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Beautiful British Parents Have More Daughters

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Abstract

The generalized Trivers-Willard hypothesis proposes that parents who possess any heritable trait that increases male reproductive success at a greater rate than female reproductive success in a given environment will have a higher-than-expected offspring sex ratio (more sons), and parents who possess any heritable trait that increases female reproductive success at a greater rate than male reproductive success in a given environment will have a lower-than-expected offspring sex ratio (more daughters). One heritable trait that increases the reproductive success of daughters much more than that of sons is physical attractiveness. The generalized Trivers-Willard hypothesis therefore predicts that physically attractive parents have more daughters. Further, if beautiful parents have more daughters and physical attractiveness is heritable, then over evolutionary history women on average should gradually become more attractive than men. The analysis of the prospectively longitudinal National Child Development Study in the United Kingdom replicates earlier findings with an American sample and confirms both hypotheses. British children who are rated by their teachers as "attractive" at age 7 have 23% higher odds of having a daughter 40 years later (proportion sons = 0.50127); those who are rated by their teachers as "unattractive" at age 7 have 25% higher odds of having a son 40 years later (proportion sons = 0.56285).

Keywords

Evolutionary biology, generalized Trivers-Willard hypothesis, offspring sex ratios, physical attractiveness

Introduction

The Trivers-Willard hypothesis[1] (TWH) proposes that parents might under some circumstances be able to vary the sex ratio of their offspring facultatively in order to maximize their reproductive success. In particular, the TWH predicts that parents in good condition are more likely to have sons, and parents in poor condition are more likely to have daughters. This prediction has been supported by data from a large number of experiments with a wide array of species.[2-4] Recent meta-analyses of the TWH include Ewen, Cassey, and Møller for birds,[5] Sheldon and West[6] for ungulates, and Cameron[7] for mammals in general. Dickemann[8,9] was the first to apply the TWH specifically to human populations, and more recent support among humans include Betzig and Weber,[10] Cameron and Dalerum,[11] Cronk,[12] Gaulin and Robbins,[13] Kanazawa,[14] and Mueller.[15]

While the TWH is one of the most celebrated principles in evolutionary biology and the preponderance of empirical evidence supports it, not all human studies have been supportive. Among industrial populations, Koziel and Ulijaszek[16] provide only qualified support, and Freese and Powell,[17] Keller et al,[18] and Ellis and Bonin[19] find no support among North American populations. Among the preindustrial populations, Stein et al[20] find no support in Ethiopia, Whiting[21] shows that polygynous mothers (who are on average married to wealthier husbands than monogamous mothers) have lower secondary sex ratios in several tribes in Kenya, and Guggenheim et al[22] uncover no support for the TWH in 35 developing nations.

While the TWH in its original formulation has specifically to do with material and economic condition of parents, the basic insight behind it may be more general. The fundamental assumption underlying the TWH is that, if males are expected to attain greater reproductive success than females, *for whatever reason*, then parents may have more sons than daughters. If, in contrast, females are expected to attain greater reproductive success than males, *for whatever reason*, then parents may have more daughters than sons. While female fitness variance is much smaller than male fitness variance among mammalian species, there is still variance among females, and some women do better than others, in terms of quality, if not quantity, of offspring.

Kanazawa[23] thus proposes the generalized Trivers-Willard hypothesis (gTWH):

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Generalized TWH: Parents who possess any heritable trait that increases male reproductive success at a greater rate (or decreases male reproductive success at a smaller rate) than female reproductive success in a given environment will have a higher-than-expected offspring sex ratio (more males). Parents who possess any heritable trait that increases female reproductive success at a greater rate (or decreases female reproductive success at a smaller rate) than male reproductive success in a given environment will have a lower-than-expected offspring sex ratio (more females).

There has been emerging evidence for the gTWH with respect to a variety of heritable traits that increase the expected reproductive success of sons or daughters. For example, big and tall parents have more sons[23-28]; sexually promiscuous parents have more sons[29,30]; violent men have more sons[31]; mothers (though not fathers) with developmental language impairment have more sons[32]; and individuals with strong systemizing brains, such as engineers, scientists, and mathematicians, have more sons, whereas those with strong empathizing brains, such as nurses, kindergarten teachers, and social workers, have more daughters.[33]

One heritable characteristic that increases daughters' reproductive success much more than sons' is physical attractiveness. Men universally seek women who are physically attractive for both long-term and short-term mating[34] because physical attractiveness is a phenotypic marker of genetic and developmental health.[35] In contrast, women have a strong preference for physically attractive men only for short-term mating (extrapair copulations).[36,37] For long-term mating, men's other traits, such as wealth and status, become more important[34] or receive higher priority.[37]

And physical attractiveness is heritable. While there has not been any study whose *principal* purpose is to demonstrate the heritability of physical attractiveness (perhaps because everyone unquestioningly assumes that beautiful parents beget beautiful children without any need for empirical demonstration), one twin study[38] suggests that the heritability of physical attractiveness $h^2 = .64$.[39] Rowe et al[40] show that the correlation in physical attractiveness between MZ twins, corrected for measurement errors, is $r = .94$, which implies a very high h^2.

Both the "sexy son" hypothesis[41] and the good-gene sexual selection theory[36] posit that physically attractive men can increase their reproductive success, not by forming pair-bonded relationships in which to raise and invest in children, but by having a large number of extrapair copulations with otherwise mated women and cuckolding their mates. Given that the probability of conception per coital act is estimated to be about .03,[42] however, a man must have 33 extrapair copulation partners (with whom he has sex once each) in order to be able to expect to produce 1 child (number of potential conception = .99). A man could achieve roughly the same number of children with 1 sexual partner with whom he has regular sex (twice a week) (number of potential conception = .96). It would be very difficult for a man to have more than 30 extrapair copulation partners in a year, especially in the ancestral environment, where our ancestors lived in a small band of about 150 individuals (men, women, and children).

The logic of the gTWH therefore suggests that physically attractive parents should be more likely to have daughters. An earlier study, with a large nationally representative sample of Americans, supports this prediction.[43] Because some have questioned the robustness of this conclusion,[44] however, I now seek to replicate the earlier finding with a British sample

Empirical Analysis

Data

The National Child Development Study (NCDS) is a large-scale prospectively longitudinal study that has followed a *population* of British respondents since birth for more than half a century. The study includes all babies (n = 17 419) born in Great Britain (England, Wales, and Scotland) during 1 week (March 03-09, 1958). The respondents are subsequently reinterviewed in 1965 (Sweep 1 at age 7; n = 15 496), in 1969 (Sweep 2 at age 11; n = 18 285), in 1974 (Sweep 3 at age 16; n = 14 761), in 1981 (Sweep 4 at age 23; n = 12 537), in 1991 (Sweep 5 at age 33; n = 11 469), in 1999-2000 (Sweep 6 at age 41-42; n = 11 419), and in 2004-2005 (Sweep 7 at age 46-47; n = 9534). There are more respondents in Sweep 2 than in the original sample (Sweep 0) because the Sweep 2 sample includes eligible children who were in the country in 1969 but not in 1958 when Sweep 0 interviews were conducted. In each sweep, personal interviews and questionnaires are administered to the respondents, to their mothers, teachers, and doctors during childhood, and to their partners and children in adulthood.

Dependent Variable: Sex of First Child

The dependent variable in the statistical analysis is the sex of the first child that the NCDS respondents have ever had in their lives (0 = female, 1 = male), measured at age 47. Fielder and Huber[45] show that 99.7% of women and 96.5% of men in a representative Swedish sample have completed their lifetime reproduction by age 45. I may therefore reasonably assume that the NCDS respondents have largely (if not entirely) completed their lifetime reproduction by age 47.

Independent Variable: Physical Attractiveness

At age 7, the teacher of each NCDS respondent is asked to describe the child's physical appearance, by choosing up to 3 adjectives from a (highly eclectic) list of 5: "attractive," "unattractive," "looks underfed," "abnormal feature," and "scruffy and dirty." From these 3 responses, I create 2 dummies. *Attractive* = 1 if the child is described at all as attractive, 0 otherwise. *Unattractive* = 1 if the child is described at all as unattractive, 0 otherwise. In all, 84.3% of the children are described as attractive, while 11.7% are described as unattractive. Because the 2 dummies Attractive and Unattractive are

mutually exclusive and nearly exhaustive, any effect I may find for one is likely a mirror image of that of the other. Further, given that a large majority of the children are described as attractive, while a much smaller proportion is described as unattractive, any effect of physical attractiveness I may find in mirror image is likely driven by the unattractive respondents rather than the attractive respondents.

Zebrowitz et al's analysis[46] of the longitudinal data from the Intergenerational Studies of Development and Aging shows that individuals' relative physical attractiveness remains very stable across the life course. Their structural equation model suggests that physical attractiveness in childhood (measured between the ages of 9 and 10) is significantly positively correlated with physical attractiveness in puberty (measured between the ages of 12 and 13 for girls and 14 and 15 for boys; $r = .70$ for boys, $r = .79$ for girls), and physical attractiveness in puberty is significantly positively correlated with physical attractiveness in adolescence (measured between the ages of 17 and 18; $r = .72$ for boys, $r = .70$ for girls). This suggests that physical attractiveness in childhood is correlated with physical attractiveness in adolescence at $r = .504$ for boys and $r = .553$ for girls.

Control Variables: Respondent Sex and Age at First Child

I control for the sex of the respondent (0 = *female*, 1 = *male*), even though, in a representative sample, sex of the parent should not have any significant effect on the sex of the first child, because each boy and each girl has a mother and a father. The sex of the respondent is measured at birth (Sweep 0).

There has been some evidence that parental age has a negative effect on offspring sex ratios (older parents being more likely to have girls).[47(p292)] I control for the age at first child, measured at age 47.

Control Variables: Social Status

In any test of the gTWH, it is very important to control for the social status of the respondent, because the original TWH[1] predicts that higher-status parents are more likely to have sons than lower-status parents. Due to a highly complex system of examinations, qualifications, and certifications in the British school system, however, education in NCDS is very seldom measured quantitatively. It is only measured quantitatively, as years of formal schooling, at age 42; 98% of the NCDS respondents have completed their formal education before Sweep 6. In addition, I control for the respondent's occupational social class (1 = *unskilled*, 2 = *semiskilled*, 3 = *skilled manual*, 4 = *skilled nonmanual*, 5 = *managerial*, 6 = *professional*) and annual earnings (in GBP). All social status variables are measured at age 42.

Control Variables: Body Size

Of all the predictions of the gTWH, the effect of body size has been most robust and replicated[23-28]. I therefore control for the respondent's height (in cm) and weight (in kg). Body size is measured at age 42.

Table 1. The Effect of Physical Attractiveness on Offspring Sex

Physical Attractiveness	(1)	(2)
Attractive	−.204*	
	(.094)	
	.815	
Unattractive		.225*
		(.105)
		1.252
Sex	.009	.014
	(.092)	(.092)
	1.009	*1.014*
Age at first child	−.019***	−.019***
	(.006)	(.006)
	.981	*.981*
Trivers-Willard controls		
Education	.009	.009
	(.008)	(.008)
	1.009	*1.009*
Social class	−.024	−.025
	(.026)	(.026)
	.976	*.976*
Earnings	.000	.000
	(.000)	(.000)
	1.000	*1.000*
Body size		
Height	.008	.008
	(.005)	(.005)
	1.008	*1.008*
Weight	−.005*	−.005*
	(.003)	(.003)
	.995	*.995*
Constant	−.325	−.505
	(.724)	(.725)
Cox & Snell pseudo-R^2	.005	.005
−2Log likelihood	6047.640	6047.788
Number of cases	4383	4383

Main entries are unstandardized regression coefficients. Values within parentheses are standard errors. Values in italics are effects on odds (e^{b_k}).
* P < .05,
** P < .01,
*** P < .001.

Results

Table 1 presents the results of a binary logistic regression analysis. Table 1, Column (1), shows that, net of sex, age at first child, education, social class, earnings, height, and weight, NCDS respondents who are rated "attractive" by their teacher at age 7 are significantly less likely to have a son as their first child. The effect on odds ($e^{-.204} = .815$) suggests that "attractive" respondents have 19% lower odds of having a son as the first child ($1 - .815 = .185$) or 23% higher odds of having a daughter as the first child (1/.815= 1.227). The coefficients in Column (1) suggest that the average attractive NCDS respondent (whose values for all the other variables in the

model are held at their means) would have the probability of having a son $P = .50127$.

Consistent with earlier studies,[47(p292)] older parents are significantly more likely to have a daughter as their first child than younger parents. Contrary to the findings of earlier studies, however, bigger and taller parents in the NCDS data do not appear to be more likely to have sons. Height has no effect on the sex of the first child, while heavier parents are significantly more likely to have *daughters*, not sons. The model as a whole accounts for a negligible proportion of the variance in the sex of first child (Cox & Snell pseudo-R^2 =.005).

Table 1, Column (2), shows that, net of the same control variables as before, NCDS respondents who are rated "unattractive" by their teacher at age 7 are significantly more likely to have a son as their first child. The effect on odds ($e^{.225}$ = 1.252) suggests that "unattractive" respondents have 25% higher odds of having a son as the first child or 20% lower odds of having a daughter as the first child (1−(1/1.252)= .201). The coefficients in Column (2) suggest that the average unattractive NCDS respondent would have the probability of having a son P = .56285.

As suggested earlier, given that being attractive and unattractive are mutually exclusive and nearly exhaustive, the effects of the 2 variables should be mirror images of each other. This indeed appears to be the case, as all the other variables in the 2 models in Columns (1) and (2), except for sex, have identical coefficients and standard errors. The effect of physical attractiveness on the sex of the first child among the NCDS respondents is likely driven by the propensity of those rated unattractive to have more sons, rather than that of those rated attractive (who comprise a large majority of the respondents) to have more daughters.

If physically more attractive parents are more likely to have daughters, as the results presented in Table 1 suggest, and if physical attractiveness is heritable, then it logically follows that, over many generations throughout human evolutionary history, women on average should gradually become physically more attractive than men. Earlier studies suggest that women on average are more attractive than men in Japan[48] and in the United States.[43] This also appears to be the case in the United Kingdom. The proportion of girls who are rated attractive by their teachers at age 7 is statistically significantly larger than the same proportion among boys (.855 vs .831, $t = 3.447$, $P < .001$). Similarly, the proportion of boys who are rated unattractive is greater than the same proportion among girls, but, due to the small number of children rated unattractive, the difference is not statistically significant (.119 vs .114, $t = -.896$, *ns*).

Conclusion

The analysis of the NCDS replicates the findings of an earlier study[43] that shows that physically more attractive young Americans are more likely to have a daughter as their first child than their physically unattractive counterparts. While some have questioned the validity of the earlier conclusion,[44] the current study replicates the findings with a British sample. Unlike the National Longitudinal Study of Adolescent Health data used in the earlier study, whose respondents are still in their early adulthood, the current study looks at completed fertility of British respondents in their late 40s. The analysis shows that children who are rated as attractive by their teachers at age 7 are significantly more likely to have a daughter as their first child 40 years later, or, more likely, children who are rated as unattractive by their teachers at age 7 are significantly more likely to have a son as their first child 40 years later. The effect is not only statistically significant but substantively large; attractive respondents have 23% higher odds of having a daughter and unattractive respondents have 25% higher odds of having a son. Alternatively, attractive respondents are 6.2% more likely to have a daughter than unattractive respondents. The results provide further empirical support for the prediction derived from the gTWH that physically more attractive parents are more likely to have daughters. Since physical attractiveness, while it increases the reproductive success of both sons and daughters, increases daughters' even more than sons', beautiful parents may be more likely to have daughters.

While the empirical analysis presented above supports the prediction derived from the gTWH that physically more attractive individuals are more likely to have daughters than physically less attractive individuals, it does not provide unqualified support for the TWH or the gTWH. None of the measures of social status (education, social class, and earnings) are significantly positively associated with the sex of the offspring, which contradicts the main prediction of the TWH. Even though the effect of body size on offspring sex is the most frequently replicated implication of the gTWH,[23-28] in the current analyses, height is not significantly associated with offspring sex, while weight is significantly *negatively* associated with it, contrary to earlier findings. Further empirical investigations into both the TWH and the gTWH are clearly necessary.

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