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ORIGINAL PAPER

Validating the Revised Mating Effort Questionnaire

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Abstract

The mating effort questionnaire (MEQ) is a multi-dimensional self-report instrument that captures factors reflecting individual effort in upgrading from a current partner, investment in a current partner, and mate seeking when not romantically paired. In the current studies, we sought to revise the MEQ so that it distinguishes among two facets of mate seeking—mate locating and mate attracting—to enable a more nuanced measurement and understanding of individual mating effort. Moreover, we developed additional items to better measure partner investment. In total, the number of items was increased from 12 to 26. In Study 1, exploratory factor analysis revealed that a four-factor solution, reflecting partner upgrading, mate locating, mate attracting, and partner investment, yielded the best fit. In Study 2, this structure was replicated using confirmatory factor analysis in an independent sample. Based on extant studies documenting the relationships between psychopathy, short-term mating effort, and sexual risk taking, a structural equation model (SEM) indicated that trait psychopathy positively predicted mate locating, mate attracting, and partner upgrading and negatively predicted partner investment. A separate SEM showed that partner upgrading positively predicted risky sexual behaviors, while partner upgrading and mate locating positively predicted acceptance of cosmetic surgery.

Keywords Mating effort · Scale equivalence · Psychopathy · Cosmetic surgery

Introduction

In most sexually reproducing species, males and females differ in their obligatory parental investment (Trivers, 1972). Parental investment is defined as any investment by the parent in an individual offspring that increases the offspring's chances of survival at a cost of the parent's ability to invest in other offspring (Trivers, 1972). Within mammals, females' have higher obligatory parental investment compared with males due to the effort required for larger gametes, gestation, lactation, and care following birth. In contrast, males' reproductive potential is much greater, because the energy required for a single act of copulation may be sufficient to produce offspring (Trivers, 1972). This differential in reproductive investment can be traced back to the difference in energetic investment in gamete production (Bateman, 1948). In species in which parental investment is solely based on energetic investment in gametes females, who invest more energy in larger and fewer gametes (Bateman, 1948; Kokko et al., 2003; Lehtonen et al., 2012), and will therefore be the limiting sex that is competed over. This means that there is greater reproductive variance in males than in females. That is, almost all females mate and reproduce, whereas some males reproduce with many females, while others are excluded all together (Bateman, 1948).

Competition for access to the limiting sex is further intensified by the operational sex ratio, the number of reproductive aged males to fecund females, within the population (Clutton-Brock & Vincent, 1991; Emlen et al., 1977). Female internal gestation and lactation all function to extend the amount of time before they can re-enter the mating pool resulting in a higher male-to-female operational sex ratio. For example, in Bornean orangutans (*Pongo pygmaeus*) male parental

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investment can effectively be restricted to a single act of copulation, whereas female parental investment is extensive involving an eight-month period of gestation, followed by a long period of lactation and infant dependency contributing to an eight-year inter-birth interval within the species (Knott, 2001). Accordingly, individual males can increase their total reproductive output more by competing for mating opportunities (Clutton-Brock & Vincent, 1991). Although there are examples in which males engage in more parental investment than do females, these instances are far fewer within the class Mammalia, where it is estimated that approximately 5% of species (including humans) are characterized by males that engage in pairbonding and post-natal care (Lukas & Clutton-Brock, 2013).

Although females are often the more investing sex, males do exercise choice during mate selection. In species where the investment in offspring is relatively evenly divided between males and females, such as humans (Marlowe, 1999), both sexes exercise choice during mate selection. Men expend effort in rearing children by providing resources, educating them, and helping them to form social alliances (Bribiescas et al., 2012). As a result, humans are selective with whom they choose to mate, expending substantial levels of mating effort to compete for and maintain access to the best mates (Buss, 1989; Clutton-Brock & Vincent, 1991). Therefore, both sexes engage in substantial levels of mating effort. Mating effort refers to energy allocating to current mates and seeking new mating opportunities (e.g., Gangestad & Simpson, 1990; Jackson & Kirkpatrick, 2007; Penke & Asendorpf, 2008).

Mating effort, which subsumes effort allocated toward current mates and new mating opportunities, can be further subdivided into various domains, including short-term mating energy allocated to casual sex (e.g., Gangestad & Simpson, 1990; Jackson & Kirkpatrick, 2007; Penke & Asendorpf, 2008), competition for access to mates (Buunk & Fisher, 2009), mate switching (reviewed in Buss et al., 2017), mate retention (Buss et al., 2008), and mate poaching (Arnocky et al., 2013; Schmitt & Buss, 2001). Although mating effort is frequently discussed as an important concept in evolutionary psychological frameworks, few scales have been designed to measure the construct, and even fewer have been subject to rigorous psychometric evaluation.

To address previous literature gaps and measurement limitations in mating effort, Albert et al. (2021) developed and validated the Mating Effort Questionnaire (MEQ). The results from their study revealed a three-factor solution, reflecting respondents' allocation of energy to attracting high mate-value partners when already paired (partner upgrading), seeking out romantic partners when single (mate seeking), and investing in their current romantic partner and relationships (partner investment). These three factors also demonstrated concurrent validity via associations with life history, sociosexuality, and mate retention. In their initial MEQ study, Albert et al. (2021) identified the need for additional item development for the mate seeking and partner investment factors. Here, we directly address this need by revising the MEQ with the addition of items reflecting mate seeking and partner investment. Additionally, items were developed to distinguish among two separate, but related mate seeking factors: mate locating, seeking environments where prospective mates are present, and mate attracting, engaging in behavior to appear desirable to members of the preferred sex. After verifying the construct validity of the revised MEQ (Study 1 and Study 2A), the concurrent validity of the scale was evaluated via its associations with appearance enhancement, psychopathy, and risky sexual behavior.

Appearance Enhancement

Across historical and cultural contexts, humans have been shown to modify their physical appearance in unique ways to court and retain desired mates, as well as to compete for valued social and material resources that can augment survival and reproductive success (Davis & Arnocky, 2022). Various forms of visual appearance enhancement serve as self-promotion strategies that can effectively increase one's value on the mating market. Nevertheless, some forms of visual appearance enhancement are far more costly to perform than others. For instance, the purchase of luxury designer jewelry, clothing, and shoes carries a significant financial cost (Hudders et al., 2014), whereas skin tanning is accompanied by considerable risks to one's physical health and longevity (e.g., melanoma; Saad & Peng, 2006). Some forms of risky appearance enhancement carry significant costs to both finances and personal health, such as cosmetic surgery, the acceptance of which appears to vary with evolutionarily relevant individual difference variables (e.g., Arnocky & Piché, 2014; Borah et al., 1999; Gabriel et al., 1997; Grazer & de Jong, 2000; Yoho et al., 2005).

In previous work, a desire to compete with same-sex rivals for mates and mating resources (i.e., intrasexual competitiveness) has been positively associated with favorable attitudes toward, and a greater willingness to spend more money on, cosmetic procedures in men and women (Arnocky & Piché, 2014). Compared to men, women expressed more positive attitudes toward cosmetic surgery (Arnocky & Piché, 2014), consistent with worldwide statistics showing that cosmetic surgery spending is significantly higher among women than men (discussed in Davis & Arnocky, 2022). Across three studies in a separate investigation, Bradshaw et al. (2019) found that women investing more in short-term mating effort expressed more favorable attitudes toward risky visual appearance enhancement, like cosmetic surgery, but not for less risky kinds of appearance modification, such as makeup. Therefore, those who compete more fiercely for mates, particularly short-term sexual partners, appear more accepting of risky medical procedures like cosmetic surgery, especially among women (Dubbs et al., 2017). The risks associated with cosmetic surgery can be significant. For example, beyond the immediate risks to health associated with invasive cosmetic procedures (e.g., infection, tissue damage, blood clots), cosmetic surgery among women has been associated with poorer physical and mental health (Schofield et al., 2002). Postoperative depression, anxiety, and disordered eating were found among female clients who underwent cosmetic surgery (van Soest et al., 2012). Taken together, cosmetic surgery appears to embody a trade-off between attracting mates, particularly short-term sexual partners, at the potential expense of health. Those who invest more time and energy into locating and attracting short-term partners at the expense of personal well-being also report higher levels of "dark" (i.e., malevolent) personality characteristics, like psychopathy (da Silva et al., 2015; Jonason et al., 2010).

Short-Term Mating Effort

People higher in psychopathy measures tend to invest more resources in short-term mating effort, and fewer resources in mental and physical well-being, long-term mating effort, and parenting (da Silva et al., 2015; Jonason et al., 2010; Međedović, 2019; Međedović & Petrović, 2019; Valentova et al., 2020). Indeed, these traits are posited to be part of a coordinated system of co-adapted traits that promotes precocious sexuality, short-term mating strategies, and aggression. Consistent with this theory, higher scores on psychopathy measures are associated with having an earlier onset of sexual activity (Visser, et al., 2010), a preference for casual sex with a variety of partners (i.e., an unrestricted sociosexual orientation; Patch & Figueredo, 2017; Tsoukas & March, 2018; Valentova et al., 2020), having more lifetime sexual partners (Patch & Figueredo, 2017), and committing infidelity more frequently (Jones & Weiser, 2014). The links between appear to be particularly strong in men (e.g., Visser et al., 2010). Moreover, higher psychopathy has been positively linked with aggression (Paulhus et al., 2018), sexual coercion (Koscielska et al., 2020), risky substance use (e.g., frequency of alcohol consumption; Jonason et al., 2010), and sexual risk-taking (e.g., frequency of unprotected sex; Dubas et al., 2017). Therefore, evidence supports the proposition that those who score higher on psychopathy measures are more likely to use short-term exploitive social and reproductive strategies.

Sexual Risk Taking

Risky sexual behavior (RSB) refers to various behaviors that include having multiple sex partners, casual sex with unknown partners, sex with high-risk partners (e.g., people they have just met), and unprotected sex (Turchik & Garske, 2009). High-RSB individuals are at increased risk of contracting sexually transmitted infections (STIs) and experiencing other negative outcomes, such as psychological distress (Turchik & Garske, 2009). Moreover, sexual encounters not only increase risk of STIs, like herpes, syphilis, chlamydia, and human immunodeficiency virus (HIV), but for all other pathogens transmitted via direct contact of bodily fluids (Halperin & Epstein, 2004; Morris & Kretzschmar, 1997) and skin surfaces (Hunt et al., 2017). Further, STIs and other pathogens can be transmitted through sperm, which may cause infertility by damaging the reproductive organs (Crespillo-Andujar et al., 2018). The fitness costs of these diseases may be very high (Lochmiller & Deerenberg, 2000)—including sterility and death (Crespillo-Andujar et al., 2018; Schryver & Meheus, 1990). Yet, STI contraction is a pervasive public health issue, with 19 million new STI cases reported annually in the USA (Renfro et al., 2022; Satterwhite et al., 2013) and over 50% of new patients between the ages of 15 and 24 (Renfro et al., 2022; Satterwhite et al., 2013). Young adults seem to be more vulnerable to STIs because of a willingness to engage in RSB, such as having sex without a condom (e.g., McMann & Trout, 2021; Renfro et al., 2022), especially when they devalue the consequences of unprotected sex (Collado et al., 2017).

Current Investigation

The current investigation had five primary aims. The first, as called for in Albert et al. (2021), was to increase the number of factors and items of the MEQ. Both the partner investment and mate seeking factors had few items (Albert et al., 2021), and thus, we aimed to increase the number of items related to partner investment and mate seeking. Moreover, rather than conceptualizing mate seeking as a single factor, we generated items for two separate but related domains—energy allocated to going into environments to find mates (i.e., mate locating), and energy allocated to attracting mates (i.e., mate attracting).

The second aim was to evaluate the construct validity of the revised MEQ via confirmatory factor analysis (CFA) and to assess scale equivalence between the sexes using multi-group confirmatory factor analysis (MGCFA). Studies employing CFA are hypothesis driven and used to verify the number of factors and patterns of factor-item relationships (Brown, 2014). Such studies can provide stronger evidence for or against the adoption of a particular measurement model. Using CFA, researchers can also evaluate a scale for measurement invariance, which is a statistical property of an instrument (e.g., a questionnaire), indicating that it measures the same construct(s), in the same way, across subgroups of respondents (Meredith, 1993; Millsap 2012; Wang et al., 2018). When measurement invariance is absent, inferences about group differences on the latent variables of interest are inappropriate because observed differences may stem from measurement bias (for a gentle introduction to measurement invariance in evolutionary psychology, see Wang et al., 2018). Because sex differences represent a key area in evolutionary psychological research, tests of measurement invariance are especially crucial in this field. Albert et al. (2021) assessed the scale equivalence between the sexes on the original MEQ and on the Intrasexual Competition Scale (ICS; Albert et al., 2022). They found that both scales have substantial elements of measurement invariance, indicating that scale scores can be used to make meaningful comparisons between the sexes. Here, we sought to assess the scale equivalence of the revised MEQ with an expanded set of items.

The third aim was to evaluate the internal consistency of the scale's factors and the fourth aim was to evaluate the concurrent validity of the scale. Based on extant research (Carter et al., 2014; Fulton et al., 2014; Jonason et al., 2017; Jonason et al., 2010; Kastner & Sellbom, 2012; Valentova et al., 2020; Yao et al., 2014), we tested whether psychopathic personality traits predicted aspects of mating effort. Additionally, we tested whether the revised MEQ factors predicted meaningful aspects of respondents' behavior related to sexual risk taking and attitudes toward appearance enhancement. This extends beyond Albert et al. (2021) by testing the predictive validity of the MEQ factors with behaviors that can have negative social and health consequences, such as STI contraction.

Sample Size Estimation

We used the *pwrSEM* package (Wang & Rhemtulla, 2021), $\alpha = 0.05$, a sample size of $n = 300$, and 500 simulations to estimate power for detecting several effect sizes based on Albert et al. (2021). The simulations were generated using a SEM with four MEQ factors, 26 items loading on their theorized factors, and one observed outcome variable regressed on the four factors. We found that $1\text{-}\beta = 0.90$ for detecting a small effect on the outcome of $\beta = 0.20$, 1.00 for detecting a MEQ factor loading of $\beta = 0.50$ (the smallest primary loading in Albert et al., 2021), and 0.82 for detecting a small factor correlation of $r = 0.20$. These results suggest sample sizes larger than $n = 300$ sufficiently powered the current studies.

Study 1: Exploring the Structure of the Revised Mating Effort Questionnaire

Method

Participants

Participants were recruited via Amazon's Mechanical Turk (MTurk) online sampling technologies. The questionnaire was programmed in Qualtrics and administered via MTurk. To reduce the number of respondents who engaged in insufficient responding effort, all respondents were required to have a HIT approval rating of 95% (i.e., MTurk requesters approved at least 95% of the workers previous jobs on the platform). Previous investigations have shown that MTurk participants are significantly more diverse than convenience samples of university undergraduates (who are frequently used in traditional lab studies; Buhrmester et al., 2016; Casler et al., 2013) and provide data of equivalent quality to that provided by in-lab participants (Buhrmester et al., 2016; Casler et al., 2013; Hauser & Schwarz, 2016). Therefore, our results should generalize more broadly than traditional lab samples of university undergraduates.

As part of a larger study on mating behavior, participants completed a demographics and lifestyle questionnaire and the revised MEQ. Participants were remunerated with 1.00 USD for completing the survey package. All respondents had to be 18 years of age or older and native English speakers. These inclusion criteria were the same for both studies. In total, 396 individuals completed the questionnaire. All repeated IP addresses were excluded from analysis, resulting in the removal of 31 cases. An additional 36 participants were excluded from analysis for failing attention checks embedded into the questionnaire.

After these procedures, data from 356 individuals (185 males and 171 females) remained for analysis. The ethnic composition of the sample was as follows: Caucasian (79.8%), Black (12.8%), East Asian (3.1%), Latin American (3.1%), South Asian (1.1%), Indigenous (< 1%). A total of 5.3% of respondents identified with multiple ethnicities. Women were aged 19 to 65 years ($M_{age} = 37.89$, SD = 11.38), while men were aged 19 to 60 years ($M_{age} = 36.05$, SD = 8.95). All respondents were recruited from the USA. Approximately 70.8% of respondents indicated being in a long-term committed romantic relationship.

Measures

Demographic and Lifestyle Questionnaire A survey was administered to obtain respondents' sex, age, ethnicity, relationship status, and sexual orientation. Participants reported whether they had ever had sexual intercourse, number of lifetime romantic partners and sex partners, frequency of past month intercourse, and their number of past-year sex partners.

Item Development for the Revised MEQ The original MEQ was comprised of six partner upgrading items, three mate seeking items, and three partner investment items. We sought to further define the boundaries of the MEQ domains and generate additional items, factor with a goal of capturing more of the mating effort construct space and ultimately providing researchers with a more nuanced understanding of variation in mating effort. The author reviewed current literature on short-term mating behavior including use of online dating applications. Based on our review, we identified mate attracting as a facet of mate seeking not captured by the MEQ, which only contained mate seeking items specific to mate locating. We also sought to generate additional items to measure partner investment, and we reviewed the literature on mate retention to identify additional content representative of this domain (Buss et al., 2008). From this review, we developed items that focused on positive inducements and behaviors that function to improve a relationship. Ultimately, we developed 15 items that appeared to have adequate content validity and added them to the original 12 items from the MEQ (see Appendix for a complete list of items). Nine items were generated to measure mate attracting, and an additional seven items were generated to better measure partner investment. Example mate attracting items include, "When I am single, I try and appear extra attractive" and "When I am single, I compliment women/men on their intelligence." An example of one of the partner investment items is "When I am in a relationship, I take on more responsibility when my partner is under stress." Participants responded using a seven-point Likert-type rating scale (1 = strongly disagree to 7 = strongly agree).

Data Analysis

Data Screening

Prior to data analysis, all cases and study variables were examined for missing values and violations of the assumptions of multivariate analysis (i.e., additivity, normality, linearity, and homogeneity of variance). Skewness values of the 28 items ranged from 0.56 (item 1) to -1.22 (item 26), indicating that the item distributions were relatively normal. Across all 28 items, the prevalence of missing data did not exceed five percent. Four cases were missing 3.23%. Given the trivial prevalence of missingness, we performed a stochastic imputation using the Mice package in *R* (van Buuren & Groothuis-Oudshoorn, 2011). Seven multivariate outliers were detected using Mahalanobis distance statistics of (χ^2[27] = 55.47, $p < 0.001$). These outliers were excluded, leaving 336 cases.

Exploratory Factor Analysis (EFA)

We conducted EFAs to analyze the underlying factor structure of the revised MEQ using the *psych* package in R (Revelle, 2013). EFAs were conducted using the guidelines outlined by Preacher and MacCallum (2003). To achieve simple structure, all items with cross-loadings that exceeded ± 0.30 were eliminated. Maximum likelihood estimation was used with direct oblimin rotation, because of expected factor correlations. Bartlett's test indicated correlation adequacy (χ^2 [351] = 2279.43, $p < 0.001$), and the KMO test indicated sampling adequacy (MSA = 0.89).

Model Fit

For all analyses, we evaluated the goodness of fit using the global χ^2 test of fit, the Standardized Root Mean Square (SRMR), the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990) and its 90% confidence interval (cf. MacCallum et al., 1996), the Tucker–Lewis Index (TLI; Tucker & Lewis, 1973), and the Comparative Fit Index (CFI; Bentler, 1990). Acceptable model fit was defined as follows: a non-significant χ^2, SRMR < 0.08, RMSEA < 0.06 (90% CI 0.05–0.08), CFI ≥ 0.95, and TLI ≥ 0.95. We elected to interpret multiple indices because they provide different information for evaluating model fit.

Results

Exploratory Factor Analysis

All 28 items were submitted to EFA. The scree plot and Kaiser's new criterion recommended four factors, whereas Kaiser's old criterion recommended three factors. Because we conceptualized the revised MEQ as a four-factor scale, we initially tested a four-factor model and fit to the data was marginal (χ^2[249] = 750.06, $p < 0.001$; CFI = 0.96; RMSEA = 0.07[0.07– 0.08]). Next, we tested a three-factor model and fit to the data was inadequate (χ^2[273] = 1370.41, $p < 0.001$; CFI = 0.91; RMSEA = 0.11[0.10– 0.12]). Returning to the four-factor model, we found that two items did not perform well and dropped them. Item 23 was dropped for having a significant cross-loading, equal to or greater than ± 0.30, while item 20 was dropped for not loading onto its hypothesized factor. The fit of the revised four-factor model appeared adequate (χ^2 = 531.38, p <0.001; CFI = 0.98; RMSEA = 0.07[0.06–0.074]), and the model accounted for 59% of the variance. Loadings and model fit information are displayed in Table 1. For individual items and scoring instructions, see Appendix.

Study 2A: Confirming the Structure of the Revised Mating Effort Questionnaire

As noted, the primary purposes of Study 2 were to: (1) confirm the structure of the MEQ found in Study 1, (2) evaluate whether the scale measures the same underlying constructs between men and women, (3) evaluate scale reliability, and (4) assess concurrent validity via associations of the revised MEQ factors. Based on extant research on mating effort, sexual risk taking, and psychopathy, a structural equation model tested whether psychopathy predicted the mating effort factor and, controlling for sex, whether the mating effort factors predicted sexual risk taking, and acceptance of cosmetic surgery.

Participants

Participants were recruited in the same manner as in Study 1 and were remunerated with 1.25 USD for completing the questionnaire. All repeated IP addresses were excluded from analysis, resulting in the exclusion of 193 cases. Eighty-four individuals were excluded for failing attention checks embedded into the questionnaire. Data from 549 participants (281 males and 268 females) were analyzed. The ethnic composition of the sample was as follows: Caucasian (79.9%), Black (10.6%), Latin American (4.4%), East Asian (3.5%), and South Asian, Indigenous, and West Asian (< 1%). A total of 5.2% of respondents identified with multiple ethnicities. Age range for female participants was 18 to 72 years (M_{age} = 35.49, SD = 10.96), and the age range for male participants was 18 to 65 years (M_{age} = 35.14, SD = 9.18). The respondents were all from the USA. Seventy-four percent of respondents indicated being in a long-term committed romantic relationship.

Measures

Participants completed the demographics and lifestyle questionnaire from Study 1, in addition to the SOI-R (Penke &

Table 1 List of items of the revised MEQ, goodness-of-fit statistics, and factor loadings

Item	Mate attracting	Partner upgrading	Partner investment	Mate locating			
14	**0.92**	− 0.04	− 0.03	0.02			
15	**0.92**	0.01	0.02	− 0.05			
17	**0.87**	− 0.04	0.02	− 0.04			
16	**0.85**	0.05	− 0.01	− 0.04			
13	**0.80**	0.05	− 0.04	0.06			
19	**0.59**	− 0.01	0.06	0.16			
18	**0.51**	0.06	0.17	0.17			
21	**0.31**	0.15	0.07	0.24			
8	0.00	− 0.03	− 0.02	**0.97**			
7	0.00	0.02	0.03	**0.88**			
9	0.28	0.14	− 0.04	**0.43**			
24	− 0.02	− 0.02	**0.74**	0.06			
11	− 0.02	0.07	**0.69**	0.05			
25	0.04	− 0.11	**0.67**	− 0.07			
26	0.05	− 0.19	**0.66**	− 0.07			
10	− 0.08	0.18	**0.62**	0.08			
22	0.06	0.06	**0.56**	− 0.12			
28	0.09	0.03	**0.48**	0.00			
12	0.06	− 0.01	**0.39**	0.10			
1	− 0.03	**0.98**	0.00	− 0.04			
2	0.00	**0.94**	− 0.02	0.00			
3	− 0.02	**0.85**	− 0.04	0.01			
6	0.08	**0.74**	0.06	0.00			
5	0.03	**0.74**	0.00	0.03			
4	0.03	**0.65**	0.02	0.08			
Goodness of fit	χ^2	*df*	**RMSEA**	**(90%CI)**	**SRMR**	**CFI**	**TLI**
Four-factor model	531.38	206	0.07	.06 -.07	0.04	0.98	0.96

Bolded items indicate factor loadings

Asendorpf, 2008), the revised MEQ (Albert et al., 2021), the Acceptance of Cosmetic Surgery Scale (ACSS; Henderson-King & Henderson-King., 2005), the Short Dark Triad (SD3; Jones & Paulhus, 2014), and the Sexual Risk Survey (SRS; Turchik & Garske, 2009; Turchik et al., 2015). These measures are described in greater detail in Study 2B. Below, we describe the CFAs, MGCFAs, and reliability analysis conducted on the MEQ.

Analysis

Data Screening

The variables were examined for the 549 remaining cases in the study. Skewness values for the 26 items ranged from 0.47 (Item 2) to –1.33 (Item 23) and kurtosis values ranged from -1.45 (Item 3) to 1.89 (Item 23), indicating that item distributions were relatively normal. All 549 cases were analyzed for the presence of missing data. Given the trivial prevalence of missingness (i.e., one case had 3.57% missing data), we performed a stochastic imputation using the *Mice* package in R (van Buuren & Groothuis-Oudshoorn, 2011). Thirty-three multivariate outliers were detected using Mahalanobis distance statistic of ($\chi^2[26] = 54.051$, $p < 0.001$), and subsequently excluded, leaving 516 cases. The assumptions of multivariate analysis were met.

Results

Confirmatory Factor Analysis

We specified two CFAs using the *lavaan* package in R (Rosseel, 2012), and the same estimators and fit information as in Study 1. Two four-factor CFAs were tested, one in which all error variances were uncorrelated and a second in which error variances between eight item pairs covaried.

First, we tested the four-factor solution in which all measurement error was random (Model 1). The χ^2 test was significant, suggesting that the model did not fit the data exactly, and remaining fit indices were outside of their cutoff values (see Table 2). The magnitudes of the standardized factor

Table 2 Goodness-of-fit indices, unstandardized and standardized factor loadings, standard errors, significance values, and *R*-square values for Model 1

		b	**SE**	***p***	***β***		
Partner upgrading	1	1.00			0.94		
Partner upgrading	2	1.01	0.03	< 0.001	0.93		
Partner upgrading	3	0.95	0.03	< 0.001	0.89		
Partner upgrading	4	0.79	0.03	< 0.001	0.77		
Partner upgrading	5	0.83	0.03	< 0.001	0.80		
Partner upgrading	6	0.81	0.03	< 0.001	0.79		
Mate locating	7	1.00			0.90		
Mate locating	8	0.95	0.05	< 0.001	0.87		
Mate locating	9	0.67	0.05	< 0.001	0.61		
Mate attracting	13	1.00			0.77		
Mate attracting	14	1.04	0.05	< 0.001	0.87		
Mate attracting	15	1.01	0.05	< 0.001	0.85		
Mate attracting	16	0.99	0.05	< 0.001	0.79		
Mate attracting	17	0.97	0.05	< 0.001	0.80		
Mate attracting	18	0.72	0.05	< 0.001	0.59		
Mate attracting	19	0.72	0.05	< 0.001	0.61		
Mate attracting	20	0.62	0.05	< 0.001	0.51		
Partner investment	10	1.00			0.43		
Partner investment	11	1.18	0.14	< 0.001	0.59		
Partner investment	12	1.19	0.14	< 0.001	0.57		
Partner investment	21	1.34	0.16	< 0.001	0.60		
Partner investment	22	1.44	0.15	< 0.001	0.77		
Partner investment	23	1.43	0.15	< 0.001	0.76		
Partner investment	24	1.26	0.14	< 0.001	0.72		
Partner investment	25	1.23	0.15	< 0.001	0.59		
Partner investment	26	1.30	0.14	< 0.001	0.74		
Goodness of fit	χ^2	***df***	**RMSEA**	**(90%CI)**	**SRMR**	**CFI**	**TLI**
Four-factor model	1394.459	293	0.085	.081 -.090	0.071	0.873	0.859

loadings ranged between 0.43 and 0.94 and the unstandardized factor loadings ranged between 0.67 and 1.44. The factor covariances were all significant and in the expected directions (all $ps \leq 0.001$). Next, we examined modification indices (MIs) to identify any sources of strain. We found relatively large MIs (> 20) suggesting that freeing the error covariances between Items 18 and 19 (MI = 210.68), Items 1 and 2 (MI = 95.04), Items 7 and 8 (MI = 73.80), Items 10 and 11 (MI = 69.73), Items 19 and 20 (MI = 36.57), Items 18 and 20 (MI = 71.06), Items 3 and 5 (MI = 29.76), and Items 1 and 3 (MI = 31.90), produced a significant improvement in fit. We specified covariances between the error variances of the above item pairs to indicate that the relationships between them could not be accounted for solely by their shared factor. In doing so, we were acknowledging that item similarity was in part due to another source, which we believe was a method effect stemming from the similarity in item wording (Brown, 2003; 2014). When we tested the re-specified model (Model 2), the χ^2 test was significant, suggesting that the model did not fit the data exactly. However, the remaining fit indices indicated good model fit (see Table 3). The magnitudes of the standardized factor loadings ranged between 0.39 and 0.90, and the unstandardized factor loadings ranged between 0.66 and 1.56 (Fig. 1).

Test of Scale Equivalence Between the Sexes

To further evaluate the stability and generalizability of Model 2, we examined measurement invariance (e.g., equal factor loadings, indicator intercepts) and population heterogeneity (e.g., equal factor variances and means) between the sexes using MGCFAs. We conducted χ^2 difference tests to assess degradation in model fit (i.e., $p < 0.05$) and assessed model parameter constraints for sources of strain when fit decreased significantly. Initially, we specified separate CFAs for men ($n = 262$) and women ($n = 254$). We found that the models for each sex fit the data well (see Table 4); therefore, we tested for equal form between the sexes. We found that the equal form model fit the data from both groups well (see Table 4), demonstrating configural invariance.

Table 3 Goodness-of-fit indices, unstandardized and standardized factor loadings, standard errors, significance values, and R-square values for Model 2

		b	**SE**	***p***	***β***		
Partner upgrading	1	1.00			0.90		
Partner upgrading	2	1.03	0.02	< 0.001	0.90		
Partner upgrading	3	0.98	0.03	< 0.001	0.88		
Partner upgrading	4	0.84	0.04	< 0.001	0.78		
Partner upgrading	5	0.89	0.04	< 0.001	0.81		
Partner upgrading	6	0.89	0.04	< 0.001	0.82		
Mate locating	7	1.00			0.64		
Mate locating	8	0.93	0.05	< 0.001	0.61		
Mate locating	9	1.27	0.11	< 0.001	0.83		
Mate attracting	13	1.00			0.77		
Mate attracting	14	1.05	0.05	< 0.001	0.88		
Mate attracting	15	1.03	0.05	< 0.001	0.87		
Mate attracting	16	0.99	0.05	< 0.001	0.79		
Mate attracting	17	0.98	0.05	< 0.001	0.81		
Mate attracting	18	0.66	0.05	< 0.001	0.54		
Mate attracting	19	0.66	0.05	< 0.001	0.56		
Mate attracting	20	0.57	0.05	< 0.001	0.46		
Partner investment	10	1.00			0.39		
Partner Investment	11	1.24	0.13	< 0.001	0.57		
Partner Investment	12	1.28	0.17	< 0.001	0.57		
Partner Investment	21	1.45	0.18	< 0.001	0.60		
Partner Investment	22	1.57	0.18	< 0.001	0.77		
Partner Investment	23	1.56	0.18	< 0.001	0.76		
Partner Investment	24	1.38	0.16	< 0.001	0.73		
Partner Investment	25	1.34	0.17	< 0.001	0.59		
Partner Investment	26	1.42	0.17	< 0.001	0.75		
Goodness of fit	χ^2	***df***	**RMSEA**	**(90%CI)**	**SRMR**	**CFI**	**TLI**
Four-factor model	740.032	325	0.056	.051 -.061	0.071	0.948	0.94

Measurement Invariance

Given the evidence of equal form, we specified a series of two-group CFAs in which we increased the number of parameter constraints. Equality constraints on the factor loadings did not significantly degrade the fit of the model ($\Delta\chi^2$ [22] = 16.43, $p = 0.79$), achieving metric invariance. However, applying equality constraints on the item intercepts significantly degraded the fit of the model ($\Delta\chi^2$[22] = 34.79, $p = 0.04$). Therefore, we analyzed the parameter constraints to identify non-invariant item intercepts. Based on our inspection of the $\Delta\chi^2$ test of releasing each individual intercept, we found that releasing the intercept of Item 4 would improve the fit of the partial scalar invariance model. The partial scalar invariance model fit the data well and did not result in significant degradation in model fit from the equal item intercepts model ($\Delta\chi^2$[21] = 24.55, $p = 0.26$). Constraining the item residuals to equality resulted in significant degradation in model fit ($\Delta\chi^2$[26] = 67.51, $p < 0.001$). Therefore, we analyzed the parameter constraints to identify non-invariant item residuals. We inspected the $\Delta\chi^2$ test for released item residuals. To achieve partial strict invariance, we released the constraints on three item residuals (Items 14, 21, and 25). This partial strict invariance model fit the data well and did not result in significant degradation in model fit from the equal item intercepts model ($\Delta\chi^2$[23] = 32.36, $p = 0.09$).

Population Heterogeneity

Imposing equality on the factor variances did not result in significant degradation in model fit from the previous model ($\Delta\chi^2$[4] = 4.76 $p = 0.31$). However, constraining the factor covariances to equality did result in significant degradation in model fit from the previous equal factor variances model, ($\Delta\chi^2$[6] = 24.89, $p < 0.001$). Therefore, we analyzed the parameter constraints to identify non-invariant factor covariances. Based on our inspection of the $\Delta\chi^2$ test of releasing each individual factor covariance, we released three factor covariances (mate locating—partner investment, partner upgrading—partner investment, mate attracting—partner investment). This partial equal factor covariances model fit the data well and did not result in significant degradation in model fit from the previous model ($\Delta\chi^2$[3] = 1.51, $p = 0.68$). We constrained the factor means to equality and inspected the effect on model fit. Constraining factor means between the sexes did not result in significant degradation in model fit from the previous model, ($\Delta\chi^2$[4] = 6.29, $p = 0.18$).

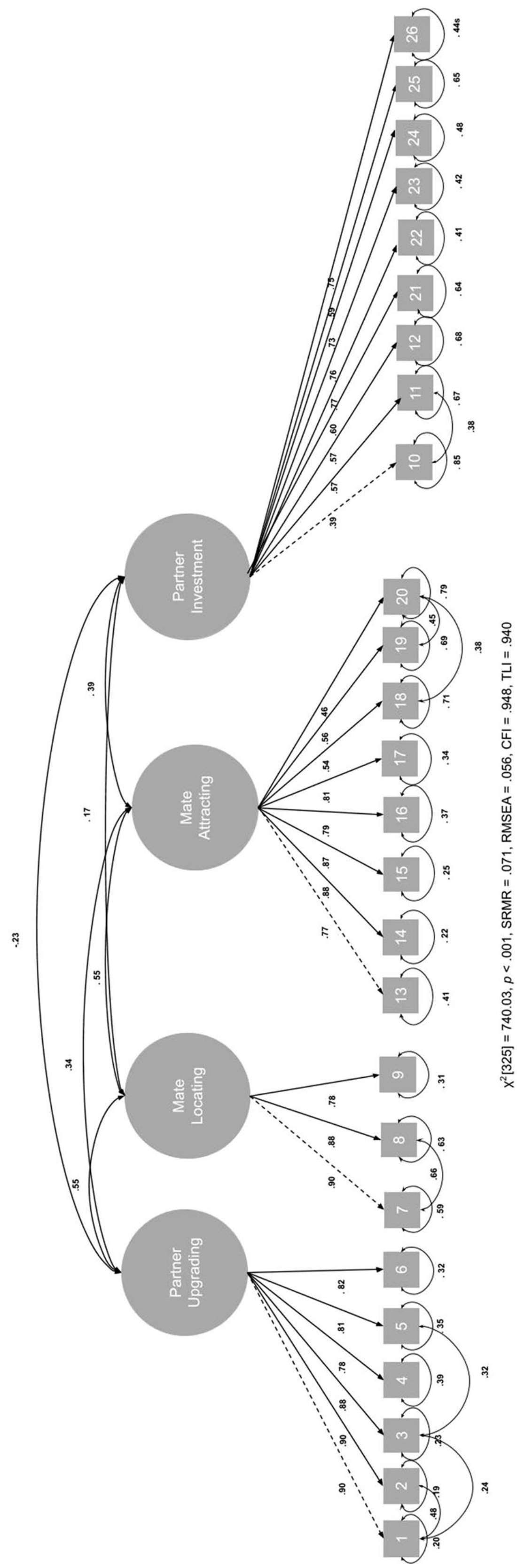

Fig. 1 Path diagram depicting the three-factor solution of the MEQ with correlated item residuals, Model 2. Note that the item loadings and residuals are standardized

Table 4 Goodness-of-fit indices for the multiple group confirmatory factor analysis testing Model 2 to ensure that the scale items loading on the same factors between the sexes (configural invariance) and that the factor loading were the equivalent between the sexes (metric invariance)

	χ^2	*df*	χ^2diff	*Δ df*	CFI	RMSEA	Δ CFI	ΔRMSEA
Men	579.565	285			0.931	0.063		
Women	483.73	285			0.956	0.052		
Equal form	1063.297	570			0.944	0.058		
Equal item loadings	1079.709	592	16.41	22	0.944	0.057	0.000	0.001
Equal item intercepts	1114.691	614	34.98***	22	0.943	0.056	0.001	0.001
Partial equal item intercepts	1104.32	613	24.61	21	0.944	0.056	0.001	0.00
Partial equal item residuals	1171.842	639	67.52***	26	0.939	0.057	0.005	0.001
Revised partial equal item residuals	1136.871	636	32.55	23	0.943	0.055	0.001	0.001
Partial equal latent variances	1141.635	640	4.76	4	0.943	0.055	0	0
Partial equal latent covariances	1168.331	646	24.89***	6	0.941	0.056	0.002	0.001
Revised equal latent covariances	1144.882	643	1.51	3	0.943	0.055	0.002	0.001
Partial equal latent means	1151.16	647	6.28	4	0.943	0.055	0	0

Table 5 Reliability coefficients (ρ) for the four factors for the entire sample as well as a function of sex

	Partner upgrading			Mate locating			Mate attracting			Partner investment		
	All	Male	Female	All	Male	Female	All	Male	Female	All	Male	Female
ρ	0.92	0.91	0.93	0.65	0.59	0.71	0.87	0.87	0.87	0.85	0.85	0.82

Scale Reliability

Next, we computed the composite reliability for the four factors using the method developed by Fornell and Larcker (1981). We elected to use this method instead of computing Cronbach's α, because Cronbach's α misestimates scale reliability except in the instances where multiple item measures are tau-equivalent, their items reflect a single dimension, and responses are free from non-random measurement error (Stijsma, 2009). See Table 5 for the reliability coefficients of the four factors for the entire sample, as well as the sample divided by sex, using the method by Fornell and Larcker (1981).

Study 2B: Nomological Net of the Mating Effort Questionnaire

The goal of Study 2B was to evaluate the concurrent validity of the revised MEQ. In addition to responses to the MEQ, we also analyzed participants' responses to the Short Dark Triad (SD3), the Sexual Risk Survey (SRS), and the Acceptance of Cosmetic Surgery Scale (ACSS). We conducted two structural equation models. In the first model, we investigated whether respondents' levels of trait psychopathy predicted respondents' levels of mating effort, and if respondents' levels of mating effort predicted their self-reported sexual risk taking. In the second model, we tested whether individuals' self-reported mating effort predicted their acceptance of cosmetic surgery.

Study Purposes and Hypotheses

Overall, we were interested in testing a model for evaluating the predictive validity of the revised MEQ using structural equation modeling (SEM). In the first SEM, we tested a model in which trait psychopathy predicted all aspects of mating effort and mating effort factors predicted sexual risk taking, after psychopathy and respondent sex was controlled. Here, we predicted that psychopathy would positively predict mating effort factors focused on the acquisition of new mates (i.e., partner upgrading, mate locating, and mate attracting) and negatively predict partner investment. We also predicted that the mating effort factors that focus on new mate acquisition would all positively predict respondents' sexual risk-taking behaviors, while controlling for psychopathy and sex.

In a second SEM, we tested whether the mate seeking factors of the MEQ predicted respondents' acceptance of cosmetic surgery while controlling respondents' sex. We predicted that respondents' levels on the three mate seeking factors of the MEQ would positively predict all three factors of the ACSS (interpersonal, social, and consider), even after respondents' sex was controlled.

The Short Dark Triad

Respondents completed the Short Dark Triad (SD3; Jones & Paulhus, 2014). The SD3 contains 27 items and measures three facets of the dark triad: Machiavellianism, narcissism, and psychopathy. Each of the subscales contains nine items. Example items for the SD3 are as follows: "It's not wise to tell your secrets" (Machiavellianism); "People see me as a natural leader" (narcissism); and "People who mess with me always regret it" (psychopathy). Previous studies have demonstrated that the internal consistency of the subscales is acceptable ($\alpha = 0.77$ to $\alpha = 0.71$). The scale has demonstrated good inter-rater agreement between peers and respondents (Jones & Paulhus, 2014). Because we only hypothesized the effects of psychopathic personality on respondents mating effort and subsequent sexual risk taking, only the psychopathy subscale of the SD3 was used in our SEM.

Sexual Risk Survey

The Sexual Risk Survey (SRS; Turchik & Garske, 2009; Turchik, et al., 2015) was developed to be a broad measure of sexual risk taking. It was originally developed on a large sample of US college students. The scale contains 23 items and is made up of five subscales: sexual risk taking with uncommitted partners (eight items, example item: "How many partners have you had sex with?"), risky sex acts (five items, example item: "How many times have you had vaginal intercourse without a latex or polyurethane condom?"), impulsive sexual behavior (five items, example item: "How many times have you left a social event with someone you just met?"), intent to engage in risky sexual behaviors (two items, example item: "How many times have you gone out to bars/parties/social events with the intent of "hooking up" and having sex with someone?"), and risky anal sex acts (three items: "How many times have you had anal sex without a condom?"). Each item describes a sexual risk behavior and participants use a free response format to indicate the frequency with which they have engaged in the behavior in the past 6 months. These raw frequencies are then recoded into ordinal values ranging from 0, least frequent, to 4, most frequent (Turchik, et al., 2015). The SRS has demonstrated good to moderate internal consistency for all five of its factors ($\alpha = 0.89$, to $\alpha = 0.61$). However, because of the lower internal consistency of the risky anal sex acts subscale ($\alpha = 0.61$), we excluded it from analysis. The SRS has also demonstrated good content and convergent validity (Turchik & Garske, 2009; Turchik et al., 2015).

Acceptance of Cosmetic Surgery Scale

The Acceptance of Cosmetic Surgery scale (ACSS; Henderson-King & Henderson-King, 2005) is a 15-item scale measuring respondents' attitudes toward, and acceptance of, cosmetic surgery. The ACSS is made up of three subscales focusing on respondents: interpersonal acceptance of cosmetic surgery ("It makes sense to have minor cosmetic surgery rather than spending years feeling bad about the way you look"); perceived social acceptance of cosmetic surgery ("If it would benefit my career, I would think about having plastic surgery"); and their past consideration of cosmetic surgery ("I have sometimes thought about having cosmetic surgery"). The internal consistencies of these subscales ranged from excellent to good ($\alpha = 0.84$–0.91). Previous investigations have established the discriminant and construct validity of the ACSS (Henderson-King & Henderson-King, 2005).

Analysis and Data Screening

Structural equation models (SEMs) were conducted using the *lavaan* package in R (Rosseel, 2012). The descriptive statistics for each scale showed that the items were relatively normally distributed, with only one item (Item 14 of the SRS) showing skewness outside of ± 2. Skewness values for the items ranged from 2.11 (Item 14 of the SRS) to -1.33 (Item 23 of the MEQ). Kurtosis values ranged from 3.87 (Item 14 of the SRS) to -1.45 (Item 3 of the MEQ).

Seventy-two cases were missing more than 5% of the data and were excluded from analysis, leaving 477 cases. After excluding these cases, less than 5% of the data was missing in all instances and we imputed these missing values using the R package, *Mice* (van Buuren, & Groothuis-Oudshoorn, 2011). Thirty-three multivariate outliers were detected using Mahalanobis distance statistic ($\chi^2[155] = 215.15$, $p < 0.001$). These outliers were deleted, leaving 444 cases for analysis (Tabachnick & Fidell, 2013). The assumptions of multivariate analysis were met.

Results

Does Psychopathy Predict Aspects of Mating Effort? Does Mating Effort Predict Sexual Risk Taking? In Model 3, we tested whether respondents' self-reported levels of psychopathy predicted their levels of mating effort. We also tested whether mating effort related to the acquisition of new romantic partners predicted sexual risk taking, while controlling for respondent sex. This model (Model 3; Fig. 2) had a combination of good and poor fit indices (Table 6). Psychopathy was positively predictive of energy allocation to locating and attracting mates when single, in addition to energy allocation to attracting higher mate-value partners when already mated. Further, psychopathy was negatively predictive of partner investment. Those individuals who reported higher levels of partner upgrading also reported a higher frequency of sexual risk taking with uncommitted partners, risky and impulsive sexual behavior, and intent to engage in risky sexual behavior. Those respondents who reported allocating more energy to attracting mates also reported intending to engage in risky sexual behavior more frequently.

Does Mating Effort Predict Acceptance of Cosmetic Surgery? In Model 4, we tested whether energy allocated

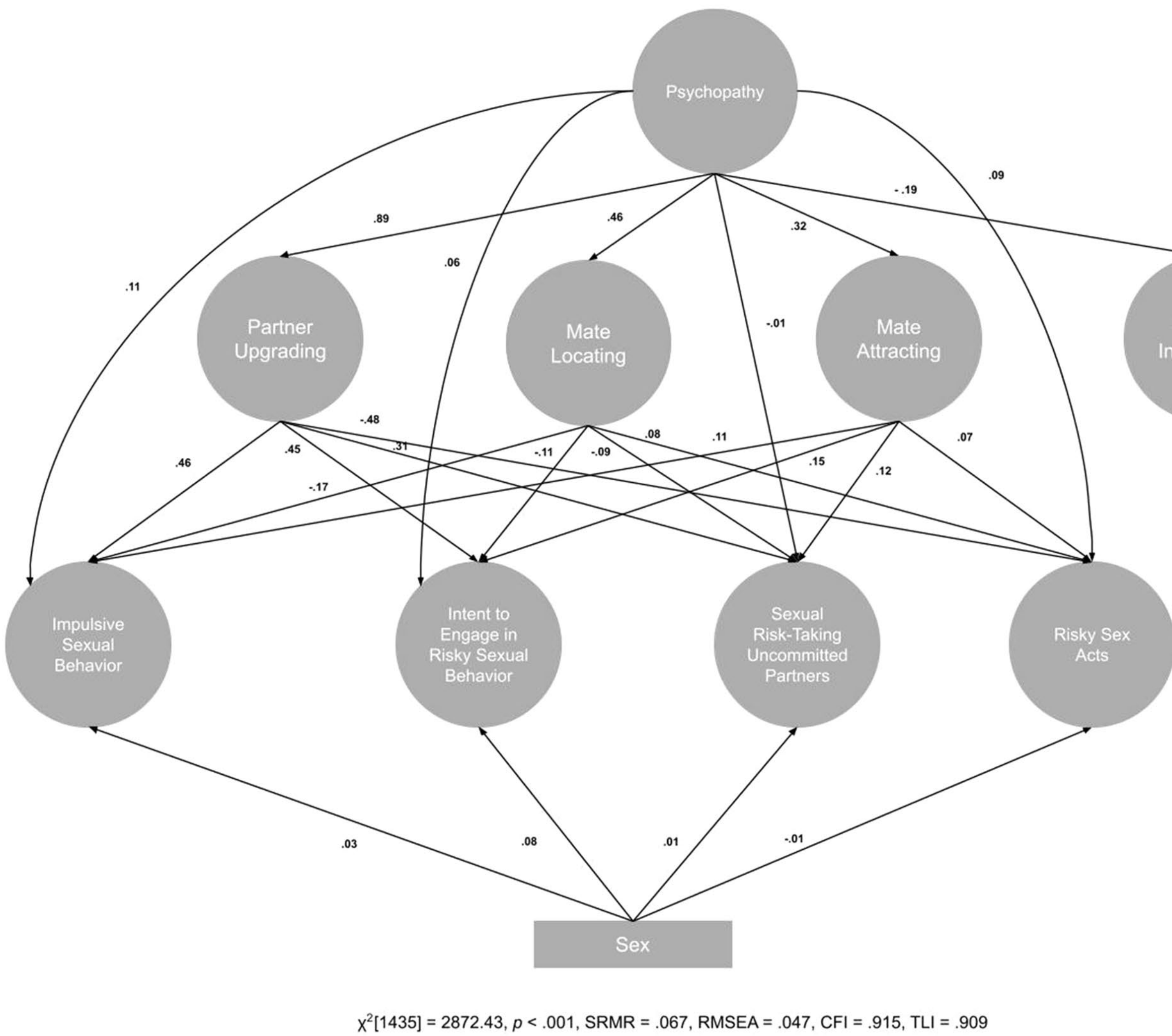

Fig. 2 Path diagram depicting the structural equation model testing the concurrent validity of the MEQ evaluating if psychopathy predicted MEQ factors and if MEQ factors predicted risky sexual behavior, controlling for respondent's sex. Regression coefficients are standardized

to securing new mates, that is, respondents' levels of partner upgrading, mate attracting, and mate locating predicted their acceptance of cosmetic surgery, while controlling for respondent sex. We specified a model with paths from these three MEQ factors and sex to the three factors of the ACSS. This model (Model 4; Fig. 3) had a combination of good and poor indices (Table 7). Women scored higher on all three factors of the ACSS (interpersonal, social, and consider) than did men. Respondents who reported allocating more energy to upgrading partners also reported greater interpersonal and social acceptance of cosmetic surgery. They were also more likely to indicate considering cosmetic surgery for themselves. Those who reported allocating more energy to locating and attracting mates when single also reported greater interpersonal acceptance of cosmetic surgery. Respondents who reported allocating more energy to locating mates also reported greater social acceptance of cosmetic surgery and reported being open to considering cosmetic surgery for themselves.

Discussion

The primary purpose of the current investigation was to improve the MEQ (Albert et al., 2021) by increasing the number of items for the partner investment factor and distinguishing among two mate seeking factors: mate attracting and mate locating. The results indicated that a four-factor solution provided the best fit to the data. When testing for scale equivalence between the sexes, the revised MEQ achieved partial measurement invariance and population heterogeneity, indicating that scale scores can be used to compare men and women. The reliability of three of the four revised MEQ factors was acceptable. Future investigations

Table 6 Goodness-of-fit statistics for standardized and unstandardized regression coefficients for Model 3

			b	**SE**	***p***	***β***	
Psychopathy	→	Partner Upgrading	1.69	0.09	< .001	0.89	
Psychopathy	→	Mate Locating	0.54	0.08	< .001	0.46	
Psychopathy	→	Mate Attracting	0.40	0.07	< .001	0.32	
Psychopathy	→	Partner Investment	− 0.11	0.03	0.001	− 0.19	
Partner Upgrading	→	Sexual Risk Taking with Uncommitted Partners	0.15	0.07	0.041	0.31	
Mate Locating	→	Sexual Risk Taking with Uncommitted Partners	− 0.07	0.07	0.321	− 0.09	
Mate Attracting	→	Sexual Risk Taking with Uncommitted Partners	0.09	0.05	0.067	0.12	
Psychopathy	→	Sexual Risk Taking with Uncommitted Partners	− 0.01	0.12	0.937	− 0.01	
Sex	→	Sexual Risk Taking with Uncommitted Partners	0.01	0.09	0.899	0.01	
Partner Upgrading	→	Risk Sex Acts	− 0.24	0.08	0.002	− 0.48	
Mate Locating	→	Risk Sex Acts	0.07	0.08	0.397	0.08	
Mate Attracting	→	Risk Sex Acts	0.05	0.05	0.298	0.07	
Psychopathy	→	Risk Sex Acts	0.08	0.13	0.534	0.09	
Sex	→	Risk Sex Acts	− 0.02	0.10	0.862	− 0.01	
Partner Upgrading	→	Impulsive Sexual Behavior	0.22	0.07	0.001	0.46	
Mate Locating	→	Impulsive Sexual Behavior	− 0.13	0.07	0.061	− 0.17	
Mate Attracting	→	Impulsive Sexual Behavior	0.08	0.05	0.084	0.11	
Psychopathy	→	Impulsive Sexual Behavior	0.10	0.12	0.392	0.11	
Sex	→	Impulsive Sexual Behavior	0.06	0.08	0.463	0.03	
Partner Upgrading	→	Intent to Engage in Risky Sexual Behavior	0.22	0.07	0.002	0.45	
Mate Locating	→	Intent to Engage in Risky Sexual Behavior	− 0.09	0.07	0.209	− 0.11	
Mate Attracting	→	Intent to Engage in Risky Sexual Behavior	0.11	0.05	0.015	0.15	
Psychopathy	→	Intent to Engage in Risky Sexual Behavior	0.06	0.12	0.628	0.06	
Sex	→	Intent to Engage in Risky Sexual Behavior	− 0.14	0.08	0.087	− 0.08	
Goodness of fit	χ^2	**d*f***	**RMSEA**	**(90%CI)**	**SRMR**	**CFI**	**TLI**
Model 3	2872.426	1435	0.047	0.045–0.050	0.067	0.915	0.909

using the revised MEQ should seek to improve the reliability of the mate locating factor by adding additional items.

The present study also provided an additional test of concurrent validity by examining previously reported relationships between psychopathy, mating effort, and sexual risk taking. As hypothesized, results from SEM indicated that psychopathy scores were positively predictive of all three short-term mating effort factors, and negatively predictive of partner investment. The present work thus bolsters previous research showing that individuals with psychopathic traits are more likely to hold relatively unrestricted (i.e., short-term) mating orientations (Jonason et al., 2011) and to allocate more energy to short-term mating effort (Valentova et al., 2020).

Extending beyond past work, the current results notably suggest that allocating mating effort in the form of partner upgrading is positively associated with intentions for, and actual engagement in, risky and impulsive sexual behaviors—such as frequent, unprotected intercourse with unfamiliar individuals. Such behaviors are consequential, creating serious risks of contracting potentially fatal sexually transmitted infections, unwanted pregnancy, or psychological distress (e.g., Bersamin et al., 2014; Turchik & Garske, 2009), among other unfavorable outcomes. Although the MEQ was clearly not designed to directly assess risky sexual behavior, the present results suggest that the partner upgrading factor, in particular, may indicate the relative likelihood of engagement in sexual risk-taking. The revised MEQ thus holds promise as a measure that can inform more targeted risk detection measures and/or contribute to efforts for the prevention or reduction of risky sexual behaviors.

The present work also provides evidence to suggest that short-term mating effort can predict attitudes that are consistent with other forms of risky behavior, such as cosmetic surgery. Indeed, MEQ partner upgrading and mate locating, for example, were positively predictive of seeing cosmetic surgery as socially acceptable, in addition to the likelihood of considering getting a cosmetic surgery procedure in future. Like the risky sexual behaviors discussed above, cosmetic surgery holds potential for significant consequences, such as physical health complications and mental health difficulties (Schofield et al., 2002; van Soest et al., 2012). To the extent that acceptance of, and interest in, cosmetic surgery predicts engagement in future cosmetic surgery operations, the MEQ may be useful for identifying individuals at higher risk of

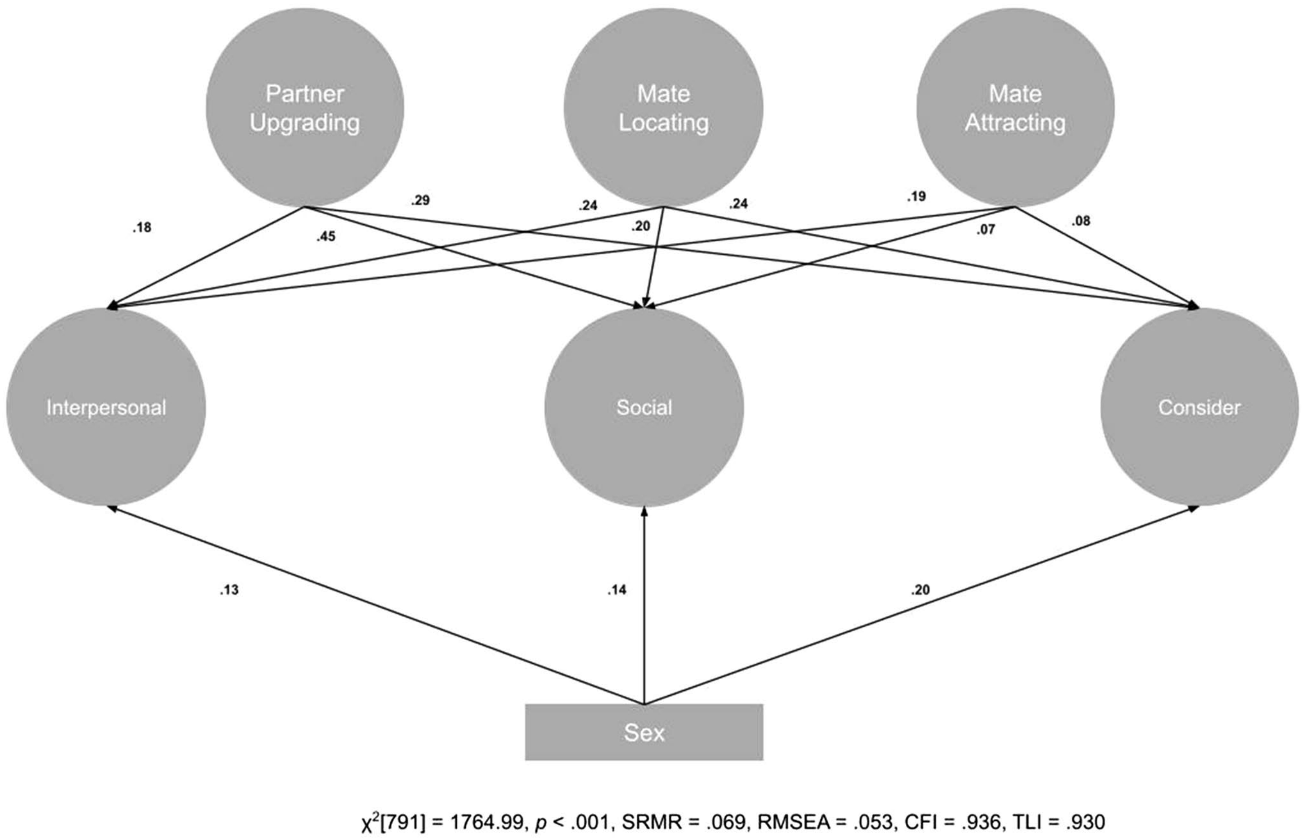

Fig. 3 Path diagram depicting the structural equation model testing the concurrent validity of the MEQ by testing if MEQ factors predict the factors of Acceptance of Cosmetic Surgery Scale controlling for sex. Regression coefficients are standardized

Table 7 Goodness-of-fit statistics for standardized and unstandardized regression coefficients for Model 4

			b	**SE**	***p***	***β***	
Partner Upgrading	→	Interpersonal	0.13	0.04	0.004	0.18	
Mate Locating	→	Interpersonal	0.27	0.10	0.005	0.24	
Mate Attracting	→	Interpersonal	0.20	0.07	0.002	0.19	
Sex	→	Interpersonal	0.35	0.12	0.003	0.13	
Partner Upgrading	→	Social	0.42	0.05	< .001	0.45	
Mate Locating	→	Social	0.29	0.11	0.010	0.20	
Mate Attracting	→	Social	0.10	0.08	0.220	0.07	
Sex	→	Social	0.51	0.14	< .001	0.14	
Partner Upgrading	→	Consider	0.26	0.06	< .001	0.29	
Mate Locating	→	Consider	0.34	0.12	0.005	0.24	
Mate Attracting	→	Consider	0.11	0.08	0.183	0.08	
Sex	→	Consider	0.73	0.15	< .001	0.21	
Goodness of fit	χ^2	**d*f***	**RMSEA**	**(90%CI)**	**SRMR**	**CFI**	**TLI**
Model 4	1764.99	791	0.053	0.049–0.056	0.069	0.936	0.93

such behaviors. Future work using longitudinal designs will be useful to further elucidate the links between mating effort, risky sexual behaviors, and risky appearance enhancement efforts.

Limitations

This study had several limitations that can serve as the starting point for future studies. First, we relied on self-reported measures for our tests of validity, and as a result, error can be introduced during the retrieval processes involved with respondents' memory and with self-presentation bias. Second, recent research has highlighted that inattentive responding can negatively affect data quality (e.g., Fleischer et al., 2015). Although we recruited MTurk workers with a 95% approval rating, in future investigations it will be important to supplement online samples with laboratory samples. We did not set out to test the discriminant validity of the revised MEQ. In future investigations, we will evaluate the discriminant validity of the MEQ by comparing the factors of the MEQ with similar but distinct measures of mating effort, including mate retention (Buss et al., 2008) and sociosexuality (Penke & Asendorpf, 2008). However, in our previous investigation evaluating the validity of the original MEQ, we found that its factors were related to, but independent from, these facets.

Participants for the present study were drawn predominantly from a "WEIRD" (Western, educated, industrialized, rich, and democratic) population (Henrich et al., 2010). Although our sample was drawn from individuals living in the USA, using MTurk enabled us to obtain a more diverse sample than what is often reported in studies measuring individual differences in mating strategies (e.g., Sabini & Green, 2004), which largely rely on a convenience sample of undergraduate students. Nevertheless, future work in diverse populations will be important to determine the utility of the revised MEQ with other demographic groups.

Future investigations could also seek to further establish the concurrent and discriminant validity of the MEQ factors with respondents' behavior. For example, we would expect that respondents who score high on the short-term mating effort factors would demonstrate higher levels of discounting consequences in favor of immediate short-term gain. This could be measured using a modified Balloon Analog Risk Task (BART; Lawyer, 2013). We would expect that individuals who score high on aspects of short-term mating effort would take more risks during the BART. Individuals discounting future consequences in favor of immediate rewards are related to their executive function. Therefore, future investigations should assess participants' executive function to evaluate whether those who show difficulty inhibiting immediate gratification despite future consequences report higher levels of short-term mating effort.

Regarding the construct validity of the scale, future investigations may benefit by including partner upgrading items that assess efforts to attract and locate mates while partnered, given that the current partner upgrading items assess efforts to attract but not locate higher value mates. Beyond partner upgrading, we are recommending future work include items capturing pluralistic mating for reasons other than partner upgrading (Buss, 2019).

Future studies that utilize this scale for studying populations that are not industrialized young adults will likely need to modify the scale. In particular, culture-specific updates should focus on mate locating items that do not center on the usage of online dating items. These items include content related to Internet access and smart devices and may therefore be utilized differentially across life stages or cultures. For instance, among the Tsimane, a relatively isolated indigenous population in the Bolivian Amazon who largely do not use smartphones, visiting other villages is a primary means of locating mates (Miner et al., 2014).

Group mean differences on an item do not necessarily imply it is a biased indicator of its latent construct; moreover, partial invariance is often sufficient for group comparisons based on latent variable models (Wang et al., 2018) and culture-specific items often yield important information about how latent psychological differences manifest in certain contexts. However, responses to two of the three mate locating items are not likely to vary much in groups without internet access, which likely precludes measurement of their construct if additional items are not added. Ultimately, attempting to identify universal strategies individuals use to locate mates in order to generate items with contents that are not population-specific is important, partly because a mix of universal and culture-specific item contents can help researchers better elucidate the role of evolved psychological mechanisms across societies.

Strengths of the Current Investigation

Strengths of the current study include the revision of an existing mating effort measure by adding additional items to create mate attracting and mate locating factors as well as adding items to the partner investment factor. An additional strength of the current investigation was the use of measurement invariance and population heterogeneity testing to ensure sex differences are not compromised by item bias. We found metric and partial scalar and strict invariance, indicating that our scale measured the same latent constructs between the sexes. Tests of measurement invariance and population heterogeneity are rarely done on individual difference measures in evolutionary psychology (cf. Wang et al., 2018). This is concerning because evolutionary psychology studies frequently involve comparison of subgroups, such as the sexes. When measurement invariance is absent, inferences about group differences regarding latent variables of interest are inappropriate because observed differences may stem from measurement bias, yet few studies have tested for measurement invariance and population heterogeneity. We hope that by drawing attention to these issues that we will encourage other researchers studying sexual attitudes and behavior to report tests of measurement invariance and population heterogeneity. This will increase the probability that findings using these measures can be replicated.

Conclusions

Based on our results, it appears that the revised MEQ is a valid measure of mating effort. This is one of few studies within the domain of mating psychology to report the confirmation of the factor structure of a measure and tests of measurement invariance and population heterogeneity within the same research report. We show that short-term mating effort serves as a good predictor of sexual risk taking, making it a useful measure for sexual health studies.

Appendix

1. If someone is more physically attractive than my romantic partner, I will begin trying to attract that person to form a new romantic relationship, while I am still in my current one. (PU).

2. If I think I have a good chance of attracting a person who is or will be wealthier than my current romantic partner, I will begin trying to attract that person to form a new romantic relationship, while I am still in my current one. (PU).

3. If someone I am attracted to is more willing than my partner to go to fun events (e.g., concerts, comedy shows) with me, I would consider leaving my partner for that person. (PU).

4. I will have sex with someone I am romantically interested in, not long after meeting them in order to secure them as my romantic partner. (PU)

5. If my partner seems uninteresting compared to someone else that I am acquainted with, I may consider leaving my partner for that person. (PU).

6. If I feel that the relationship that I am in will not last, I begin to look for potential romantic partners even while I am still in the current relationship. (PU).

7. When I am single and looking to meet someone, I would consider online dating and matchmaking sites (e.g., Match, OkCupid, eharmony, Plenty of Fish, etc.). (ML).

8. When I am single, I would consider using matchmaking apps (e.g., Hinge, Bumble). (ML).

9. When I am single, I would consider joining clubs and organizations so that I can meet attractive women. (ML).

10. When my partner is sick, I do more than most people my age and sex would do to care for their partner. (PI).

11. When my partner is in crisis (e.g., grieving over the death of a friend or relative) I do more than most people would to care for her. (PI).

12. When I am in a relationship, it is important that my partner feels like we have an exciting sex life. (PI).

13. When I am single, I compliment women on their appearance. (MA).

14. When I am single, I compliment women on their personality. (MA).

15. When I am single, I compliment women on their intelligence. (MA).

16. When I am single, I compliment women on their sense of style. (MA).

17. When I am single, I compliment women on their kindness. (MA).

18. When I am single, I try and appear extra attractive. (MA).

19. When I am single, I wear nice clothes. (MA).

20.When I am single, I focus on getting in shape. (MA).

21. When I am in a relationship, I cook for my partner. (PI).

22. When I am in a relationship, I buy my partner expensive gifts. (PI).

23. When I am in a relationship, I take on more responsibility when my partner is under stress. (PI).

24. When I am in a relationship, I comfort my partner when she is distressed. (PI).

25. When I am in a relationship, I try and help my partner solve her problems. (PI).

26. When I am in a relationship, I work on forming a relationship with her parents. (PI).

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All studies were approved by Boston University in accordance with the Declaration of Helsinki for the ethical treatment of human subjects. Participants provided informed consent prior to beginning the studies.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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