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ORIGINAL PAPER

The Development and Psychometric Evaluation of a New Mating Effort Questionnaire

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Abstract

In this study, we review the psychometric literature on mating effort and find that extant instruments (1) have not been adequately evaluated in terms of internal structure and measurement invariance, and (2) disproportionately focus on mate retention and intrasexual competition tactics designed to repel competitors, relative to attraction and investment effort. To address these gaps in the literature, we carried out two studies to develop and validate a new Mating Effort Questionnaire (MEQ). In Study 1, we report a pilot study in which participants' responses to an item pool were submitted to exploratory factor analysis. In Study 2, we replicated the structure found in Study 1 using confirmatory factor analysis in an independent sample. A three-factor solution yielded the best fit. The three factors reflected respondents' allocation of energy to attracting high mate value partners when already mated, seeking out romantic partners when single, and investing in their current romantic partner and relationships. Strong partial measurement invariance held across the sexes, implying that observed scores may be used to compare them. We also found evidence of concurrent validity via associations between the MEQ and constructs such as sociosexual orientation, K-factor, mate retention behaviors, and respondents' sexual behavior. These findings suggest that the MEQ is a valid and novel measure of individual differences in mating effort which is well suited to complement existing mating effort measures.

Keywords Life history · Human mating · Measurement · Mating effort

Introduction

Reproductive strategies are adaptive programs that function to promote reproductive success (Gangestad & Simpson, 2000). Investments in reproductive strategies can be subdivided into energy allocated toward (1) current mates, (2) offspring, and (3) seeking new mating opportunities (Marlowe, 1999; Rowe, Vazsonyi, & Figueredo, 1997). Mating effort, which subsumes effort allocated toward (1) and (3), can be further subdivided into various domains such as allocation of energy to casual sex (e.g., Gangestad & Simpson, 1990; Jackson & Kirkpatrick, 2007; Penke & Asendorpf, 2008), intrasexual competition for access to mates (Buunk & Fisher, 2009), mate switching (reviewed in Buss, Goetz, Duntley, Asao, & Conroy-Beam, 2017), mate retention (Buss, Shackelford, & McKibbin, 2008), and mate poaching (i.e., attempts to mate with those who already have romantic partners; Arnocky, Sunderani, & Vaillancourt, 2013; Schmitt & Buss, 2001). Mating effort is likely to be fundamentally, and perhaps reciprocally, related to mating outcomes. A lack of mating effort may lead to an individual being unmated, for instance, or individuals' mating effort may be in part motivated by the emotional distress stemming from involuntary single-hood, the experience of desiring to be in a relationship but being unable to form one (Apostolou, Papadopoulou, & Georgiadou, 2019; Apostolou, Shialos, Kyrou, Demetriou, & Papamichael, 2018). Despite substantive interest in mating strategies (e.g., Buss and Schmitt's [1993] seminal paper on sexual strategies theory, for instance, had been cited over 4000 times when this article was in preparation), relatively few psychometric measures of mating effort have been developed and fewer still have been subjected to robust psychometric

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evaluation (see Table 1 for a catalogue of known mating effort domains). These are important gaps in the literature because robust psychometric evaluation, including assessment of convergence among multiple measures of similar theoretical constructs, is crucial for establishing construct validity.

To address these gaps, we briefly review the psychometrics of extant mating effort instruments and then describe the development and initial validation of a new measure of mating effort—the Mating Effort Questionnaire (the MEQ). This new measure assesses facets of mating effort that are not covered by, or are underrepresented in, previous measures. Ultimately, a more comprehensive suite of measures of mating effort, and its constituent factors, may be used to address new research questions as well as evaluate convergent validity among theoretically similar concepts.

Psychometrics of Current Mating Effort Measures

Item Content

We began this project by reviewing the literature to identify scales that measure aspects of mating effort. We identified the Rowe et al. (1997) and Kruger (2017) mating effort scales as instruments explicitly designed to assess mating effort. We also reviewed scales that measured facets of mating effort such as short-term mating orientation (Jackson & Kirkpatrick, 2007; Penke & Asendorpf, 2008) and mate retention (Buss et al., 2008). Through face inspection of the item content of the Rowe et al. Mating Effort Scale (MES), we concluded that it measures respondents' adherence to a short-term mating strategy, willingness to pursue a pluralistic mating strategy including extra-pair mating, tendency to poach others' romantic partners, willingness to engage in mate guarding tactics, and self-perceived mate value. Inspecting the item content of Kruger's mating effort scale revealed that, like the MES, it contains items measuring respondents' adherence to a short-term mating strategy, willingness to engage in mate poaching, and self-perceived attractiveness. Kruger's scale also contains an item assessing costly signaling.

Both the Sociosexual Orientation Inventory Revised (SOI-R) and the Short-term Mating Orientation, Long-term Mating Orientation (hereafter, STMO/LTMO; Jackson & Kirkpatrick, 2007) scales measure individuals' sexual behavior and attitudes toward, or perceived likelihood of engaging in, uncommitted sexual relationships. Unlike the SOI-R, the STMO/LTMO also measures the extent to which individuals value the formation of long-term committed romantic relationships. Unlike the STMO/LTMO, the SOI-R also measures the extent to which individuals fantasize about and experience arousal associated with someone to whom they are not committed. The Mate Retention Inventory Short Form (MRI-SF; Buss et al., 2008) measures efforts to prevent partner defection (e.g., inflicting cost and provisioning benefits to the romantic partner), one subcategory of mating effort. The Mating Effort Instrument (MEI; Apostolou et al., 2018) is a brief measure of respondents' attitudes toward forming a long-term relationship. Finally, the Anonymous Romantic Attraction Survey (ARAS) measures mate poaching tactics as well as general efforts to attract mates (Schmitt & Buss, 2001), while the Components of Self-Perceived Mate Value (CSPMV; Fisher, Cox, Bennett, & Gavric, 2008) instrument measures self-perceived short-term mate value.

As presented in Table 1, the content overlap among mating effort instruments is sparse. Among instruments assessing resources allocated to new mates, four measure attitudes toward casual sex or endorsement of a short-term mating orientation, three assess poaching, and three assess perceived short-term mate value. Only a single measure taps into valuing looks instead of long-term potential, and the same is true for costly signaling. No extant instruments appear to measure partner upgrading (i.e., investment in attracting other individuals who are perceived to be of higher mate value than their current romantic partner; Buss et al., 2017; Greiling & Buss, 2000).

Partner upgrading is not subsumed by constructs such as mate poaching or infidelity because individuals may leave a partner for one of higher mate value without cheating or poaching. The Investment Model (Rusbult, 1983) contends that individuals' decisions to continue or defect from a relationship are reflective of a cost–benefit analysis, in which the costs and benefits derived from the current relationship are weighted against the potential benefits provided from alternatives who could fill the role (Rusbult, 1980, 1983; Rusbult & Buunk, 1993). These actions involve energy expenditure by the individual who is deciding to upgrade partners and thus can be conceptualized within a life history framework as investments in the domain of mating effort (Marlowe, 1999; Rowe et al., 1997). Thus, additional measure development work is needed to capture this facet of mating effort.

Although the MES contains an item that focuses on measuring respondents' willingness to engage in extra-pair mating, it does not highlight a reason why the respondent should start an additional relationship. An individual's mate value refers to the extent to which he/she possesses traits, linked to genetic fitness, that are perceived by the opposite sex as desirable because they signal the individual's ability to produce and rear fit offspring, enhancing the reproductive success of the selecting individual (Sugiyama, 2015). The time and energy available for investment in any one mate and shared offspring is finite. Therefore, individuals should only seek to divert energy away from their current relationships when the benefit of doing so exceeds the cost of the increased energy expended toward mating.

Like partner upgrading, no extant instruments appear to measure mate seeking efforts. Furthermore, although at least two instruments assess most aspects of investment in current partner retention, only one scale assesses partner investment/provisioning. We also observed that only one mating effort

Table 1 Mating effort domains

Domain of effort	Sub-domain of effort	ARAS (Schmitt & Buss, 2001)	FDMR (Buunk & Fisher, 2009)	ME (Kruger, 2017)	MES (Rowe et al., 1997)	STMO/LTMO (Jackson & Kirkpatrick, 2007)	SOI-R (Penke & Asendorpf, 2008)	Mating effort instrument (MEI) (Apostolou et al., 2018)	Mate retention (Buss et al., 2008)	CSPMV (Fisher & Cox, 2011)	MEQ (Albert et al.)
New mates	Poaching	•		•	•						
	Casual sex/ STMO										
	Desire				•		•				
	Attitudes			•	•	•	•				
	Behavior	•				•	•				
	Infidelity				•						
	Mate seeking										•
	Upgrading										•
	Costly signaling			•							
	Short-term mate value			•	•					•	
	Valuing looks instead of long-term potential				•						
Mate retention	LTMO					•	•	•			
	Guarding				•				•		
	Investment/provisioning								•		•
	Competitor derogation		•						•		
	Self-promotion		•						•		
	Competitor manipulation		•						•		
	Mate manipulation								•		
	Other								•		

The Albert et al. row reflects the dimensions that the MEQ is expected to cover

scale assesses mate manipulation. Overall, items with content related to investment in partner upgrading, mate seeking, and partner investment appear absent or underrepresented in psychometric research on mating effort. As such, additional measure development efforts in these areas are needed to capitalize on evolutionary theorizing. Therefore, we sought to develop a measure of mating effort that could complement existing measures focused on components related to intrasexual competition (Buunk & Fisher, 2009), mate retention (Buss et al., 2008), and short-term mating behavior (Penke & Asendorpf, 2008; Rowe et al., 1997; Simpson & Gangestad, 1991).

Internal Structure

Above, we highlighted the need for additional instruments that (1) capture content domains not well represented in current mating effort instruments, and (2) facilitate evaluations of construct validity. In addition to this, more studies of the internal structures of measures that tap domains of mating effort are needed. For instance, to the best of our knowledge the factor structure of the MES (Rowe et al., 1997) has not been tested with either exploratory or confirmatory factor analysis. Rather, prior research has assumed the MES is unidimensional (e.g., Charles & Egan, 2005). This may seem like a reasonable assumption, but mating effort is part of a complex multidimensional process (or processes). Individuals can vary in the amount of energy that they allocate to each stage of the mating process, from locating mates when single (Penke & Asendorpf, 2008), to engaging in tactics to attract mates once they have been located (Kruger, 2017; Rowe et al., 1997), to retaining (Buss et al., 2008) and investing in them once mated (Jackson & Kirkpatrick, 2007; Kruger, 2017). For example, someone who allocates a great deal of resources to locating a mate when he/she is single may not necessarily invest a great deal of energy into maintaining a relationship when pair bonded. Instruments that conceptualize mating effort as a single factor may fail to capture important variation within a broader multidimensional construct. Given this possibility, additional research is needed to determine the dimensionality of mating effort.

Measurement Invariance

Measurement invariance 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, Chen, Dai, & Richardson, 2018). When measurement invariance is absent, inferences about group differences regarding latent variables of interest are inappropriate because observed differences may stem from measurement bias (for a beginner's guide to measurement invariance in evolutionary psychology, see Wang et al., 2018). Because one of the key areas of study in evolutionary psychology is sex differences, tests of measurement invariance are especially crucial in this field. Relevant to the current study, Wang et al. conducted a systematic review of the uptake of measurement invariance testing in evolutionary psychology and found that few studies had tested measures of reproductive strategy for invariance. For instance, the Sociosexual Orientation Inventory (SOI; Simpson & Gangestad, 1991) might be the most popular measure of reproductive psychology and behavior; however, Wang et al. found that only three studies had tested the SOI for measurement invariance.

Current Study

The objective of the current study was to develop a short mating effort measure with item content that is not yet well represented in existing instruments, which could be used in combination with extant instruments to produce an extensive assessment of individuals' mating strategies. The purpose of Study 1 was to develop a short instrument measuring variation in partner upgrading, mate seeking, and partner investment efforts—the MEQ. Study 1 explored the internal structure of the MEQ. In Study 2A, we confirmed the results of Study 1 in an independent sample, evaluated whether the MEQ measured the same underlying constructs between the sexes (i.e., tested for measurement invariance), and assessed subscale reliability. We proceeded to evaluate the concurrent validity of the MEQ via its associations with the Mini-K, sociosexuality, mate retention behaviors, and proxies of reproductive success (Study 2B).

Study 1: Exploring the Structure of the Mating Effort Questionnaire

Method

Participants

Participants were recruited via Amazon's Mechanical Turk. Previous investigations have demonstrated that online studies using crowd sourcing platforms, such as MTurk, produce findings consistent with those conducted in laboratory settings (e.g., Casler, Bickel, & Hackett, 2013). The questionnaire was programmed in Qualtrics and administered via Amazon Mechanical Turk. As part of a larger study on mating behavior, participants completed the demographics and lifestyle questionnaire as well as the MEQ. Participants were remunerated with $2.00 USD for completing the survey package. The study and all materials were approved by the Boston University Institutional Review Board.

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, 341 individuals completed the questionnaire. All repeated IP addresses were excluded

from analysis, resulting in the removal of 20 cases. We restricted the sample to those identifying as heterosexual, resulting in the exclusion of 50 additional respondents (35 females and 15 males) because we were unsure if individuals with a non-heterosexual orientation would respond to the items of the Mating Effort Questionnaire in the same way as heterosexual individuals and there were too few of the former to test for measurement equivalence. To determine sexual orientation, participants indicated whether they were primarily attracted to men, women, or both sexes by selecting from one of four response options (1 = men, 2 = women, 3 = both, 4 = prefer not to answer). This was cross-referenced with participants self-reported sex to determine their sexual orientation. After these procedures, data from 271 individuals (134 males and 137 females) were available for analysis. The ethnic composition of the sample was as follows: Caucasian (70.5%), South East Asian (10.3%), Black (7.3%), Asian (6.5%), Latin American (3.8%), Aboriginal (< 1%), Arab/West Asian (< 1%), and multiple ethnicities (3.7%). Women were aged 19–72 (M_{age} = 36.96, SD = 11.09), while men were aged 19–73 (M_{age} = 35.29, SD = 10.61). The respondents were recruited from the following countries: The U.S. (76.1%), India (15.4%), and another 21 countries all of which contributed less than 1% of the cases.[1] Approximately 81% of respondents indicated being in a long-term committed romantic relationship.

Measures

Demographic and Lifestyle Questionnaire We administered a survey to ascertain sex, age, ethnicity, relationship status, and sexual orientation. Participants reported whether they had 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 Mating Effort Questionnaire After conducting a literature review to identify the content domains the new scale would assess, we generated 21 items using logical partitioning, used our content expertise on mating effort to evaluate them, and then tested their dimensionality. Based on the extant literature, we predicted that our scale items would reflect three first-order factors subsuming: (1) effort allocated to investing in the current mate(s), (2) effort allocated to upgrading mates, and (3) effort allocated to seeking out mates when single. Approximately equal numbers of items were generated for each of the hypothesized factors of partner upgrading, mate seeking, and partner investment. Participants responded using 7-point Likert-type items (1 = strongly disagree to 7 = strongly agree), with some items reversed scored.

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 for the 21 items ranged from 0.87 (Item 7) to − 1.27 (Item 6), indicating that the item distributions were relatively normal. Across all 21 items, the prevalence of missing data did not exceed five percent. 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 statistic of ($\chi^2[21] = 46.80$, $p < .001$). These outliers were excluded, leaving 264 cases.

Exploratory Factor Analysis (EFA) We conducted EFAs to analyze the underlying factor structure of the Mating Effort Questionnaire using the *psych* package in R (Revelle, 2018). EFA analyses 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 ($\chi^2[210] = 2279.43$, $p < .001$), and the KMO test indicated sampling adequacy (MSA = 0.86).

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, Browne, & Sugawara, 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 nonsignificant 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 21 items were submitted to the EFA. A parallel analysis criterion recommended four factors, whereas the scree plot and Kaiser's criterion recommended two factors. We elected to

[1] The countries that these respondents were from: Bangladesh, Bulgaria, Canada, Ecuador, Germany, Hong Kong, Indonesia, Italy, Jamaica, Kenya, Latvia, Mexico, Nicaragua, Poland, Portugal, Romania, Sweden, The Dominican Republic, The Phillipines, The Republic of Lithuania, and Venezuela.

test a three-factor model in addition to the two- and four-factor model. As discussed in the Introduction, we conceptualized the MEQ as measuring three distinct factors relating to allocating energy toward: seeking out higher mate value partners when already mated, investment in current mates, and locating prospective mates when single. We tested the two-factor model. Two models were evaluated, and three items had cross-loadings equal to or greater than ± 0.30. These three items were dropped because we intended to develop scales that could be summed. The two-factor model, which accounted for 43% of the variance, did not fit the data well. The χ^2 test was significant, and all fit indices were outside acceptable cutoff values.

Next, we tested the four-factor model. Two models were tested, and four items were dropped for having salient cross-loadings (equal to or greater than ± 0.30). The four-factor model fit the data well; however, the fourth factor only subsumed two items, both of which were negatively worded (Table S2, Items 15 and 17) and only explained five percent of the variance. Inspection of item contents for Items 15 and 17 revealed that they likely reflected a method factor given they were both negatively worded, rather than a theoretically meaningful dimension of mating effort. The four factors accounted for 48% of the explained variance.

We tested the three-factor model because of our theoretical rational described in the Introduction and because of the substantive problems with the four-factor solution identified above. In total, three EFAs were tested and seven items were dropped. Two additional items were removed because they did not load onto any factor. The three-factor solution explained 51% of the variance. Factor 1 accounted for 24% of the explained variance, included six items, and measured energy allocated toward seeking out a partner of higher mate value when they were already in a relationship (i.e., partner upgrading). Factor 2 accounted for 14% of the explained variance, included three items, and measured effort allocated to seeking out romantic partners when they were single (i.e., mate seeking). Factor 3 accounted for 12% of the explained variance, included three items, and measured energy allocated to investing in current romantic partners (i.e., partner investment). See Table 2 for goodness-of-fit statistics for the three-factor EFA and the factor loadings of the three-factor model. Please refer to Supplement 1, Table S2 for the goodness-of-fit statistics and the factor loadings for the remaining models. In Study 2A, we sought to confirm the factor structure of the reduced MEQ using an independent sample.

Study 2A: Confirming and Validating the Structure of the Mating Effort Questionnaire

The primary purposes of study 2A were to: (1) confirm the structure of the MEQ found in Study 1, (2) evaluate if the scale measures the same underlying constructs between men and women by conducting tests for measurement invariance and population heterogeneity using multiple group CFA (MGCFA), and (3) evaluate scale reliability.

Methods

Participants

Participant recruitment and questionnaire programming and administration were the same as in Study 1. Participants were remunerated with $1.50 USD for completing the questionnaire. The study and all materials were approved by the Boston University Institutional Review Board. In total, 428 individuals completed the questionnaire. All repeated IP addresses were excluded from analysis, resulting in the exclusion of 17 cases. Additionally, we excluded all individuals who did not report a heterosexual orientation ($n = 44$, females = 30, males = 14) for the same reasons as in Study 1. The method for determining sexual orientation was the same as in Study 1.

Data from 367 participants (186 males and 181 females) were analyzed. The ethnic composition of the sample was as follows: Caucasian (60.5%), South Asian (22.4%), Asian (7.1%), Black (6.0%), Latin American (2.8%), Aboriginal (< 1%), Arab/West Asian (< 1%), South East Asian (< 1%), and multiple ethnicities (4.1%). Women were aged 19–70 ($M_{age} = 39.13$, SD = 11.38) and men were aged 21–76 ($M_{age} = 36.25$, SD = 11.57). The respondents were recruited from the following countries: The U.S. (64.6%), India (28.4%), and an additional 20 countries all of which contributed less than 1% of the cases.[2] Four cases were excluded for missing greater than five percent of the data, leaving 363 cases for analysis. Approximately 85% of respondents indicated being in a long-term committed romantic relationship.

Measures

The Study 1 demographics and lifestyle questionnaire, the MEQ, the SOI-R (Penke & Asendorpf, 2008), the MRI-SF (Buss et al., 2008), and the Mini-K (Figueredo et al., 2006) were administered in Study 2. Below, we focus our analysis on the MEQ and return to the SOI-R (Penke & Asendorpf, 2008), MRI-SF (Buss et al., 2008), and the Mini-K in Study 2B, which examines the nomological net of the MEQ.

Data Screening

We screened the data for the 363 remaining cases. Skewness values for the 12 items ranged from 0.65 (Item 7) to − 0.92 (Item 6), and kurtosis values ranged from 0.58 (Item 6) to

[2] These countries were: Bangladesh, Brazil, Canada, Ecuador, Estonia, Indonesia, Italy, Jamaica, Mexico, Nigeria, Pakistan, Poland, Romania, The Dominican Republic, The Phillipines, The UK, Trinidad and Tobago, Ukraine, and Venezuela.

Table 2 Reduced items corresponding to the three-factor model

Items	3-Factor model loadings		
	Partner upgrading	Mate seeking	Partner investment
3. If I think I have a good chance of attracting a person who is more physically attractive than my current romantic partner, I will begin trying to attract that person for the purposes of eventually starting a new relationship, while I am still in my current relationship	**0.87**	− 0.05	0.03
7. If I think I have a good chance of attracting a person who has better prospects (i.e., is likely to be wealthier than her(his) peers in the future) than my current romantic partner, I will consider trying to attract that person, for the purposes of beginning a relationship with her (him), while I am still in my current relationship	**0.81**	0.01	0.01
11. 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	**0.68**	0.06	− 0.08
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	**0.60**	0.00	0.08
9. If my partner seems uninteresting compared to someone else that I am acquainted with, I may consider leaving my partner for that person	**0.58**	0.00	0.03
1. 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	**0.53**	0.13	− 0.15
14. When I am single and looking to meet someone, I would consider online dating and matchmaking sites (e.g., match, OkCupid, E-harmony, Plenty of Fish, etc.)	− 0.06	**0.93**	0.01
18. When I am single, I would consider using matchmaking apps (e.g., Tinder, Bumble)	0.22	**0.64**	0.01
16. When I am single, I would consider joining clubs and organizations so that I can meet attractive women (men)	0.06	**0.48**	0.00
10. When my partner is sick, I do more than most people my age and sex would do to care for their partner	0.03	0.01	**0.83**
12. 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 (him)	− 0.04	− 0.04	**0.69**
8. When I am in a relationship, it is important that my partner feels like we have an exciting sex life	− 0.03	0.15	**0.49**

Goodness of fit	χ^2	df	RMSEA	90% CI	SRMR	CFI	TLI
3-Factor model	69.24	33	0.07	0.04–0.09	0.03	0.965	0.930

Goodness-of-fit statistics for the three-factor EFA reported in the pilot study are reported below

Significant factor loadings are bolded for ease of interpretation

− 1.28 (Item 1), indicating that item distributions were relatively normal. The process of data screening was the same as in Study 1. Ten multivariate outliers were detected using Mahalanobis distance statistic of ($\chi^2[14] = 29.14, p < .001$) and were excluded, leaving 353 cases. No assumptions of multivariate normality (ref., data screening) were violated.

Results

Confirmatory Factor Analysis

We specified two CFAs using the *lavaan* package in R (Rosseel, 2012), and the same estimator and fit information as in Study 1. Two three-factor CFAs were tested, one in which all error variances were uncorrelated and the other in which error variances between three pairs of items were allowed to correlate. For both three-factor models, we specified Item 8 as loading on both the partner upgrading factor and the mate seeking factor. This cross-loading was specified because we hypothesized that this item would load onto the mate seeking factor in our EFA; however, it loaded onto the partner upgrading factor.

First, we tested the three-factor solution in which all measurement error was random (Model 1). Although the χ^2 test was significant, suggesting that the model did not fit the data exactly, the remaining fit indices either reached or approached their specified cutoff values (Table 3). The magnitudes of the standardized factor loadings ranged between 0.24 and 0.95, and that of the unstandardized factor loadings ranged between 0.24 and 1.14 (see Supplement Table S3). The factor covariances were all significant and in the expected directions: partner upgrading–mate seeking = 0.24, partner upgrading–partner investment = − 0.14, mate seeking–partner investment = 0.25 (all *ps* ≤ .024). Please see Figure S1 in the Supplement for path diagrams of the three-factor CFA.

Table 3 Unstandardized and standardized factor loadings, standard errors, significance values, and R^2 values for Model 2 (i.e., three-factor solution with correlated residuals) and goodness-of-fit indices for Model 1 and Model 2

Item	Factor	*b*	SE	*p*	*β*	R^2
1	Partner upgrading	1.00			0.71	.50
3	Partner upgrading	1.03	0.08	< .001	0.80	.64
5	Partner upgrading	1.11	0.08	< .001	0.88	.78
6	Partner upgrading	0.78	0.08	< .001	0.56	.43
7	Partner upgrading	0.99	0.08	< .001	0.74	.55
10	Partner upgrading	0.98	0.07	< .001	0.78	.61
8	Mate seeking	1.00			0.95	.90
6	Mate seeking	0.23	0.05	< .001	0.22	.43
2	Mate seeking	0.89	0.05	< .001	0.87	.75
12	Mate seeking	0.54	0.05	< .001	0.56	.31
11	Partner investment	1.00			0.86	.73
9	Partner investment	0.98	0.08	< .001	0.88	.77
4	Partner investment	0.56	0.06	< .001	0.50	.25

Model	χ^2	df	χ^2 diff	RMSEA	90% CI	SRMR	CFI	TLI
1	168.00	50		0.08	0.07–0.10	0.07	0.946	0.929
2	101.63	47	66.37***	0.06	0.04–0.07	0.07	0.975	0.965

***Significant chi-square difference test $p < .001$

Next, we examined modification indices (MIs) to identify any sources of strain. We found relatively large MIs (> 20) suggesting that freeing the error variances between Items 9 and 12 (MI = 50.02), Items 5 and 7 (MI = 37.33), and Items 7 and 9 (MI = 27.35) would result in significant improvement in fit. We specified covariances between the error variances of the above item pairs in order 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). We tested the re-specified model (Model 2) and 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 (Table 3). We conducted a χ^2 difference test and found that Model 2 fit significantly better than Model 1 (Table 3). As shown in Table 3, the magnitudes of the unstandardized factor loadings ranged between 0.23 and 1.11 and those of the standardized factor loadings were between 0.22 and 0.95. The factor covariances were as follows: partner upgrading–mate seeking = 0.24, partner upgrading–partner investment = − 0.13, mate seeking–partner investment = 0.25 (all *ps* ≤.036). Although the covariances among the factors were significant, they were relatively small, suggesting that a higher-order factor is implausible and that the items should not be summed or averaged to construct a total score. Please see Fig. 1 for the path diagrams of the three-factor CFA with correlated residual variances.

Measurement Invariance and Population Heterogeneity 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., $p < .05$) and assessed model parameter constraints for sources of strain when fit decreased significantly.

Initially, we specified separate CFAs for men ($n = 178$) and women ($n = 175$). We found that the models for each sex fit the data well (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 (Table 4), demonstrating configural 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 ($\Delta\chi^2[10] = 11.45$, $p = .32$). Furthermore, the item intercepts were invariant between the two groups ($\Delta\chi^2[9] = 11.24$, $p = .26$). However, constraining the item residuals to equality did result in significant degradation in model fit ($\Delta\chi^2[12] = 22.22$, $p < .04$). Therefore, we analyzed the parameter constraints to identify non-invariant item residuals. Based on our inspection of the expected parameter change (EPCs), we elected to free the residual of Item 12 of the partner upgrading factor (EPC = 0.46). The partial equal item residuals model fit the data well and did not result in significant degradation in model fit from the equal

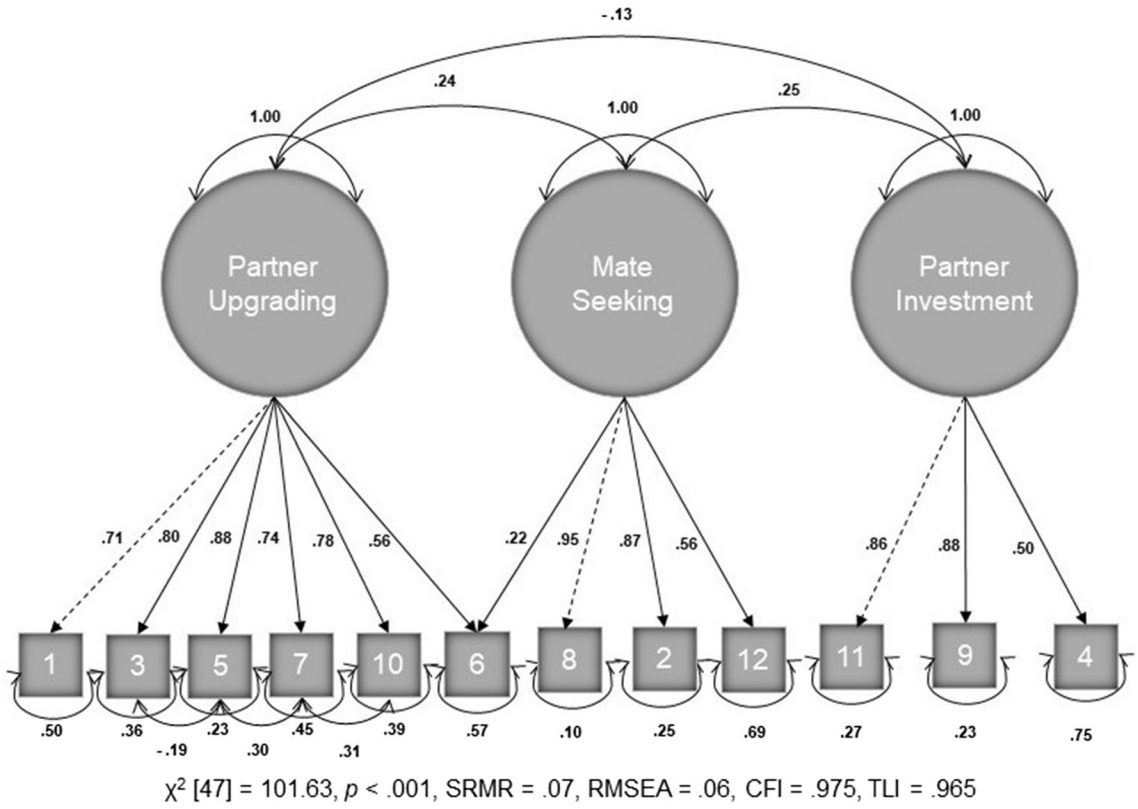

Fig. 1 Path diagram depicting the three-factor solution of the MEQ with correlated item residuals, Model 2. Note that the item loadings and residuals are standardized

Table 4 Goodness-of-fit indices for the multiple group confirmatory factor analysis of the MEQ testing the scale's measurement invariance and population heterogeneity

	χ^2	df	χ^2 diff	Δdf	CFI	RMSEA	ΔCFI	ΔRMSEA
Single group solutions								
Men ($n = 178$)	60.86	47			0.987	0.04		
Women ($n = 175$)	112.88 ***	47			0.943	0.09		
Measurement invariance								
Equal form	173.76 ***	94			0.964	0.07		
Equal item loadings	185.21 ***	104	11.45	10	0.963	0.07	< 0.001	0.002
Equal item intercepts	196.44 ***	113	11.24	9	0.962	0.07	0.001	0.002
Equal item residual variances	218.67 ***	125	22.22*	12	0.958	0.07	0.004	< 0.001
Partial equal item residual variances (freed equality constraints for Item 12)	211.78 ***	124	15.33	11	0.960	0.06	0.002	0.002
Partial equal item residual covariances	244.75 ***	127	32.98***	3	0.947	0.07	0.013	0.009
Partial equal item residual covariances (residual covariances between Items 3 and 5 freed)	213.32***	126	1.54	2	0.960	0.06	0.013	0.009
Population heterogeneity								
Partial equal latent variances	214.46***	129	1.15	3	0.961	0.06	0.001	0.002
Partial equal latent covariance	220.62***	132	6.16	3	0.960	0.06	0.001	0.001
Partial equal latent means	240.44***	135	19.83***	3	0.952	0.07	0.008	0.005

*$p < .05$; **$p < .01$; ***$p < .001$

Table 5 Reliability coefficients ρ and α for all three factors for the entire sample as well as by sex

	Partner upgrading			Mate seeking			Partner investment		
	All	Men	Women	All	Men	Women	All	Men	Women
ρ	0.87	0.87	0.86	0.81	0.82	0.80	0.80	0.81	0.80
α	0.89	0.89	0.88	0.77	0.78	0.75	0.78	0.77	0.78

item intercepts model ($\Delta\chi^2[11] = 15.33, p = .17$). Constraining the item residual covariances resulted in significant degradation in model fit from the previous partial equal item residuals model ($\Delta\chi^2[3] = 32.98, p < .001$). Based on our inspection of the EPCs, we elected to free the residual covariance between Items 5 and 7 (EPC = 0.051). Freeing this parameter improved the fit of the model such that it no longer resulted in a significant degradation in model fit ($\Delta\chi^2[2] = 1.54, p = .46$).

Regarding population heterogeneity, imposing equality on the factor variances did not result in significant degradation in model fit from the previous model ($\Delta\chi^2[3] = 1.15, p = .77$). Moreover, constraining the latent covariances did not result in significant degradation in model fit from the previous model ($\Delta\chi^2[3] = 6.16, p = .10$). However, imposing equality on the factor means resulted in a significant degradation in model fit from the previous model, ($\Delta\chi^2[3] = 19.83, p < .001$), indicating that the latent variable means differed between the sexes. Therefore, we inspected the differences between the latent variable means in the previous model, which tested for equal factor covariances.

Inspecting the partner upgrading latent variable means revealed that the latent mean for women was 0.50 standard units lower than men's, and this difference was significant (Wald $z[1] = -4.32, p < .001$). Women's mean score for the mate seeking factor was 0.18 standard units lower than men's, which was significant (Wald $z[1] = -1.66, p = .01$). The sexes did not significantly differ on their mean factor score for partner investment (Wald $z[1] = 0.54, p = .59$), and women's mean factor score for partner investment was 0.06 standard units greater than was men's. Overall, these results suggest that the structures of men's and women's responses to MEQ items were largely equivalent, and men scored higher on partner upgrading and mate seeking.

In addition to testing if the scale was equivalent between the sexes, we also tested whether the item intercepts remained constant across respondents regardless of their age and relationship status. We also tested if the pattern of item responding was similar between individuals of the two most commonly reported ethnicities, Caucasian/White and South Asian. Overall, the MEQ measures the same constructs independent of relationship status, age, and reported ethnic background. For a detailed description of these analyses, see the Supplement. Please see Table 4 for the goodness-of-fit indices for the MGCFAs.

Scale Reliability

Next, we computed the composite reliability for the three factors using the method developed by Fornell and Larcker (1981). We elected to use this method in addition to 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). However, because Cronbach's α is so ubiquitous in psychological measurement we report it as well. All reliability coefficients were greater than 0.7, indicating acceptable reliability. Please see Table 5 for the reliability coefficients of the three factors for the entire sample, as well as the sample divided by sex, using the method by Fornell and Larcker (1981) and Cronbach's α.

Study 2B: Nomological Net of the Mating Effort Questionnaire

As a reminder, we also sought to evaluate the concurrent validity of the mating effort questionnaire. In addition to the mating effort data, we also analyzed responses to the SOI-R, the Mini-K, the MRI-SF, and questions related to sexual strategies that could serve as proxies for respondents' reproductive success. Based on prior research documenting small negative associations between Mini-K scores and mating effort facets (Figueredo, Cuthbertson, Kauffman, Weil, & Gladden, 2012; Valentova, Junior, Štěrbová, Varella, & Fisher, 2020), as well as evidence of moderate to large positive associations between SOI-R scores and mating effort facets (Kruger, 2017; Patch & Figueredo, 2017; Penke & Asendorpf, 2008), we expected that respondents who reported lower K-factor scores (which may imply lesser somatic and parental effort) and who reported a less restricted sociosexual orientation would score higher on the partner upgrading and mate seeking factors. Moreover, we expected those who had higher K-factor scores and more restricted sociosexual orientation to score higher on partner investment.

In a separate model, we assessed covariances between the factors of the MEQ and the factors of the MRI-SF. Because mate retention is one component of mating effort, we expected the factors of the MRI-SF to significantly covary with the factors of the MEQ. Based on item inspection of the MRI-SF, we expected strong positive relationships between the partner investment factor of the MEQ and the factor containing items which center on benefit provisioning mate retention. We expect that factors containing items of punishment of infidelity and commitment manipulation would be positively related to the partner upgrading factor of the MEQ as both involve the

implementation of strategies to obtain or retain the highest mate value partner regardless of social acceptability of tactics needed to obtain the desired outcome.[3]

Finally, we were interested in the extent to which MEQ factors predicted mating outcomes including total number of romantic partners, number of sex partners, number of past-year sex partners, and frequency of intercourse in the past-month. We expected that those who scored higher on the partner upgrading and mate seeking factors would also report a greater number of total and past-year sex partners. We made no predictions of how the partner investment factor would be related to reproductive outcomes. Furthermore, to correct for an inflated Type 1 error, due to multiple hypothesis testing, we employed a conservative α value of 0.005 (Benjamin et al., 2018). For all SEMs, we consider p values $\leq .005$ to be significant and interpret those $\leq .05$ as merely suggestive of a relationship and require subsequent testing (Benjamin et al., 2018).

Method

Measures

Arizona Life History Battery Short Form (Mini-K) The Mini-K is a 20-item brief report scale designed to tap into the domains of the Arizona Life History Battery (ALHB; Figueredo et al., 2006). Items were rated on a 7-point Likert-type scale, anchored at − 3 (strongly disagree) to 3 (strongly agree). The Mini-K measures the domains of (1) family social contact and support; (2) friends social contact and support; (3) altruism; (4) mother/father relationship quality; (5) insight, planning, and control; (6) intentions toward infidelity; and (7) religiosity, with two to three items measuring each construct. Based on a recent investigation by Richardson, Chen, Dai, Brubaker, and Nedelec (2017), we elected to analyze the factor structure of the Mini-K rather than assuming that the scale was unidimensional.

Mate Retention Mate retention behavior was measured using the Mate Retention Inventory Short Form (MRI-SF; Buss et al., 2008). The MRI-SF contains 38 items along which respondents indicate how often they have performed the target behavior in the past-year, using a Likert-type scale ranging from 0 = "Never" to 3 = "Often." Like the Mini-K, we elected to analyze the factor structure of the MRI-SF (Buss et al., 2008). A 35-item 5-factor solution produced the best fitting model. The five lower-order factors are described in detail in the Supplement. Briefly, the five factors of the MRI-SF appeared to measure respondents' cost-inflicting mate retention behaviors, benefit provisioning mate retention behaviors, commitment manipulation, infidelity threat and signals of possession (cf. Buss et al., 2008).

[3] A report of the EFA and CFA for the MRI-SF can be found in the supplement.

Sociosexual Orientation Participants completed the Revised Sociosexual Orientation Inventory (SOI-R; Penke & Asendorpf, 2008). High scores on this measure indicate more unrestricted sociosexuality (Penke & Asendorpf, 2008). The measure includes nine items that measure past sexual behavior (e.g., "With how many different partners have you had sex within the past 12 months?"), attitudes toward non-committal sex (e.g., "Sex without love is ok"), and desire (e.g., "How often do you have fantasies about having sex with someone you are not in a committed romantic relationship with?"). Participants responded using a 9-point Likert-type scale.[4]

Analytic Plan: Structural Equation Modeling

We specified a series of structural equation models (SEMs). In Model 3, we investigated whether aspects of respondent K-factor and sociosexuality scores would predict their levels of mating effort. The factors that were included were: the three factors of the MEQ, the five lower-order factors of the Mini-K (Figueredo et al., 2006; Richardson et al., 2017), and the two factors of the SOI-R, determined through EFA and CFA (Penke & Asendorpf, 2008).[5] Regarding the Mini-K, we confirmed that the scale was made up of five lower-order factors which we believe reflected insight planning and control, emotional closeness, family support, friend support, and community involvement. In line with previous research (Penke & Asendorpf, 2008), CFAs that we specified for the SOI-R items demonstrated that the scale was made up of three lower-order factors: sociosexual attitude, desire, and behavior. Additionally, we specified a separate SEM to investigate factor covariances among the MEQ and MRI-SF factors (Model 4). The factors included in the model were the three factors of the MEQ and the four factors from the MRI-SF. Finally, we specified separate SEM (Model 5) to investigate whether the factors of the MEQ predicted age at first sexual intercourse, adjusted number of lifetime sex and romantic partners, number of past-year sex partners, and frequency of intercourse in the past-month (controlling for relationship status).

Test of Concurrent Validity with Aspects of Life History and Sociosexuality

Data Screening

The descriptive statistics for the three scales showed that the items were relatively normally distributed. Skewness values

[4] For the exploratory and confirmatory factor analysis of all scales, please see the supplement.

[5] We did not include the behavior factor of the SOI-R in these analyses because we viewed this factor as an outcome of mating effort, not a predictor of mating effort.

ranged from 2.41 (Item 1 of the SOI-R) to − 1.20 (Item 11 of the Mini-K). Three cases were missing more than five percent of the data and were excluded from analysis, leaving 364 cases. After excluding these cases, less than five percent of the data were missing in all instances and we elected to impute these missing values using the R package, *mice*. Eleven multivariate outliers were detected using Mahalanobis distance statistic of ($\chi^2[44] = 78.75, p < .001$) and excluded, leaving 353 cases. No assumptions of multivariate normality (ref., data screening) were violated.

Results

To test the concurrent validity of the MEQ, we specified a SEM in which we regressed all lower-order factors of the Mini-K and the two factors of the SOI-R onto the factors of the MEQ. This model (Model 3) had a combination of good and poor fit indices (Table 6).

Regarding the lower-order factors of the Mini-K, respondents who scored lower on the insight planning and control factor scored higher on partner upgrading ($b = -0.49, \beta = -0.26, z = -2.67$, SE = 0.18, $p = .008$) and lower on partner investment ($b = 0.73, \beta = 0.45, z = 3.90$, SE = 0.19, $p < .001$); however, the former was no longer significant after adjusting for multiple comparisons. The extent to which respondents felt supported by their friends (i.e., scored high on the friend support factor) positively predicted their partner investment ($b = 0.32, \beta = 0.39, z = 3.30$, SE = 0.10, $p < .001$), suggesting that those respondents who reported closer friendships also tended to be more investing partners. Moreover, those who reported being more involved in their community (i.e., scored higher on the community involvement factor) scored higher on partner upgrading ($b = 0.54, \beta = 0.57, z = 4.55$, SE = 0.12, $p < .001$) and lower on partner investment ($b = -0.30, \beta = -0.38, z = -2.91$, SE = 0.10, $p = .004$). For the SOI-R, sexual desire was a significant positive predictor of their levels of mate seeking ($b = 0.25, \beta = 0.26, z = 2.81$, SE = 0.09, $p = .005$) and partner upgrading ($b = 0.31, \beta = 0.44, z = 5.35$, SE = 0.06, $p < .001$). Please see Table 6 (Model 3) for the full set of standardized and unstandardized regression coefficients (Fig. 2).

Tests of Concurrent Validity Using Self-Reported Mate Retention

Data Screening

The descriptive statistics for the two scales showed that the items were relatively normally distributed. Skewness values ranged from 1.75 (Item 38 of the MRI-SF) to − 0.93 (Item 4 of the MEQ). Nine cases were missing more than 5% of the data and were excluded from analysis, leaving 358 cases. After excluding these cases, less than 5% of the data was missing in all instances and we elected to impute these missing values using the R package, *mice*. Twenty-two multivariate outliers were detected using Mahalanobis distance statistic of ($\chi^2[53] = 90.57, p < .001$) and excluded, leaving 343 cases. No assumptions of multivariate normality (ref., data screening) were violated.

Results

We tested the extent to which all three factors of the MEQ covaried with the five factors of the MRI-SF (Model 4). The model had a combination of good and poor fit indices (Table 6). Partner upgrading positively covaried with the cost-inflicting factor ($b = 0.65, \beta = 0.72, z = 8.42$, SE = 0.08, $p < .001$), whereas partner investment significantly negatively covaried with the cost-inflicting factor ($b = -0.20, \beta = -0.26, z = -4.04$, SE = 0.05, $p < .001$). The mate seeking factor positively covaried with the cost-inflicting factor ($b = 0.20, \beta = 0.16, z = 2.74$, SE = 0.07, $p = .006$); however, this relationship did not achieve statistical significance after correcting for multiple hypothesis tests (Benjamin et al., 2018). The partner investment factor significantly positively covaried with benefit provisioning ($b = 0.30, \beta = 0.49, z = 6.36$, SE = 0.05, $p < .001$). Respondents levels of partner upgrading significantly positively covaried with their levels of commitment manipulation ($b = 0.54, \beta = 0.55, z = 7.13$, SE = 0.08, $p < .001$), their tendency to punish infidelity ($b = 0.50, \beta = 0.52, z = 6.75$, SE = 0.08, $p < .001$), and their tendency to signal possession of their partner ($b = 0.57, \beta = 0.47, z = 6.29$, SE = 0.09, $p < .001$). Please see Table 6 (Model 4) for standardized and unstandardized regression coefficients (Fig. 3).

Tests of Concurrent Validity Using Proxies of Respondents Reproductive Success

Data Screening

For these analyses, we were interested in determining which factors of the MEQ were predictors of participants' sexual behavior. Therefore, prior to screening we inspected our data to ensure that all respondents who indicated having had sexual intercourse went on to report a number of lifetime sex partners greater than zero and that those who indicated having never had sexual intercourse went on to report a number of lifetime sex partners of zero. Nineteen individuals were eliminated because they did not meet these criteria, and another two individuals were eliminated as they did not indicate whether they were currently in a long-term romantic relationship, leaving 344 cases. Data screening was the same as above. Respondents' total number of romantic partners, lifetime sex partners, past-year sex partners, and frequency of sex in the past-month were not normally distributed (skewness values ranged from

Table 6 Unstandardized and standardized regression coefficients, standard errors, and *p* values for Model 3, Model 4 and Model 5

Mini-K-factor		MEQ factor	*b*	SE	*p*	*β*
Model 3						
Insight planning and control	→	Partner upgrading	− 0.49	0.18	.008	− 0.26
Emotional closeness	→	Partner upgrading	0.16	0.16	.34	0.17
Family support	→	Partner upgrading	0.02	0.06	.74	0.02
Friend support	→	Partner upgrading	− 0.21	0.11	.05	− 0.21
Community involvement	→	Partner upgrading	0.54	0.12	< .001*	0.57
Sociosexual attitude	→	Partner upgrading	0.22	0.14	.12	0.30
Sociosexual desire	→	Partner upgrading	0.31	0.06	< .001*	0.44
Insight planning and control	→	Mate seeking	0.43	0.25	.09	0.17
Emotional closeness	→	Mate seeking	− 0.04	0.22	.86	− 0.03
Family support	→	Mate seeking	0.12	0.08	.16	0.10
Friend support	→	Mate seeking	− 0.07	0.14	.62	− 0.06
Community involvement	→	Mate seeking	− 0.03	0.14	.83	− 0.03
Sociosexual attitude	→	Mate seeking	0.03	0.19	.87	0.03
Sociosexual desire	→	Mate seeking	0.25	0.09	< .01*	0.26
Insight planning and control	→	Partner investment	0.73	0.19	< .001*	0.45
Emotional closeness	→	Partner investment	− 0.16	0.16	.32	− 0.21
Family support	→	Partner investment	− 0.07	0.06	.20	− 0.10
Friend support	→	Partner investment	0.32	0.10	< .001*	0.39
Community involvement	→	Partner investment	− 0.30	0.10	< .001*	− 0.38
Sociosexual attitude	→	Partner investment	− 0.15	0.14	.26	− 0.25
Sociosexual desire	→	Partner investment	− 0.01	0.06	.94	− 0.01
MRI-SF factor		MEQ factor	*b*	SE	*p*	*β*
Model 4						
Cost inflicting	→	Partner upgrading	0.65	0.08	< .001	0.72
Cost inflicting	→	Mate seeking	0.20	0.07	.01	0.16
Cost inflicting	→	Partner investment	– 0.20	0.05	< .001	– 0.26
Benefit provisioning	→	Partner upgrading	– 0.08	0.05	.09	– 0.11
Benefit provisioning	→	Mate seeking	0.15	0.06	.02	0.15
Benefit provisioning	→	Partner investment	0.30	0.05	< .001	0.49
Commitment manipulation	→	Partner upgrading	0.54	0.08	< .001	0.55
Commitment manipulation	→	Mate seeking	0.16	0.08	.04	0.12
Commitment manipulation	→	Partner investment	– 0.05	0.05	.34	– 0.06
Punish infidelity	→	Partner upgrading	0.50	0.08	< .001	0.52
Punish infidelity	→	Mate seeking	0.12	0.08	.15	0.09
Punish infidelity	→	Partner investment	– 0.09	0.05	.07	– 0.11
Signals of possession	→	Partner upgrading	0.57	0.09	< .001	0.47
Signals of possession	→	Mate seeking	0.16	0.10	.11	0.10
Signals of possession	→	Partner investment	– 0.02	0.07	.76	– 0.02
Predictor variable		Outcome variable	*b*	SE	*p*	*β*
Model 5						
Partner investment	→	Partner number	0.02	0.02	.22	0.07
Partner upgrading	→	Partner number	0.01	0.01	.69	0.02
Mate seeking	→	Partner number	0.02	0.01	.03	0.13
Respondent age	→	Partner number	0.01	0.001	< .001	0.41
Partner investment	→	past-year sex partners	0.003	0.01	.63	0.03
Partner upgrading	→	past-year sex partners	0.02	0.01	.003*	0.16
Mate seeking	→	past-year sex partners	− 0.001	0.004	.89	− 0.01

Table 6 (continued)

Predictor variable		Outcome variable	*b*	SE	*p*	*β*
Relationship status	→	past-year sex partners	− 0.18	0.02	< .001*	− 0.48
Partner investment	→	past-month sex	0.03	0.02	.12	0.09
Partner upgrading	→	past-month sex	− 0.02	0.02	.36	− 0.05
Mate seeking	→	past-month sex	− 0.002	0.01	.87	− 0.01
Relationship status	→	past-month sex	− 0.61	0.06	< .001*	− 0.48
Partner investment	→	Lifetime sex partners	0.03	0.02	.20	0.08
Partner upgrading	→	Lifetime sex partners	0.01	0.02	.57	0.03
Mate seeking	→	Lifetime sex partners	0.02	0.01	.08	0.10
Respondent age	→	Lifetime sex partners	0.01	0.002	< .001*	0.37

		χ^2	df	RMSEA	(90% CI)	SRMR	CFI	TLI
(*n* = 353)	Model 3	1085.89	511	0.06	0.05–0.06	0.07	0.912	0.898
(*n* = 343)	Model 4	1843.37	956	0.05	0.05–0.06	0.06	0.912	0.905
(*n* = 331)	Model 5	267.20	112	0.07	0.06–0.08	0.07	0.941	0.919

Goodness-of-fit statistics for the models are above

To control for multiple hypothesis testing, we specified a conservative *p* value ≤ .005. Significant relationships are denoted with an * for ease of viewing

4.96 to 7.88) and were log10-transformed prior to analysis. The log10 transformation was effective in reducing the skewness of these four outcome variables (skewness values of the log-transformed variables ranged from 0.18 to 1.52). No cases were missing more than 5% of the data. Due to the trivial presence of missingness, we elected to replace missing values using the R package, *mice*. Thirteen multivariate outliers were detected and excluded, using Mahalanobis distance statistic of ($\chi^2[20] = 45.31$, $p < .001$), leaving 331 cases. No assumptions of multivariate normality (ref., data screening) were violated.

Results

We tested the extent to which all three factors of the MEQ predicted respondents' log-transformed number of romantic partners, and lifetime sex partners controlling for respondents age. Additionally, we tested the extent to which all three factors of the MEQ predicted log10-transformed number of past-year sex partners, and frequency of intercourse in the past-month, controlling for relationship status.

This model (Model 5) had a combination of good and poor fit statistics (Table 6). The mate seeking factor was a significant predictor of lifetime number of romantic partners ($b = 0.02$, $\beta = 0.13$, $z = 2.23$, SE = 0.01, $p = .03$), controlling for age; however, this relationship did not achieve statistical significance after correcting for multiple hypothesis tests (Benjamin et al., 2018). Additionally, those who scored higher on the partner upgrading factor reported significantly more past-year sex partners ($b = 0.02$, $\beta = 0.16$, $z = 2.98$, SE = 0.01, $p = .003$), controlling for relationship status, suggesting that those who reported being willing to leave their partner for one they perceived to have higher mate value also had more sex partners. Please see Table 6 (Model 5) for standardized and unstandardized regression coefficients (Fig. 4).

Discussion

The purpose of the current investigation was to develop a scale to measure under-explored components of mating effort which complimented existing mating effort measures. We developed the MEQ and evaluated its psychometric properties. The study of human variation in mating strategies is a central focus of researchers studying the evolution of human behavior. Although many scales have been developed to measure facets related to mating effort, few explicitly measure the construct (e.g., Fisher et al., 2008; Gangestad & Simpson, 1990; Penke & Asendorpf, 2008). To our knowledge, only two other scales have been designed which explicitly measure mating effort (Kruger, 2017; Rowe et al., 1997), and these scales primarily measure the energy individuals expend toward new mating opportunities. Both Kruger (2017) and Rowe et al. (1997) conceptualized mating effort as a unidimensional construct which focuses on an adherence to a short-term, pluralistic mating strategy. Importantly, none of the mating effort scales we reviewed contain items designed to assess partner upgrading and mate seeking and only the Buss et al. (2008) MRI-SF assesses investment in current partners. In the current study, therefore, we sought to develop a multidimensional measure of mating effort which compliments extant measures by focusing on partner upgrading, mate seeking, and partner investment.

We began by developing 21 items theorized to reflect multiple distinct components of mating effort (see Table S1 in the Supplement) and then used EFA and data from 264

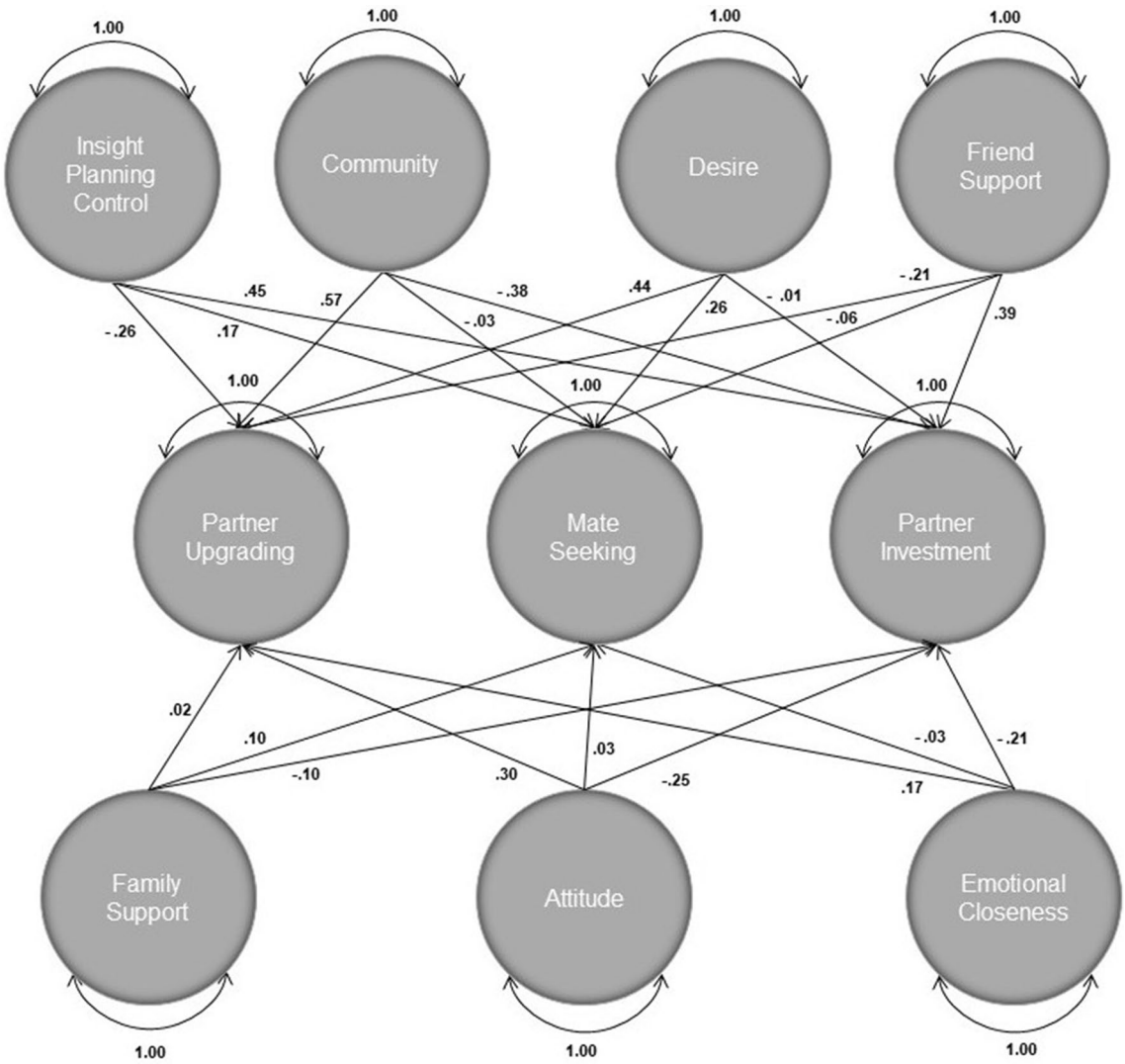

Fig. 2 Path diagram depicting the structural equation model testing the concurrent validity of the MEQ by regressing all Mini-K factors and the desire and attitude factor of the SOI-R onto the MEQ factors. Regression coefficients are standardized

heterosexual individuals to determine their structure. None of the methods used to determine the number of factors in our scale recommended a single-factor solution, providing evidence that covariance among the items could not be explained by a single mating effort factor.

A three-factor model with correlated item residuals produced the best fit to the data. The covariances among the three factors, although significant, were all relatively small, suggesting that a higher-order factor was implausible. Results indicated that the MEQ achieved a strong degree of measurement invariance and we detected significantly higher levels of partner upgrading and mate seeking in males relative to females. Furthermore, we did not detect evidence of population heterogeneity. The strong degree of measurement invariance suggests that scale scores can be used to compare the sexes. Furthermore, the reliability coefficients associated with the three-factor solution were acceptable.

Results from our SEMs indicated that the community involvement factor of the Mini-K and the sexual desire factor of the SOI-R were significant predictors of respondents' levels of partner upgrading. Those who reported a greater predisposition to upgrade partners reported greater community involvement. It could be that community involvement reflects, in part, a drive to identify and acquire higher-quality mates that may be available. However, it could also be that a third variable, status-seeking, was responsible for the relationship between partner upgrading and community involvement, such that individuals drive to enhance their status motivated them to be more involved in their

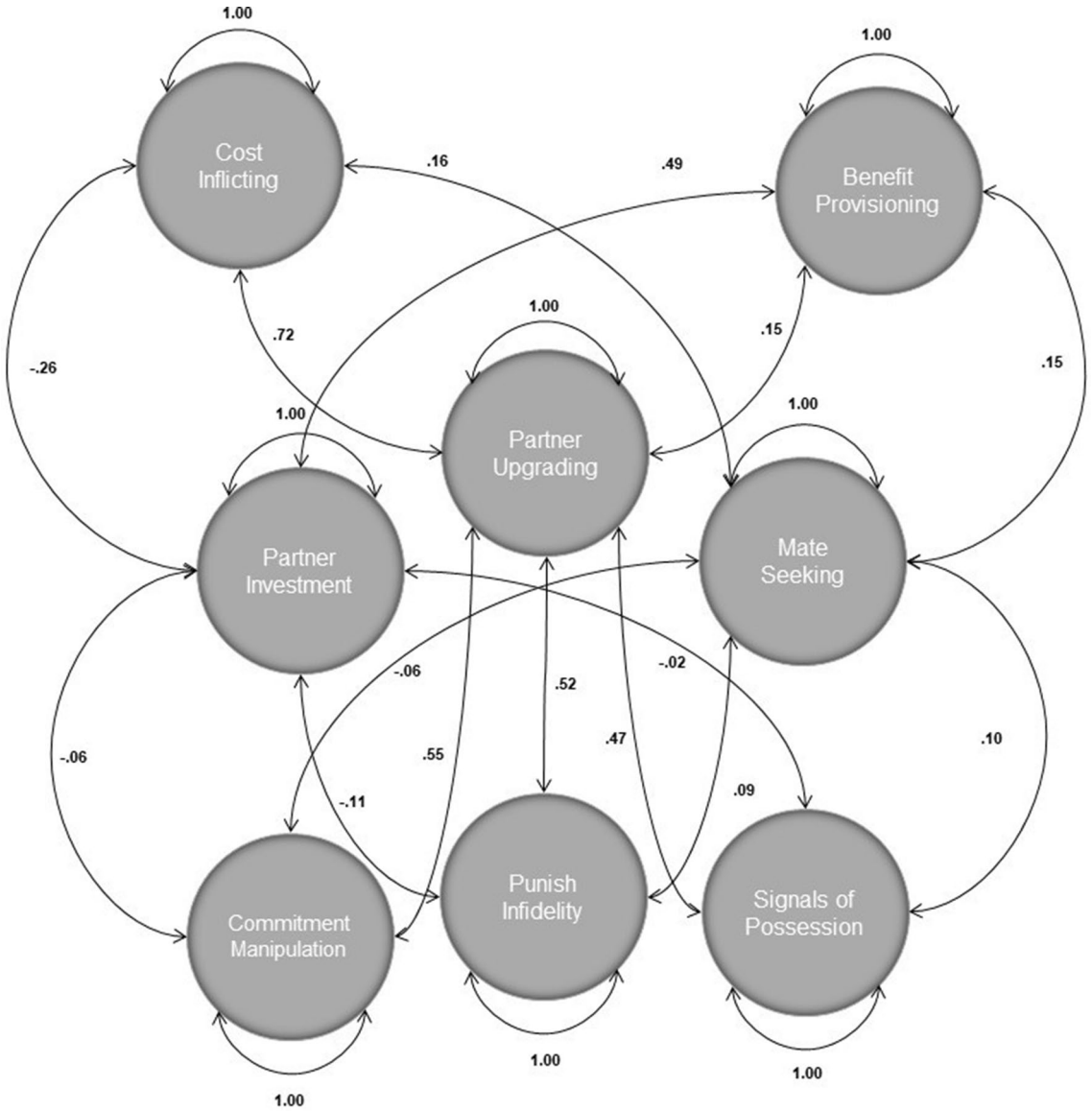

Fig. 3 Path diagram depicting the structural equation model testing the concurrent validity of the MEQ by specifying covariances between all factors of the MEQ with all of the factors of the MRI-SF. Covariances are standardized

community and also to be more willing to leave their partner for one of higher mate value. Moreover, individuals who scored higher on sexual desire also scored higher on partner upgrading, suggesting that those who were more open to casual sexual relationships were more predisposed to upgrade partners. We found suggestive relationships between insight, planning, and control, as well as friend support with partner upgrading, such that those who had lower levels of insight planning and control and friend support also reported a greater tendency to engage in partner upgrading. This could suggest that individuals who engage in lower levels of planning or deliberation were also more predisposed to upgrade partners. Moreover, those who did not feel as though they had a supportive friendship network were more likely to report engaging in partner upgrading behavior. However, in the current study these relationships met conventional *p* value cutoffs, but not more stringent criteria (i.e., $p < .005$; Benjamin et al., 2018).

K-factor domains, but not sociosexual orientation, were significant predictors of partner investment. Insight, planning, and control were significant positive predictors of partner investment, which would suggest that individuals, who were more predisposed to engage in planned and deliberate actions, also reported being more investing romantic partners. It would also seem that individuals who reported exerting more effort in their romantic

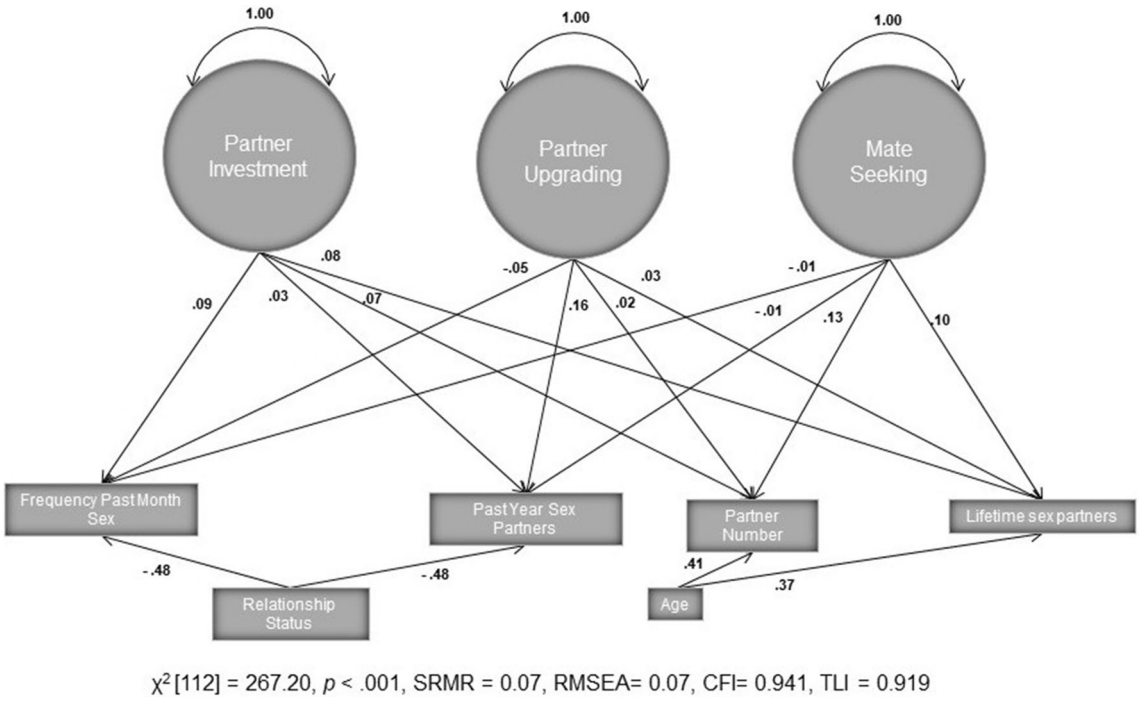

Fig. 4 Path diagram depicting the structural equation model testing the concurrent validity of the regressing measures of the respondents' sexual strategies onto the partner upgrading and mate seeking factors of the MEQ

relationships also reported more positive and intimate relationships with their friends. Those who felt more supported by their friends also tended to be more invested in romantic partners. Moreover, individuals who reported lower levels of community involvement reported greater levels of partner investment. It could be that individuals that are more driven to seek status within their communities as part of a strategy to attract new mates also report investing relatively less in current romantic partners.

Partner upgrading covaried with cost-inflicting mate retention strategies, suggesting that individuals who were predisposed to leave their partner for one of higher mate value are also more willing to inflict costs on current partners and intrasexual rivals as a mate retention tactic. Furthermore, partner upgrading covaried with individual's tendency to engage in commitment manipulation, suggesting that individuals who were more predisposed to leave their partner for one of higher mate value were also more willing to attempt to manipulate their level of commitment as a mate retention tactic. These individuals also were more willing to punish suspected infidelity and to be more vigilant to infidelity cues. From this analysis, respondent tendency to engage in partner upgrading behaviors is associated with a sexual strategy involving negative and manipulative mate retention behaviors (Buss et al., 2008).

Conversely, individuals who reported a greater willingness to invest in their current romantic partner were also more likely to engage in benefit provisioning as a strategy to retain their current romantic partner. This is not surprising as individuals who allocate more mating effort to investing in their current romantic partner may be more likely to try and increase their partners relationship satisfaction by providing them with benefits to retain them. Critically, in the current investigation we did not control for participants relationship satisfaction. It could be that individuals who are not satisfied with their relationship are more likely to engage in these more negative mate retention behaviors, while also being more willing to leave their partner for one of higher mate value. Individuals who reported higher levels of partner upgrading also reported having more past-year sex partners, even after relationship status was controlled. This suggests that individuals who report a greater tendency to engage in seeking additional high mate value partners also have more sex partners. The above findings suggest that our scale captures unique components of mating effort and that the factors of our scale can be used to predict proxies of reproductive success. The results of the current investigation improve our understanding of individual differences in sexual strategies by situating the factors of the MEQ within a broader context that accounts for respondents' K-factor scores, their openness to engaging in casual sexual relationships, and their mate retention tactics.

Limitations and Future Directions

The present study has several limitations, which provide avenues for future research. First, this investigation relied on self-reported measures. As a result, error can be introduced during the retrieval processes involved with memory and with self-presentation bias. Second, although we made the MEQ to identify facets of mating effort not well covered by current scales, we may have missed some domains. Therefore, in future iterations of the scale we intend to supplement the MEQ with additional items generated using focus groups and peer-act nomination (e.g., Jonason & Buss, 2012).

The partner investment and mate seeking factors both have a relatively small number of items. Generating additional items using these methods would help to create a larger item set which could yield a more detailed description of these two factors. In future iterations of the MEQ, we will seek to situate the items representing the partner upgrading factor within a broader pool of items focusing on energy allocated toward mate switching (Buss et al., 2017). Decisions to upgrade partners likely reflect a cost–benefit trade-off which involves considering the energetic and emotional costs associated with dissolving the current relationship and expending energy to attract the desirable alternative partner (Buss et al., 2017; Rusbult, 1983; Rusbult & Buunk, 1993). Therefore, future investigations should test whether mated individuals' levels of relationship satisfaction predict their tendency to endorse any items from the partner upgrading factor.

Such studies could benefit by obtaining larger samples. Participants for the present study were drawn predominately from a "WEIRD" (Western, educated, industrialized, rich and democratic) population (Henrich, Heine, & Norenzayan, 2010). Although our sample was primarily drawn from individuals living in the U.S., 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 who are younger and more educated than the general population. Future investigations should obtain a balanced sample of individuals from the U.S. as well as a non-WEIRD population (Henrich et al., 2010) and conduct tests of measurement invariance, and population heterogeneity to evaluate the extent to which the MEQ measures the same constructs across these populations. However, our preliminary comparison of respondents reporting Caucasian ethnicity with those reporting South Asian ethnicity would suggest that response patterns are relatively consistent across these two groups (see Supplement).

Finally, many young adults of both sexes report wanting to be in a relationship but are unable to attract and/or retain romantic partners (Apostolou et al., 2018, 2019). This is evidenced by high rates of involuntary singlehood (Apostolou et al., 2019). In one survey of a large sample of young adult Greek Cypriots approximately half reported difficulty in either starting or maintaining a relationship (Apostolou et al., 2018), whereas another study of Greek Cypriots found that of those who were single approximately half reported wanting to be in a relationship but were unable to form one. The difficulty in forming an intimate relationship could be further exacerbated by parents and offspring disagreement over what constitutes an ideal romantic partner (Apostolou & Wang, 2018). Future investigations on mating effort could benefit by measuring and accounting for involuntary singlehood and its causes when measuring mating effort.

Strengths of the Current Investigation

Strengths of the current study include the development of a new measure that assesses facets of mating effort that are underrepresented in, or not covered by, current instruments, as well as the use of measurement invariance and population heterogeneity testing to ensure sex differences are not compromised by item bias. We found metric and scalar invariance, as well as a strong degree of strict invariance, indicating that our scale measured the same latent constructs between the sexes. Notably, the finding that men had a higher latent mean score on the partner upgrading and mate seeking factors corresponds to previous research on sex differences in reproductive strategies (Buss & Schmitt, 1993).

Conclusions

We developed a new mating effort scale, tested if it measured the same constructs between the sexes, and tested its concurrent validity using SEM. To our knowledge, this is the first study to disseminate the development of a new mating effort measure as well as tests of measurement invariance and population heterogeneity within the same research report. Here, we would like to draw attention to the fact that although social and behavioral sciences, including evolutionary psychology research, frequently involve group comparisons (e.g., the sexes), researchers still do not often test whether their scales actually measure the same constructs between important subgroups (e.g., see Vandenberg & Lance, 2000; Wang et al., 2018). As a result, subgroup differences obtained through self-report measures may not reflect actual differences, but instead could be because the scale does not measure the same construct(s) between subgroups. We hope that this 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.

Author Contributions GA, SA, and ZS generated the items. GA came up with the study design. GA conducted all analysis with critical support, and advice from GBR. GA and GBR wrote the manuscript, while SA and CHS

provided critical feedback. All authors have consented to the submission of the current draft.

Compliance with Ethical Standards

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

Ethical Approval This study was performed in line with the principles of the Declaration of Helsinki. All study procedures were approved by the Boston University Institutional Review Board.

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

References

Apostolou, M., Papadopoulou, I., & Georgiadou, P. (2019). Are people single by choice? Involuntary singlehood in an evolutionary perspective. *Evolutionary Psychological Science, 5*(1), 98–103. https://doi.org/10.1007/s40806-018-0169-1.

Apostolou, M., Shialos, M., Kyrou, E., Demetriou, A., & Papamichael, A. (2018). The challenge of starting and keeping a relationship: Prevalence rates and predictors of poor mating performance. *Personality and Individual Differences, 122,* 19–28. https://doi.org/10.1016/j.paid.2017.10.004.

Apostolou, M., & Wang, Y. (2018). Parent–offspring conflict over mating in Chinese families: Comparisons with Greek Cypriot families. *Evolutionary Psychology*. https://doi.org/10.1177/1474704918764162.

Arnocky, S., Sunderani, S., & Vaillancourt, T. (2013). Mate-poaching and mating success in humans. *Journal of Evolutionary Psychology, 11*(2), 65–83. https://doi.org/10.1556/JEP.11.2013.2.2.

Benjamin, D. J., Berger, J. O., Johannesson, M., Nosek, B. A., Wagenmakers, E. J., Berk, R., … Cesarini, D. (2018). Redefine statistical significance. *Nature Human Behaviour, 2*(1), 6. https://doi.org/10.1038/s41562-017-0189-z.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107,* 238–246. https://doi.org/10.1037//0033-2909.107.2.238.

Brown, T. A. (2003). Confirmatory factor analysis of the Penn State Worry Questionnaire: Multiple factors or method effects? *Behaviour Research and Therapy, 41*(12), 1411–1426. https://doi.org/10.1016/S0005-7967(03)00059-7.

Brown, T. A. (2014). *Confirmatory factor analysis for applied research*. New York, NY: Guilford Publications.

Buss, D. M., Goetz, C., Duntley, J. D., Asao, K., & Conroy-Beam, D. (2017). The mate switching hypothesis. *Personality and Individual Differences, 104,* 143–149. https://doi.org/10.1016/j.paid.2016.07.022.

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100*(2), 204–232. https://doi.org/10.1037/0033-295X.100.2.204.

Buss, D. M., Shackelford, T. K., & McKibbin, W. F. (2008). The Mate Retention Inventory-Short Form (MRI-SF). *Personality and Individual Differences, 44*(1), 322–334. https://doi.org/10.1016/j.paid.2007.08.013.

Buunk, A. P., & Fisher, M. (2009). Individual differences in intrasexual competition. *Journal of Evolutionary Psychology, 7*(1), 37–48. https://doi.org/10.1556/JEP.7.2009.1.5.

Casler, K., Bickel, L., & Hackett, E. (2013). Separate but equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. *Computers in Human Behavior, 29*(6), 2156–2160. https://doi.org/10.1016/j.chb.2013.05.009.

Charles, K. E., & Egan, V. (2005). Mating effort correlates with self-reported delinquency in a normal adolescent sample. *Personality and Individual Differences, 38*(5), 1035–1045. https://doi.org/10.1016/j.paid.2004.06.021.

Figueredo, A. J., Cuthbertson, A. M., Kauffman, I. A., Weil, E., & Gladden, P. R. (2012). The interplay of behavioral dispositions and cognitive abilities: Sociosexual orientation, emotional intelligence, executive functions and life history strategy. *Temas em Psicologia, 20*(1), 87–100.

Figueredo, A. J., Vásquez, G., Brumbach, B. H., Schneider, S. M., Sefcek, J. A., Tal, I. R., … Jacobs, W. J. (2006). Consilience and life history theory: From genes to brain to reproductive strategy. *Developmental Review, 26*(2), 243–275. https://doi.org/10.1016/j.dr.2006.02.002.

Fisher, M., & Cox, A. (2011). Four strategies used during intrasexual competition for mates. *Personal Relationships, 18*(1), 20–38. https://doi.org/10.1111/j.1475-6811.2010.01307.x.

Fisher, M., Cox, A., Bennett, S., & Gavric, D. (2008). Components of self-perceived mate value. *Journal of Social, Evolutionary, and Cultural Psychology, 2*(4), 156–168. https://doi.org/10.1037/h0099347.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50. https://doi.org/10.1177/002224378101800104.

Gangestad, S. W., & Simpson, J. A. (1990). Toward an evolutionary history of female sociosexual variation. *Journal of Personality, 58*(1), 69–96. https://doi.org/10.1111/j.1467-6494.1990.tb00908.x.

Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: Trade-offs and strategic pluralism. *Behavioral and Brain Sciences, 23*(04), 573–587. https://doi.org/10.1017/S0140525X0000337X.

Greiling, H., & Buss, D. M. (2000). Women's sexual strategies: The hidden dimension of extra-pair mating. *Personality and Individual Differences, 28*(5), 929–963. https://doi.org/10.1016/S0191-8869(99)00151-8.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). Most people are not WEIRD. *Nature, 466*(7302), 29. https://doi.org/10.1038/466029a.

Jackson, J. J., & Kirkpatrick, L. A. (2007). The structure and measurement of human mating strategies: Toward a multidimensional model of sociosexuality. *Evolution and Human Behavior, 28*(6), 382–391. https://doi.org/10.1016/j.evolhumbehav.2007.04.005.

Jonason, P. K., & Buss, D. M. (2012). Avoiding entangling commitments: Tactics for implementing a short-term mating strategy. *Personality and Individual Differences, 52*(5), 606–610. https://doi.org/10.1016/j.paid.2011.12.015.

Kruger, D. J. (2017). Brief self-report scales assessing life history dimensions of mating and parenting effort. *Evolutionary Psychology, 15*(1), 1474704916673840.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1,* 130–149. https://doi.org/10.1037/1082-989X.1.2.130.

Marlowe, F. (1999). Male care and mating effort among Hadza foragers. *Behavioral Ecology and Sociobiology, 46*(1), 57–64. https://doi.org/10.1007/s002650050592.

Meredith, W. (1993). Measurement invariance, factor analysis and factorial invariance. *Psychometrika, 58*(4), 525–543. https://doi.org/10.1007/BF02294825.

Millsap, R. E. (2012). *Statistical approaches to measurement invariance*. London: Routledge. https://doi.org/10.4324/9780203821961.

Patch, E. A., & Figueredo, A. J. (2017). Childhood stress, life history, psychopathy, and sociosexuality. *Personality and Individual Differences, 115,* 108–113. https://doi.org/10.1016/j.paid.2016.04.023.

Penke, L., & Asendorpf, J. B. (2008). Beyond global sociosexual orientations: A more differentiated look at sociosexuality and

its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology, 95*(5), 1113. https://doi.org/10.1037/0022-3514.95.5.1113.

Preacher, K. J., & MacCallum, R. C. (2003). Repairing Tom Swift's electric factor analysis machine. *Understanding Statistics, 2*(1), 13–43. https://doi.org/10.1207/S15328031US0201_02.

Revelle, W. (2018). *Psych: Procedures for personality and psychological research*. Evanston, IL: Northwestern University.

Richardson, G. B., Chen, C. C., Dai, C. L., Brubaker, M. D., & Nedelec, J. L. (2017). The psychometrics of the Mini-K: Evidence from two college samples. *Evolutionary Psychology, 15*(1), 1–12. https://doi.org/10.1177/1474704916682034.

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*(2), 1–36.

Rowe, D. C., Vazsonyi, A. T., & Figueredo, A. J. (1997). Mating-effort in adolescence: A conditional or alternative strategy. *Personality and Individual Differences, 23*(1), 105–115. https://doi.org/10.1016/S0191-8869(97)00005-6.

Rusbult, C. E. (1980). Commitment and satisfaction in romantic associations: A test of the investment model. *Journal of Experimental Social Psychology*, *16*(2), 172–186. https://doi.org/10.1016/0022-1031(80)90007-4.

Rusbult, C. E. (1983). A longitudinal test of the investment model: The development (and deterioration) of satisfaction and commitment in heterosexual involvements. *Journal of Personality and Social Psychology, 45*(1), 101–117. https://doi.org/10.1037/0022-3514.45.1.101.

Rusbult, C. E., & Buunk, B. P. (1993). Commitment processes in close relationships: An interdependence analysis. *Journal of Social and Personal Relationships, 10*(2), 175–204. https://doi.org/10.1177/0265407593102002.

Sabini, J., & Green, M. C. (2004). Emotional responses to sexual and emotional infidelity: Constants and differences across genders, samples, and methods. *Personality and Social Psychology Bulletin, 30*(11), 1375–1388. https://doi.org/10.1177/0146167204264012.

Schmitt, D. P., & Buss, D. M. (2001). Human mate poaching: Tactics and temptations for infiltrating existing mateships. *Journal of Personality and Social Psychology, 80*(6), 894–917. https://doi.org/10.1037/0022-3514.80.6.894.

Simpson, J. A., & Gangestad, S. W. (1991). Individual differences in sociosexuality: Evidence for convergent and discriminant validity. *Journal of Personality and Social Psychology, 60*(6), 870–883. https://doi.org/10.1037/0022-3514.60.6.870.

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research, 25*(2), 173–180. https://doi.org/10.1207/s15327906mbr2502_4.

Stijsma, K. (2009). On the use, the misuse, and the very limited usefulness of Cronbach's alpha. *Psychometrika, 74*(1), 107–120. https://doi.org/10.1007/S11336-008-9101-0.

Sugiyama, L. S. (2015). Physical attractiveness: An adaptationist perspective. In D. M. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 1–68). Hoboken, NJ: Wiley.

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika, 38*(1), 1–10. https://doi.org/10.1007/BF02291170.

Valentova, J. V., Junior, F. P. M., Štěrbová, Z., Varella, M. A. C., & Fisher, M. L. (2020). The association between Dark Triad traits and sociosexuality with mating and parenting efforts: A cross-cultural study. *Personality and Individual Differences, 154,* 109613. https://doi.org/10.1016/j.paid.2019.109613.

van Buuren, S., & Groothuis-Oudshoorn, K. (2011). mice: Multivariate imputation by chained equations in R. *Journal of Statistical Software, 45*(3), 1–67. https://doi.org/10.18637/jss.v045.i03.

Vandenberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods, 3*(1), 4–70. https://doi.org/10.1177/109442810031002.

Wang, S., Chen, C. C., Dai, C. L., & Richardson, G. B. (2018). A call for, and beginner's guide to, measurement invariance testing in evolutionary psychology. *Evolutionary Psychological Science, 4*(2), 166–178. https://doi.org/10.1007/s40806-017-0125-5).