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Long-term mating positively predicts both reproductive fitness and parental investment

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Abstract

Empirical data on the relations between mating and reproductive success are rare for humans, especially for industrial and post-industrial populations. Existing data show that mating (and especially long-term mating) can be beneficial for fitness, especially that of males. This finding is in line with the hypothesis of sexual selection operating in human populations. The present research expands on previous studies by: 1) analysing additional fitness indicators, including having children with different partners; 2) including parental investment in the analysis as another important marker of sexual selection; 3) analysing several mediators between mating, reproductive fitness and parental investment, i.e. age of first and last reproduction and desired number of children. The data were obtained in 2019 from a sample of parents living in Serbia (*N*=497). The findings showed that long-term mating (duration of longest partner relationship) was positively related to parental investment and number of offspring and grand-offspring. Furthermore, the link between long-term mating and reproductive success was completely mediated by the age of first reproduction and desired number of children. Short-term mating (number of sexual partners) was marginally positively related to the number of children participants had with different partners and negatively related to parental investment. No sex differences in the link between mating, fitness and parental investment were detected. In general, the signatures of sexual selection were weak in the present data, but those that were detected were in line with sexual selection theory. The present findings provide a deeper insight into the adaptive function of mating and also the mechanism of how mating is beneficial for fitness.

Keywords: Mating; Fitness; Parental investment

Introduction

Mating systems have large variations in all mammals (Clutton-Brock, 1989). For both males and females, these include monogamy and promiscuity as strategies for obtaining mates, but also mate guarding, defence against poachers and other behaviours. Humans are no exception in this variation in mating systems. Variation is present in marriage forms and includes monogamy, polygamy, polyandry or polygynandry and other forms of mate bonding (Marlowe, 2000). Behaviours related to mating vary as well, including the tendency to have long-term vs short-term partner relationships, extra-pair mating, mate poaching and mate guarding (Buss, 2006; Buss & Schmitt, 2019).

Evolutionary psychologists first thought that these differences in mating behaviours can be located in a single dimension that captures various mating strategies, labelled as socio-sexuality (Simpson & Gangestad, 1991). Higher expression of this behavioural trait depicts a tendency towards short-term mating and uncommitted relationships, while it is expected that long-term mating would be at the opposite pole of this dimension. However, empirical findings have shown that short- and long-term mating are not the opposite poles of a singular mating strategy but two

separate behavioural patterns (Jackson & Kirkpatrick, 2007; Holtzman & Senne, 2014; Buss & Schmitt, 2019). When measured using self-reporting questionnaires, it is expected that short- and long-term mating will be negatively correlated, but when behavioural indicators are used (like number of sexual partners and longest relationship duration) these mating patterns seem to be largely unassociated (Međedović, 2020a).

Individuals compete for acquiring and keeping mates but the strategies for mating may be different for each sex due to various biological factors like anisogamy and the operational sex ratio (proportion of males and females that participate in the mating pool). The form of natural selection that generates traits which help individuals to compete for mates against the members of their own sex and to acquire mating partners is called 'sexual selection' (Darwin, 1871). It is assumed that the sex that is more affected by sexual selection (usually but not necessarily males) should show higher variation in fitness (most frequently measured as reproductive success) and mating, and higher correlation between mating and fitness; these three indicators of sexual selection are labelled as Bateman coefficients (Bateman, 1948; Arnold & Duvall, 1994). Hence, Bateman's coefficients provide a methodological framework that can be used to empirically measure sexual selection in various species, including humans (Borgerhoff Mulder, in press).

Despite the theoretical importance of measuring mating, reproduction and the relations between mating and reproductive success in humans, empirical findings on this topic are relatively scarce. However, the existing data are congruent with the predictions, and thus show the fruitfulness of applying the framework of sexual selection to humans. It has been shown that males have higher variation in mating (measured as remarrying) and reproduction, and higher associations between mating and reproductive success; these findings have been detected in pre-industrial Finnish populations (Courtiol *et al.,* 2012) and early 20th century US populations (Jokela *et al.,* 2010). Some evolutionary anthropologists measured not only the number of marriage partners, but the time spent married (or more generally, the time spent in a monogamous partner relationship) as well because this may serve as the additional measure of mating with potentially multiple benefits for fitness (Blurton Jones, 2016; Borgerhoff Mulder, 2017). Indeed, data from a rural natural-fertility population in Tanzania showed that males, but not females, had fitness benefits from time spent married, which is again congruent with the predictions of sexual selection (Borgerhoff Mulder & Ross, 2019). Finally, long-term mating can be operationalized by the duration of the longest partner relationships; this measure has benefits since it can be applied to non-married individuals as well, which is especially important in modern human populations (Međedović, 2020a). It has been shown that the duration of longest partner relationship has fitness benefits for males, but not for females, while short-term mating (measured as the total number of sexual partners) is unrelated or even negatively related to fitness (Međedović, 2020a).

Parental investment can be defined as every investment in offspring that prevents a parent from investing in further reproduction (Trivers, 1972). In species where males are more affected by sexual selection it has been found that males also have lower levels of parental investment (Trivers, 1972; Jennions & Kokko, 2010). Parental investment should lead to higher offspring quality, i.e. to the development of various traits in offspring that could be beneficial for their own fitness (Međedović & Petrović, 2019). However, since it redirects parents from further investment in mating and reproduction it may generate mating–parenting and quantity–quality trade-offs in a population (Lack, 1947; Trivers, 1972). Indeed, it has been shown that both a quantity–quality (Borgerhoff Mulder, 2000; Gillespie *et al.,* 2008) and mating–parenting (Gangestad & Simpson, 2000) tradeoff may exist in human populations, depending on various ecological conditions. However, there is an important question of how to measure parental investment in the first place, especially in post-industrial, WEIRD (Western, Educated, Industrialized, Rich and Democratic) societies. Measuring breastfeeding, vaccination of children or children's education can be valid measures of parental investment in pre-industrial populations but their application to modern human populations is questionable. It has been proposed that self-reported measures

of socio-emotional investment in children may serve as proxy measures of parental investment (Međedović, 2019, 2020b) and this is the strategy applied in the present study.

The primary goal of the present study was to analyse the relations between short- and long-term mating, reproductive fitness and parental investment. The secondary goal was to test for potential mediating variables that may explain the link between mating and fitness. Previous research has suggested that the age of first reproduction can be one of the traits that mediates the mating–fitness association (Međedović, 2020a). Hence, age of first reproduction, and two other traits that should be closely related to fitness itself – age of last reproduction and desired number of children – were explored. Data were collected from a sample of parents (this was necessary in order to measure parental investment). Two additional fitness indicators beside number of children – number of grandchildren and number of children participants had with different partners –were explored as well. Therefore, the study design was composed of two predictor variables (short- and long-term mating), three mediating variables (age of first reproduction, age of last reproduction and desired number of children) and four criteria measures (numbers of children, grandchildren and children with different partners, together with parental investment).

The main explanatory framework used to generate the study hypotheses and interpret the results was the sexual selection theory. The following hypotheses were set based on this conceptual framework and previous empirical findings: 1) long-term mating is beneficial for fitness (the associations between short-term mating and fitness were not hypothesized, except with children with different partners, since these two variables are conceptually linked); 2) fitness benefits of long-term mating are more expressed in males than females.

Methods

Sample and procedure

The study sample consisted of 497 participants (54% females) who were the parents of psychology students at the Singidunum University of Belgrade. All students were attending the second year of their studies at the university. Students took the questionnaires to their parents to fill in as a part of a psychology course they were taking. Participation in the research was voluntary, both for students and their parents; students received an extra credit for the psychology course they were taking if they volunteered to participate in the research. The questionnaires were put in envelopes and sealed by the study participants after they had filled them in, in order to ensure anonymity. Additional efforts were made to ensure the validity of data by three procedures: 1) the students were told that their parents should seal the envelopes containing their completed questionnaires; 2) in the instructions for participants (shown on the first page of the questionnaire) participants were asked to seal their questionnaires in the envelope before giving the envelope to their children; 3) when the envelopes were received, the researchers checked that had been properly sealed.

The participants in the sample were not related to each other and observations from only one parent per student (randomly assigned) were used. The mean age of the participants was 51.55 years (SD=6.36), suggesting that they were near the end of their reproductive phase at the time of data collection. The participants were more highly educated than average: 53.3% had finished college, 17.2% had some other form of higher education, 28.3% had finished high school while only 1.2% had finished elementary school.

Measures

There are self-report scales for measuring short- and long-term mating strategies (Jackson & Kirkpatrick, 2007); however, these scales assess attitudes towards mating, not mating itself. Previous research has shown that these scales do not unambiguously correspond to the behavioural indicators of mating. Furthermore, behavioural indicators have turned out to be better

predictors of fitness (Međedović, 2020a). With this in mind, behavioural indicators of mating were measured, and short- and long-term mating were assessed using the variables 'number of sexual partners' and 'duration of longest (partner) relationship' (in months), respectively.

Reproductive success was measured via the 'number of (biological) children' and 'number of (biological) grandchildren'. Participants were also asked to indicate the 'number of children (they had) with different partners'. Since the number of participants who had children with different parents was low, this measure was dichotomized and thus discriminated between individuals who had, and did not have, children with different partners. 'Age at first reproduction' and 'age at last reproduction' were measured via the question: 'How old were you when you had your first/last child?' In addition, the participants provided their 'desired number of children' by answering the question: 'When you started to think about having children, how many children in total did you want to have?'

Kin care – the children scale from the Fundamental Social Motives Inventory (Neel *et al.*, 2016) – was used as a proxy measure of parental investment ($\alpha = 0.73$). This scale has six items (e.g. 'I often think about how I could stop bad things from happening to my children'). The response scale is based on a five-point Likert-type scale, where 1 stands for 'I completely disagree' and 5 denotes 'I completely agree'.

Data analysis

The descriptive statistics of the study participants were analysed separately for males and females; the aim was to explore the difference in variables' variation and means (using the Levene test and independent samples *t*-test) and to test if these differences were in line with sexual selection theory. Then, bivariate correlations between analysed variables were assessed, followed by multivariate regression models for the prediction of reproductive fitness and parental investment measures. Furthermore, the interactions between participant's sex and mating patterns in the prediction of these criteria were tested in an attempt to capture Bateman's third coefficient (the hypothesized interaction that males with higher mating success would have elevated reproductive success). Finally, potential mediators between mating and criteria variables (reproduction and parental investment) were tested, with ages of first and last reproduction and desired number of children being explored as potential mediators. Multi-group path analysis was used to test the mediation model.

Results

Sex differences and correlations between variables

Table 1 shows the descriptive statistics (raw scores) of the study participants and the differences in variance and means between the sexes. The majority of the analysed variables were operationalized as count measures and therefore would not be expected to have a normal distribution, so all variables were normalized using the Blom algorithm before the inferential statistical procedures were implemented. This procedure eliminates univariate outliers as well. Males had larger variation in age of last reproduction and parental investment. Furthermore, males had higher mean scores for age of first and last reproduction and number of sexual partners; on the other hand, they had lower scores on the measure of parental investment. Parents having children with different partners were not analysed because this was a binary measure.

Table 2 shows the results of the bivariate analysis of the associations between the examined measures. Pearson's coefficients of linear correlation were calculated for all measures except children with different partners; a point biserial correlation coefficient was calculated for this measure. The findings showed that number of sexual partners correlated positively with children with different partners and negatively with parental investment. Duration of longest relationship was

Table 1. Descriptive statistics and differences in variance and means between the sexes

Variable	Males	Females	$F_{(Levene)}$	t-test
Number of sexual partners	16.63 (11.23)	12.83 (10.13)	0.285	3.967**
Duration of longest relationship (months)	141.48 (140.94)	163.87 (138.80)	0.148	−1.78
Age of first reproduction (years)	29.14 (4.90)	27.12 (4.50)	0.029	4.806**
Age of last reproduction (years)	34.16 (5.31)	31.71 (4.45)	4.014*	5.536**
Desired number of children	2.60 (0.87)	2.49 (0.84)	0.053	1.438
Number of children	2.07 (0.66)	1.98 (0.66)	0.022	1.62
Number of grandchildren	0.20 (0.69)	0.15 (0.64)	1.871	0.724
Parental investment	4.47 (0.63)	4.60 (0.51)	13.223*	−2.572*

*$p < 0.05$; **$p < 0.01$.

Table 2. Correlations between the examined measures

	1	2	3	4	5	6	7	8
1. Number of sexual partners								
2. Duration of longest relationship	0.17**							
3. Age of first reproduction	0.04	−0.13**						
4. Age of last reproduction	0.07	−0.07	0.58**					
5. Desired number of children	0.07	0.20**	−0.11*	0.01				
6. Number of children	0.08	0.16**	−0.30**	0.22**	0.28**			
7. Number of grandchildren	0.07	0.17**	−0.23**	0.05	0.14**	0.28**		
8. Children with different partners	0.11*	−0.02	−0.08	0.33**	0.05	0.21**	0.11*	
9. Parental investment	−0.12**	0.11*	−0.01	−0.08	0.01	−0.06	0.04	−0.08

*$p < 0.05$; **$p < 0.01$.

positively associated with the desired number of children, number of children, number of grand-children and parental investment, but negatively related with age of first reproduction. The measures related to reproduction had the expected associations as well. All three measures of reproductive success correlated positively between themselves; desired number of children was positively associated with the observed number of offspring and grand-offspring as well. Age of first reproduction was negatively correlated with number of children and number of grandchildren, while age of last reproduction was positively related with the number of children and children with different partners. Age of first reproduction and age of last reproduction were highly related between themselves as well. This was an expected result because for the participants with only one child, the first and last age of reproduction represent the same event.

Predicting reproductive fitness and parental investment

Table 3 shows the results of four regression models for the prediction of reproductive fitness measures estimated with sex, age and education, together with mating patterns as the predictor variables; note that participant's income was controlled in the models as well as a measure of socioeconomic status (income was assessed as a monthly salary expressed in Euros: $M = 859.34$; $SD = 952.66$). Multiple linear regressions were calculated for all variables except

Table 3. Prediction of reproductive fitness measures

|	Number of children β (SE)	Parental investment β (SE)	Number of grandchildren β (SE)	Children with different partners β (SE)
Sex	−0.05 (0.06)	0.08 (0.06)	0.05 (0.058)	0.63 (0.65)
Age	0.03 (0.01)	0.00 (0.00)	0.29 (0.004)**	0.02 (0.06)
Education	−0.06 (0.03)	−0.03 (0.03)	−0.12 (0.031)**	−0.04 (0.35)
Income	0.10 (0.00)*	−0.03 (0.00)	−0.03 (0.00)	0.63 (0.31)*
Number of sexual partners	0.03 (0.00)	−0.12 (0.00)**	0.01 (0.00)	0.62 (0.33)†
Duration of longest relationship	0.16 (0.00)**	0.12 (0.00)*	0.09 (0.00)*	−0.03 (0.29)
Number of children	—	—	0.25 (0.04)**	1.11 (0.01)**
F/χ^2	3.68**	3.32**	15.35**	21.08**
R^2	0.04	0.04	0.18	0.06

*$p<0.05$; **$p<0.01$; †$p=0.062$.

number of children with different partners; binary logistic regression model was estimated here. Number of children was added as a predictor in the models where the number of grandchildren and number of children with different partners were set as the criteria measures, since it represents a crucial covariate. All four regression models were statistically significant; percentages of explained variance were relatively low (from 4% of explained variation in number of children and parental investment to 18% of explained variation in the number of grandchildren). Long-term mating had an independent positive contribution to the prediction of the number of children and number of grandchildren, together with parental investment. Short-term mating negatively predicted parental investment and had a marginally positive contribution to the prediction of children with different partners.

The interactions between the indicators of mating and participant's sex were calculated. These variables were added on the next level in the hierarchical linear regression for the prediction of all four criteria measures. However, no significant interactions were found. Hence, participant's sex does not appear to moderate the link between mating, reproductive fitness and parental investment in the present data.

Mediators of the mating–fitness link

Three potential mediator variables in the mating–fitness link were tested (Figure 1). These were the variables that have been conceptually and empirically (as shown by bivariate relations) associated with reproductive success: age of first reproduction, age of last reproduction and desired number of children. Short- and long-term mating were set as the predictor variables, these three measures as the mediators, and the number of children, grandchildren, children with different partners, and parental investment as the criteria measures. Age, education and income were controlled for in the analysis as well: only participant's age was shown to significantly contribute to the model. However, this is not shown in Figure 1 in order to save space. All variables were modelled as observable ones. The findings of a multi-group path analysis showed that the model was statistically identical for males and females ($\chi^2(27)=20.91$; $p>0.05$), therefore the path coefficients are not shown for each sex separately, but for the whole model ($\chi^2(27)=60.73$; $p<0.01$; Normed Fit Index [NFI]=0.95; Comparative Fit Index [CFI]=0.97; Root Mean Square of Error of Approximation [RMSEA]=0.05). Only significant coefficients are shown in Figure 1.
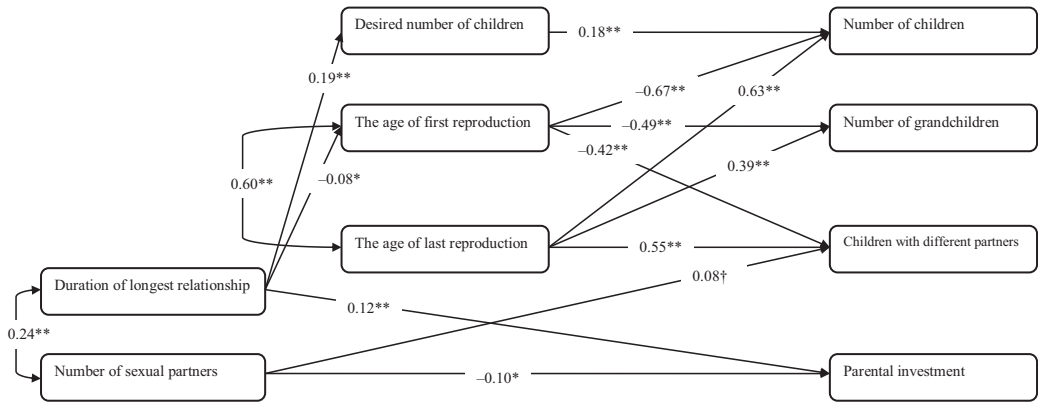
Figure 1. Mediation path analysis of the links between mating, reproductive fitness and parental investment. Correlations are shown with double arrows; hypothesized causal paths are shown with single arrows. †p=0.07; *p<0.05; **p<0.01.

Number of sexual partners was negatively related with parental investment and had a marginally significant positive path to children with different parents. Duration of the longest relationship did not have any direct links to the measures of reproductive fitness in the model; it was positively related to parental investment and desired number of children with a negative path to age of first reproduction. Age of first reproduction and age of last reproduction were related to all three measures of reproductive fitness (negatively and positively, respectively), while desired number of children had a positive path only to number of children. (Interestingly, the correlations between the measures of reproductive fitness were not significant any more when the mediators were added to the analysis.) Mediation analysis showed that long-term mating had significant indirect effects on all measures of reproductive fitness via age of first reproduction and desired number of children: β=0.12; p<0.01 for the number of children; β=0.08; p<0.01 for the number of grandchildren, and β=0.06; p<0.01 for children with different partners.

Discussion

Data on the links between mating patterns and evolutionary fitness are still scarce, especially for contemporary humans. Yet these data are very important for the understanding of the selection regimes that operate on mating behaviour, including sexual selection which effects may be detected if there are sex differences in the associations between mating and reproduction (Bateman's third coefficient). In the present study, parental investment was explored beside reproduction success, as a trait which may influence fitness itself. Finally, reproductive cognitions and events which can mediate the associations between mating and reproduction were analysed. Based on existing theory and previous research, the assumption that long-term mating has more adaptive potential compared with short-term mating was empirically tested; furthermore, the hypothesis that the benefits of long-term mating are more pronounced in males compared with females was evaluated as well. The study data showed that long-term mating was indeed beneficial both for reproductive fitness and parental investment; hence, the first hypothesis has been empirically confirmed. However, sex-specific effects of mating on reproductive fitness or parental investment were not found; therefore, the second hypothesis was not confirmed in the present data.

Before the results of mating–fitness links are discussed, the data on the relations between the reproduction-related measures and parental investment are analysed. The analysed reproductive events were associated in an expected manner: age of first reproduction was negatively related to both indicators of reproductive success and the total expected number of children (which is congruent with previous studies: Kirk *et al.,* 2001; Tropf *et al.,* 2015; Sanjak *et al.,* 2018). Age of last

reproduction was shown to be beneficial for fitness as well, having a positive relation with number of children and children with different partners. Having children with multiple partners clearly represents an additional fitness indicator because it is positively associated with reproductive success, but it provides other benefits for fitness as well, as offspring with higher variation in their genetic material may have greater fitness (Moorad, 2013). Finally, the total desired number of children contributes to fitness as well, as it was found to be positively associated with reproductive success in general and negatively associated with the timing of first reproduction. An elevated desired number of offspring displays a higher intentional motivation for having children, which is one of the major determinants of observed fertility (Miller *et al.,* 2010), and has been associated with reproductive fitness in previous studies (Međedović, 2020b). This link is in line with previous descriptions of modern human reproduction as a partly rational and intentional process.

Parental investment may be viewed as a trait that can elevate fitness as in various species parental effort enhances the probability of offspring survival and reproduction. However, it is unclear whether this is the case in modern humans, especially in populations in demographic transition. Parental investment should be a part of at least two major evolutionary tradeoffs: a quantity–quality tradeoff and mating–parenting tradeoff. The first is based on negative associations between the number and quality and offspring: the more offspring an individual has, the less can be invested in each of them. This tradeoff was not detected in the current data. Some authors have suggested that the quantity–quality tradeoff is more probable in natural fertility populations because of their higher mean fertility before demographic transition (Međedović, 2021). Indeed, this tradeoff has been empirically detected in agro-pastoral populations (Borgerhoff Mulder, 2000) and pre-industrial Finish societies (Gillespie *et al.*, 2008) but it has been harder to detect post-industrial human samples (Međedović, 2020b). On the other hand, a tradeoff between short-term mating and parental investment was observed in the current study: behavioural orientation towards a higher number of sexual partners is negatively related to care for children. This is in accordance with previous data (Beall & Schaller, 2014; Međedović, 2019; Valentova *et al.,* 2019). However, this tradeoff is restricted for short-term mating: long-term mating was positively associated with socio-emotional care for children in the present study.

The current data demonstrated the adaptive potential of long-term mating, with this predicting number of children and grandchildren, together with parental investment. This finding is in accordance with previous data (Borgerhoff Mulder & Ross, 2019; Međedović, 2021). In fact, previous research has suggested that age of first reproduction may serve as a mediator of the link between long-term mating and reproductive success (Međedović, 2020a). This finding is confirmed and broadened by showing the mediating roles of total desired number children along with age of first reproduction in the link between long-term mating and fertility: individuals in longer relationships want to have more children and to start their family earlier, which is associated with higher fitness. Note that long term-mating was indirectly related to having children with different partners as well, via these mediators. Age of last reproduction turned out to be an important reproductive fitness predictor as well, but it was not related to the mating patterns in the path analysis, so it did not mediate the link between mating and reproductive fitness. Short-term mating also had marginally significant positive relations with having children with multiple parents. These associations may indeed be illuminative of fitness maximization strategies in modern humans. Since selection on offspring mortality is relaxed in contemporary human populations, parents may turn to multiple mating and extra-pair mating in order to acquire the benefits of having children with higher genetic variability. This pattern has previously been proposed for males (Sear & Mace, 2008), but scholars generally suggest that the benefits of multiple mating could be equally beneficial for females and males (Borgerhoff Mulder, in press; Brown *et al.,* 2009). Hence, the present findings highlight the adaptive potentials of long-term mating; short-term mating showed much less fitness-related benefits. The findings indicate that long-term mating may be under positive directional selection; if there is genetic variation behind long-term mating, it could respond to selection, which may lead to a change in its phenotypic population

levels. The existing data show genetic variation for short-term mating (Cherkas *et al.,* 2004; Zietsch *et al.,* 2015); the data for long-term mating are largely absent from existing empirical research, but it could be reasonably assumed that such a variation exists because genetic variation has been found for all behavioural traits that have been analysed in behavioural genetic studies (Turkheimer, 2000). Thus, it is possible that mating patterns continue to evolve in contemporary humans.

Mating has frequently been analysed from the viewpoint of sexual selection. According to the seminal principles derived by Bateman (1948) (see also Borgerhoff Mulder, in press), higher variation in mating and reproduction should be expected, together with higher associations between mating and fitness in males compared with females. Previous empirical data have confirmed these assumptions of sexual selection theory (Jokela *et al.,* 2010; Courtiol *et al.,* 2012; Borgerhoff Mulder & Ross, 2019; Međedović, 2020a). Bateman's third coefficient was a particular point of interest in the present study since it shows different fitness potentials of mating for males and females; its detection may suggest an evolution of sexual dimorphism in this behavioural pattern. However, no effect was found in the current data. Generally, the signatures of sexual selection were rather rare and unsystematic. However, note that the significant effects regarding sex differences are in line with sexual selection theory, showing higher variation in age of last reproduction and parental investment in males. Males also had higher scores on the measures of first and last age of reproduction, short-term mating and lower levels of parental investment. The results on the sex differences in short-term mating and parental investment are congruent with previous findings (Schmitt, 2005; Međedović & Petrović, 2019). The data on sex differences in parental investment are particularly interesting. Parental investment can be conceived as post-copulatory investment (in contrast to pre-copulatory traits like developing gametes or the mating effort itself), which should be lower in males (Trivers, 1972; Jennions & Kokko, 2010).

One of the main reasons why more robust evidence of sexual selection was not found in the present study, including Bateman's third coefficient, was the structure of the sample. The variation in reproductive success in the sample was low (there were no participants without children), which decreased the probability of observing these effects. Also, previous studies showed that when childless individuals were excluded from the analysis, some of the effects of natural selection were absent. For example, an association between income and reproductive success in males could be detected if childless individuals were included in the analysis; when only individuals with children were analysed, this association was not significant (Fieder & Huber, 2007). Furthermore, it is possible that interactions between sex and mating in the prediction of reproductive success may be more complex – they could be dependent on the participant's socioeconomic status. For example, it has been found that income and social status are negatively related to number of children for woman but positively related in men (Hopcroft, 2006; 2015; Nettle & Pollet, 2008; Huber *et al.,* 2010). Income is related to mating patterns differently in males and females as well. Data show that high-income men are more likely to marry, less likely to divorce, and if divorced have a higher probability of remarrying and have a lower probability of being childless compared with men with low income. However, some of these associations are opposite for females, with income being positively related to the chance of divorce, negatively related to the probability of remarriage and positively related to the probability of childlessness (Hopcroft, 2021). Hence, three-way interactions may be plausible in the analysis of the sexual selection on mating – the interactions between sex, mating patterns and socioeconomic status. These interactions could not be analysed in the present research because they require large sample sizes, but future studies could apply more complex designs for further advancement in this topic.

There are several important limitations of the present study, including the sample size and study structure. The sample was not representative; in fact, it consisted of students' parents, which are probably more educated and of higher SES than the general population – hence, the findings cannot be easily generalized and they demand further corroboration from different samples. The expected effect sizes were relatively low, especially for the interaction effects, so a larger sample

would be preferable as well. Only parents were examined in the present study because parental investment was one of the central criteria measures in the analysis. However, this sample has lower variation in reproductive success as childless individuals were excluded from the sample. Constricted variance in reproductive success might be a reason why some expected effects were not detected – for example, those relating to sex differences in mating–reproduction links. A self-reported measure of the socio-emotional care of children was used as a proxy measure for parental investment. This operationalization of parental investment certainly has its limitations; however, it is generally hard to measure parental investment in post-industrial humans and researchers may dedicate more attention to this problem in future studies.

The design of the present study was cross-sectional, which prevented conclusions being made about the causal relationships between the variables. Future studies could include more indicators depicting mating patterns in more detail, such as mate choice, extra-pair mating, mate guarding or other forms of intra-sexual competition. Furthermore, potential mediators between mating and fitness such as environmental or cultural characteristics would be fruitful to analyse as well.

Mating represents a behavioural pattern which is crucially related to fitness, and thus behavioural evolution in general. However, research on the links between mating and fitness has been relatively neglected in evolutionary human sciences. Despite its limitation, the present research testifies to the fruitfulness of a behavioural ecological approach to the analysis of mating patterns in humans. The study findings are in accordance with existing theory and those of previous studies. However, examining the links between a trait and fitness represents only the beginning of an evolutionary ecological analysis of a certain trait. More complex models can be applied to the examination of how, and under what conditions, mating patterns can increase fitness. This is an exciting and thought-provoking task for future studies of the behavioural ecology of mating. The current study may be an incentive for more in-depth exploration of the evolution of mating in contemporary humans.

Conflicts of Interest. The author has no conflicts of interest to declare.

Ethical Approval. The author asserts that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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