Evolution and Human Behavior 40 (2019) 112–125

Contents lists available at ScienceDirect

Evolution and Human Behavior

journal homepage: www.elsevier.com/locate/ens

What people prefer and what they think they prefer in short- and long-term partners. The effects of the phase of the menstrual cycle, hormonal contraception, pregnancy, and the marital and the parenthood status on partner preferences

Jaroslav Flegr[a,b,*], Amy E. Blum[c], Ondřej Nekola[a], Šebestián Kroupa[d]

[a] Department of Philosophy and History of Science, Division of Biology, Faculty of Science, Charles University in Prague, Viničná 7, Prague 128 44, Czechia
[b] National Institute of Mental Health, Klecany 250 67, Czechia
[c] Harvard Medical School, Boston, MA, USA
[d] Department of History and Philosophy of Science, University of Cambridge, UK

ARTICLE INFO

Keywords:
Mate selection preferences
Sexual selection
Partner choice
Indicator theory
Handicap theory
Immunocompetence handicap theory
Dominance
Hormonal cycle
Attractiveness
Mating strategy

ABSTRACT

The issue with most studies concerned with mate selection preferences in humans is that they rely on declarations and rational actions of experimental subjects, which are affected by their pre-conceived opinions and prejudices. Moreover, current research suggests that subcortical structures and processes, rather than the neocortex, play the principal role in actual partner choice behaviour. Consequently, we have only limited information on how relevant our current knowledge is in relation to real-life human ethology. To address these issues, we surveyed 2718 women and 4073 men between the ages of 16–50 and compared their declared and observed preferences for various properties in short-term and long-term partners. We found differences between what the subjects declared to prefer and what they preferred in reality: for example, men declared that wealth was the second least desirable property out of eleven in short-term partners, but we observed that in reality, they considered wealth the third most important factor after charisma and sense of humour. Similarly, while women declared that dominance and masculinity were desirable properties in short-term partners, in the observational part of the study, they showed little preference for these traits. Furthermore, we investigated the effects of the phase of the menstrual cycle, hormonal contraception, pregnancy, and partnership and parenthood status on these preferences. We found some support for the good parents hypothesis and no support for the good genes and the immunocompetence handicap hypotheses when observed, rather than declared preferences were considered. We also detected that hormonal contraception, and parenthood and partnership status influenced declared preferences in considerable ways, but had only a small, if any, impact on observed preferences. We suggest interpreting the results of studies reliant on declarations and rational actions of experimental subjects with great caution.

1. Introduction

Mate selection preferences in women have been intensively studied over the past 30 years, largely in the context of the good genes and the good parents hypotheses. According to these, mate choice in many animal species has evolved to help the choosier sex – or the one which invests more resources into the offspring, typically females – find either an optimal donor of good genes or an optimal provider of resources for the offspring (Trivers, 1974). The handicap theory (Zahavi, 1975) and the indicator theory (Hamilton & Zuk, 1982) explain how certain male traits can help females recognise such carriers of good genes (Pomiankowski, 1998) or good resources (Griffith, Owens, & Burke, 1999), respectively. According to the good genes theories, females choose males with traits handicapping their carriers, ideally with low or nil heritability, e.g. injuries (Kokko & Lindstrom, 1996; Sundberg & Dixon, 1996), since only males with high-quality genotype and phenotype have a reasonable chance to survive to their sexual maturity despite such handicaps. The good parents theories, then, suggest that the traits preferred by females directly signal high vitality of males (and therefore their capacity to provide resources to offspring) and,

* Corresponding author at: Department of Philosophy and History of Science, Division of Biology, Faculty of Science, Charles University in Prague, Viničná 7, Prague 128 44, Czechia.
E-mail address: flegr@cesnet.cz (J. Flegr).

https://doi.org/10.1016/j.evolhumbehav.2018.09.003
Received 30 January 2018; Received in revised form 26 August 2018; Accepted 3 September 2018

indirectly, the presence of good genes (Pomiankowski, 1998).

Very often, however, males with the best genes are not the best providers of resources (e.g. parental care) and sometimes there is even a negative correlation between these two qualities (Waynforth & Dunbar, 1995). To cope with this fact, females of certain species evolved a mixed mating strategy: they attempt to find one male to provide genes to their offspring as a biological parent and a different male to care for the offspring (Penton-Voak et al., 1999; Reynolds, 1996). Whereas this strategy is profitable for both females and genetic fathers of the offspring, it is highly disadvantageous for the males who provide parental care to extra-pair offspring. In species with hidden or unadvertised ovulation, females can rely on this strategy by copulating with good-gene carriers in their fertile phase (before ovulation) and with good parental care providers in the non-fertile phases of their reproductive cycle (Havlíček, Dvořáková, Bartoš, & Flegr, 2006). In other words, females will tend to prefer males possessing one set of traits – those signalling the presence of good genes – in the fertile phase of their cycle and another set of traits – those signalling the presence of resources and the willingness to provide these resources, including parental care – in the non-fertile phase of their cycle (Gangestad & Thornhill, 2008; Penton-Voak & Perrett, 2000). Similarly, they will search for a carrier of good genes once they have found a good resource provider and vice-versa (Lindova et al., 2016).

According to the immunocompetence handicap hypothesis (Folstad & Karter, 1992), the quality of the males' immune system is honestly signalled through the expression of testosterone-dependent traits, which together determine the masculinity of their human carriers (Gangestad & Buss, 1993; Thornhill & Gangestad, 1999). Based on the results obtained in various animal systems, testosterone has numerous immunosuppressive effects and therefore only carriers of genes which encode resistance to common parasites and pathogens can afford to express testosterone in high concentrations (Roberts, Buchanan, & Evans, 2004). It has also been suggested that masculinity is preferred by females as it honestly signals the presence of traits that are useful for their carriers (and consequently also for their potential male offspring) in intra-sexual competition for resources, including females (Scott, Clark, Boothroyd, & Penton-Voak, 2013). Based on these presumptions, one would predict that women in the fertile phase of their cycle prefer more masculine men than in the non-fertile phases of their cycle (Debruine, Jones, Smith, & Little, 2010; Jones et al., 2008). By the same token, women are expected to prefer more masculine men as one-night stand partners (potential providers of good genes), while masculinity should play a lesser role when seeking a life partner, or a potential provider of resources, (Gangestad & Thornhill, 2008; Little, Cohen, Jones, & Belsky, 2007; Penton-Voak & Perrett, 2000).

There are several problems in the theoretical background of mate selection studies. Their authors usually focus on some evolutionary theories, but neglect other, often more strongly empirically supported ones. For instance, the Red Queen hypothesis (Hamilton, 1980; Jaenike, 1978) holds that parasites which typically have shorter generation times (and thus evolve faster than their hosts) are nearly always better adapted to the genotypes of hosts that were among the most resistant in the previous generation. Consequently, by choosing the most resistant (or most masculine) males as fathers – as predicted by the good genes hypothesis –, females may risk having heavily parasitized offspring, since parasites could have already adapted to the phenotypes of hosts that had been among the most successful in the previous generation. The good parents hypothesis offers opposing predictions to the more frequently tested good genes hypothesis. According to this hypothesis, it pays off for females to prefer higher quality males in the non-fertile rather than the fertile phase of the cycle or, in other words, when searching for the best resource providers (including physical protection) rather than when searching for the best genes providers. This is because genotypes (and corresponding phenotypes and fitness) are not directly inherited in sexually reproducing organisms, as they arise de novo in every generation from the combination of the genes of the two parents (Dawkins, 1982; Flegr, 2010). Consequently, the quality of the father does not guarantee a high-quality offspring. On the other hand, it is always advantageous for the female to choose a resistant and vigorous resource provider for her offspring to minimise the risk of infection to herself and her offspring, as well as receive better and longer-lasting parental care (Able, 1996). Of course, the good parents hypothesis also has its shortcomings. For example, the highest quality males are often less willing to invest their resources into offspring (Gangestad & Simpson, 2000).

The most important methodological problem of the majority of published studies is that their results can be influenced by pre-conceived opinions of experimental subjects, including their prejudices (Buss, 1989; Csajbok & Berkics, 2017). For example, if women are asked which properties they prefer in a life partner, their answer is probably closer to what they think they should prefer in such partners. Similarly, when they are asked to make a choice between two (either natural or artificially manipulated) photos of men, they are likely to decide based on their pre-conceived opinions on the desirability of the trait in which the two photos differ. The readiness to report, for example, a preference for a socially undesirable property in short-term and long-term partners could change between the phases of the menstrual cycle far more dramatically than the actual female preferences themselves. It is likewise possible that in real-life situations, human mate selection could be driven by factors quite different from conscious, rationally-based opinions.

Some studies avoid this problem by investigating properties in the subjects' real-life partners rather than testing for their preferences in experimental or questionnaire studies. This approach can be used to study the effects of some factors, e.g. physical properties, sexual orientation, and cultural or family background (Courtiol, Picq, Godelle, Raymond, & Ferdy, 2010; Courtiol, Raymond, Godelle, & Ferdy, 2010; DeBruine et al., 2006; Sterbova et al., 2018; Valentova, Varella, Bartova, Sterbova, & Dixson, 2017); however, it is less suitable for investigations of other, more variable factors (fertility, partnership and parenthood status). Moreover, such ‘realised preferences’ are determined not only by the subjects' mating preferences, but also by other external factors, such as availability and mating preferences of the partners with the preferred properties (DeBruine et al., 2006).

We have devised a novel method for exploring human mate preferences, which seeks to cope with the said methodological problems and avoid the influence of a priori predictions about what people – conditioned by the theories discussed – think they should prefer. We applied this method to investigate the influence of various sociobiological factors on humans mate selection preferences. Using a Facebook-based snowball method, we collected and analysed data from 2718 women and 4073 men between the ages of 16–50, who participated in our electronic questionnaire about their preferences for specific traits in short-term and long-term partners. The participants also rated 40 photos of men and 40 photos of women for attractiveness and niceness, which – as supported by previous research – can be used as proxies for preferences in short-term (one-night stand) and long-term (life) partners, respectively (Lindova et al., 2016).

2. Materials and methods

2.1. Participants

Male and female participants were invited to take part in “an experiment studying the differences in declared and actual partner choice preferences and the dependence of these preferences on various biological and social factors”. The sample collection itself was conducted through a Facebook-based snowball method (Kankova, Flegr, & Calda, 2015), primarily among the members of the volunteer group called ‘Lab bunnies’ (in Czech ‘Pokusní Králíci’), which includes Czech and Slovak nationals willing to take part in ethological and psychological research (Flegr & Hodny, 2016).

2.2. Stimuli

Forty randomly selected photos of male faces and forty randomly selected photos of female faces were collected from various Internet resources, including college athletics websites. Our criteria were: age 18–70, frontal view, neutral expression, resolution at least 1165 × 1476 pixels, background and hair covered with a grey mask.

2.3. Procedure

Each participant rated every photo on the Likert scale from 1 to 8 (1 – not at all, 8 – very strongly) for attractiveness, niceness and one of the eleven focal properties. These properties were altruism, dominance (from very submissive to very dominant), faithfulness, generosity, charisma, intelligence, sense of humour, kindness, masculinity (from very feminine to very masculine), wealth, and youth (from very old to very young). These focal properties (and physical attractiveness and niceness) were chosen because they were the eleven most frequently listed items in a survey of 120 university students, who were asked about "the most desirable qualities in potential partners" (Fig. S1). The order of the photos was randomized for every participant and each property. In addition to rating photos for different properties, the participants were asked to consider the importance of these eleven traits and of physical attractiveness when looking for a life partner and when looking for a one-night stand partner using the same 1 to 8 scale (1 – not at all important, 8 – very important).

Furthermore, each subject provided other relevant information, such as their age, and their relationship and parenthood status. Female participants were asked about the current day and the usual length of their menstrual cycle, about the use of hormonal birth control pills and about whether they were currently pregnant. Using the same Likert scale, the participants also indicated how strongly they are sexually attracted to the individuals of the same and of the opposite sex (1 – not at all, 8 – very strongly). Since the primary subject of our analyses was the influence of fertility on perceived and declared male desirability, only non-homosexual participants (i.e. those who declared to be attracted to individuals of the opposite sex at least as strongly as to the individuals of the same sex) in reproductive age (16–50) with a regular length of the menstrual cycle (20–37 days) were considered in our analyses. For female participants with a 28-day cycle, the days 7–14 were considered as the fertile phase, whereas for participants with a different length of the cycle, the end of the 7-day long fertile phase was calculated as F = L – 14, where F represents the last day of the follicular phase and L stands for the length of the cycle (Havlíček et al., 2006). All participants were informed that they can skip any question or terminate the experiment at any stage. To explore the robustness of our method, namely its sensitivity to the nature of visual stimuli, we ran a similar smaller-scale study in which the photos of forty cats and forty dogs (instead of forty men and forty women) were rated by an independent set of 2900 participants. For an outline of data collection, see Fig. S1.

2.4. Sample structure

Between January 2013 and February 2014, 10,270 subjects started and 7966 completed the experiment. We filtered out the data for all participants younger than 16 and older than 50, and for those who skipped any important part of the test (i.e. failed to provide information on their sex, age, sexual attraction to individuals of the same or the opposite sex). We also eliminated the data of those subjects who rated the photos in a uniform way (with the standard deviation of scores for male or female photos lower than 0.5), and of those who provided suspicious combinations of information about their body weight and height (e.g. body height lower than 140 cm with body weight above 80 kg). This data pre-processing had been done before any analyses were begun. The final data set contained information from 5309 subjects.

2.5. Statistical analyses

We calculated Pearson's *r* correlation coefficients between the scores allocated by the subjects to individual photos for attractiveness/niceness and for a particular focal property (e.g. masculinity). In this fashion, we sought to investigated whether photos with a high score in that focal property ranked high or low in attractiveness and niceness; for example, whether a specific female participant considered males rated high in masculinity attractive or not. We computed correlation coefficients between the focal property and attractiveness/niceness only in cases with at least five data points for the participant (five photos rated for the focal property and niceness/attractiveness). The attractiveness and niceness scores were used as a proxy for the extent to which the males (for female subjects) and the females (for male subjects) in the photos were regarded as preferable one-night stand and life partners, respectively (Lindova et al., 2016). Therefore, the correlation coefficients of the focal property (e.g. masculinity) with attractiveness or niceness were considered as indicative of the preference for this focal property in one-night stand and life partners, respectively.

Except for masculinity in men, and charisma in both men and women, the coefficients had approximately normal distributions. Consequently, for analyses of the influence of different socio-biological factors in question on mate preferences, we used parametrical statistical methods (general linear models, GLM). Nonetheless, we also tested these effects (separately for men and women and for attractiveness- and niceness-related coefficients) with non-parametric methods, namely with the partial Kendall correlation (controlling for age). The results of parametric and non-parametric tests were without substantial differences. We used Spearman's rank correlation R for the quantification of the similarity of results obtained in the questionnaire part of the study (declared preferences) and in the observational part using four different sets of visual stimuli (opposite-sex people, same-sex people, cats, dogs). Our aim was to look for similarities in the rankings of preferences for individual properties obtained with these five methods.

Our study focused on preferences for eleven properties, which we suspected to influence the attractiveness and niceness of potential partners. It is possible, however, that some other property, which was not on our list, could also influence the attractiveness and niceness of potential partners. To search for such unknown properties and to test their association with, for example, the fertility status of female participants, we used a factor analysis (principal axis factoring, mean substitution of missing data, no rotation) with the 40 attractiveness and the 40 niceness scores attributed by female participants to the 40 male photos as the input variables (Liskova, Landova, & Frynta, 2015). In this fashion, we extracted individual components of attractiveness and niceness. The optimal number of independent factors was computed using a parallel analysis (O'Connor, 2000) implemented in R software, version 3.1.3; all other tests were conducted in Statistica, v. 10.

To investigate the influence of the participants' socio-biological background on their declared and observed preferences, we explored the associations of the allocated scores (declared preferences), of the correlation coefficients (observed preferences) and of the factors obtained in our factor analysis with various social and biological (binary) variables: namely, parenthood and partnership status, pregnancy, use of hormonal contraception, and the phase of the menstrual cycle. Again, these analyses were primarily conducted using repeated measure GLM with age as the covariate (see *Results* for details). Non-parametric partial Kendall correlation analyses yielded qualitatively equivalent results. Corrections for multiple tests were performed using the Benjamini-Hochberg procedure (Benjamini & Hochberg, 1995) with the false discovery rate of 0.20. For an outline of the data analysis, see Fig. S2.

Table 1
The age structure of the participants of the study.

Age	< 20	20–24	25–29	30–34	35–39	40–44	45–50	Total
Men	151	648	822	850	747	495	360	4073
Women	175	797	661	384	285	221	195	2718
Total	326	1445	1483	1234	1032	716	555	6791

3. Results

3.1. Data description

The population of subjects between 16 and 50 years of age totalled 4073 men (mean age: 32.3, SD: 8.04) and 2718 women (mean age: 29.2, SD: 8.31). Table 1 shows the age structure of the population. Among men and women, 8.7% and 3.6%, respectively, declared to be more strongly attracted to individuals of the same sex than to individuals of the opposite sex and, therefore, were considered homosexual for the purposes of our study. Consequently, we analysed only the subset of non-homosexual participants in the age of 16–50. Within this subset, 2.7% of women were pregnant, 34.7% of women and 28.6% of men reported to have at least one child, and 72.1% of women and 67.5% of men reported to have a long-term partner. To study the influence of the use of hormonal contraception, we looked at the sample of 2271 women (mean age: 29.40, SD: 8.31), who provided the information required. To study the influence of the phase of the menstrual cycle, we used two samples of women who provided the information required for the calculation of the phase of the menstrual cycle: firstly, the sample of 1943 women, 509 (26.2%) of whom were in the fertile phase (mean age: 29.06, SD: 8.24); and, secondly, the sub-sample of 1356 women who reported not to use hormonal contraception, 353 (26.0%) of whom were in the fertile phase (mean age: 30.13, SD: 8.37).

3.2. Declared preferences

Declared preferences for individual properties in life and one-night stand partners were calculated as arithmetic means of the subjects' responses in the first questionnaire section of the survey (Figs. 1 and 2). When looking for a long-term relationship, female participants claimed to seek faithfulness (1), intelligence (2), kindness (3), and sense of humour (4), while showing less interest in wealth (12), youth (11), physical attractiveness (10), and dominance (9). Similarly, when looking for a life partner, male participants claimed to seek faithfulness (1), kindness (2), intelligence (3), sense of humour (4), while showing less interest in masculinity (12), wealth (11), dominance (10), and youth (9).

On the other hand, women declared that an ideal one-night stand partner should be charismatic (1), have a sense of humour (2), be physically attractive (3) and masculine (4), while properties such as faithfulness (12), wealth (11), altruism (10), and youth (9) were declared to be unimportant. Males declared that an ideal one-night stand partner should be physically attractive (1), have a sense of humour (2), and be charismatic (3) and young (4), while qualities such as masculinity (12), wealth (11), faithfulness (10), and altruism (9) were declared to be undesirable. To investigate differences in the properties in terms of their desirability in one-night stand and life partners, we conducted 24 separate repeat measure GLM analyses, 12 for men and 12 for women. Each analysis used preferences for one of the 12 focal properties in life and one-night stand partners as two dependent variables (repeat measures) and age as independent variable. In women, these tests revealed highly significant ($p < 0.0001$) differences between preference for life and for one-night stand partners for all properties, except for sense of humour ($p = 0.058$, $eta^2 = 0.002$). In men, we found highly significant ($p < 0.00005$) differences in all properties but generosity ($p = 0.195$, $eta^2 = 0.0006$) and sense of humour ($p = .114$, $eta^2 = 0.001$). For the directions and effect sizes, refer to Figs. 1 and 2; for detailed results, see Table 2.

3.3. Observed preferences

Each participant rated 40 male and 40 female photos for one of the 11 properties, as well as for attractiveness and niceness. Correlation coefficients between the rated property and niceness were regarded as a

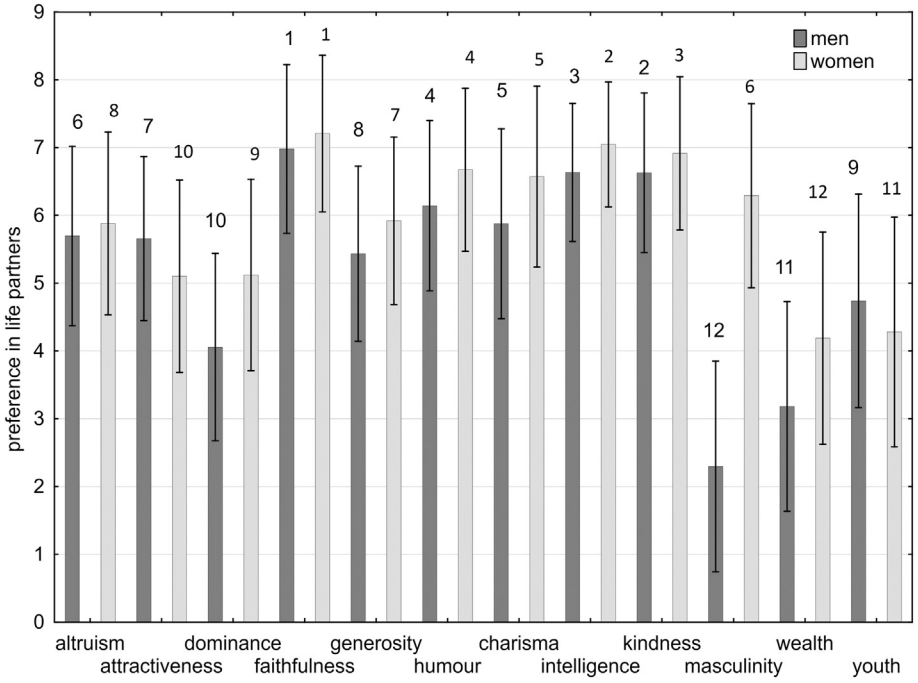

Fig. 1. Declared male and female preferences for individual properties in life partners.
The columns, whiskers and the numbers above the columns show the mean score (on the scale 1–8), the standard deviation, and the order of preferences for individual properties, respectively.

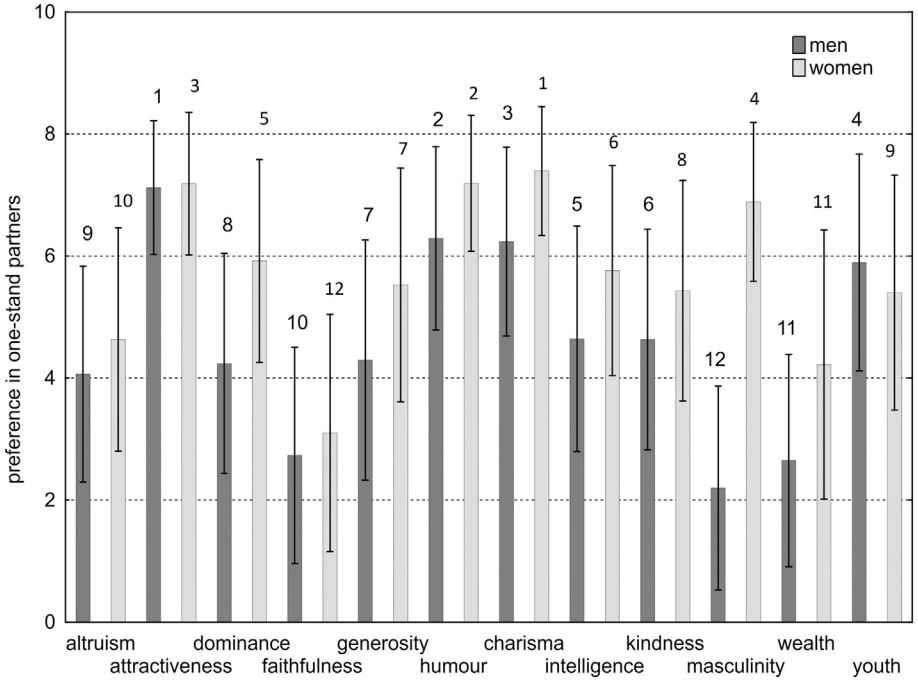

Fig. 2. Declared male and female preferences for individual properties in one-night stand partners.
The columns, whiskers and the numbers above the columns show the mean score (on the scale 1–8), the standard deviation, and the order of preferences for individual properties, respectively.

proxy for preference for this property in life partners, while correlation coefficients between the rated property and attractiveness were taken as a proxy for preference for this property in one-night stand partners (Lindova et al., 2016). Figs. 3 and 4 show the means of these correlation coefficients for all these properties in both men and women. Table 2 ranks declared preferences of male and female participants from the most (1) to the least desirable (12) property to demonstrate the differences between declared and observed preferences. Simultaneously, Table 3 lends support to the robustness of the method with respect to the nature and quality of the rated photos, showing observed preferences of the participants measured with opposite sex photos, same sex photos, as well as photos of cats and dogs (see Supplementary Table S1 for the Spearman correlations of the rankings obtained with these four sets of stimuli).

When looking for a long-term relationship, we observed preferences among female participants for sense of humour (1), kindness (2), altruism (3), and intelligence (4), while detecting less interest in dominance (11), youth (10), masculinity (9), and faithfulness (8). Similarly, when looking for a long-term relationship, male participants were observed to prefer sense of humour (1), charisma (2), kindness (3), and intelligence (4), while showing less interest in masculinity (11), dominance (10), faithfulness (9), and youth (8). In one-night stand partners, women were observed to prefer charisma (1), sense of humour (2), intelligence (3), and kindness (4), while properties such as youth (11), dominance (10), faithfulness (9), and masculinity (8) were among the least important. Males were observed to prefer charisma (1), sense of humour (2), wealth (3), and kindness (4) in one-night stand partners, while properties like masculinity (11), faithfulness (10), dominance (9), altruism (8) were not desirable. To investigate differences in the properties in terms of their desirability in one-night stand and life partners, we conducted 22 separate repeat measure GLM analyses, 11 for men and 11 for women. Each analysis used observed preferences for one of the 12 focal properties in life and one-night stand partners as two dependent variables (repeat measures) and age as independent variable. In women, these tests revealed significant differences in all properties, except for charisma ($p = 0.367$), masculinity ($p = 0.690$),

Table 2
Effect of type of partnership on declared preferences of particular properties.

	Men				Women			
	F	**p**	**eta²**	**df**	**F**	**p**	**eta²**	**df**
Altruism	87.160	**0.00000**	0.029	2895	33.630	**0.00000**	0.015	2147
Attractiveness	290.703	**0.00000**	0.091	2895	273.066	**0.00000**	0.113	2147
Dominance	126.062	**0.00000**	0.042	2895	89.668	**0.00000**	0.040	2147
Faithfulness	776.620	**0.00000**	0.212	2895	707.804	**0.00000**	0.248	2147
Generosity	1.680	0.19505	0.001	2895	5.505	**0.01906**	0.003	2147
Humour	2.506	0.11354	0.001	2895	3.587	0.05836	0.002	2147
Charisma	79.617	**0.00000**	0.027	2895	59.915	**0.00000**	0.027	2147
Intelligence	344.930	**0.00000**	0.106	2895	139.339	**0.00000**	0.061	2147
Kindness	222.532	**0.00000**	0.071	2895	139.967	**0.00000**	0.061	2147
Masculinity	71.331	**0.00000**	0.024	2895	52.699	**0.00000**	0.024	2147
Wealth	115.261	**0.00000**	0.038	2895	42.122	**0.00000**	0.019	2147
Youth	36.599	**0.00000**	0.012	2895	58.307	**0.00000**	0.026	2147

Results of repeat measures ANCOVAs. The significant p-values are printed in bold, the p-values lower than 0.000005 are coded as 0.00000.

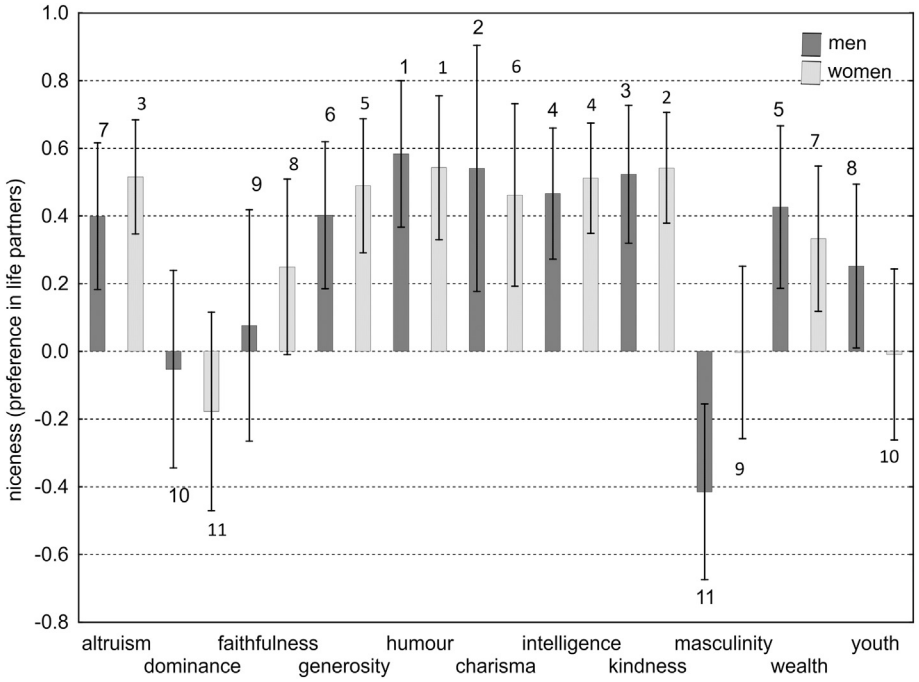

Fig. 3. Observed male and female preferences for individual properties in life partners.
The columns, whiskers and the numbers above the columns show the mean correlation coefficient, the standard deviation, and the order of preferences for individual properties, respectively. Negative correlations imply that the property is undesirable.

wealth ($p = 0.778$), and youth ($p = 0.211$). In men, there were significant ($p < 0.005$) differences for all properties but dominance ($p = 0.132$), sense of humour ($p = 0.235$), charisma ($p = 0.578$), and wealth ($p = 0.080$). For the directions and effect sizes, refer to Figs. 3 and 4; for detailed results, see Table 4.

3.4. Differences between declared and observed preferences

Comparisons between Figs. 1 and 3, and between Figs. 2 and 4 reveal stark differences between declared and observed preferences for individual properties in life and in one-night stand partners, respectively. To calculate the correspondence between declared preferences (ratings 1–8) and observed preferences (correlation coefficients from −1.0 to 1.0) in individual subjects, we used a GLM analysis with observed preferences as the dependent variable, and declared preferences and age as independent variables. The results (Table 5) confirm that for most properties, the correlation between declared and observed preferences is very weak. For some of them (e.g. charisma in life partners among men or generosity in one-night stand partners among women), the non-significant trends are even negative.

To demonstrate the method's independence from the nature of the stimuli, we calculated Spearman rank correlations between the ranks of declared preferences and the ranks of observed preferences measured with four different sets of stimuli (opposite-sex people, same-sex people, cats, dogs). Table S1 shows that in females, declared and observed preferences for properties in life partners correlated relatively

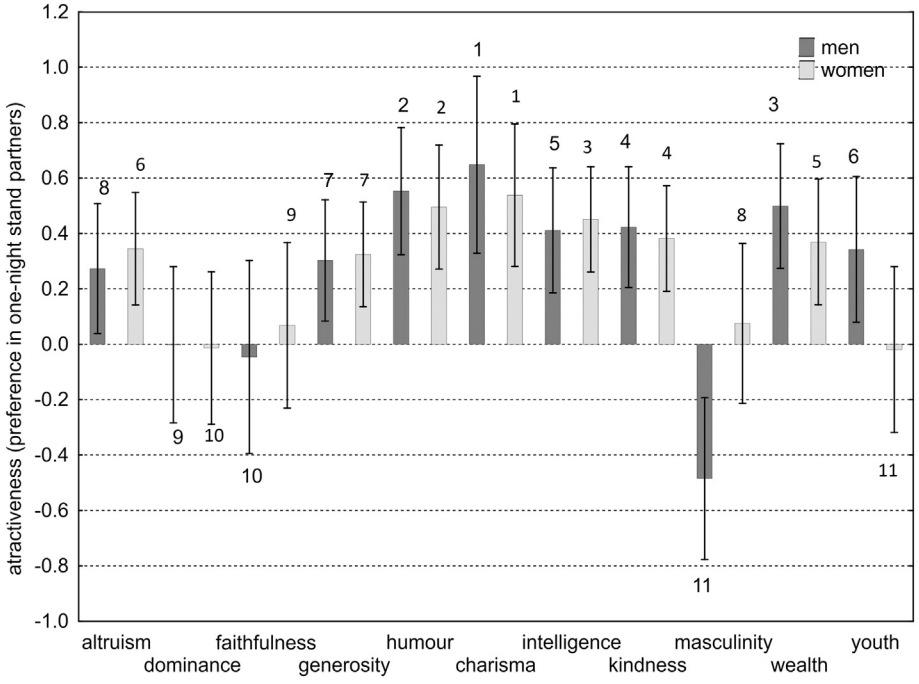

Fig. 4. Observed male and female preferences for individual properties in one-night stand partners.
The columns, whiskers and the numbers above the columns show the mean correlation coefficient, the standard deviation, and the order of preferences for individual properties, respectively. Negative correlations imply that the property is undesirable.

Table 3
Declared and observed preferences for individual properties in one-night stand and life partners.

	Men night, declared	Men night, opposite-sex photos	Men night, same-sex photos	Men night, cat photos	Men night, dog photos	Men life, declared	Men life, opposite-sex photos	Men life, same-sex photos	Men life, cat photos	Men life, dog photos	Women night, declared	Women night, opposite-sex photos	Women night, same-sex photos	Women night, cat photos	Women night, dog photos	Women life, declared	Women life, opposite-sex photos	Women life, same-sex photos	Women life, cat photos	Women life, dog photos
Altruism	9	8	6	5	6	6	7	4	3	6	10	6	7	3	5	8	3	4	2	2
Attractiveness	1					7					3					10				
Dominance	8	9	9	11	11	10	10	10	11	11	5	10	9	10	10	9	11	10	11	11
Faithfulness	10	10	10	7	8	1	9	8	6	5	12	9	10	6	6	1	8	8	5	5
Generosity	7	7	7	4	3	8	6	6	4	2	7	7	6	5	4	7	5	5	3	3
Humour	2	2	4	6	5	4	1	3	2	4	2	2	2	7	7	4	1	1	6	6
Charisma	3	1	1	1	2	5	2	5	5	7	1	1	1	1	2	5	6	6	4	7
Intelligence	5	5	2	3	1	3	4	2	7	1	6	3	4	4	1	2	4	3	7	4
Kindness	6	4	5	2	4	2	3	1	1	3	8	4	5	2	3	3	2	2	1	1
Masculinity	12	11	8	10	10	12	11	9	10	10	4	8	11	11	11	6	9	11	10	10
Wealth	11	3	3	9	7	11	5	7	9	8	11	5	3	8	8	12	7	7	9	9
Youth	4	6	11	8	9	9	8	11	8	9	9	11	8	9	9	11	10	9	8	8

The table shows the rankings of male and female preferences as declared by the subjects or measured using four sets of stimuli, namely opposite-sex, same-sex, and cat and dog photos. The lower the number, the more preferred the property. Preference for physical attractiveness cannot be measured using our method.

strongly regardless of the type of stimuli: opposite-sex photos (Spearman Rho = 0.60), same-sex photos (Spearman Rho = 0.57), cat photos (Spearman Rho = 0.45) and dog photos (Spearman Rho = 0.49). In contrast, we found nearly no affinity between female declared and observed preferences for properties in one-night stand partners using opposite-sex photos (Spearman Rho = 0.15), same-sex photos (Spearman Rho = −0.10), cat photos (Spearman Rho = −0.03), and dog photos (Spearman Rho = 0.07). We have to emphasise that even for life partners, the strength of the correlation between the ranks of declared and observed preferences was lower (and for one-night stand partners dramatically lower) than in the case of the correlation between the ranks of observed preferences measured with different types of stimuli.

In men, declared and observed preferences for properties in life partners were strongly correlative regardless of whether we used opposite-sex photos (Spearman Rho = 0.77), same-sex photos (Spearman Rho = 0.83) or cat (Spearman Rho = 0.80) and dog photos (Spearman Rho = 0.77). We also found similar concordances in preferences for properties in one-night stand partners when using opposite-sex photos (Spearman Rho = 0.57), and cat (Spearman Rho = 0.70) and dog photos (Spearman Rho = 0.57). However, the correlations were much weaker when estimated using same-sex photos (Spearman Rho = 0.27). Table S1 also shows that the results for observed preferences were similar, regardless of the set of stimuli used. In all cases, however, we found a stronger concordance between opposite-sex photos and dog photos in women, and between opposite-sex photos and cat photos in men. This corresponds to common Czech gender stereotypes concerning these species (cats as feminine and dogs as masculine).

3.5. The influence of partnership and parenthood status, use of hormonal contraception, and the phase of the menstrual cycle on declared and observed preferences

Nearly all declared preferences and numerous observed preferences were dependent on the age of the subject (Table S2). Therefore, to investigate the effects of all binary variables on declared preferences (namely partnership and parenthood status, use of hormonal contraception, and the phase of the menstrual cycle), we included the covariate age in all models. Univariate MANCOVAs with all 24 declared preferences for life and one-night stand partners as dependent variables showed that only partnership status, parenthood status, and the use of hormonal contraception had significant effects on male and female preferences (Table 6). To identify the preferences affected by the individual factors, we used repeat measures ANCOVA analyses, where the mean preferences for particular properties in one-night stand and life partners were dependent variables (repeated measures), while the binary factor (e.g. parenthood status), age, age-binary factor interaction, R1 (one-night stand vs life partners), R1-binary factor interaction and R1-age interaction were independent variables (Table 6). The effects of the phase of the menstrual cycle were also computed in the subpopulation of women who did not use hormonal contraception. The results of these analyses were approximately the same, except for a weaker main effect of fertility on the preference for young partners ($Eta^2 = 0.001$) and a stronger effect of R1-fertility interaction on the preference for young partners; in other words, in relatively lower preference for young males as one-night stand partners ($Eta^2 = 0.004$).

Independently, for the same purpose, we also used partial Kendall correlation tests with the age of participants as a covariate (Table S3). Each participant rated only one of the 11 properties (and attractiveness and niceness) and, therefore, MANCOVA tests could not be used to analyse the effects of our binary factors on observed preferences. Consequently, we performed only repeat measure analyses, where the dependent variables were the correlation coefficient for the correlation between the focal property and attractiveness and the correlation coefficient between the focal property and niceness, while the binary factor (e.g. parenthood status), age, age-binary factor interaction, R1

Table 4
Effect of type of partnership on observed preferences for particular properties.

	Men				Women			
	F	p	eta^2	df	F	p	eta^2	df
Altruism	15.276	**0.00012**	0.055	261	25.737	**0.00000**	0.117	195
Dominance	2.285	0.13174	0.008	291	4.186	**0.04218**	0.022	184
Faithfulness	17.911	**0.00003**	0.073	227	9.341	**0.00254**	0.044	205
Generosity	10.816	**0.00116**	0.043	240	50.421	**0.00000**	0.216	183
Humour	1.417	0.23510	0.006	234	4.637	**0.03237**	0.021	219
Charisma	0.310	0.57824	0.001	269	0.819	0.36657	0.004	191
Intelligence	8.381	**0.00410**	0.030	273	11.100	**0.00104**	0.057	184
Kindness	8.220	**0.00446**	0.029	277	5.834	**0.01663**	0.029	198
Masculinity	11.119	**0.00096**	0.035	305	0.928	0.33661	0.005	189
Wealth	3.086	0.08016	0.012	254	0.080	0.77789	0.000	232
Youth	9.298	**0.00250**	0.030	298	1.573	0.21128	0.008	199

Results of repeat measures ANCOVAs. The significant p-values are printed bold, the p-values lower than 0.000005 are coded as 0.00000.

Table 5
Correlations between declared and observed preferences for individual properties (within-subject analysis).

	Women life partner		Women one-night stand		Men life partner		Men one-night stand	
	B	p	B	p	B	p	B	p
Altruism	0.026	0.722	−0.032	0.660	**0.188**	**0.003**	0.114	0.073
Dominance	**0.283**	**0.001**	**0.248**	**0.001**	**0.118**	**0.045**	0.085	0.150
Faithfulness	**0.225**	**0.001**	0.087	0.229	0.104	0.124	**0.180**	**0.008**
Generosity	0.072	0.316	−0.068	0.376	0.112	0.086	−0.009	0.896
Humour	−0.021	0.763	−0.041	0.560	0.097	0.150	0.059	0.391
Charisma	0.085	0.248	**0.177**	**0.014**	−0.073	0.233	0.020	0.752
Intelligence	−0.022	0.763	**0.184**	**0.011**	**0.181**	**0.003**	**0.142**	**0.022**
Kindness	0.072	0.312	**0.211**	**0.003**	0.048	0.421	0.001	0.989
Masculinity	**0.241**	**0.001**	**0.205**	**0.005**	0.085	0.140	**0.181**	**0.002**
Wealth	**0.187**	**0.007**	0.069	0.317	0.083	0.196	−0.024	0.712
Youth	−0.053	0.469	**0.185**	**0.010**	0.002	0.974	**0.137**	**0.020**

Correlations (slope B and statistical significance p) between declared preferences (scores on the scale 1–8) and observed preferences (correlation coefficients on the scale − 1.0–1.0) were calculated using GLM (observed preferences as the dependent variable; declared preferences and the age of the subject as independent variables). Significant correlations are printed in bold.

Table 6
The effects of partnership and parenthood status, use of hormonal contraception, the phase of the menstrual cycle, and pregnancy on declared preferences in partners.

Property		Altruism	Attractiveness	Dominance	Faithfulness	Generosity	Charisma	Intelligence	Humour	Kindness	Masculinity	Wealth	Youth
	Women												
Parenthood 0.017, 0.020	Main effect	0.000	0.000	0.000	0.002	0.000	0.001	0.001	0.000	0.000	0.002	0.000	0.001
	Interaction	0.000	**0.002**	0.001	**0.004**	0.000	0.001	**0.003**	0.001	0.000	0.000	0.001	0.001
Partnership < 0.0001, 0.049	Main effect	0.000	**0.003**	0.000	0.001	0.001	0.000	0.000	0.001	**0.002**	**0.002**	0.000	0.000
	Interaction	0.000	**0.002**	**0.001**	**0.009**	0.000	0.000	**0.010**	0.000	**0.009**	**0.002**	**0.003**	0.000
Contraception < 0.0001, 0.032	Main effect	**0.005**	**0.002**	0.000	0.000	0.000	**0.003**	**0.003**	**0.005**	0.000	**0.003**	**0.003**	0.000
	Interaction	0.000	**0.001**	**0.002**	**0.004**	0.000	**0.002**	0.000	**0.003**	0.001	0.000	**0.002**	0.000
Pregnancy 0.572, 0.011	Main effect	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.000	0.000	0.000	0.002	0.000
	Interaction	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001
Fertility 0.267, 0.015	Main effect	**0.002**	0.000	0.000	**0.002**	**0.005**	0.000	0.001	0.000	**0.002**	0.000	0.001	**0.003**
	Interaction	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
	Men												
Parenthood < 0.0001, 0.026	Main effect	0.000	0.000	0.000	0.000	0.000	**0.001**	0.000	0.000	**0.001**	**0.005**	0.000	**0.002**
	Interaction	0.000	**0.005**	0.001	**0.002**	0.000	0.001	0.000	**0.002**	0.000	0.000	**0.003**	**0.002**
Partnership < 0.0001, 0.048	Main effect	0.000	**0.003**	0.000	0.000	0.001	**0.007**	**0.007**	0.000	**0.002**	**0.003**	0.000	**0.003**
	Interaction	0.000	**0.004**	0.000	**0.003**	0.000	0.000	0.000	0.000	0.000	0.000	**0.003**	**0.020**

The table shows the effect sizes (Eta^2) computed with repeat measures GLM, where the mean preferences for individual properties in one-night stand and in life partners were dependent variables (repeated measures), while the binary factor (e.g. parenthood), age, age-binary factor, and R1 (one-night stand vs life partners), R1-binary factor and R1-age were independent variables. Upper rows show the results for the main effects of individual factors, while lower rows show the results for the interaction between the factor and the type of partner (one-night stand vs life partner). The results in bold are significant after correction for multiple tests. The first column of the table shows the effects of individual factors (significance and effect size) computed using MANCOVA with all 22 declared preferences in life and one-night stand partners as dependent variables.

Table 7
The effects of partnership and parenthood status, use of hormonal contraception, the phase of the menstrual cycle, and pregnancy on observed preferences in partners.

Property		Altruism	Dominance	Faithfulness	Generosity	Humour	Charisma	Intelligence	Kindness	Masculinity	Wealth	Youth
		Women										
Parenthood	Main effect	0.004	0.000	0.012	0.028	0.001	0.001	0.000	0.013	0.002	0.010	0.000
	Interaction	0.005	0.010	0.017	0.017	0.012	0.004	0.001	0.001	**0.036**	0.005	0.001
Partnership	Main effect	0.000	0.017	0.001	0.001	0.002	0.001	0.000	0.001	0.000	0.000	0.014
	Interaction	0.000	0.000	0.003	0.001	0.007	0.007	0.005	0.000	**0.038**	0.006	0.010
Contraception	Main effect	0.001	0.005	0.003	0.002	0.013	0.000	0.003	0.004	0.000	0.000	0.000
	Interaction	0.014	0.000	0.000	0.000	0.013	0.000	0.000	0.007	0.006	0.005	0.000
Pregnancy	Main effect	0.002	0.000	0.006	0.000	0.000	0.007	0.000	0.021	0.000	0.011	0.000
	Interaction	0.000	0.003	0.000	0.000	0.014	0.000	0.001	0.001	0.005	0.004	0.000
Fertility	Main effect	0.022	0.009	0.001	0.004	0.002	0.001	0.000	0.002	0.010	0.005	0.004
	Interaction	0.000	**0.046**	0.000	0.001	**0.032**	0.000	**0.049**	0.007	0.002	0.004	0.000
		Men										
Parenthood	Main effect	0.000	0.003	**0.025**	0.000	0.003	0.003	0.000	0.002	0.000	0.000	0.002
	Interaction	0.002	0.006	0.004	0.001	0.001	0.000	0.000	0.002	0.006	0.004	0.002
Partnership	Main effect	0.001	0.002	0.001	0.017	0.003	0.010	0.001	0.000	0.001	0.001	0.001
	Interaction	0.000	0.003	0.011	0.002	0.000	0.001	0.003	0.000	0.001	0.000	0.001

The table shows the effect sizes (Eta^2) computed with repeat measures GLM, where the mean coefficients of correlation between an individual property and attractiveness or niceness (proxy for the preference for this property in one-night stand or life partners) were dependent variables (repeated measures), while the binary factor (e.g. parenthood status), age, age-binary factor, R1 (one-night stand vs life partners), R1-binary factor and R1-age were independent variables. Upper rows show the results for the main effects of individual factors, while lower rows show the results for the interaction between the factors and the type of partner (one-night stand vs life partner). The results printed in bold are significant after correction for multiple tests.

(one-night stand vs life partners), R1-binary factor interaction and R1-age interaction were independent variables (Table 7). The effect of the phase of the menstrual cycle on the observed preferences was studied also in the subpopulation of women who did not use hormonal contraception. Here, the effect of R1-fertility interaction on charisma was not significant; however, the effect sizes (Eta^2) for dominance and intelligence were similar to those observed in the entire female population (dominance: 0.053, charisma: 0.006, intelligence: 0.042).

We also performed partial Kendall tests (Table S4). Fig. 5 illustrates the effects of fertility on observed preferences in both short-term and long-term partners for the properties with significant fertility-R1 interaction, namely dominance, sense of humour and intelligence.

3.6. The influence of partnership and parenthood status, use of hormonal contraception, and the phase of the menstrual cycle on factors detected by factor analysis

To detect the existence of any male properties that could be appreciated differently by women in the fertile and the non-fertile phase of the cycle, we performed a factor analysis with the 40 attractiveness and 40 niceness ratings attributed by women to the forty male photos as input variables. A parallel analysis showed that women seemed to discriminate 19 independent components of attractiveness and niceness in the male photos (factors 1–19). Subsequently, we computed these factors for each female participant and then searched for associations between these factors and partnership and parenthood status, use of hormonal contraception, the phase of the menstrual cycle, and gravidity. For this purpose, we used MANCOVA test with all 19 factors as dependent variables and then ANCOVA tests for each of the 19 factors as the dependent variable. Only one factor, F10, correlated (positively) with the fertility status: MANCOVA $p = 0.708$, $Eta^2 = 0.008$, $F_{19,1922} = 0.801$, NCOVA $p = 0.022$, $Eta^2 = 0.003$, $F_{1,1940} = 5.236$ (F10). Partnership status correlated with three factors, namely F4, F8, and F10: MANCOVA $p = 0.003$, $Eta^2 = 0.018$, $F1_{9,2234} = 2.119$, ANCOVA $p = 0.004$, $Eta^2 = 0.004$, $F_{1,2252} = 8.125$ (F4); 0.033, 0.002, 4576 (F8); 0.004, 0.004, 8.314 (F10). Parenthood status correlated with three factors, namely F5, F7, and F8: MANCOVA $p = 0.061$, $Eta^2 = 0.013$, $F_{19,2172} = 1.546$, ANCOVA $p = 0.026$, $Eta^2 = 0.002$, $F_{1,2190} = 4.953$ (F5); 0.033, 0.002, 4.564 (F7); 0.006, 0.003, 7.598 (F8). The use of hormonal contraception correlated with six factors, namely F7, F8, F10, F15, F17, and F18: MANCOVA $p < 0.0005$, $Eta^2 = 0.030$ $F_{19,2250} = 3.717$, ANCOVA $p = 0.022$, $Eta^2 = 0.002$, $F_{1,2268} = 5.243$ (F7); < 0.0005, 0.008, 17.391 (F8); 0.009, 0.003, 4.528 (F10); 0.022, 0.002, 5.268 (F15); 0.018, 0.002, 5.574 (F17); < 0.0005, 0.006, 12,665 (F18). Gravidity correlated with one factor: F17 – MANCOVA $p = 0.157$, $Eta^2 = 0.011$, $F_{19,2238} = 1.324$, ANCOVA $p = 0.010$, $Eta^2 = 0.003$, $F_{1,2256} = 6.702$ (F17). To reveal the possible nature of factor F10, which correlated with the fertility status, we computed correlations between its factor loadings and the mean scores in properties attributed by female participants to individual male photos. Factor 10 was positively loaded with the niceness of the photos that scored high in intelligence (Pearson's $r = 0.243$) and in wealth (Pearson's $r = 0.194$), and negatively loaded with the niceness of the photos that scored high in youth (Pearson's $r = -0.155$) and also negatively loaded with the attractiveness of the photos that scored high in dominance (Pearson's $r = -0.302$). In other words, we found a relationship with practically the same traits that showed an association with the phase of the menstrual cycle (see Table 5). The same conclusion is also supported by the visual comparison of composite photographs created from the ten photos with the highest and the ten photos with the lowest loadings for factor 10 (Fig. 6).

4. Discussion

We have observed clear differences between what our participants declared to prefer and what they actually preferred in partners of the opposite sex (Figs. 1–4, Table 3). Most interestingly for the purpose of this study, females declared a strong preference for masculine and dominant men as one-night stand partners (average score of 6.93 and 5.94 on the scale 1 to 8, respectively), but our analyses of their observed preferences revealed no correlation between attractiveness and these qualities ($r = 0.075$ and -0.013, respectively). In other words, females did not tend to give high marks for attractiveness to photos which they rated high in masculinity and dominance, as their declared preferences would predict. It seems that female participants could be influenced by a cultural bias, further reinforced by the aforementioned mate choice selection hypotheses as they are sometimes presented in media or discussed on various public forums. Consequently, they may report what they think they should prefer rather than their actual mate preferences. We observed a similar disparity in the preference for wealth in both short-term and long-term partners: both male and female participants did not declare wealth very important (it was either the

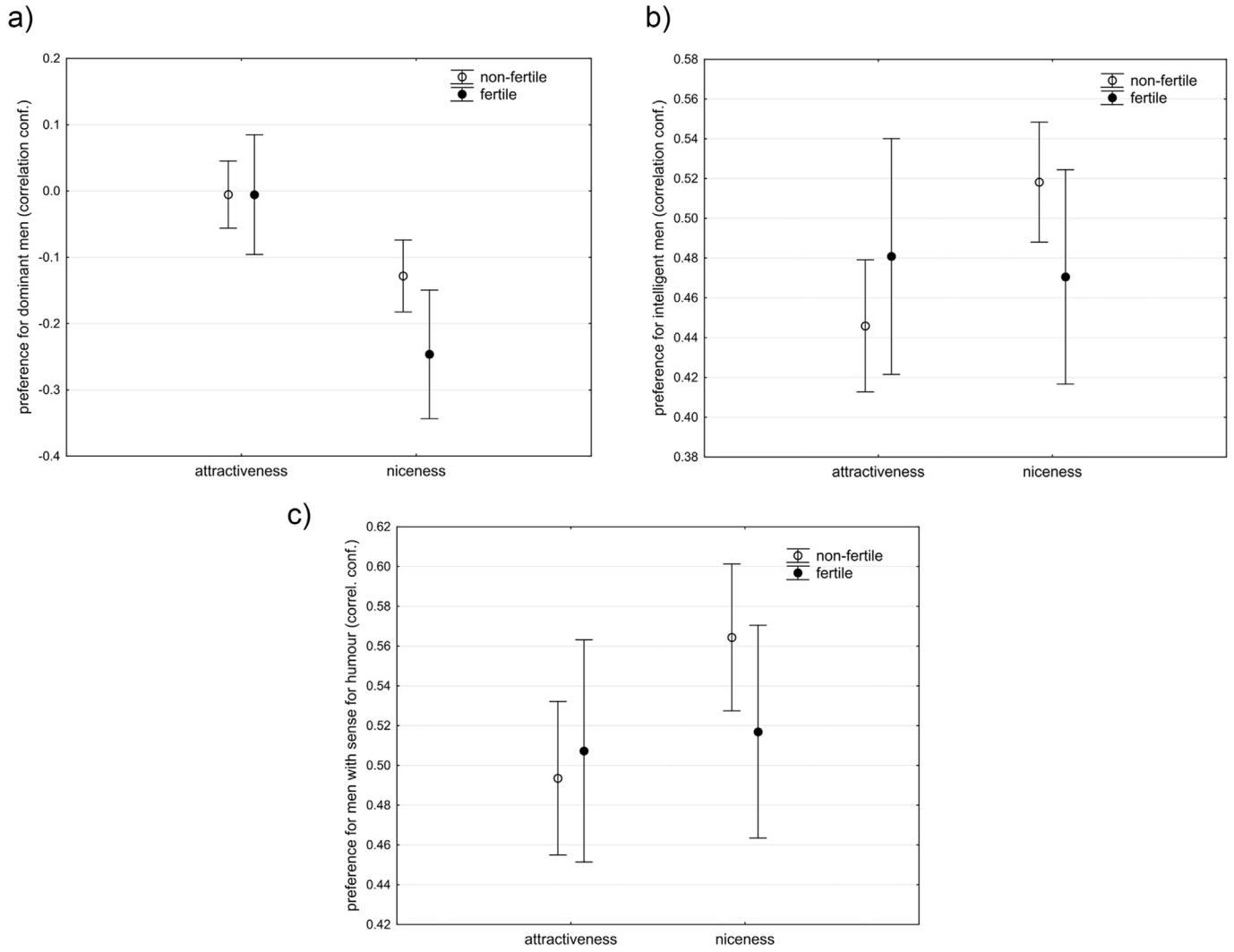

Fig. 5. The influence of the phase of the menstrual cycle on preferences for a) dominance; b) intelligence; and c) sense for humour. The spreads show the 95% confidence interval.

Fig. 6. Composite photographs created from the photos that loaded factor 10 most positively (left) and most negatively (right).
The left composite was created from the 10 photos, the niceness of which loaded factor 10 most positively, while the right composite was constructed from the 10 photos, the niceness of which loaded factor 10 most negatively. Women in the fertile phase of the menstrual cycle favoured photos with a positive value in factor 10.

second least or the least important quality in all cases), but our analyses revealed moderately strong correlations between attractiveness and wealth ($r > 0.4$). Again, it seems that participants may have been influenced by their pre-conceived norms and reluctance to declare an outright preference for a strongly material quality. The preference for a rich partner – or one that can provide resources for the offspring – has been previously associated with females seeking life partners; nonetheless, our results suggest that material resources play a strong role for both sexes and both in short-term and long-term relationships. Lastly, we found divergences in preferences for faithfulness in life partners both among men and women. While both sexes declared that this quality is essential in long-term relationships (average score of 6.99 in men and 7.21 in women on the scale 1 to 8), our analyses detected no or very weak correlations between niceness and faithfulness ($r = 0.077$ in men, $r = 0.250$ in women).

The results suggest that preferences for individual properties, which subjects report in questionnaires, may differ radically from their real-world preferences. The reliability of the questionnaire-based data was studied by measuring the correlation between declared and observed preferences (within-subject design, Table 3) and by measuring the correspondence of ranks of declared and observed preferences (between-subjects design, Table 2). These two approaches give rather different results. For example, in the questionnaire part of the study masculinity was rated the fourth most preferable property in potential

one-night stand partners, but in the observational part it ranked as the eighth most desirable from the 11 properties. However, the within-subject analysis revealed relatively strong correlations between declared and observed preferences (B = 0.205). In contrast, generosity ranked as the seventh most desirable property among both declared and observed preferences; nevertheless, the correlation between declared and observed preferences in individual women was non-significant and negative (B = −0.068). The between-subject design measures systematic shifts in the importance of individual properties. For example, on average, women considered masculinity relatively important (and indicate this in the questionnaire). Nevertheless, they seemed to prefer other traits when rating potential one-night stand partners for attractiveness. Similarly, on average, men considered wealth irrelevant in potential one-night stand partners, but women regarded rich were rated as very attractive as one-night stand partners in the observational part of the study (and probably also in real life). Low correlations between declared and observed preferences in the within-subjects analyses therefore reflect the amount of stochastic noise in the ratings. For example, some women who prefer masculine men claim that masculinity is very important in one-night stand partners, whereas other women who also prefer masculine men claim that masculinity is irrelevant. The main purpose of our analyses was to show how much and in which directions the use of a questionnaire could shift the information obtained regarding relative preferences for individual properties in potential partners. The results of between-subjects analyses are more relevant in this respect.

Both declared and observed preferences were found to depend on specific biological and socio-biological variables, with significant differences across the subsets. For example, use of hormonal contraception affected 9 of the 12 properties in declared preferences, but showed no significant effects on observed preferences in the same group. Similarly, partnership status in men had a significant influence on 8 of the 12 properties in declared preferences, but we found no significant influence on observed preferences. The results suggest that certain biological or socio-biological factors influence the opinions of subjects and, consequently, their responses in questionnaires; however, the effects of these factors on actual preferences and, therefore, most probably on the subjects' behaviour in the real world, can be negligible. At first sight, the classical questionnaire-based method was more sensitive, as it detected a higher number of influences of socio-biological variables on preferences. However, this was merely an artefact of the sample size: whereas all participants rated all 12 properties in the questionnaire section of the study (declared preferences), < 10% of participants rated each of the 11 properties (observed preferences). In fact, comparisons between Tables 6 and 7 demonstrate that the effects detected in the second part of the study (observed preferences) were much stronger, usually explaining between 3 and 5% of variability in preferences (vs < 1% in the questionnaire section, which explored declared preferences).

Our results showed no support for preference for masculinity (or dominance) in women in the fertile phase of the menstrual cycle and, therefore, concur with a number of recent articles. Firstly, studies which measured actual endocrine changes in women have reported that although women's general sexual desire is associated with fertility, variations in hormonal levels appear unrelated to preferences for masculine secondary sexual traits, such as facial masculinity, facial hair and muscularity (Dixson et al., 2018; Dixson & Brooks, 2013; Dixson, Lee, Blake, Jasienska, & Marcinkowska, 2018; Jones et al., 2017; Jones et al., 2018; Jünger, Kordsmeyer, Gerlach, & Penke, 2018; Marcinkowska et al., 2016; Marcinkowska, Galbarczyk, & Jasienska, 2018). Furthermore, our results are in agreement with the conclusions of other recent studies (Scott et al., 2013), as well as with those of two recent meta-analytical studies, even though the first one reported no support (Wood, Kressel, Joshi, & Louie, 2014) and the second “robust” support (Gildersleeve, Haselton, & Fales, 2014) for effects of the phase of the cycle on female mate preferences. Both studies actually showed that the effect of fertility was more likely to be detected: 1) when olfactory rather than visual cues were studied; 2) in earlier rather than in recent studies; 3) in published rather than in unpublished studies; 4) in studies that use less precise methods of detection of the fertile phase of the female cycle; and 5) in studies that use a broader definition of the fertile phase of the cycle (Wood & Carden, 2014). Both studies also showed large inconsistencies across past studies, with about one third of the articles showing no effect of the fertile phase on preferences, as well as demonstrating that the positive effects of the phase of the cycle were driven by a few studies showing large effect sizes (Havlíček, Roberts, & Flegr, 2005; Wood & Carden, 2014). Since recent studies have found little or no support for the effect of the fertile phase or concentration of hormones on female preferences, it seems likely that earlier, largely positive results could have been partly caused by the File Drawer effect.

In our study, the phase of the cycle had an impact on declared preferences for altruism, faithfulness, generosity, kindness and youth, regardless of the type of the partner (short or long-term). However, our analyses of observed preferences detected no preference for masculinity among women in the fertile phase of the cycle, no preference for dominance in one-night stand partners and aversion to dominance in life partners. We observed that women in the non-fertile phase of the cycle showed a higher preference for intelligent men as life partners and lower (but still rather high) preference for intelligent men as one-night stand partners; nearly an identical pattern appeared in preferences for men with sense for humour. Taken together, our results brought no support for the indicator good genes hypothesis, as women preferred more intelligent and funnier men (potential donors of good genes) in the non-fertile rather than in the fertile phase of the menstrual cycle. Similarly, we found no evidence for the handicap theory, as females expressed no preference for masculine or dominant men. The lower desirability of dominant men as life partners could be considered as supporting the good parents hypothesis; however, no effect of the fertile phase was observed on altruism, generosity, and kindness.

We found a robust influence of both parenthood and partnership status on declared preferences in both female and male subjects (Lindova et al., 2016). In women, the former affected 3 and the latter 7 out of the 11 declared preferences, while in men both factors affected 8 out of the 11 declared preferences. Nonetheless, in observed preferences, we detected only weak associations with these factors. Namely, males with children (who are exposed to a lower risk of infidelity from their female partners) preferred faithful women less than males without children, and only females with stable partners and with children (who are more likely to seek good genes rather than good resource providers) preferred masculine men as one-night stand partners. Similarly, we confirmed the existence of numerous effects of the use of hormonal contraception on declared female preferences; namely, on 9 out of the 12 traits. However, no such influences were observed in the second part of our survey, which investigated actual preferences. This seems to suggest that opinions and attitudes – especially those concerning mate selection – of females on contraceptive pills differ from the ones of women not using hormonal contraception (which could be of course the cause, not the effect of taking of pills). In contrast, our results suggest that use of hormonal contraception causes only small, if any differences in actual mate choice-related preferences, which are likely to have a greater bearing on the real-life mate choice behaviour than opinions and beliefs of the subjects.

Our research indicates that the results of standard questionnaire studies concerned with mate selection preferences should be approached with great caution. It is highly likely that their subjects either do not know their actual preferences or try to conceal them from researchers and possibly even from themselves. They could consider certain preferences undesirable or shameful from an ethical point of view or incompatible with their private or shared intragroup ideological orientation (for instance, the discussed preference for rich partners or the lack of preference for masculine and dominant one-night

stand partners). A more reliable set of information can be obtained by using other behavioural methods, which do not rely on the subjects' opinions or declarations, but observe what kinds of properties participants actually consider attractive in life or one-night stand partners (Millar, 2013; Whyte, Torgler, & Harrison, 2016). Our method – which relies on calculating the mean correlation between attractiveness (proxy for the presence of properties preferred in one-night stand partners) and niceness (proxy for the presence of properties preferred in life partners) scores and focal property scores allocated by one subject to individual photos – represents a simple, participant-friendly, high-throughput option. We would like to emphasise that the participants were not asked to rate the desirability of individual properties. They were asked to rate images of people (or cats or dogs) for their scores in individual properties and independently, in another part of the test, to rate the same images for attractiveness and niceness. Actual preferences for individual properties were later calculated as the coefficient of correlation between the focal property and attractiveness or niceness.

The critical point of the method is to compute mean correlations of, for example, attractiveness with masculinity – i.e. not correlations of attractiveness with mean masculinity (Wood & Brumbaugh, 2009). The disadvantage of the latter method, as it has been already suggested, is its inflating influence on the sizes of the measured effect (Brand & Bradley, 2012). However, the main advantage of the former method – and of the present study – is its insensitivity to differences in the assessment of individual properties among different participants. Depending on their individual experiences with specific people, the subjects differ in the perception of physiognomic traits that they consider typical for carriers of individual properties, e.g. for dominant males. Regardless of that, all participants seeking a dominant partner will rate the photos that they subjectively consider more dominant as more attractive than the photos that they subjectively consider less dominant. The method seems robust as illustrated by Table 3, which shows that the photos of humans can be substituted, for example, with photos of cats and dogs. Although the order of preferred properties differed slightly across the set, this may have been caused partly by the lower number of participants (30–50 male and 128–166 female participants per one property in the animal part of the study), and partly by the different connotations of some of the traits, e.g. sense of humour (funny vs witty) and faithfulness (loyalty and devotion vs fidelity) when applied to animals versus humans. It is important to note, however, that the robustness of the method with respect to different sets of stimuli does not necessarily equate to the validity of the method (whether it truly measures what we wish to measure). It will be necessary to test the validity of the method by using other sets of stimuli, ideally context-free or context-neutral ones, such as abstract drawings. At the same time, it is important to note that such validity tests have probably never been conducted for traditional questionnaire-based methods either.

Another important aspect of the present study is that we did not ask the participants “how attractive they considered the person in the photo as a potential life or one-night stand partner”. Instead, we asked them to rate the attractiveness and niceness of the person in the photo. This helped us receive reliable data from non-heterosexual participants (not used in the present study), as well as enabled us to use neutral stimuli for control, such as dogs, cats or cars. Furthermore, when researchers use the standard explicit question “Which properties do you prefer in one-night stand partners?”, participants often complain that they do not seek one-night stand partners and some of them may even terminate their participation. Consequently, the profile of such subpopulations and the results of such studies could suffer from biases. As the longitudinal study from Lindova et al., 2016 indicates, ratings of attractiveness and niceness are excellent proxies for desirability as one-night stand and life partners, respectively.

In contrast to most previous studies, we searched for any kinds of differences in mate selection preferences between women in the fertile and in the non-fertile phase of the cycle, rather than focusing on specific cues (presumed to be) associated with good genes (masculinity, dominance, symmetry or health). This helped us recognise that the differences observed in actual female preferences were related to a set of different personality traits: namely that women in the non-fertile phase of the cycle showed a significantly stronger preference for intelligent males with a sense of humour than women in the fertile phase. The nature of these traits suggests that the primary ‘aim’ of this biological adaptation (if any) is not to find providers of good genes in the fertile phase of the cycle, but perhaps rather to find good resource providers in the non-fertile phase (Jones et al., 2008). This could also explain the seemingly paradoxical results of many previous studies, especially stronger effects of the fertile phase on female mate choice in studies that relied on a broader definition of the fertile phase of the cycle. It is evident that a more broadly defined fertile phase by default leads to a more narrowly defined non-fertile phase of the cycle (Gildersleeve et al., 2014). It has been speculated that high progesterone levels at the peak of the non-fertile phase mimic pregnancy, which could have profound influences on female behaviour (Jones et al., 2008; Puts, 2006). In our study, pregnant women expressed a preference for kindness in both types of partners; however, this effect lost its significance after correction for multiple tests, possibly due to the very low number of pregnant women in our sample (as low as 3 per property). It is plausible that pregnant women (as opposed to women in the non-fertile phase of the cycle) prefer less dangerous men. The avoidance of any kind of threat was proposed to be commonplace in pregnant women (Lienard, 2011).

4.1. Limitations

One obvious limitation of the present study is the fact that the participants self-reported the data needed for the calculation of the phase of their menstrual cycle (Blake, Dixson, O'Dean, & Denson, 2016; Gangestad et al., 2016). The results of recent meta-analytic studies, however, indicate that this is the most frequently used method in this research field and that the results obtained with more exact and objective methods (e.g. by measuring hormone concentrations) are not more reliable than methods reliant on self-reported data. The largest advantage of self-reporting is that it can be applied to data sets larger by orders of magnitude (in this case ca. 2718 women) than the (theoretically) more precise methods. Gangestad et al. (2016) recommended using data from at least 700 participants to compensate for the imprecision of this method. Our data set is nearly four times as large and, therefore, probably high enough to obtain reliable results with respect to the effects of the phase of the menstrual cycle, use of hormonal contraception, and partnership and parenthood status on declared preferences. However, the number of pregnant participants was only 3–9 per property and, therefore, the results concerning the effects of pregnancy on female mate selection preferences must be considered as preliminary.

We performed the study only on non-homosexual participants and controlled for their age. In future studies, the confounding effects of other variables – such the participants' own attractiveness, wealth and health (Debruine et al., 2010; Debruine, Jones, Tybur, Lieberman, & Griskevicius, 2010; Jones et al., 2005; Jones et al., 2013; Wincenciak et al., 2015) – could be controlled for to reduce the possibility of receiving weaker effects and interactions. Nearly all of the previous studies were conducted on young people at the peak of their fertility and sexual activity and typically on students evaluating photos of other students (Koscinski, 2009). Our study, however, has been conducted on a heterogeneous sample of population in the age range of 16–50, with the age of stimuli between ca. 18–70. It will be important to repeat this study on a larger and independent sample of subjects and with different sets of stimuli. For historical reasons, the composition of the Czech and the Slovak population and their cultural background is very homogeneous. Consequently, it would be very interesting to repeat this study on another population, ideally with a very different cultural background.

5. Conclusion

The most important result of the present study is, firstly, the finding that declared and actual preferences of both males and females differ. Consequently, studies of mate selection preferences should not rely on what participants report in questionnaires or on which one of the two photos they rate higher in forced-choice studies. Secondly, our research suggests that due to historical reasons, certain biologically-based hypotheses and the effects of specific sociobiological factors – such as the effect of the phase of the menstrual cycle – are being over-studied, while the effects of other, arguably also important factors – such as partnership and parenthood status – are being neglected. Perhaps we may try to forget our precious hypotheses for a while and return to the exploratory stage of research of human sexuality. Doing this, we could generate new data-based, rather than theory-based hypotheses, which could be tested in future confirmatory studies.

Open data

Data Availability: The data associated with this research are available at Figshare https://figshare.com/s/ed5481101faf03ab5dac.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.evolhumbehav.2018.09.003.

Authors contributions

JF designed and organised the study, analysed the data and wrote the manuscript. ŠK analysed the data and wrote the manuscript. AEB and OK prepared the system for the collection of data. All co-authors participated in the finalisation of the manuscript.

Competing interests

The authors have no competing interests.

Funding

This research was funded by the grant UNCE 204056, Charles University Research agency.

Data accessibility

The data associated with this research is available at https://doi.org/10.6084/m9.figshare.5350714.

The project was approved by the IRB of the Faculty of Science, Charles University in Prague (2014/05).

Acknowledgements

We would like to thank Zsófia Csajbók and Jan Havlíček for their valuable comments and their help with the final version of the paper. We also thank two anonymous reviewers for their detailed and extremely helpful feedback.

References

Able, D. J. (1996). The contagion indicator hypothesis for parasite-mediated sexual selection. *Proceedings of the National Academy of Sciences of the United States of America, 93*, 2229–2233.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society Series B-Methodological, 57*(1), 289–300.

Blake, K. R., Dixson, B. J. W., O'Dean, S. M., & Denson, T. F. (2016). Standardized protocols for characterizing women's fertility: A data-driven approach. *Hormones and Behavior, 81*, 74–83.

Brand, A., & Bradley, M. T. (2012). More Voodoo correlations: when average-based measures inflate correlations. *Journal of General Psychology, 139*(4), 260–272.

Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypothesis tested in 37 cultures. *Behavioral and Brain Sciences, 12*(1), 1–14.

Courtiol, A., Picq, S., Godelle, B., Raymond, M., & Ferdy, J. B. (2010). From preferred to actual mate characteristics: The case of human body shape. *PLoS One, 5*(9).

Courtiol, A., Raymond, M., Godelle, B., & Ferdy, J. B. (2010). Mate choice and human stature: Homogamy as a unified framework for understanding mating preferences. *Evolution, 64*(8), 2189–2203.

Csajbok, Z., & Berkics, M. (2017). Factor, factor, on the whole, who's the best fitting of all? Factors of mate preferences in a large sample. *Personality and Individual Differences, 114*, 92–102.

Dawkins, R. (1982). *The extended phenotype, The gene as the unit of selection.* Oxford: W.H. Freeman and Comp.

Debruine, L., Jones, B. C., Frederick, D. A., Haselton, M. G., Penton-Voak, I. S., & Perrett, D. I. (2010). Evidence for Menstrual Cycle Shifts in Women's Preferences for Masculinity: A Response to Harris (in press) "Menstrual Cycle and Facial Preferences Reconsidered" Commentary. *Evolutionary Psychology, 8*, 768–775.

Debruine, L. M., Jones, B. C., Little, A. C., Boothroyd, L. G., Perrett, D. I., Penton-Voak, I. S., & Tiddeman, B. P. (2006). Correlated preferences for facial masculinity and ideal or actual partner's masculinity. *Proceedings of the Royal Society B-Biological Sciences, 273*(1592), 1355–1360.

Debruine, L. M., Jones, B. C., Smith, F. G., & Little, A. C. (2010). Are attractive men's faces masculine or feminine? The importance of controlling confounds in face stimuli. *Journal of Experimental Psychology-Human Perception and Performance, 36*, 751–758.

Debruine, L. M., Jones, B. C., Tybur, J. M., Lieberman, D., & Griskevicius, V. (2010). Women's preferences for masculinity in male faces are predicted by pathogen disgust, but not by moral or sexual disgust. *Evolution and Human Behavior, 31*, 69–74.

Dixson, B. J., Blake, K. R., Denson, T. F., Gooda-Vossos, A., O'Dean, S. M., Sulikowski, D., ... Brooks, R. C. (2018). The role of mating context and fecundability in women's preferences for men's facial masculinity and beardedness. *Psychoneuroendocrinology, 93*, 90–102.

Dixson, B. J., & Brooks, R. C. (2013). The role of facial hair in women's perceptions of men's attractiveness, health, masculinity and parenting abilities. *Evolution and Human Behavior, 34*(3), 236–241.

Dixson, B. J. W., Lee, A. J., Blake, K. R., Jasienska, G., & Marcinkowska, U. M. (2018). Women's preferences for men's beards show no relation to their ovarian cycle phase and sex hormone levels. *Hormones and Behavior, 97*, 137–144.

Flegr, J. (2010). Elastic, not plastic species: frozen plasticity theory and the origin of adaptive evolution in sexually reproducing organisms. *Biology Direct, 5*, 2.

Flegr, J., & Hodny, Z. (2016). Cat scratches, not bites, are associated with unipolar depression - cross-sectional study. *Parasites & Vectors, 9*.

Folstad, I., & Karter, A. J. (1992). Parasites, bright males, and the immunocompetence handicap. *American Naturalist, 139*, 603–622.

Gangestad, S. W., & Buss, D. M. (1993). Pathogen prevalence and human mate preferences. *Ethology and Sociobiology, 14*(2), 89–96.

Gangestad, S. W., Haselton, M. G., Welling, L. L. M., Gildersleeve, K., Pillsworth, E. G., Burriss, R. P., ... Puts, D. A. (2016). How valid are assessments of conception probability in ovulatory cycle research? Evaluations, recommendations, and theoretical implications. *Evolution and Human Behavior, 37*(2), 85–96.

Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: Trade-offs and strategic pluralism. *Behavioral and Brain Sciences, 23*(4), 573.

Gangestad, S. W., & Thornhill, R. (2008). Human oestrus. *Proceedings of the Royal Society B-Biological Sciences, 275*, 991–1000.

Gildersleeve, K., Haselton, M. G., & Fales, M. R. (2014). Do women's mate preferences change across the ovulatory cycle? A meta-analytic review. *Psychological Bulletin, 140*(5), 1205–1259.

Griffith, S. C., Owens, I. P. F., & Burke, T. (1999). Environmental determination of a sexually selected trait. *Nature, 400*(6742), 358–360.

Hamilton, W. D. (1980). Sex versus non-sex versus parasite. *Oikos, 35*(2), 282–290.

Hamilton, W. D., & Zuk, M. (1982). Heritable true fitness and bright birds: A role for parasites? *Science, 218*, 384–387.

Havlíček, J., Dvořáková, R., Bartoš, L., & Flegr, J. (2006). Non-advertized does not mean concealed: Body odour changes across the human menstrual cycle. *Ethology, 112*, 81–90.

Havlíček, J., Roberts, S. C., & Flegr, J. (2005). Women's preference for dominant male odour: effects of menstrual cycle and relationship status. *Biology Letters, 1*, 256–259.

Jaenike, J. (1978). An hypothesis to account for the maintenance of sex in populations. *Evolutionary Theory, 3*, 191–194.

Jones, B. C., Debruine, L. M., Perrett, D. I., Little, A. C., Feinberg, D. R., & Smith, M. J. L. (2008). Effects of menstrual cycle phase on face preferences. *Archives of Sexual Behavior, 37*(1), 78–84.

Jones, B. C., Feinberg, D. R., Watkins, C. D., Fincher, C. L., Little, A. C., & Debruine, L. M. (2013). Pathogen disgust predicts women's preferences for masculinity in men's voices, faces, and bodies. *Behavioral Ecology, 24*(2), 373–379.

Jones, B. C., Hahn, A. C., Fisher, C. I., Wang, H., Kandrik, M., & Debruine, L. M. (2017). General sexual desire, but not desire for uncommitted sexual relationships, tracks changes in women's hormonal status. Psychoneuroendocrinology.

Jones, B. C., Hahn, A. C., Fisher, C. I., Wang, H., Kandrik, M., Han, C., ... Debruine, L. M. (2018). No compelling evidence that preferences for facial masculinity track changes in women's hormonal status. *Psychological Science, 29*, 996–1005.

Jones, B. C., Little, A. C., Boothroyd, L., Feinberg, D. R., Cornwell, R. E., Debruine, L. M., ... Perrett, D. I. (2005). Women's physical and psychological condition independently predict their preference for apparent health in faces. *Evolution and Human Behavior, 26*, 451–457.

Jünger, J., Kordsmeyer, T. L., Gerlach, T. M., & Penke, L. (2018). Fertile women evaluate male bodies as more attractive, regardless of masculinity. *Evolution and Human Behavior, 39*, 412–423.

Kankova, S., Flegr, J., & Calda, P. (2015). The influence of latent toxoplasmosis on

women's reproductive function: four cross-sectional studies. *Folia Parasitologica, 62*.
Kokko, H., & Lindstrom, J. (1996). Evolution of female preference for old mates. *Proceedings of the Royal Society B-Biological Sciences, 263*, 1533–1538.
Koscinski, K. (2009). Current status and future directions of research on facial attractiveness. *Anthropological Review, 72*, 45–65.
Lienard, P. (2011). Life stages and risk-avoidance: Status- and context-sensitivity in precaution systems. *Neuroscience and Biobehavioral Reviews, 35*(4), 1067–1074.
Lindova, J., Little, A. C., Havlicek, J., Roberts, S. C., Rubesova, A., & Flegr, J. (2016). Effect of partnership status on preferences for facial self-resemblance. *Frontiers in Psychology, 7*.
Liskova, S., Landova, E., & Frynta, D. (2015). Human preferences for colorful birds: Vivid colors or pattern? *Evolutionary Psychology, 13*(2), 339–359.
Little, A. C., Cohen, D. L., Jones, B. C., & Belsky, J. (2007). Human preferences for facial masculinity change with relationship type and environmental harshness. *Behavioral Ecology and Sociobiology, 61*, 967–973.
Marcinkowska, U. M., Ellison, P. T., Galbarczyk, A., Milkowska, K., Pawlowski, B., Thune, I., & Jasienska, G. (2016). Lack of support for relation between woman's masculinity preference, estradiol level and mating context. *Hormones and Behavior, 78*, 1–7.
Marcinkowska, U. M., Galbarczyk, A., & Jasienska, G. (2018). La donna è mobile? Lack of cyclical shifts in facial symmetry, and facial and body masculinity preferences—A hormone based study. *Psychoneuroendocrinology, 88*, 47–53.
Millar, M. (2013). Menstrual cycle changes in mate preferences for cues associated with genetic quality: the moderating role of mate value. *Evolutionary Psychology, 11*(1), 18–35.
O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and velicer's MAP test. *Behavior Research Methods Instruments & Computers, 32*(3), 396–402.
Penton-Voak, I. S., & Perrett, D. I. (2000). Female preference for male faces changes cyclically: Further evidence. *Evolution and Human Behavior, 21*, 39–48.
Penton-Voak, I. S., Perrett, D. I., Castles, D. L., Kobayashi, T., Burt, D. M., Murray, L. K., & Minamisawa, R. (1999). Menstrual cycle alters face preference. *Nature, 399*, 741–742.
Pomiankowski, A. N. (1998). The evolution of female mate preference for male genetic quality. *Oxford Surveys in Evolutionary Biology, 5*, 136–184.
Puts, D. A. (2006). Cyclic variation in women's preferences for masculine traits - Potential hormonal causes. *Human Nature-An Interdisciplinary Biosocial Perspective, 17*(1), 114–127.
Reynolds, J. D. (1996). Animal breeding systems. *Trends in Ecology & Evolution, 11*, 68–72.
Roberts, M. L., Buchanan, K. L., & Evans, M. R. (2004). Testing the immunocompetence handicap hypothesis: a review of the evidence. *Animal Behaviour, 68*, 227–239.
Scott, I. M. L., Clark, A. P., Boothroyd, L. G., & Penton-Voak, I. S. (2013). Do men's faces really signal heritable immunocompetence? *Behavioral Ecology, 24*(3), 579–589.
Sterbova, Z., Trebicky, V., Havlicek, J., Turecek, P., Varella, M. A. C., & Valentova, J. V. (2018). Father's physique influences mate preferences but not the actual choice of male somatotype in heterosexual women and homosexual men. *Evolution and Human Behavior, 39*(1), 130–138.
Sundberg, J., & Dixon, A. (1996). Old, colourful male yellowhammers, *Emberiza citrinella*, benefit from extra-pair copulations. *Animal Behaviour, 52*, 113–122.
Thornhill, R., & Gangestad, S. W. (1999). Facial attractiveness. *Trends in Cognitive Sciences, 3*(12), 452–460.
Trivers, R. L. (1974). Parent-offspring conflict. *American Zoologist, 14*(1), 249–264.
Valentova, J. V., Varella, M. A. C., Bartova, K., Sterbova, Z., & Dixson, B. J. W. (2017). Mate preferences and choices for facial and body hair in heterosexual women and homosexual men: Influence of sex, population, homogamy, and imprinting-like effect. *Evolution and Human Behavior, 38*(2), 241–248.
Waynforth, D., & Dunbar, R. I. M. (1995). Conditional mate choice strategies in humans: evidence from "lonely hearts" advertisements. *Behaviour, 132*, 755–779.
Whyte, S., Torgler, B., & Harrison, K. L. (2016). What women want in their sperm donor: A study of more than 1000 women's sperm donor selections. *Economics & Human Biology, 23*, 1–9.
Wincenciak, J., Fincher, C. L., Fisher, C. I., Hahn, A. C., Jones, B. C., & Debruine, L. M. (2015). Mate choice, mate preference, and biological markets: the relationship between partner choice and health preference is modulated by women's own attractiveness. *Evolution and Human Behavior, 36*(4), 274–278.
Wood, D., & Brumbaugh, C. C. (2009). Using revealed mate preferences to evaluate market force and differential preference explanations for mate selection. *Journal of Personality and Social Psychology, 96*, 1226–1244.
Wood, W., & Carden, L. (2014). Elusiveness of menstrual cycle effects on mate preferences: Comment on Gildersleeve, Haselton, and Fales (2014). *Psychological Bulletin, 140*(5), 1265–1271.
Wood, W., Kressel, L., Joshi, P. D., & Louie, B. (2014). Meta-analysis of menstrual cycle effects on women's mate preferences. *Emotion Review, 6*(3), 229–249.
Zahavi, A. (1975). Mate selection-a selection for a handicap. *Journal of Theoretical Biology, 53*, 205–214.