behavior has been criticized for being too simplistic or imprecise (Sear, 2020) or having problematic underlying assumptions (Volk, 2025), though some scholars suggest that the theory is in a validation phase where further research will likely clarify rather than eliminate it as a predictive framework for psychosocial phenomena (see, for e.g., the "LHT-P" model proposed by Nettle & Frankenhuis, 2020). As such, further tests of our model using other physiological indicators apart from puberty timing will contribute to validating not only our propositions but also LHT more broadly.

Lastly, an old criticism of ENT is that "general intelligence" or the *g*-factor as studied by psychometricians is not a particular ability or mechanism but the hypothetical explanans of a certain pattern of correlations among abilities. From this view, higher versus lower intelligence as measured by IQ largely reflects differences in cognitive speed and capacity rather than the presence of a special adaptation to novel environments. However, this view has been outmoded by Kanazawa's (2004) introduction of ENT and all the subsequent empirical evidence in support of it (summarized in Kanazawa, 2012), which comprehensively showed that what we now call "general intelligence" originally evolved as a domain-specific psychological adaptation to deal with evolutionarily novel problems. As such, "general intelligence" helps little in solving evolutionarily familiar problems, rendering more intelligent individuals (with higher levels of *g*) not much better than less intelligent individuals in handling commonplace situations like mating, parenting, and friendships (Kanazawa, 2004, 2007, 2012). Psychometric *g*, on the other hand, mainly indexes (relatively minor) individual differences (on the zoological scale from amoebas to humans) in the operation of this evolved psychological mechanism.

Future Directions

While our study is only the latest addition to a large array of studies that empirically support SIT, LHT, and ENT, this was the first time that a prediction for an integration of the three theories was tested. Thus, future studies should seek to examine our propositions using other combinations of theoretically relevant variables. For instance, SIT might predict an association between intelligence and obligate physiological traits other than puberty timing such as height (Pearce et al., 2005) or strength (Meincke et al., 2016); would the predictions of ENT that more intelligent individuals would capitalize less on those traits than less intelligent individuals would (e.g., taking up less physically demanding occupations) similarly occur through the more facultative aspects of LHT (e.g., long-term planning; Figueredo et al., 2006; Liu et al., 2023)?

Another way to test and refine our proposed synthesis further is to examine alternative explanations. Although many of our predicted links held despite controlling for a variety of confounds, it is noteworthy that some outcomes—in particular those pertaining to facultative reproductive behavior—were altered after factoring in education, nutritional status, and health. Future research can delve into the unique roles played by these factors in explaining the relationships between intelligence, reproductive capabilities, and reproductive behaviors. Considering that intelligence and education are so strongly correlated because of their mutually reinforcing effects on one another (Deary et al., 2007; Ritchie & Tucker-Drob, 2018; Roth et al., 2015), it is perhaps not too unexpected that they would appear interchangeable as predictors. Nevertheless, it will be highly illuminating to explore how education clarifies the dynamics we outlined. For example, intelligent individuals may have lengthened puberty because puberty is a critical period for brain development and learning (Fuhrmann et al., 2015; Larsen & Luna, 2018), and more intelligent individuals may be inclined toward extended learning as part of somatic investment to obtain highly specialized knowledge and competencies. Thus, intelligent individuals may enter puberty earlier but also finish later, which could also account for delayed reproduction. Other alternative explanations that are worth investigating include openness to experience, which correlates highly with intelligence (Bates & Shieles, 2003; DeYoung et al., 2005) and has been shown to be under negative selection in American samples (Jokela, 2012), or contraceptive use which, together with prolonged education, can result in low fertility among high-intelligence individuals (Colleran, 2016; Kanazawa, 2005; Kendal et al., 2005).

The impact of contraception—an evolutionarily novel innovation—is a particularly interesting area to explore because it decouples sexual activity from reproduction and thus renders number of children a less reliable proxy of reproductive behavior. Numerous studies have already demonstrated the complications that birth control creates for LHT-related research. For instance, *K*-factor scales have been shown to positively predict fertility when fast life history strategists—consistent with low parenting effort (Brase, 2013)—report desiring no offspring and use contraceptives to limit their fertility to desired levels (Mathes, 2018; Woodley of Menie et al., 2017). On the other hand, slow strategists may—consistent with higher parenting effort—actually desire children and, being planful, will produce their desired numbers of children and achieve a reproductive advantage, resulting in fertility outcomes that oppose what we might typically expect from LHT. As individual differences in life history strategy dynamically influence the use of contraception (B. C. Miller, 2002), further research that elucidates other routes by which intelligence activates or suppresses reproductive mechanisms through birth control and family planning will be insightful and contribute to addressing ambiguities in the LHT literature.

As a final word, why general intelligence not only predicts higher sperm quality but also rose over the last 100,000 years (as evidenced by polygenic score-based studies involving ancient DNA; e.g., Piffer & Kirkegaard, 2024; Woodley et al., 2017) despite being negatively correlated with fertility remains an interesting question and hints at additional mechanisms waiting to be uncovered. One way to attack this question is to think about how intelligence might compensate for its reduced fertility in order for selection to promote higher levels of the trait. For instance, more intelligent individuals may be producing higher quality offspring albeit at a slower rate, so the lower fertility is "paid for" by having more reproductively viable children (Kaplan et al., 2000; Yong et al., 2025). Another approach is to look at how other individuals with little to zero reproductive output, such as homosexuals (Vasey et al., 2007) and grandmothers (Hawkes et al., 1998), can still enhance their inclusive fitness by helping relatives survive and reproduce better. Thus, a speculative angle is whether more intelligent individuals who help their siblings to raise children can still be reproductively successful despite having fewer children themselves. There may also be hitherto unknown forms of sperm competition or stringent gametic selection among more intelligent or educated women which trade the fertility advantage implied by higher-quality sperm for offspring quality (e.g., Huber et al., 2010; Joshi, 2002; Pizzari & Parker, 2009; Urbina et al., 2024; Whyte et al., 2018). Importantly, it could also be that general intelligence was selected because more intelligent individuals had more children in the ancestral environment. While it is not possible to know what the correlation between general intelligence and fertility was in the ancestral past, the negative correlation where more intelligent individuals have fewer children today could be due to intelligence being the root of much evolutionarily mismatched behavior (e.g., Kanazawa et al., 2022; Kanazawa, 2004, 2014b). Once again, gamete quality is obligate whereas reproductive behavior—when to have sex and how many children to have—is facultative, and more intelligent individuals in highly mismatched modern environments have more affordances to pursue the evolutionarily atypical behavior of having fewer children.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40750-025-00258-5.

Author Contribution J. Y. and S. K. contributed equally to the manuscript.

Funding None.

Data Availability The NCDS data used in Study 1 are publicly and freely available to registered users of the UK Data Service (https://ukdataservice.ac.uk/). The Add Health data used in Study 2 can be obtained by contacting addheath-contracts@unc.edu and signing a one-year no-fee contract for replication purposes only.

Declarations

Conflict of Interest The authors declare no competing interests.

References

Alwin, D. F., & McCammon, R. J. (1999). Aging versus cohort interpretations of intercohort differences in GSS vocabulary scores. *American Sociological Review, 64*, 272–286. https://doi.org/10.2307/2657532

Anderson, E. L., Howe, L. D., Wade, K. H., Ben-Shlomo, Y., Hill, W. D., Deary, I. J., ... & Hemani, G. (2020). Education, intelligence and Alzheimer's disease: evidence from a multivariable two-sample Mendelian randomization study. *International Journal of Epidemiology*, *49*(4), 1163–1172. https://doi.org/10.1093/ije/dyz280

Arden, R., Gottfredson, L. S., Miller, G. F., & Pierce, A. (2009). Intelligence and semen quality are positively correlated. *Intelligence, 37*(3), 277–282. https://doi.org/10.1016/j.intell.2008.11.001

Arden, R., Luciano, M., Deary, I. J., Reynolds, C. A., Pedersen, N. L., Plassman, B. L., ... & Visscher, P. M. (2016). The association between intelligence and lifespan is mostly genetic. *International Journal of Epidemiology*, *45*(1), 178–185. https://doi.org/10.1093/ije/dyv112

Asklund, C., Jensen, T. K., Jørgensen, N., Tabor, A., Sperling, L., & Skakkebæk, N. E. (2007). Twin pregnancy possibly associated with high semen quality. *Human Reproduction, 22*(3), 751–755. https://doi.org/10.1093/humrep/del449

Bailey, J. M., Kirk, K. M., Zhu, G., Dunne, M. P., & Martin, N. G. (2000). Do individual differences in sociosexuality represent genetic or environmentally contingent strategies? Evidence from the Australian twin registry. *Journal of Personality and Social Psychology, 78*(3), 537–545. https://doi.org/10.1037/0022-3514.78.3.537

Barbaro, N., Shackelford, T. K., Holub, A. M., Jeffery, A. J., Lopes, G. S., & Zeigler-Hill, V. (2019). Life history correlates of human (Homo sapiens) ejaculate quality. *Journal of Comparative Psychology, 133*(3), 294–300. https://doi.org/10.1037/com0000161

Bates, T. C., & Shieles, A. (2003). Crystallized intelligence as a product of speed and drive for experience: The relationship of inspection time and openness to *g* and Gc. *Intelligence, 31*(3), 275–287. https://doi.org/10.1016/S0160-2896(02)00176-9

Bostofte, E., Serup, J., & Rebbe, H. (1982). Relation between sperm count and semen volume, and pregnancies obtained during a twenty-year follow-up period. *International Journal of Andrology, 5*(3), 267–275. https://doi.org/10.1111/j.1365-2605.1982.tb00255.x

Brant, A. M., Munakata, Y., Boomsma, D. I., DeFries, J. C., Haworth, C. M., Keller, M. C., ... & Hewitt, J. K. (2013). The nature and nurture of high IQ: an extended sensitive period for intellectual development. *Psychological Science*, *24*(8), 1487–1495. https://doi.org/10.1177/0956797612473119

Brase, G. (2013). *Do life-history strategies and mating orientation translate into desires for children? Oral Presentation given at the 25th Annual Meeting of the Human Behavior and Evolution Society*. Florida, USA.

Calvin, C. M., Batty, G. D., & Deary, I. J. (2011). Cognitive epidemiology. In T. Chamorro-Premuzic, S. von Stumm, & A. Furnham (Eds.), *The Wiley-Blackwell handbook of individual differences* (pp. 427–460). Wiley-Blackwell. https://doi.org/10.1002/9781444343120.ch16

Colleran, H. (2016). The cultural evolution of fertility decline. *Philosophical Transactions of the Royal Society b: Biological Sciences, 371*, 20150152. https://doi.org/10.1098/rstb.2015.0152

Corning, P. A., Kauffman, S. A., Noble, D., Shapiro, J. A., & Vane-Wright, R. I. (Eds.). (2023). *Evolution "on purpose": Teleonomy in living systems*. MIT Press.

Deary, I. J. (2010). Cognitive epidemiology: Its rise, its current issues, and its challenges. *Personality and Individual Differences, 49*(4), 337–343. https://doi.org/10.1016/j.paid.2009.11.012

Deary, I. J., Strand, S., Smith, P., & Fernandes, C. (2007). Intelligence and educational achievement. *Intelligence, 35*(1), 13–21. https://doi.org/10.1016/j.intell.2006.02.001

Deary, I. J., Weiss, A., & Batty, G. D. (2010). Intelligence and personality as predictors of illness and death: How researchers in differential psychology and chronic disease epidemiology are collaborating to understand and address health inequalities. *Psychological Science in the Public Interest, 11*(2), 53–79. https://doi.org/10.1177/1529100610387081

Del Giudice, M. A. (in press). A turning point for the life history approach to individual differences. In S. Kanazawa (Ed.), *Genes, environments, and differential susceptibility: Current topics in evolutionary developmental psychology*. Cambridge University Press.

DeLecce, T., Fink, B., Shackelford, T., & Abed, M. G. (2020). No evidence for a relationship between intelligence and ejaculate quality. *Evolutionary Psychology, 18*(3), 1474704920960450. https://doi.org/10.1177/1474704920960450

DeYoung, C. G., Peterson, J. B., & Higgins, D. M. (2005). Sources of openness/intellect: Cognitive and neuropsychological correlates of the fifth factor of personality. *Journal of Personality, 73*, 825–858. https://doi.org/10.1111/j.1467-6494.2005.00330.x

Dunkel, C. S., van der Linden, D., & Holler, R. H. (2021). Life history strategy and intelligence: Commonality and personality profile differences. *Personality and Individual Differences, 175*, 110667. https://doi.org/10.1016/j.paid.2021.110667

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk: The impact of harsh versus unpredictable environments on the evolution and development of life history strategies. *Human Nature, 20*, 204–268. https://doi.org/10.1007/s12110-009-9063-7

Figueredo, A. J., Vásquez, G., Brumbach, B. H., Schneider, S. M., Sefcek, J. A., Tal, I. R., ... & Jacobs, W. J. (2006). Consilience and life history theory: From genes to brain to reproductive strategy. *Developmental Review*, *26*(2), 243–275. https://doi.org/10.1016/j.dr.2006.02.002

Figueredo, A. J., Cuthbertson, A. M., Kauffman, I. A., Weil, E., & Gladden, P. R. (2012). The interplay of behavioral dispositions and cognitive abilities: Sociosexual orientation, emotional intelligence, executive functions and life history strategy. *Temas Em Psicologia*, *20*(1), 87–100. https://pepsic.bvsalud.org/scielo.php?pid=S1413-389X2012000100008&script=sci_abstract&tlng=en. Accessed 18 Feb 2025

Figueredo, A. J., Wolf, P. S. A., Olderbak, S. G., Gladden, P. R., Fernandes, H. B. F., Wenner, C., ... & Rushton, J. P. (2014). The psychometric assessment of human life history strategy: A meta-analytic construct validation. *Evolutionary Behavioral Sciences*, *8*(3), 148–185. https://doi.org/10.1037/h0099837

Flynn, J. R. (1999). Searching for justice: The discovery of IQ gains over time. *American Psychologist, 54*(1), 5–20. https://doi.org/10.1037/0003-066X.54.1.5

Frankenhuis, W. E., & Amir, D. (2022). What is the expected human childhood? Insights from evolutionary anthropology. *Development and Psychopathology, 34*(2), 473–497. https://doi.org/10.1017/S0954579421001401

Fuhrmann, D., Knoll, L. J., & Blakemore, S. J. (2015). Adolescence as a sensitive period of brain development. *Trends in Cognitive Sciences, 19*(10), 558–566. https://doi.org/10.1016/j.tics.2015.07.008

Glenn, N. D. (1999). Further discussion of the evidence for an intercohort decline in education-adjusted vocabulary. *American Sociological Review, 64*, 267–271. https://doi.org/10.2307/2657531

Guo, Z., Ren, X., Zhao, J., Jiao, L., & Xu, Y. (2021). Can pets replace children? The interaction effect of pet attachment and subjective socioeconomic status on fertility intention. *International Journal of Environmental Research and Public Health, 18*(16), 8610. https://doi.org/10.3390/ijerph18168610

Halpern, C. T., Joyner, K., Udry, J. R., & Suchindran, C. (2000). Smart teens don't have sex (or kiss much either). *Journal of Adolescent Health, 26*(3), 213–225. https://doi.org/10.1016/S1054-139X(99)00061-0

Hawkes, K., O'Connell, J. F., Jones, N. B., Alvarez, H., & Charnov, E. L. (1998). Grandmothering, menopause, and the evolution of human life histories. *Proceedings of the National Academy of Sciences, 95*(3), 1336–1339. https://doi.org/10.1073/pnas.95.3.1336

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences, 33*, 61–135. https://doi.org/10.1017/s0140525x0999152x

Hilbe, J. M. (2009). Logistic regression models. *CRC Press*. https://doi.org/10.1201/9781420075779

Hilbe, J. M. (2011). *Negative binomial regression* (2nd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511973420

Hopcroft, R. L. (2006). Sex, status, and reproductive success in the contemporary United States. *Evolution and Human Behavior, 27*(2), 104–120. https://doi.org/10.1016/j.evolhumbehav.2005.07.004
Hope, D., Bates, T. C., Dykiert, D., Der, G., & Deary, I. J. (2015). More symmetrical children have faster and more consistent choice reaction times. *Developmental Psychology, 51*(4), 524–532. https://doi.org/10.1037/a0038756
Huang, M.-H., & Hauser, R. M. (1998). Trends in black-white test-score differentials: II. The WORDSUM vocabulary test. In Neisser, U. (ed.), *The rising curve: Long-term gains in IQ and related measures* (pp. 303–332). American Psychological Association. https://doi.org/10.1037/10270-011
Huber, S., Bookstein, F. L., & Fieder, M. (2010). Socioeconomic status, education, and reproduction in modern women: An evolutionary perspective. *American Journal of Human Biology, 22*(5), 578–587. https://doi.org/10.1002/ajhb.21048
Isler, K., & van Schaik, C. P. (2006). Metabolic costs of brain size evolution. *Biology Letters, 2*(4), 557–560. https://doi.org/10.1098/rsbl.2006.0538
Ivanovic, D. M., Leiva, B. P., Pérez, H. T., Olivares, M. G., Dıaz, N. S., Urrutia, M. S. C., ... & Larraın, C. G. (2004). Head size and intelligence, learning, nutritional status and brain development: head, IQ, learning, nutrition and brain. *Neuropsychologia*, *42*(8), 1118–1131. https://doi.org/10.1016/j.neuropsychologia.2003.11.022
Jarzebski, M. P., Elmqvist, G. A., Fukushi, K., Eckersten, S., Haase, D., Goodness, J., Khoshkar, S., Saito, O., Takeuchi, K., Theorell, T., Dong, N., Kasuga, F., Watanabe, R., Sioen, G. B., Yokohari, M., & Pu, J. (2021). Ageing and population shrinking: Implications for sustainability in the urban century. *NPJ Urban Sustainability, 1*(1), 17. https://doi.org/10.1038/s42949-021-00023-z
Jokela, M. (2012). Birth-cohort effects in the association between personality and fertility. *Psychological Science, 23*(8), 835–841. https://doi.org/10.1177/0956797612439067
Joshi, H. (2002). Production, reproduction, and education: Women, children, and work in a British perspective. *Population and Development Review, 28*(3), 445–474. https://doi.org/10.1111/j.1728-4457.2002.00445.x
Kanazawa, S. (2004). General intelligence as a domain-specific adaptation. *Psychological Review, 111*, 512–523. https://doi.org/10.1037/0033-295X.111.2.512
Kanazawa, S. (2005). An empirical test of a possible solution to "the central theoretical problem of human sociobiology." *Journal of Cultural and Evolutionary Psychology, 3*(3–4), 255–266. https://doi.org/10.1556/JCEP.3.2005.3-4.3
Kanazawa, S. (2007). Mating intelligence and general intelligence as independent constructs. In G. Geher & G. F. Miller (Eds.), *Mating intelligence* (pp. 309–336). Psychology Press.
Kanazawa, S. (2012). *The intelligence paradox: Why the intelligent choice isn't always the smart one*. Turner Publishing Company.
Kanazawa, S. (2014a). General intelligence, disease heritability, and health: A preliminary test. *Personality and Individual Differences, 71*, 83–85. https://doi.org/10.1016/j.paid.2014.07.028
Kanazawa, S. (2014b). Intelligence and childlessness. *Social Science Research, 48*, 157–170. https://doi.org/10.1016/j.ssresearch.2014.06.003
Kanazawa, S. (2024). Why all evolutionary psychological theories must be tested in WEIRD societies. *Evolutionary Psychological Science, 10*, 33–39. https://doi.org/10.1007/s40806-024-00383-6
Kanazawa, S., & Hellberg, J. E. (2010). Intelligence and substance use. *Review of General Psychology, 14*(4), 382–396. https://doi.org/10.1037/a0021526
Kanazawa, S., & Kovar, J. L. (2004). Why beautiful people are more intelligent. *Intelligence, 32*(3), 227–243. https://doi.org/10.1016/j.intell.2004.03.003
Kanazawa, S., & Perina, K. (2009). Why night owls are more intelligent. *Personality and Individual Differences, 47*(7), 685–690. https://doi.org/10.1016/j.paid.2009.05.021
Kanazawa, S., & Perina, K. (2012). Why more intelligent individuals like classical music. *Journal of Behavioral Decision Making, 25*(3), 264–275. https://doi.org/10.1002/bdm.730
Kanazawa, S., Li, N. P., & Yong, J. C. (2022). Sunshine on my shoulders makes me happy… especially if I'm less intelligent: How sunlight and intelligence affect happiness in modern society. *Cognition and Emotion, 36*(4), 722–730. https://doi.org/10.1080/02699931.2022.2029358
Kaplan, H., Hill, K., Lancaster, J., & Hurtado, A. M. (2000). A theory of human life history evolution: Diet, intelligence, and longevity. *Evolutionary Anthropology, 9*(4), 156–185. https://doi.org/10.1002/1520-6505(2000)9:4%3c156::AID-EVAN5%3e3.0.CO;2-7
Kendal, J. R., Ihara, Y., & Feldman, M. W. (2005). Cultural niche construction with application to fertility control: A model for education and social transmission of contraceptive use. *Morrison Institute for Population and Resource Studies*. Working Paper, 102.

Kirkegaard, H., Möller, S., Wu, C., Häggström, J., Olsen, S. F., Olsen, J., & Nohr, E. A. (2020). Associations of birth size, infancy, and childhood growth with intelligence quotient at 5 years of age: A Danish cohort study. *The American Journal of Clinical Nutrition, 112*(1), 96–105. https://doi.org/10.1093/ajcn/nqaa051

Larsen, B., & Luna, B. (2018). Adolescence as a neurobiological critical period for the development of higher-order cognition. *Neuroscience and Biobehavioral Reviews, 94*, 179–195. https://doi.org/10.1016/j.neubiorev.2018.09.005

Lawlor, D. A., Batty, G. D., Morton, S. M., Deary, I. J., Macintyre, S., Ronalds, G., & Leon, D. A. (2005). Early life predictors of childhood intelligence: Evidence from the Aberdeen children of the 1950s study. *Journal of Epidemiology and Community Health, 59*(8), 656–663. https://doi.org/10.1136/jech.2004.030205

Li, N. P., & Kanazawa, S. (2016). Country roads, take me home… to my friends: How intelligence, population density, and friendship affect modern happiness. *British Journal of Psychology, 107*, 675–697. https://doi.org/10.1111/bjop.12181

Liu, Y. Y., Lu, H. J., Zhu, N., & Chang, L. (2023). Environmental harshness, life history, and crystallized intelligence of Chinese adolescents. *Evolutionary Psychology, 21*(3), 14747049231190052. https://doi.org/10.1177/14747049231190051

Maestripieri, D., Henry, A., & Nickels, N. (2017). Explaining financial and prosocial biases in favor of attractive people: Interdisciplinary perspectives from economics, social psychology, and evolutionary psychology. *Behavioral and Brain Sciences, 40*, e19. https://doi.org/10.1017/s0140525x16000340

Mathes, E. W. (2018). Life history theory and tradeoffs: An obituary study. *Evolutionary Psychological Science, 4*, 391–398. https://doi.org/10.1007/s40806-018-0144-x

Mayer, R. E. (2000). Intelligence and education. In R. J. Sternberg (Ed.), *Handbook of intelligence* (pp. 519–533). Cambridge University Press. https://doi.org/10.1017/CBO9780511807947.024

Meincke, R. H., Osler, M., Mortensen, E. L., & Hansen, Å. M. (2016). Is intelligence in early adulthood associated with midlife physical performance among Danish males? *Journal of Aging and Health, 28*(3), 530–545. https://doi.org/10.1177/0898264315594139

Meisenberg, G. (2010). The reproduction of intelligence. *Intelligence, 38*(2), 220–230. https://doi.org/10.1016/j.intell.2010.01.003

Miller, G. F. (2000). Mental traits as fitness indicators: Expanding evolutionary psychology's adaptationism. *Annals of the New York Academy of Sciences, 907*, 62–74. https://doi.org/10.1111/j.1749-6632.2000.tb06616.x

Miller, B. C. (2002). Family influences on adolescent sexual and contraceptive behavior. *Journal of Sex Research, 39*(1), 22–26. https://doi.org/10.1080/00224490209552115

Miner, J. B. (1957). *Intelligence in the United States: A survey – with conclusions for manpower utilization in education and employment*. Springer.

Nettle, D., & Frankenhuis, W. E. (2020). Life-history theory in psychology and evolutionary biology: One research programme or two? *Philosophical Transactions of the Royal Society of London Series b: Biological Sciences, 375*(1803), 20190490. https://doi.org/10.1098/rstb.2019.0490

Patel, D. P., Meeks, H. T., Hanson, H. A., Pastuszak, A. W., Hotaling, J. M., & Smith, K. R. (2021). Lower total motile count is associated with smaller historic intergenerational family size: A pedigree analysis from the Utah population database. *Journal of Assisted Reproduction and Genetics, 38*, 1207–1213. https://doi.org/10.1007/s10815-021-02115-2

Pearce, M. S., Deary, I. J., Young, A. H., & Parker, L. (2005). Growth in early life and childhood IQ at age 11 years: The Newcastle Thousand Families Study. *International Journal of Epidemiology, 34*(3), 673–677. https://doi.org/10.1093/ije/dyi038

Piffer, D., & Kirkegaard, E. O. W. (2024). Evolutionary trends of polygenic scores in European populations from the Paleolithic to modern times. *Twin Research and Human Genetics, 27*(1), 30–49. https://doi.org/10.1017/thg.2024.8

Pizzari, T., & Parker, G. A. (2009). Sperm competition and sperm phenotype. *Sperm Biology*, 207–245. https://doi.org/10.1016/B978-0-12-372568-4.00006-9

Pontzer, H., & McGrosky, A. (2022). Balancing growth, reproduction, maintenance, and activity in evolved energy economies. *Current Biology, 32*(12), R709–R719. https://doi.org/10.1016/j.cub.2022.05.018

Prokosch, M. D., Yeo, R. A., & Miller, G. F. (2005). Intelligence tests with higher *g*-loadings show higher correlations with body symmetry: Evidence for a general fitness factor mediated by developmental stability. *Intelligence, 33*(2), 203–213. https://doi.org/10.1016/j.intell.2004.07.007

Račevska, E., & Tadinac, M. (2019). Intelligence, music preferences, and uses of music from the perspective of evolutionary psychology. *Evolutionary Behavioral Sciences, 13*(2), 101–110. https://doi.org/10.1037/ebs0000124

Reeve, C. L., Heeney, M. D., & Woodley of Menie, M. A. (2018). A systematic review of the state of literature relating parental general cognitive ability and number of offspring. *Personality and Individual Differences, 134*, 107–118. https://doi.org/10.1016/j.paid.2018.05.036

Ritchie, S. J., & Tucker-Drob, E. M. (2018). How much does education improve intelligence? A meta-analysis. *Psychological Science, 29*(8), 1358–1369. https://doi.org/10.1177/0956797618774253

Rolston III, H. (2017). Technology and/or nature: Denatured/renatured/engineered/artifacted life? *Ethics and the Environment, 22*(1), 41–62. https://doi.org/10.2979/ethicsenviro.22.1.03

Roth, B., Becker, N., Romeyke, S., Schäfer, S., Domnick, F., & Spinath, F. M. (2015). Intelligence and school grades: A meta-analysis. *Intelligence, 53*, 118–137. https://doi.org/10.1016/j.intell.2015.09.002

Sear, R. (2020). Do human ‘life history strategies’ exist? *Evolution and Human Behavior, 41*(6), 513–526. https://doi.org/10.1016/j.evolhumbehav.2020.09.004

Sigman, M., & Whaley, S. E. (1998). The role of nutrition in the development of intelligence. In U. Neisser (Ed.), *The rising curve: Long-term gains in IQ and related measures* (pp. 155–182). American Psychological Association. https://doi.org/10.1037/10270-005

Simonton, D. K. (2015). Psychology as a science within Comte’s hypothesized hierarchy: Empirical investigations and conceptual implications. *Review of General Psychology, 19*(3), 334–344. https://doi.org/10.1037/gpr0000039

Sternberg, R. J. (2017). An alternative interpretation of climate data: Intelligence. *Behavioral and Brain Sciences, 40*, e96. https://doi.org/10.1017/S0140525X16001102

Urbina, D. R., Frye, M., & Lopus, S. (2024). No end to hypergamy when considering the full married population. *Population and Development Review, 50*(3), 909–922. https://doi.org/10.1111/padr.12643

Vasey, P. L., Pocock, D. S., & VanderLaan, D. P. (2007). Kin selection and male androphilia in Samoan *fa’afafine*. *Evolution and Human Behavior, 28*(3), 159–167. https://doi.org/10.1016/j.evolhumbehav.2006.08.004

Villamor, E., & Jansen, E. C. (2016). Nutritional determinants of the timing of puberty. *Annual Review of Public Health, 37*(1), 33–46. https://doi.org/10.1146/annurev-publhealth-031914-122606

Volk, A. A. (2025). Pumping the brakes on Psychosocial Acceleration Theory: Revisiting its underlying assumptions. *Evolution and Human Behavior, 46*(1), 106657. https://doi.org/10.1016/j.evolhumbehav.2025.106657

Walasek, N., Frankenhuis, W. E., & Panchanathan, K. (2022). Sensitive periods, but not critical periods, evolve in a fluctuating environment: A model of incremental development. *Proceedings of the Royal Society B, 289*(1969), 20212623. https://doi.org/10.1098/rspb.2021.2623

Whyte, S., Chan, H. F., & Torgler, B. (2018). Do men and women know what they want? Sex differences in online daters’ educational preferences. *Psychological Science, 29*(8), 1370–1375. https://doi.org/10.1177/0956797618771081

Wilson, J. A., & Gove, W. R. (1999). The intercohort decline in verbal ability: Does it exist? *American Sociological Review, 64*, 253–266. https://doi.org/10.2307/2657530

Wolfle, L. M. (1980). The enduring effects of education on verbal skills. *Sociology of Education, 53*(2), 104–114. https://doi.org/10.2307/2112492

Wood, C. L., Lane, L. C., & Cheetham, T. (2019). Puberty: Normal physiology (brief overview). *Best Practice and Research Clinical Endocrinology and Metabolism, 33*(3), 101265. https://doi.org/10.1016/j.beem.2019.03.001

Woodley, M. A. (2011). The cognitive differentiation-integration effort hypothesis: A synthesis between the fitness indicator and life history models of human intelligence. *Review of General Psychology, 15*(3), 228–245. https://doi.org/10.1037/a0024348

Woodley of Menie, M. A., & Madison, G. (2015). The association between *g* and *K* in a sample of 4246 Swedish twins: A behavior genetic analysis. *Personality and Individual Differences*, *75*, 80-84. https://doi.org/10.1016/j.paid.2014.10.027

Woodley, M. A., Younuskunju, S., Balan, B., & Piffer, D. (2017). Holocene selection for variants associated with general cognitive ability: Comparing ancient and modern genomes. *Twin Research and Human Genetics, 20*(4), 271–280. https://doi.org/10.1017/thg.2017.37

Woodley of Menie, M. A., Cabeza de Baca, T., Fernandes, H. B. F., Madison, G., Figueredo, A. J., & Aguirre, M. P. (2017). Slow and steady wins the race: K positively predicts fertility in the USA and Sweden. *Evolutionary Psychological Science*, *3*, 109-117.https://doi.org/10.1007/s40806-016-0077-1

Yong, J. C., & Li, N. P. (2022). Elucidating evolutionary principles with the traditional Mosuo: Adaptive benefits and origins of matriliny and "walking marriages." *Culture and Evolution, 19*(1), 22–40. https://doi.org/10.1556/2055.2022.00017

Yong, J. C., Lim, A. J. Y., & Li, N. P. (2024). When social status gets in the way of reproduction in modern settings: An evolutionary mismatch perspective. *Culture and Evolution, 20*(1), 59–76. https://doi.org/10.1556/2055.2022.00028

Yong, J. C., Lim, C. H., Jonason, P. K., & Thomas, A. G. (2025). Income and sex moderate the association between population density and reproduction: A multilevel analysis of life history strategies across 23 nations. *Archives of Sexual Behavior*, *54*, 289–305. https://doi.org/10.1007/s10508-024-02955-w

Zamroziewicz, M. K., Talukdar, M. T., Zwilling, C. E., & Barbey, A. K. (2017). Nutritional status, brain network organization, and general intelligence. *NeuroImage, 161*, 241–250. https://doi.org/10.1016/j.neuroimage.2017.08.043

Authors and Affiliations

Jose C. Yong[1] · Satoshi Kanazawa[2]

✉ Jose C. Yong
jose.yong@jcu.edu.au

Satoshi Kanazawa
S.Kanazawa@lse.ac.uk

1 Present Address: School of Social and Health Sciences, James Cook University, 49 Sims Drive, Singapore 387380, Singapore

2 Department of Management, London School of Economics and Political Science, Houghton Street, London WC2A 2AE, UK