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Variation in Women's Mate Preferences Over the Development of a
Monogamous Relationship Corresponds with Changes in Men's Life
History Strategy

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Authors' contributions **Rebecca Owens**: conceptualisation, methodology, software, validation, formal analysis, investigation, resources, data curation, writing original draft, writing review and editing, visualisation, project administration. **Helen Driscoll**: methodology, writing review and editing, supervision. **Daniel Farrelly**: conceptualisation, writing review and editing, supervision.

Ethics approval This research adhered to the guidelines of the British Psychological Society and was approved by the University of Sunderland Research Ethics Group.

Consent to participate All participants provided fully informed consent to participate.

Consent for publication Ethical approval included consent to publish the results from anonymised data

Abstract

Much research has examined how men's mating strategies change over the development of a relationship consistent with predictions from Life History Theory. Specifically, research shows both physiological and behavioural indicators of mating effort decrease once men are mated, and further once they become fathers, unless they remain engaged in mating effort. This switch from mating to parenting effort is sexually selected, and therefore the corresponding shifts in women should be examined, though to date, women's short- or long-term mate preferences have been studied as separate entities rather than as a transition from short- to long- term. We examined how women's mate preferences changed over the development of a relationship, to see if they varied consistently with what is known about variation in men's mating effort. Vignettes detailed four key milestones in the development of a relationship and women rated the importance of the man at each stage displaying indicators of mating or parenting effort. Women increasingly prioritised indicators of parenting effort in men as the relationship developed, consistent with what is known about men's reduction in mating effort in favour of parenting effort over the development of a relationship. The results support predictions from Life History Theory and highlight the interacting mutually reinforcing nature of sexually selected behaviours.

Keywords: Life History Theory, Mate Preferences, mating effort, sexual selection

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1. Introduction

Life History Theory (Figueredo et al., 2006) specifies that lifetime energy is dynamically allocated into fitness-enhancing components; somatic, mating (seeking more mating opportunities), and parenting (investing in offspring) effort. Lifetime energy is finite, therefore organisms must make trade-offs in how energy is allocated (Hill & Kaplan, 1999). Most relevant to mating strategy is the allocation of reproductive effort into mating and parenting components. Women typically prioritise parenting effort over mating effort (e.g. Klug, Bonsall, & Alonzo, 2013) due to the sex-differentiated adaptive problems (Buss & Schmitt, 1993) arising from sex differences in reproductive variance (Bateman, 1948) and parental investment (Trivers, 1972). Much is known about men's mating strategies, how they vary across the lifespan, and the physiological underpinning of this (Ellison, 2001). However, comparatively little is known about lifetime variation in a woman's mate preferences, despite their role in sexually selecting and reinforcing male mating strategies. Both components must therefore be examined in order to fully understand variation in mating preferences (Hunt, Breuker, Sadowski, & Moore, 2009).

Men's higher fitness variance means they are technically able to gain direct reproductive benefits by prioritising mating effort over parenting effort. Social dominance, supported by fluctuating testosterone levels (Mazur & Booth, 1998), was key to ancestral men successfully prioritising mating effort (Davies & Shackelford, 2006; Geary, 1998). Evidence of this mating strategy is present in modern men; men are more motivated than women to dominate across many domains, such as artistic displays (Miller, 2001), academia (Kanazawa, 2000, 2003), sport (Deaner, 2006; Faurie, Pontier, & Raymond, 2004), as well as in socially undesirable behaviours such as risky driving, risky sexual activity, gambling, substance abuse and criminality (Baker & Maner, 2009; Beattie, 2008; Byrnes, Miller, & Schafer, 1999; Ermer, Cosmides, & Tooby, 2008; Wilson & Daly, 1985). This motivation typically decreases once mated (Farrelly & Nettle, 2007; Kanazawa, 2000, 2003), as do testosterone levels (e.g. Burnham et al., 2003), which further decrease on becoming fathers (e.g. Gettler, McDade, Feranil, & Kuzawa, 2011), unless they remain engaged in mating effort (e.g. Farrelly, Owens, Elliott, Walden, & Wetherell, 2015; McIntyre, Gangestad, Gray, Chapman, & Thornhill, 2006). Cumulatively, this narrative shows how male mating motivation may change over the development of a relationship. Specifically, it suggests men initially prioritise mating- over parenting effort, and this gradually shifts as mating resources are secured, consistent with Life History Theory.

However, there is less clarity in the narrative surrounding variation in female preferences. Evidence of women being attracted to indicators of masculinity in short-term mates and indicators of parenting effort in long-term

partners is relatively robust, but how women manage this transition during the course of a single relationship is unclear. For example, attractiveness in terms of fluctuating asymmetry in men indicates higher testosterone levels (Hamilton & Zuk, 1982; Thornhill & Gangestad, 1993), and there is evidence women prioritise this more so in short-term than long-term mates (Jones et al., 2018; Valentine, Li, Penke, & Perrett, 2014). Further evidence for this comes from male athletes self-reporting more sexual partners than non-athletes, and a positive correlation between athletic performance and number of mates (Faurie et al., 2004). Cross cultural evidence also supports this; for example, ritual wrestlers father more children than non-wrestlers (Llaurens, Raymond, & Faurie, 2009) and hunting ability among the Aché men is positively correlated with the number of offspring raised to adulthood (Kaplan & Hill, 1985). There is no such evidence for this variation among men's mating preferences. Conversely, women typically prefer men who are cooperative, altruistic, agreeable, and show indicators of investment willingness in a long-term partner (Buss & Schmitt, 1993; Farrelly, Clemson, & Guthrie, 2016). For example, Farrelly et al., (2016) showed that men who were less attractive but high in altruism were preferred in long-term over short-term mating contexts, more so than attractive men low in altruism. Such findings highlight the contrast in female long- and short-term mating preferences, yet they do not address how these preferences interact within a single relationship or how they may change over time.

One potential suggestion to reconcile this is the role of strategic pluralism in female mating strategies (Gangestad & Simpson, 2000). Strategic pluralism is one adaptive mating strategy for women that involves developing a long-term relationship with one man in order to gain provisioning and investment benefits but capitalising on short-term mating opportunities with other men of higher genetic quality. Evidence for strategic pluralism primarily comes from evidence that women find masculine features more attractive when they are fertile (Roney, Simmons, & Gray, 2011), particularly if they rate their partners as relatively low in sexual desirability, which the authors measured as a proxy for testosterone-dependent features (Larson, Haselton, Gildersleeve, & Pillsworth, 2013). However, more recent research has questioned the role of the menstrual cycle in female mating behaviours (e.g. Jones et al., 2018a,b), therefore it is important to examine alternative explanations of variation in female mating preferences. Furthermore, though strategic pluralism may have been *one* adaptive mating strategy for ancestral women, monogamy, or serial monogamy, were also adaptive strategies. Examining short- versus long-term mating preferences in women does not consider the nuances in mate preferences within a single relationship or reconcile this with what is known about the variation in male mating behaviours.

The current research examined whether variation in women's mate preferences over the development of a relationship would complement the narrative demonstrated in men given the sexually selected and mutually

reinforcing (Hunt et al., 2009) nature of sex and relationships in increasing fitness gains. Life History Theory suggests that men will rapidly increase testosterone-supported mating behaviours during adolescence, as the costs of doing so are relatively low, but this changes as fitness gains are made so the costs of maintaining this become too high. As women have been shown to prefer indicators of testosterone-dependent masculinity in short-term contexts and the opposite in long-term contexts (Jones et al., 2018; Valentine et al., 2014), it is suggested here that women's preferences for such features may decrease over the development of a single relationship in order to encourage provisioning and investment. Women may consciously or unconsciously encourage a partner to reduce indicators of mating effort in order to protect their own fitness, as abandonment for another mate would have been catastrophic to the fitness of ancestral women, consistent with the suggestion that women have reinforced sexually selected behaviours. Thus, it can be speculated that men may consciously or unconsciously decrease mating effort as a relationship develops in order to indicate commitment. This pattern of mating preferences and mating strategies would be mutually selected and reinforcing, as suggested in sexually selected behaviours (Hunt et al., 2009). Allocation of life history energy is dynamic; emerging evidence shows plasticity in mating strategies in response to evolutionarily relevant environmental cues. For example, men increase mating effort in short-term contexts, and in parenting effort in long-term contexts, which appeals simultaneously with context-specific female mate preferences (Thomas & Stewart-Williams, 2018). Calibration of life history energy is highly plastic therefore we should also expect women to be sensitive to environmental cues requiring men to prioritise mating or parenting effort.

The aim here was to see how women's preferences for men to engage in mating-related and parenting-related effort may change as the need for male investment increases over the development of a relationship. We examined this by asking women to rate the importance of various indicators of mating-related and parenting-related effort in a partner over the development of a hypothetical relationship at four key points in terms of an increasing preference for male investment. It was expected that women would increasingly prioritise indicators of parenting effort, and decreasingly prioritise indicators of mating effort in men as the relationship develops.

2. Method

2.1. Participants

Women (N = 190) voluntarily responded to online recruitment advertisements (on social media sites and online psychological research sites); some were students participating for partial course credit. Age ranged from 18-58

years ($M = 26.93$, $SD = 9.48$). The sample demographics are shown in Table I, and all data collected is openly available at <https://osf.io/6wa5t/>.

Table I. Final sample demographic information

	<i>n</i>	%
<i>Sexuality</i>		
Heterosexual	176	92.6
Homosexual	1	0.5
Bisexual	9	4.7
Asexual	3	1.6
Declined to Answer	1	0.5
<i>Relationship Status</i>		
Single	43	22.6
Casually Dating	13	6.8
Committed Relationship	77	40.5
Cohabiting/Married	57	30
<i>Parental Status</i>		
Non-Parents	127	66.8
Have Biological Children	58	30.5
Have Non-Biological Children	3	1.6
Have Biological and Non-Biological Children	2	1.1
<i>Fertility Status</i>		
Fertile	16	8.4
Naturally Cycling but Not Fertile	55	28.9
Not Naturally Cycling	108	56.8
Declined to Answer	11	5.8

2.2. Materials

A story was created detailing the development of a hypothetical, heterosexual relationship from first meeting to a long-term committed relationship. The story consisted of four scenarios varying the level of mating and parenting effort the man in the story would be expected to show, consistent with Life History theory. In each scenario, the participant was asked to imagine themselves as the subject and to rate the importance of the man in the story displaying indicators of mating and parenting effort to identify critical time points when women prefer men to reallocate their reproductive energy. The first scenario described the couple first meeting, highlighting the short-term nature of the liaison with no expectation of investment, thus indicators of mating-effort should be prioritised

here. The second scenario increased perceived commitment between the pair by describing the first anniversary of the couple. We therefore expected to see indicators of mating effort become less important in favour of parenting effort, consistent with evidence of men maintaining mating effort (testosterone levels in this case) comparable to single men until after the first year of a relationship (Farrelly et al., 2015). The third scenario detailed the couple's fifth anniversary and a larger shift in the prioritising of parenting effort over mating effort. The final scenario described the first birthday of their first child, which should show a complete shift to prioritising of indicators of parenting effort over mating effort. The scenarios ranged from 135 words long to 366 and can be found at <https://osf.io/6wa5t/>.

Ten women (aged 20-59 years) piloted the story by reporting how important they felt it was for the man in each stage of the story to have various characteristics indicative of mating and parenting effort (see Table II in supplementary information). and analyses showed the scenarios elicited different responses at each stage consistent with either parenting or mating effort. a repeated-measures ANOVA showed there was no effect of relationship stage ($F(1.22, 11.01) = 0.36, p = .602, \eta_p^2 = .039$), though there was an effect of indicator type on importance ratings, ($F(1, 9) = 6.09, p = .036, \eta_p^2 = .403$), and there was also an interaction between relationship stage and indicator type ($F(1.12, 10.04) = 5.83, p = .034, \eta_p^2 = .393$), suggesting the story was suitable for use.

Twenty-five questionnaire items were generated with reference to Gangestad, Garver-Apgar, Simpson, and Cousins', (2007) female mate preference factors, 'good investing mate qualities' and 'intrasexual competition'. These factors correspond with the two anchors of reproductive effort, parenting effort and mating effort respectively, including behavioural and psychological characteristics. Indicators of mating effort ($n = 10$) represented competitive, dominance striving behaviours and indicators of parenting effort ($n = 15$) were those that emphasised a focus on the future, being loyal and committed, and indicators of good financial prospects (shown in Tables III and IV in supplementary information). Participants were asked to indicate how important it was for each statement to apply to the man in each scenario on a 7-point Likert scale (not at all important – extremely important).

Item analyses and reliability analyses were very good for both sets of items at all stages of the hypothetical relationship. Cronbach's Alpha values for the mating effort items ranged from .78 to .87 across the stages and values for the parenting effort items ranged from .81 to .93.

Previous research has highlighted a role of the menstrual cycle in affecting women's opinions about the attractiveness of men, particularly when considering short-term mating scenarios (Gangestad et al., 2007),

however recent research has questioned this (Jones et al., 2018). Women provided the necessary information for researchers to calculate their conception probability using estimates by Wilcox et al., (2001) at the time of participation using the reverse counting method in order to control for this. Specifically, participants were asked whether they were naturally cycling ($n = 81$), whether they take hormonal contraception ($n = 104$), or were otherwise non-normally cycling ($n = 5$). Those who indicated they were naturally cycling, they were asked if they had taken hormonal contraception within the last three months ($n = 8$), and how many days their menstrual cycle usually was. Participants indicated the date of their last menstrual period, and followed up participation with the start date of their next menstrual period to confirm their fertility status at the time of participation.

2.3. Design

We used an experimental design, with two independent variables; the first, relationship stage in the hypothetical scenario, was a within groups variable on four levels (stage 1 – through – 4). The second independent variable, mating strategy indicator, was a within groups variable on two levels, mating effort and parenting effort. The dependent variable was the mean responses to mating and parenting effort items at each stage of the hypothetical scenario, which used a Likert scale of 1 (not at all important) to 7 (extremely important). Estimates of conception probability was included as a covariate.

2.4. Procedure

Following ethical approval, participants were invited to participate online and were provided with the link to the study, hosted on Qualtrics. The link first showed the participant information page and participants indicated informed consent before continuing on to the study. Participants read the first scenario then responded to the statements regarding indicators of mating and parenting effort specifically about the first scenario. Participants then moved on to the second scenario, then the third, and finally the fourth. At each stage, participants were clearly asked to consider themselves as the subject of the scenario and to indicate how important it would be for the man in the preceding scenario to display the stated traits and characteristics. Participants then provided the information about their menstrual cycle and their email address to provide the relevant follow-up details. This concluded participation.

3. Results

A 2 (indicator of mating strategy; mating effort/parenting effort) x 4 (relationship stage 1 – 4) x 2 (parental status; parents/non-parents) mixed ANCOVA was conducted on mean responses. There was no effect

of conception probability ($F(1, 176) = 0.28, p = .596, \eta_p^2 = .002$), nor did conception probability significantly interact with mating strategy indicator, ($F(1, 176) = 0.41, p = .839, \eta_p^2 < .001$), or with relationship status ($F(1.48, 260.69) = 0.17, p = .781, \eta_p^2 = .001$). Given these results and the complexities of conducting ANCOVA analyses on repeated measures variables and the increased error associated with this analysis (Schneider, Avivi-Reich, & Mozuraitis, 2015), the analyses proceeded without the covariate.

A 2 x 4 x 2 mixed ANOVA showed an effect of parental status, whereby non-parents ($M = 4.89$) gave higher importance ratings overall than parents ($M = 4.59$), $F(1, 188) = 8.60, p = .004, \eta_p^2 = .044$, though parental status did not interact with either mating strategy indicator, $F(1, 188) = 3.77, p = .053, \eta_p^2 = .020$, or relationship stage $F(1.51, 284.51) = 0.58, p = .514, \eta_p^2 = .003$. Furthermore, indicators of parenting effort were rated as significantly more important overall than indicators of mating effort, $F(1, 188) = 754.48, p < .001, \eta_p^2 = .80$; the descriptive statistics are provided in Table V.

Table V. Means and (standard deviations) of rated importance (1-7) of indicators of mating strategy at each stage of the hypothetical relationship provided by parents and non-parents

	Parenting Effort	Mating Effort	Overall
Stage 1 (first meeting)			
Parents	4.54 (1.26)	3.85 (0.89)	4.20
Non-Parents	4.84 (1.27)	4.16 (0.93)	4.50
Stage 2 (first anniversary)			
Parents	5.61 (0.52)	3.71 (0.92)	4.66
Non-Parents	5.65 (0.73)	4.09 (0.91)	4.87
Stage 3 (fifth anniversary)			
Parents	5.88 (0.52)	3.62 (1.10)	4.75
Non-Parents	6.04 (0.65)	4.11 (1.01)	5.07
Stage 4 (child's first birthday)			
Parents	6.00 (0.52)	3.54 (1.15)	4.77
Non-Parents	6.20 (0.65)	4.02 (1.15)	5.11
Overall	5.60	3.87	

There was a significant interaction of parenting and mating effort indicators with relationship stage, $F(1.41, 266.60) = 153.72, p < .001, \eta_p^2 = .449$, shown in Figure I.

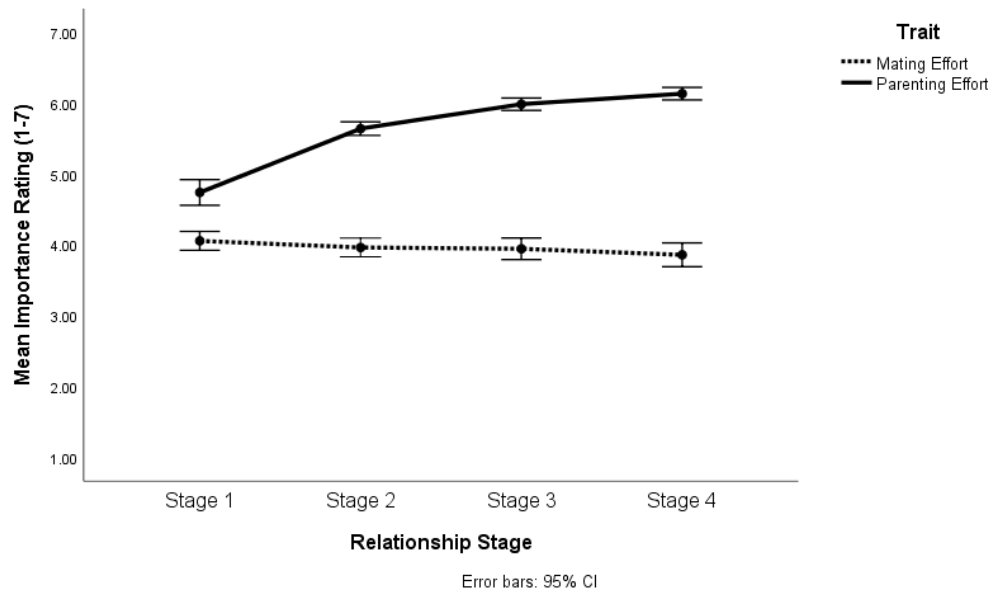


Figure I. Significant interaction of mating strategy indicator and stage of relationship on importance of indicating mating or parenting effort.

Simple effects analyses showed there was a significant effect of relationship stage on the importance of mating effort indicators, $F(1.58, 298.29) = 3.89, p = .031, \eta_p^2 = .020$, however Bonferroni pairwise comparisons showed that decreases in the importance ratings of indicators of mating effort were not significant at any stage of the relationship. There was a significant effect of relationship stage on the importance ratings of indicators of parenting effort, $F(1.32, 250.08) = 175.00, p < .001, \eta_p^2 = .481$ and Bonferroni pairwise comparisons indicated that the importance of parenting effort significantly increased at each stage of the relationship.

To further examine how the relative importance of mating and parenting effort indicators changed over the development of the relationship, the mating strategy indicator was collapsed by calculating the proportional difference between mating effort and parenting effort at each stage of the relationship. A repeated measures ANOVA showed a significant effect of the relationship stage on the relative importance of indicators of mating and parenting effort, $F(1.56, 299.65) = 102.26, p < .001, \eta_p^2 = .351$. Bonferroni pairwise comparisons showed the relative importance of parenting effort indicators over mating effort indicators increased significantly at each stage of the relationship, as shown in Figure II.

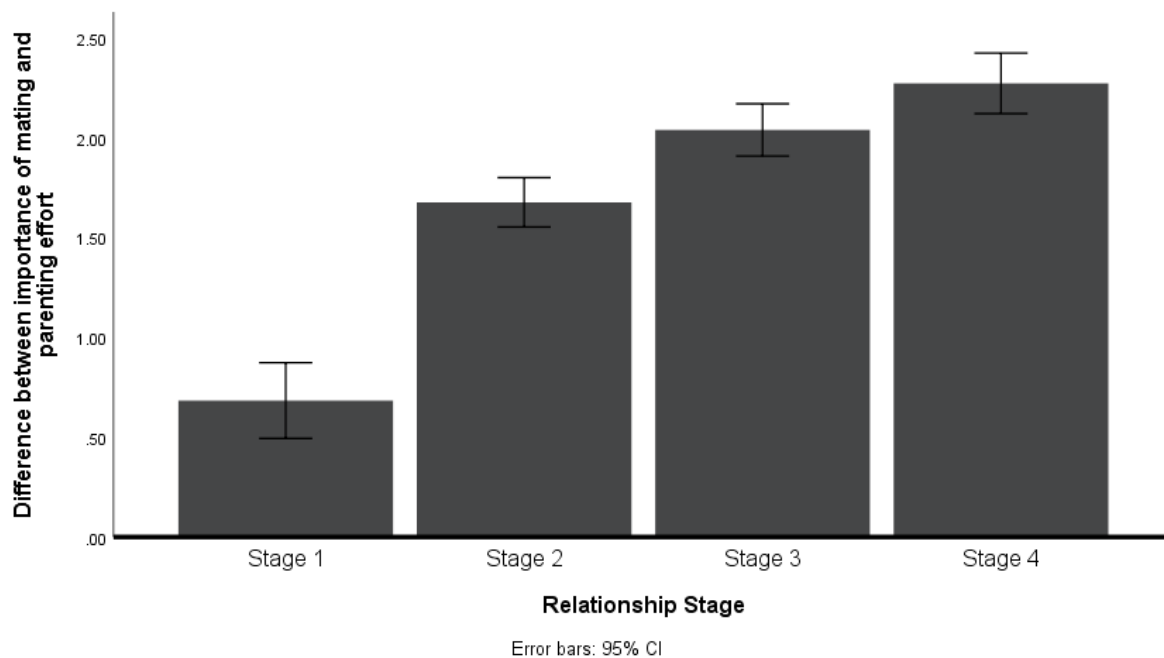


Figure II. The change in relative importance of mating and parenting effort over the development of the relationship

4. Discussion

In this study, we sought to examine changes in women’s mate preferences over the course of a single relationship from short- to long-term, rather than examining short- and long-term preferences in isolation. Previous research shows robust evidence of distinct differences in women’s short- and long-term mate preferences which correspond to men’s mating short- and long-term mating strategies within a life history framework. Evidence of the reallocation in male reproductive effort from mating-oriented to parenting-oriented as a relationship develops has been consistently demonstrated both behaviourally and physiologically, though the corresponding transition in female mate preferences has not been shown. We provide evidence here that women’s mate preferences are consistent with the variation shown in men’s mating behaviours; specifically, women increasingly prefer indicators of parenting effort in men as a relationship develops, which is also consistent with Life History Theory.

We also found here that women rate indicators of parenting effort in men as more important overall than indicators of mating effort. Life history and parental investment theories suggest that seeking indicators of investment potential and willingness in the form of parenting effort was the most successful mating strategy for women in

terms of maximising reproductive success. This is also consistent with behavioural and physiological evidence from men, which shows a decrease in indicators of mating effort, in the form of engagement in competition and testosterone levels, in favour of increased parenting effort over the development of a relationship. Interestingly, we found the sharpest increase in the importance of indicators of parenting effort was between scenario one (first meeting) and scenario two (first anniversary). This is consistent with research by Farrelly et al. (2015), who found that men in relationships of less than one year maintained testosterone levels comparable to single men, indicating their reproductive energy was primarily oriented toward mating effort until the one year mark, after which testosterone levels decreased. This, taken with the results of the current research, may suggest a crucial time point in reallocation of reproductive effort at around this point in a relationship. This is further supported by Farrelly et al. (2015) as there was no linear decrease in men's testosterone levels, however the suggestion made here is speculative and requires formal testing.

Interestingly, Life History Theory suggests increases in parenting effort should be at the expense of mating effort, but women did not rate indicators of mating effort as consistently less important as the relationship developed. This is not interpreted as evidence against Life History Theory however; there are two possible explanations for this finding. Firstly, the lack of consistent, statistically significant decreases in the importance of indicators of mating effort may be due to the self-report design of the research. Because there are no real-world consequences to the research, there is nothing to force the trade-off between mating and parenting effort in men. The self-report nature of the current research means participants are able to indicate what would be closer to ideal mate preferences – being high in indicators of mating effort as well as parenting effort – rather than real trade-offs. Longitudinal research would be ideal but impractical, therefore future research of this nature could operate on a hypothetical budget to force participants to make the trade-off, such as in research by Li, Kenrick, Bailey, and Linsenmeier (2002), and Thomas et al., (2019). Related to this point is the role of mate value among the sample in the current research. Buss and Shackelford (2008) suggested that high mate value women are more inclined to highly prioritise indicators of both mating and parenting effort, being less inclined to compromise due to their high mate value. Thus, it may be the case that the importance ratings of mating effort indicators are inflated in the current research, either because of the design of the study and/or because of characteristics of the current sample, though overall indicators of mating effort were not inflated here.

The relatively lower importance of indicators of mating effort overall shown in the current research is also consistent with the current theoretical basis. Though indicators of mating effort are generally perceived as attractive in men, they also indicate a greater likelihood of abandonment in favour of alternative mates. If a man

increases his parenting effort as a relationship progresses, then by default he is evidencing his commitment to the relationship by reducing his mating effort. By reducing his mating effort, he may become less attractive to rival mates, further reducing the likelihood of abandonment. The importance of mating effort indicators did decrease as the relationship developed overall, but the decrease was extremely small and did not show significant differences at each stage of the relationship. However, it was expected that indicators of mating effort would be rated as more important in the first scenario, which described a short-term encounter. Mating effort indicators were rated highest following scenario one than the other scenarios, but this was not above the median response. It is possible that this was also due to the self-report nature of the study because indicators of mating effort are often consciously rated as undesirable but unconsciously perceived as attractive, particularly when observing the behaviours. An example of this comes from perceptions of the Dark Triad personality traits, Machiavellianism, psychopathy and narcissism. These traits are not overtly deemed as attractive, however men high in these traits tend to be successful in following a fast mating strategy. Research suggests that this is because covertly and behaviourally, high Dark Triad men are perceived as attractive (Back, Schmukle, & Egloff, 2010; Holtzman & Strube, 2013), but it is unlikely that such socially undesirable traits would be explicitly rated as attractive.

A further limitation of the study which must be considered here is whether the content of the vignettes were confounding by priming the participants to respond in the desired way. However, the vignettes were designed to be more naturally constructed rather than more artificial. The content of the vignettes is intended to show what the subject of each scenario is thinking, which is a general happiness with her relationship status in each scenario. If the scenarios were written in a different tone, such as one of general dissatisfaction, or if only the facts were presented to participants, the responses may have been different. Nevertheless, it is suggested that this was the most appropriate and viable method for conducting the current study, though future research could investigate this further. Future research may also consider further examination of the transition between stage 1 and 2 where short-term relationships become long-term. This is clearly a key transition when discussing mating strategies as previous research has also highlighted (Farrelly et al., 2015), and a more detailed and targeted investigation of the motivations and preferences as they vary across this time is welcomed. Furthermore there are additional variables that may affect preferences across the stages such as Sociosexual Orientation (Penke & Asendorpf, 2008), and future investigation of these, possible as pre-registered studies, can shed further light on how women's mate preferences may change in relationships.

Overall, the findings from the current research support predictions from Life History Theory and previous findings from male samples showing that men decrease their mating effort as the need to provide investment increases.

Hunt et al., (2009) highlighted the importance of considering both components of sexual selection when examining sexually selected traits – male-male competition and female mate choice. This is because sexual selection very rarely acts upon one of these processes, and the processes simultaneously can reinforce the development of the sexually selected construct being examined, or oppose it. The current research adds to the body of evidence suggesting mutually beneficial adaptive mate strategies have been selected, as female mate choice encourages men to behave in ways that are consistent with female mate preferences, resulting in a mutually beneficial reallocation of mating effort to parenting effort in men as a long-term relationship develops. As women are obliged to invest in offspring more heavily than men, the longer they are devoted to a monogamous relationship, the bigger the potential risk partner abandonment would be to her reproductive success. Promoting men to slow their mating strategy by increasing parenting effort therefore encourages their commitment to the relationship as well as diverting their attention from alternative potential mating opportunities. Future research should examine this possibility in more depth and detail, including using experimental designs to augment the existing findings.

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