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## Does parental age difference affect offspring count in humans? Comment on Fieder and Huber

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## Comment

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Comment on Fieder and Huber

In a recent paper, Fieder & Huber (2007) attempt to estimate the 'fitness effects' of parental age differences, to test the hypothesis that age preferences are evolutionarily acquired. The authors use modern data from the *Swedish Total Population Registry*. In their specifications, Fieder & Huber (2007) use offspring count as their dependent variable and parental age difference as an independent variable. They report that, in men, fitness is maximized when marrying a woman 4 years younger and, in women, it is maximized when marrying a man 6 years older. However, the authors do not control for women's reproductive value in their regressions. Replicating their findings using a dataset of pre-modern Swedish individuals, we show that when controlling for women's reproductive value, the estimated effect of parental age differences on reproductive success disappears.

In their paper, Fieder & Huber (2007) do mention the possibility that part of the observed increase in fertility may be due to a direct effect of the woman's age at the time of the formation of the couple. They address this concern by including a covariate for partner's age in 2003. However, this amounts to controlling for a pure cohort effect and not reproductive value.

To quantify the magnitude of the bias introduced by not controlling for women's reproductive value, we replicate and extend the analysis using data from a pre-modern Swedish population. The choice of a pre-modern study population has at least two distinct advantages. First, our sample allows us a fairly precise way to control for when the couple first formed and began reproducing. Since there are very few pre-nuptial births in this sample (of the order of 3–4%), woman's age at marriage is a good proxy for her reproductive value when the couple was formed. Second, the evolutionary significance of age preferences is arguably best tested in populations that do not employ modern methods of birth control.

Our data are obtained from the Demographic Database at Umeå University, Umeå, Sweden, and comprise 4285 women who married once and their 26 560 children. The retrieval covers individuals born between 1655 and 1843. Using this dataset, we first replicate the regressions in Fieder & Huber (2007) with qualitatively similar results. We then control for the woman's

Table 1. Parental age difference and offspring count. (Dependent variable is the number of children born. Results are estimated with OLS. Heteroskedasticity-robust standard errors within parenthesis. Two asterisks denote statistical significance at the 1% level and one asterisk at the 10% level in a *t*-test.)

	number of children born			
	(1)	(2)	(3)	(4)
constant	6.053** (0.046)	6.343** (0.055)	14.689** (0.228)	14.560** (0.239)
age difference	0.0820** (0.0072)	0.1371** (0.0071)	−0.0222** (0.0064)	−0.0139* (0.0069)
age difference sq.		−0.00855** (0.00078)		−0.00099* (0.00052)
woman's age at marriage			−0.3183** (0.0078)	−0.3123** (0.0085)
<i>N</i>	4285	4285	4285	4285
<i>R</i> <sup>2</sup>	0.029	0.074	0.278	0.278

reproductive value. Consider the following model:

$$y_i = \alpha + \beta_1 x_i + \beta_2 x_i^2 + \beta_3 z_i + \varepsilon_i, \quad (1)$$

where  $y_i$  denotes the number of children of couple  $i$ ;  $x_i$  is the difference between the husband's and the wife's age in years; and  $z_i$  is the wife's age at marriage. A positive  $x_i$  implies that the husband is older than his wife.

In table 1, we report the results from running the regression in equation (1), as well as various restricted versions of the model. In columns (1) and (2) of table 1, we report the results from a linear and a quadratic model, respectively. The results are similar to those in Fieder & Huber (2007). The estimates in column (1) suggest that a couple with a zero age differential has on average 6.05 children, and that an increase in the age differential of 1 year is associated with having 0.08 more children. Our estimates in column (2) imply that offspring count is maximized when the husband is 8.02 years older than his wife, far above the actual mean age difference of 1.76 years observed in our data. This divergence between the estimated optimal age difference and a much lower empirically observed age difference should be a cause of concern. Were it really the case that the estimated coefficient had a causal interpretation, it would be necessary to account for the puzzling divergence between the fitness maximizing age difference predicted by the model and the age differences observed in the data. In columns (3) and (4) of table 1, we report the same specification but control for the woman's age at marriage. Two results are worth noting. First, there is a very large increase in the proportion of variance explained, as captured by the  $R^2$  statistic, when a woman's age at marriage is included. Second, the estimated positive effect of parental age differences on reproductive success disappears. The reason for this result is the strong negative correlation between the age difference and the woman's age at marriage (−0.40). That is, women who marry at a young age tend to marry men older than themselves. Once age at marriage is controlled for, the coefficient on parental age difference drops dramatically and is actually *negative*. A probable explanation for this result is that the older

The accompanying reply can be viewed on page 80 or at <http://dx.doi.org/doi:10.1098/2007.0567>.

the husband, the more likely it is that he will die before his wife reaches menopause. Alternatively, men's ability to father children may be declining with age. Regardless of which hypothesis is true, there is no evidence of a positive effect on offspring count of marrying an older husband.

The positive correlation between parental age difference and age at marriage is not unique to the women in our sample. Men who marry before the age of 25, on average, find a spouse who is 2.3 years older. The corresponding figure for women marrying before 25 is 4.4 years.

Taken together, our results suggest that a more parsimonious interpretation of the result in Fieder & Huber (2007) is that the significance of the coefficient on parental age difference is, at least to a considerable extent, spurious, reflecting a correlation between parental age difference and reproductive value. None of this should be taken to imply that the universally expressed preference for women (men) to seek an older (younger) partner is without evolutionary logic. Our findings do, however, cast doubt on the interpretation that age differences *per se*, as opposed to reproductive value, entail fitness advantages. We

therefore suggest that the best explanation of the available data is that women who marry at a younger age have more children, but that once this is controlled for, having an older husband is in fact associated with a lower offspring count.

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