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Original Article

Condition-dependent calibration of men's uncommitted mating orientation: evidence from multiple samples

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ABSTRACT

Physical strength and physical attractiveness are both hypothesized as indicators of overall phenotypic condition in humans. Strategic Pluralism Theory (Gangestad & Simpson, 2000) predicts that men's orientation toward uncommitted mating is facultatively calibrated (i.e. contingently adjusted over ontogeny) in response to condition-dependent physical features, such as strength and attractiveness. Herein, we suggest that previous research bearing on this hypothesis has been limited because (a) researchers have often neglected to distinguish between mating orientations and past sexual behavior and (b) sample sizes have not always been large enough to reliably detect correlations of moderate magnitude. To address these issues and extend previous findings, we present aggregated data from three independent samples of young adults that permit us to examine multiple measures of physical strength and attractiveness in relation to uncommitted mating orientation, committed mating orientation, and past sexual behavior. As predicted, meta-analyses across samples demonstrated that strength and attractiveness were positively correlated with men's (but not women's) uncommitted mating orientation (but not committed mating orientation). In addition, strength (in men only) and attractiveness (in both sexes) positively predicted participants' number of past sex partners. Moreover, path analyses demonstrated that the association of men's physical features with their number of sex partners was mediated via uncommitted mating orientation. These results (a) provide the most extensive support to date for the hypothesis that men's uncommitted mating orientation is calibrated to condition-dependent features and (b) clarify the sex-specific functional links among physical features, mating orientations and sexual behavior.

1. Introduction

Human mating systems include multiple types of relationships, from monogamous pair bonds to brief sexual affairs and extra-pair copulations (Gurven, Winking, Kaplan, von Rueden, & McAllister, 2009; Kelly, 1995; Pillsworth & Haselton, 2006; Winking, Kaplan, Gurven, & Rucas, 2007). This manifest variation, in turn, reflects a diverse range of *mating orientations* (Buss & Schmitt, 1993; Gangestad & Simpson, 2000). For example, because the maximum potential reproductive rate is higher among men than women, men are also higher than women on average in the motivation to pursue sex in the absence of long-term commitment (Buss & Schmitt, 1993; Jackson & Kirkpatrick, 2007). However, there is also massive variation in mating orientations *within* each sex, such that an individual, whether male or female, may primarily seek uncommitted affairs, exclusively seek monogamous pair bonds, or pursue some combination of these types of relationships (Buss & Schmitt, 1993; Gangestad & Simpson, 2000; Jackson & Kirkpatrick, 2007; Larson, Pillsworth, & Haselton, 2012; Pillsworth & Haselton, 2006). Thus, a foundational question in the study of human mating concerns the origins of individual differences in mating orientations: What explains within-sex variation in the pursuit of committed pair bonds and uncommitted sex?

Strategic Pluralism Theory (Gangestad & Simpson, 2000) posits that individual differences in mating orientations are *facultatively calibrated* (i.e. contingently adjusted over ontogeny) in response to cues that have predicted the fitness costs and benefits of alternative behavioral phenotypes over human evolutionary history. One of this theory's key postulates, for example, is that (a) ancestral men in better *phenotypic condition* (i.e. who could more efficiently convert energy into fitness) were more likely to succeed in acquiring sexual partners outside of committed relationships, and therefore (b) men's uncommitted mating orientation will be calibrated to variations in their condition-dependent phenotypic features (e.g., physical

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attractiveness). As we review below, extant research has often supported this condition-dependent calibration hypothesis by demonstrating positive associations of condition-dependent physical features with men's orientation toward uncommitted mating. However, certain methodological limitations have also led to some contradictory findings, and important theoretical distinctions implied by this hypothesis remain untested.

In this paper, we provide the most extensive and multi-faceted test to date of the hypothesis that men's (but not women's) orientation toward uncommitted (but not committed) mating is calibrated to variations in condition-dependent features—in this case, physical strength and physical attractiveness. To this end, we examine multiple measures of strength and attractiveness in relation to context-specific mating orientations and past sexual behavior in three independent samples of young adults.

1.1. The condition-dependent calibration hypothesis of men's uncommitted mating orientation

In the tradition of strategic pluralism theory (Gangestad & Simpson, 2000), a number of theorists have discussed the hypothesis that men's uncommitted mating orientation is facultatively calibrated in response to phenotypic features dependent on overall phenotypic condition (Buss, 2009; Frederick & Haselton, 2007; Gangestad, Bennett, & Thornhill, 2001; Rhodes, Simmons, & Peters, 2005). Broadly speaking, "phenotypic condition" refers to an individual's ability to efficiently convert energy into fitness-enhancing traits and outcomes (Tomkins, Radwan, Kotiaho, & Tregenza, 2004). This ability is determined by a variety of factors, including genome-wide mutation load, possession of genotypes that are well adapted to local pathogens, and exposure to developmental insults (Gangestad, Merriman, & Thompson, 2010; Gangestad et al., 2001; Penke, Denissen, & Miller, 2007; Tomkins et al., 2004). Importantly, phenotypic condition alters the trade-offs inherent in investing energy into traits that promote intrasexual competition and mate attraction. For instance, all else equal, an individual in better phenotypic condition will need to allocate less energy toward somatic maintenance and pathogen defense, and will therefore be able to invest more heavily in developing energetically expensive musculature for competing with rivals (Frederick & Haselton, 2007; Gallup, White, & Gallup, 2007; Gangestad, Garver-Apgar, Simpson, & Cousins, 2007; Lassek & Gaulin, 2009; Lukaszewski & Roney, 2011). Thus, although low physical strength alone does not necessarily indicate poor overall condition (because energy is finite and can be allocated in multiple ways), high physical strength is a positive indicator of being in good enough condition to invest heavily in muscle growth and maintenance (Frederick & Haselton, 2007; Lassek & Gaulin, 2009). Similarly, physical attributes that are judged as sexually attractive (e.g., symmetry; cues to sex hormone levels) theoretically indicate the relative absence of harmful mutations that disrupt optimal development and/or immune function (Gangestad et al., 2001; Little, Jones, & Debruine, 2011; Roney, 2009). It is for reasons such as these that physical strength and physical attractiveness are hypothesized to be condition-dependent features in humans.

There are at least two routes through which higher physical strength and attractiveness theoretically enabled ancestral men to engage in uncommitted mating. First, because much of the heritable variance in condition-dependent features is maintained over evolutionary time through stochastic processes such as mutation-selection balance (Penke et al., 2007; Tomkins et al., 2004), both strength and attractiveness functioned as indicators of men's genetic quality ancestrally (Frederick & Haselton, 2007; Gangestad & Simpson, 2000). Therefore, ancestral women likely found these features sexually attractive and preferred them in partners for uncommitted affairs. Consistent with this, modern women prefer these features in mates—and more so in uncommitted relative to committed mating contexts (Frederick & Haselton, 2007; Gangestad et al., 2007; Li & Kenrick, 2006). Second, because sex without commitment is a valuable reproductive resource for men, pursuing uncommitted matings would have often elicited direct intrasexual aggression from rivals (Daly & Wilson, 2005; Puts, 2010; Simpson, Gangestad, Christensen, & Leck, 1999). Ancestrally, physically stronger men would have been more likely to prevail in intrasexual contests and/or sustain lower levels of conflict-related injury than physically weaker men (see Hill et al., 2013; Puts, 2010; Sell, Hone, & Pound, 2012; Simpson et al., 1999).

Taken together, these arguments suggest that ancestral men who were physically stronger or more attractive would have been relatively likely to secure net reproductive benefits by pursuing sex without commitment. If so, it follows than men's uncommitted mating orientation may be facultatively calibrated over ontogeny via evolved conditional rules of the form: "*To the extent that I am [(physically stronger) (more attractive)] than other men, invest in the pursuit of uncommitted mating opportunities.*"

Importantly, this condition-dependent calibration hypothesis applies only to men. Given differences between the sexes in their levels of obligatory parental investment, ancestral men could theoretically accrue dramatic increases in fitness through short-term sexual affairs, whereas women faced a much lower ceiling on the number of offspring they could produce via sex with multiple partners (Buss & Schmitt, 1993). Moreover, to the extent that uncommitted sex partners were likely to provide less paternal investment in offspring than committed partners, ancestral women engaging in purely sexual affairs would have been left with a disproportionate share of the childrearing responsibility (Gangestad & Simpson, 2000). It would not have been adaptive on average, therefore, for more attractive women to be differentially motivated to engage in uncommitted mating—especially because women in better phenotypic condition were in the best position to elicit monogamous investment from high-quality men (Buss & Schmitt, 1993; Buss & Shackelford, 2008; Larson et al., 2012).

Additionally, the logic of strategic pluralism predicts that the orientation toward committed mating will not be calibrated to condition-dependent features in either sex. Theories of human reproduction generally posit that long-term bonds took hold as a common pillar of human mating systems, because of the massive fitness benefits they generate for both sexes via cooperative investment in offspring and the sexual division of labor (Buss & Schmitt, 1993; Gangestad & Simpson, 2000; Gurven et al., 2009). For this reason, what distinguishes men in better phenotypic condition from those in poorer condition should not likely be that they are inclined to forego the benefits of committed relationships, but that they can more often afford to pursue uncommitted mating opportunities as a supplemental tactic (Buss & Schmitt, 1993; Gangestad & Simpson, 2000).

1.2. Previous research bearing on the condition-dependent calibration hypothesis

A number of extant studies have tested associations of physical strength and physical attractiveness with the orientation toward uncommitted mating. Most of these have operationalized the latter in one of two ways. First, many studies have employed the Sociosexual Orientation Inventory (SOI; Simpson & Gangestad, 1991) or Revised SOI (SOI-R; Penke & Asendorpf, 2008)—both of which index one's willingness to engage in sex without commitment. Second, some studies have used peoples' number of past sex partners as a proxy for their uncommitted mating orientation.

Research using these methods has produced mixed support for the condition-dependent calibration hypothesis as defined above—which, to reiterate, predicts that men's (but not women's) uncommitted mating orientation is calibrated to condition-dependent features. For example, among both men and women, SOI (or SOI-R) scores have been found to correlate positively with self-rated physical attractiveness (Clark, 2004; Penke & Asendorpf, 2008; Perilloux, Cloud, & Buss, 2013) as well as third-party ratings of attractiveness (Honekopp, Rudolph, Beier, Liebert, & Muller, 2007; Rhodes et al., 2005; Thornhill & Gangestad, 1994). Likewise, among both sexes, number of past sex partners has been found to correlate positively with measures of self-rated physical attractiveness (Penke & Asendorpf, 2008; Perilloux et al., 2013) and third-party ratings of attractiveness (Gangestad et al., 2001; Honekopp et al., 2007; Rhodes et al., 2005; Thornhill & Gangestad, 1994). Additionally, measures of physical strength and muscularity have been found to positively predict men's SOI scores (Gangestad et al., 2007) and their number of past sex partners (Frederick & Haselton, 2007; Gallup et al., 2007; Hill et al., 2013). Taken together, then, these findings support the prediction that men's phenotypic condition is positively correlated with their uncommitted mating orientation. However, counter to the prediction that this association should be limited to men, these results also appear to indicate that physical attractiveness positively predicts women's orientation toward uncommitted mating.

Further complicating the overall picture is the fact that some studies have failed to replicate the positive correlations reported above. For example, published studies have reported non-significant associations of women's rated attractiveness with their SOI scores (Perilloux et al., 2013; Stillman & Maner, 2009) and also their number of sex partners (Perilloux et al., 2013). Moreover, one study reported a null association between men's actual physical strength and their SOI scores (Simmons & Roney, 2011), and another even reported a *negative* association between men's rated facial attractiveness and SOI (Boothroyd, Jones, Burt, DeBruine, & Perrett, 2008).

In summary, previous studies reporting associations of physical attractiveness and strength with measures of mating orientation have yielded mixed results—certain of which are inconsistent with the hypothesis that men's (but not women's) uncommitted mating orientation is calibrated to condition-dependent physical features. If this hypothesis is correct, for instance, then why are men's attractiveness and strength somewhat inconsistently correlated with their mating orientations across studies? And why do some studies find that attractive women engage in uncommitted mating more frequently than less attractive women?

1.2.1. Limitations of previous research

In what follows, we argue that prior studies may not have provided clear evidence for the condition-dependent calibration hypothesis described above because (a) they have employed operational definitions that do not distinguish between strategic mating orientations and past sexual behavior and (b) sample sizes in individual studies have not always been large enough to detect small-to-moderate correlations.

A notable feature of the original SOI (Simpson & Gangestad, 1991) is its very broad bandwidth, resulting from the fact that it aggregates items that assess *uncommitted mating orientation* (the willingness to engage in sex without commitment) and *past sexual behavior* (number of sex partners). Importantly, recent research has supported the claim that these should often be treated as separate components (Jackson & Kirkpatrick, 2007; Penke & Asendorpf, 2008; Webster & Bryan, 2007). This is because a person's past sexual behavior is constrained and influenced by a number of factors other than strategic mating orientations. To take one example, a man may be highly motivated to engage in uncommitted mating, but unable to fully actualize his desire during a given time period due to a local paucity of women who are willing to engage in casual sex (although men should be expected to adjust their strategies to long-term trends in mating opportunities; see Kenrick, Li, & Butner, 2003). As such, men's phenotypic condition may tend to show a larger or more consistent association with their *motivation* to engage in uncommitted mating than with their previous success in acquiring sexual partners. If so, the SOI's aggregation of items assessing mating orientation and past sexual behavior, respectively, could lead to the underestimation of correlations between men's condition-dependent features and their uncommitted mating orientation.

The aggregation of mating orientations and past sexual behavior in previous research may also help explain why women's attractiveness appears to positively predict their uncommitted mating orientation in some studies. Specifically, even if attractive women are not differentially open to casual sex, they will presumably be subject to more advances from attractive men—many of which may, whether accurately or deceptively, signal long-term romantic interest (Haselton, Buss, Oubaid, & Angleitner, 2005). As such, more attractive women may end up having more partners than less attractive women simply by virtue of the larger number of courtship attempts they receive (Jackson & Kirkpatrick, 2007; Perilloux et al., 2013). If so, attractive women will tend to exhibit higher overall SOI scores even if they are not more motivated or willing to engage in uncommitted mating (Jackson & Kirkpatrick, 2007).

Moreover, it follows from the logic described above that the association of men's condition-dependent physical features with their number of sex partners should actually be *mediated* through the orientation toward uncommitted mating—such that stronger and more attractive men are calibrated to pursue uncommitted mating opportunities, and thereby acquire more sex partners. Importantly, however, the aggregation of items assessing mating orientation and past sexual behavior precludes examination of this meditational hypothesis. Indeed, to our knowledge, no prior studies have tested the hypothesis that effects of men's strength or attractiveness on mating success are mediated via their uncommitted mating orientation.

Finally, many of the individual studies reviewed above may have been somewhat underpowered to reliably detect associations of men's physical features with mating orientations and past sexual behavior. On average, the extant research suggests that these associations, when present, are small-to-moderate in magnitude. Given the inevitability of sampling error, it is not reasonable to expect that true correlations will replicate in all samples, especially if the relevant samples and/or population-level effect sizes are not exceptionally large. Indeed, recent research using Monte-Carlo simulations (Schonbrodt & Perugini, 2013) indicates that estimates of effect sizes for relatively small correlations (e.g., $r = .25$) do not stabilize until sample sizes reach 200–250—a threshold that has not typically been approached for sex-specific samples in prior studies. As such, some of the inconsistent findings in the literature could simply reflect sampling error across studies with limited power to detect the predicted correlations.

In sum, because of these issues pertaining to the operational definition of variables and limited statistical power, respectively, previous studies may have partially concealed adaptively patterned sex-specific associations among condition-dependent physical features, context-specific mating orientations, and past sexual behavior.

1.3. The current research

In the current research, we sought to provide a test of the condition-dependent calibration hypothesis that (a) includes multiple measures of physical strength and attractiveness; (b) distinguishes between uncommitted mating orientation, committed mating orientation, and past sexual behavior; and (c) is adequately powered to detect the predicted associations. To these ends, we collected measures of actual physical strength, self-rated physical strength, other-rated physical attractiveness, and self-rated physical attractiveness from three independent samples of young adults. In addition, participants completed measures of uncommitted mating orientation and committed mating orientation, and reported on their past numbers of sex partners and one-night stands.

Taken together, the logic described above suggests five specific predictions:

- *Prediction 1*: Physical strength and physical attractiveness will positively predict men's uncommitted mating orientation. There will be no such associations for women.
- *Prediction 2*: Neither physical strength nor attractiveness will predict committed mating orientation in either sex.
- *Prediction 3:* Physical strength and attractiveness will positively predict men's number of past sex partners and one-night stands.
- *Prediction 4*: Physical attractiveness will positively predict women's number of past sex partners and one-night stands.
- *Prediction 5*: The associations of men's physical strength and attractiveness with their number of past sex partners will be mediated via their uncommitted mating orientation. There will be no such mediation among women.

2. Methods

2.1. Participants

Participants were from three independent samples of undergraduates from two university campuses on the west coast of the United States. Sample 1 included 186 men who were part of a study on attraction at UCLA (mean age = 21.3 years, SD = 4.7). Sample 2 included 175 undergraduates (86 men; 89 women) who were part of a study on personality origins at UCSB (mean age = 19.4 years, SD = 1.3). Sample 3 included 209 undergraduates (110 men; 99 women) who were part of a different study at UCSB (mean age = 18.7 years, SD = 1.4). Where sample sizes deviate from these total *N*s for particular measures, this is indicated below.

2.2. Materials and procedures

All participants were tested in the context of larger studies conducted under controlled laboratory conditions, and self-report measures were collected via either paper-and-pencil questionnaires (Samples 1 and 2) or computer-based data collection software (Sample 3). Operational definitions of variables were either identical or conceptually similar across the three independent samples. They are as follows:

2.2.1. Actual physical strength

In all three samples, participants' actual physical strength was measured via procedures validated with weightlifting machines by Sell et al. (2009; see also Lukaszewski, 2013; Lukaszewski & Roney, 2011; Gallup et al., 2007). Two measures of strength were obtained using a Jamar® hydraulic dynamometer: chest/arm strength and grip strength. For chest/arm strength, participants held the dynamometer in front of their chest, and pressed inward with both arms until they felt they could not apply additional pressure. For grip strength, participants held the dynamometer at their side and squeezed with their dominant hand until they felt they could not apply additional pressure. As in previous studies, chest and grip strengths were significantly correlated in all samples [(Sample 1 men: $r = .59$, n = 181, $p < .01$); (Sample 2 men: $r = .57$, n = 85, $p < .001$; women: $r = .61$, n = 89, $p < .001$); (Sample 3 men: $r = .62$, n = 110, $p < .001$; women: $r = .47$, n = 99, $p < .001$), and these two measures were therefore averaged to form a physical strength composite variable for each participant.

2.2.2. Self-rated physical strength

In Sample 1, self-rated strength was measured via a single percentile ranking item: "If you were to take a random sample of 100 other people from [this campus] of my same age and sex, I would be physically stronger than __% of them." Response options ranged from 0 to 100, in 10-point intervals.

This same percentile ranking item was administered to Sample 2, plus an additional item of the same format that measured self-rated fighting ability: "If you were to take a random sample of 100 other people from [this campus] of my same age and sex, I would be able to beat __% of them in a physical fight." Responses to these two items ($r = .74$, $p < .001$) were combined to form a single unit-weighted composite.

In Sample 3, self-rated strength was measured via a single item, which asked participants to rate themselves relative to others of their same age and sex on a scale running from 1 (weak) to 7 (strong).

2.2.3. Other-rated physical attractiveness

Participants from all samples were photographed from a standardized distance against a solid wall, while facing forward with hands at their sides. In Samples 1 and 3, participants wore their own clothing, whereas participants from Sample 2 wore identical tank-top undershirts provided by the researchers. These full body photos were then rated by third parties for physical attractiveness on scales running from 1 (very unattractive) to 7 (very attractive).

In Sample 1, 53 of 186 participants were photographed. Photos of this sub-sample were rated for attractiveness by 22 young women at UCLA. A subset of 40 men was rated by 13 of the raters (mean inter-rater $r = .59$), and the other subset of 13 men was rated by the remaining 9 raters (mean inter-rater $r = .46$). As such, all ratings were averaged to form a composite score for each participant.

From Sample 2, 155 of 175 participants (78 men; 77 women) were rated for overall physical attractiveness by 12 undergraduates at UCSB (five women). Agreement was high across raters (mean inter-rater $r = .37$), and all ratings were therefore averaged to form a composite score for each participant.

Participants from Sample 3 were rated for overall physical attractiveness by 12 undergraduates at UCSB (six women). Agreement was high across raters (mean inter-item $r = .37$), and all ratings were therefore averaged to form a composite score for each participant.

2.2.4. Self-rated physical attractiveness

Sample 1 participants completed two items measuring perceptions of their attractiveness to the opposite sex, which asked them to indicate their agreement from 1 (strongly disagree) to 7 (strongly agree): "Relative to my peer group, I consider myself much more attractive" and "Relative to my peer group, I can get dates with great ease." Responses to these items ($r = .38$, $p < .01$) were combined into a unit-weighted composite.

In Sample 2, self-rated physical attractiveness was measured by a three-item scale ($\alpha = .82$). The first item was a percentile ranking: "If you were to take a random sample of 100 other people from [this campus] of my age and sex, I would be more physically attractive than __ % of them". The other two items were rated on 1–7 Likert scales: "How physically attractive are you relative to individuals of your same age and sex?" and "At a normal social gathering, what percentage of women (men) are more physically attractive than you?" These items were *z*-scored before inclusion in a unit-weighted composite.

In Sample 3, participants completed a 10-item physical attractiveness scale ($\alpha = .93$) containing items similar to those rated by Samples 1 and 2. Example items include "I am a physically attractive person"; "At a purely physical level, I am more attractive than most people of my same age and sex"; and "I am not a physically attractive person" (reverse-scored).

2.2.5. Uncommitted and committed mating orientations

Participants in Sample 1 completed the three-item "attitude" subscale from the original SOI (Simpson & Gangestad, 1991), which is hypothesized to primarily tap into uncommitted mating orientation (Jackson & Kirkpatrick, 2007). As recommended by Webster and Bryan (2007), we also included in this SOI attitude scale one item that was originally part of the behavior subscale (which asks subjects to project the number of sex partners they will likely have over the next five years). These four items were combined into a unit-weighted composite indexing a short-term strategy ($\alpha = .74$; n = 170).

Subjects in Samples 2 (n = 146) and 3 (n = 203) completed the scales from Jackson and Kirkpatrick's (2007) Multidimensional Sociosexual Orientation Inventory tapping into uncommitted and committed mating orientations, respectively (note: Jackson & Kirkpatrick originally referred to these scales as "short-term mating orientation" and "long-term mating orientation"). Internal consistency was adequate for uncommitted mating orientation in Samples 2 ($\alpha = .93$) and 3 ($\alpha = .94$), and committed mating orientation in Samples 2 ($\alpha = .87$) and 3 ($\alpha = .89$).

2.2.6. Past sexual behavior

Participants in all samples were asked to report the total number of different partners with whom they have had (a) sexual intercourse; and (b) a one-night stand (i.e. "the number of partners with whom you have had sex on one and only one occasion"). Total number of sexual partners was also transformed into a dummy-coded "sexual experience" variable indicating whether the subject was sexually inexperienced (i.e. has not had sex = 0) or experienced (i.e. has had sex = 1). Sexually inexperienced subjects represented 24% of Sample 1, 25% of Sample 2, and 37% of Sample 3.

Total sample size for past number of sex partners was 180 in Sample 1 and 148 in Sample 2 (74 men; 74 women). Total sample size for past number of one-night stands was 176 men in Sample 1 and 146 in Sample 2 (73 men; 73 women). Because of a technical problem with the data collection software that was not corrected until mid-way through the study, past sexual behavior data were only available for 86 participants in Sample 3 (48 men; 38 women).

2.3. Data analyses

We evaluated our predictions in multiple phases. First, to prepare the data for the analyses described below, we began by creating within sample *z*-scores for each measured variable. Second, we computed pair-wise correlations among all measured variables, which are presented individually by sample in Tables S1-S3 (see online supplementary materials, available on the journal's website at www.ehbonline.org).

Next, in order to conduct focused tests pertaining to condition-dependent physical features, we created composite variables that combined our objective and self-rated measures of physical strength and physical attractiveness. These composites were justified by a Principal Components Analysis including within sample *z*-scores for actual strength, self-rated strength, other-rated attractiveness, and self-rated attractiveness. Confirming the pattern on a scree plot, varimax rotation revealed two interpretable components that together explained 68% of the total variance in the solution. The first component captured physical strength (loadings: self-rated strength = .82; actual strength = .76) and the second component captured physical attractiveness (loadings: other-rated attractiveness = .91; self-rated attractiveness = .63). Thus, we created unit-weighted composite variables based on these components and used these for all analyses presented below involving physical strength and physical attractiveness.

In order to examine the magnitude and robustness of the predicted pattern of results across all samples and participants that provided pertinent data, we meta-analyzed the set of two to three effect sizes across our samples for each pair-wise correlation. Because the effect sizes we meta-analyzed came from three independent samples with different compositions (e.g., different ratios of male to female participants) and tested under different conditions (e.g., in different labs in the context of different larger studies), we conducted random-effects analyses. In order to give more precisely measured effects (e.g., from larger samples) more "pull" on weighted mean effect sizes, we weighted each effect size by the inverse of its variance (see Borenstein, Hedges, Higgins, & Rothstein, 2009). All meta-analyses were conducted using Comprehensive Meta-Analysis version 2.2 software (Borenstein, Hedges, Higgins, & Rothstein, 2008).

Next, we used within-sample *z*-scores to test hypotheses pertaining to interactions between variables and mediation, respectively, across all participants who provided pertinent data. As described below, ANOVAs were used to test predicted interactions, and tests of mediation were conducted within structural equation models computed in AMOS using maximum likelihood estimation procedures (Kline, 2005). With regard to the latter, mediation was established via bias-corrected bootstrapping procedures using 5000 bootstrap iterations and 95% confidence intervals (Preacher & Hayes, 2008).

3. Results

In support of Prediction 1, the meta-analyses indicated that men's physical strength and physical attractiveness were each positively correlated with their uncommitted mating orientation (Table 1). Also in support of Prediction 1, these associations were small and non-significant among women (Table 1). In support of Prediction 2, neither strength nor attractiveness was significantly associated with committed mating orientation in either sex (Table 1). Together, Predictions 1 and 2 indicate that strength and attractiveness will have *selective* associations with men's (but not women's) uncommitted (but not committed) mating orientation. To test this selectivity, we first conducted mixed-model ANOVAs across all participants from Samples 2 and 3 who provided pertinent data. In these analyses, sex (women vs men) was a between-subjects factor, mating orientation (uncommitted vs committed) was a within-subjects factor, and strength or attractiveness, respectively, was treated as a continuous covariate. As predicted, the three-way interaction among these variables was significant for strength [$F_{1,346} = 3.27$, $p < .05$] and marginally significant for attractiveness [$F_{1,331} = 2.55$, $p = .08$]. Next, follow-up two-way (sex x strength or attractiveness) ANOVAs revealed that this overall pattern was driven, as predicted, by larger associations of both strength [$F_{1,346} = 13.63$, $p < .001$] and attractiveness [$F_{1,331} = 6.82$, $p < .001$] with uncommitted mating orientation among men than women. In contrast, there was no evidence that sex interacted with strength or attractiveness in the prediction of committed mating orientation [$Fs < 1$, $ps > .50$].

In support of Prediction 3, the meta-analyses indicated that men's physical strength and attractiveness both positively predicted their status as sexually experienced, number of past sex partners, and number of one-night stands (Table 1). In support of Prediction 4, women's attractiveness positively predicted their status as sexually experienced, number of sex partners, and number of one-night stands (Table 1). As expected, these associations were absent for women's physical strength (Table 1). Two-way ANOVAs then examined whether these associations differed in magnitude between the sexes. These analyses demonstrated that the association of physical strength with participants' number of sex partners was, as predicted, significantly larger among men than women [$F_{1,403} = 4.68$, $p < .01$]. In addition, although attractiveness predicted participants' number of sex partners among both sexes, this association was significantly larger among men than women [$F_{1,266} = 10.58$, $p < .001$].

As implied by our predictions, a mixed-model ANOVA indicated that women's physical attractiveness exhibited a marginally larger association with their number of sex partners than with their uncommitted mating orientation [$F_{1,100} = 3.30$, $p = .07$]. No such interaction was present for women's physical strength [$F_{1,109} = .01$, $p = .97$]. Among men, counter to tentative expectation, there was no evidence that attractiveness was more strongly associated with uncommitted mating orientation than with number of sex partners [$F_{1,158} = .05$, $p = .82$]. However, men's strength was significantly more strongly associated with their uncommitted mating orientation than with their number of sex partners [$F_{1,281} = 5.20$, $p < .05$].

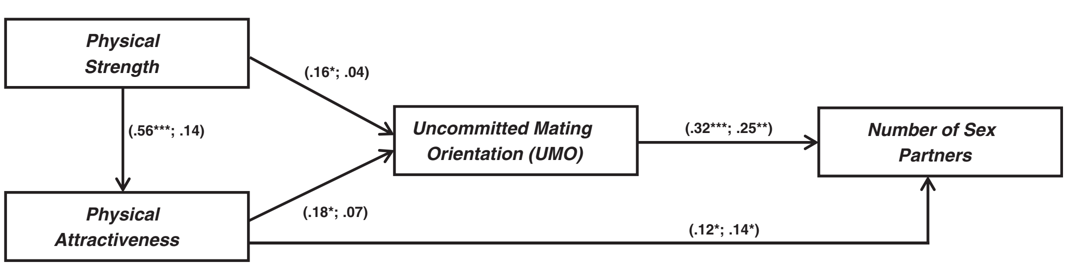
Table 1
Meta-analyzed correlations among physical strength, physical attractiveness, mating orientations, and past sexual behavior.

	Physical Strength	Physical Attractiveness	Uncommitted Orientation	Committed Orientation	Sexual Experience	Number of Sex Partners	One-Night Stands
Physical Strength	–	*r* = .58*** CI [.49, .66] (n = 237)	*r* = .30*** CI [.20, .39] (n = 346)	*r* = .10 CI [−.05, .25] (n = 181)	*r* = .15* CI [.01, .29] (n = 295)	*r* = .20*** CI [.09, .31] (n = 295)	*r* = .18** CI [.05, .31] (n = 293)
Physical Attractiveness	*r* = .14 CI [−.14, .40] (n = 176)	–	*r* = .30*** CI [.17, .41] (n = 221)	*r* = −.01 CI [−.19, −.08] (n = 175)	*r* = .35*** CI [.21, .48] (n = 168)	*r* = .31*** CI [.17, .44] (n = 168)	*r* = .21** CI [.06, .36] (n = 163)
Uncommitted Orientation	*r* = .06 CI [−.10, .21] (n = 168)	*r* = .10 CI [−.06, .25] (n = 159)	–	*r* = −.14 CI [−.43, .18] (n = 181)	*r* = .32*** CI [.16, .46] (n = 289)	*r* = .43*** CI [.33, .52] (n = 289)	*r* = .43*** CI [.33, .52] (n = 289)
Committed Orientation	*r* = .05 CI [−.12, .22] (n = 168)	*r* = .07 CI [−.17, .30] (n = 159)	*r* = −.22† CI [−.43, .01] (n = 168)	–	*r* = −.15† CI [−.32, .03] (n = 121)	*r* = −.12 CI [−.37, .14] (n = 121)	*r* = −.18 CI [−.54, .25] (n = 121)
Sexual Experience	*r* = −.09 CI [−.27, .10] (n = 112)	*r* = .32*** CI [.13, .49] (n = 102)	*r* = .13 CI [−.16, .39] (n = 111)	*r* = −.03 CI [−.22, .16] (n = 111)	–	*r* = .43*** CI [.31, .54] (n = 299)	*r* = .28*** CI [.17, .38] (n = 293)
Number of Sex Partners	*r* = −.04 CI [−.42, .35] (n = 112)	*r* = .24* CI [.05, .42] (n = 102)	*r* = .31† CI [−.02, .56] (n = 111)	*r* = −.17† CI [−.35, .02] (n = 111)	*r* = .55*** CI [.32, .72] (n = 112)	–	*r* = .87*** CI [.81, .91] (n = 293)
One-Night Stands	*r* = .02 CI [−.19, .24] (n = 112)	*r* = .20* CI [.001, .38] (n = 102)	*r* = .35*** CI [.15, .52] (n = 111)	*r* = −.09 CI [−.28, .10] (n = 111)	*r* = .40*** CI [.23, .54] (n = 112)	*r* = .84*** CI [.55, .95] (n = 112)	–

Note. Weighted mean correlations and 95% confidence intervals [lower limit, upper limit] are presented above the diagonal for men and below the diagonal for women. †$p \le .10$; *$p \le .05$; **$p \le .01$; ***$p \le .001$.

In order to test Prediction 5, we evaluated the path model depicted in Fig. 1 using data from all participants for whom we had overall strength, overall attractiveness, and uncommitted mating orientation (220 men; 159 women); among these participants, when past sex partner data were missing, these data points were replaced with the mean *z*-score. In the specified model, strength and attractiveness are causes of uncommitted mating orientation, which in turn has a causal impact on people's number of sex partners. In addition, because strength is a component of men's attractiveness (Frederick & Haselton, 2007; Lukaszewski, 2013), we included a direct path from strength to attractiveness to reflect this. Inclusion of this path also permitted us to determine the extent to which the association of men's strength with their number of sex partners was mediated via effects on their attractiveness. The analysis was run as a multi-group model wherein path coefficients were permitted to vary freely for men and women.

The final path model provided solid support for Prediction 5 (Fig. 1), and also generated a number of additional insights. Among men, strength and attractiveness each had independent direct effects on uncommitted mating orientation, which in turn significantly mediated the effects of these physical features on men's number of sex partners. Focused tests of specific indirect paths (Fig. 1, inset) indicated that the effect of men's strength on their number of sex partners was significantly mediated via strength's effect on attractiveness (but was not independently mediated via strength's direct effect on uncommitted mating orientation). Moreover, in addition to the indirect effects of men's strength and attractiveness on their number of sex partners, there was also a direct effect of men's attractiveness on their number of sex partners. Among women, confirming the patterns evident in the meta-analysis, neither strength nor attractiveness had effects on uncommitted mating orientation, but attractiveness had a direct effect on number of sex partners.



Indirect Paths	Standardized Indirect Effects: Men	Women
Strength → Attractiveness → UMO	.13**	.01
Strength → Attractiveness → UMO→ Sex Partners	.06*	.01
Strength → Attractiveness → Sex Partners	.08**	.02
Strength → UMO → Sex Partners	.02	.01
Attractiveness → UMO → Sex Partners	.11**	.03

Fig. 1. Path model depicting all hypothesized causal relationships. Standardized path coefficients for men are on the left within parentheses, and coefficients for women are on the right within parentheses. Standardized coefficients for indirect paths are inset. *$p < .05$; **$p < .01$; ***$p < .001$.

4. Discussion

Findings from multiple independent samples of young adults supported all five of our specific predictions regarding adaptively patterned associations of condition-dependent physical features with context-specific mating orientations and past sexual behavior. Crucially, composite measures of physical strength and attractiveness were positively correlated with measures of men's (but not women's) uncommitted mating orientation (but not committed orientation)—which is consistent with the hypothesis that men's uncommitted mating orientation is *selectively* calibrated to their condition-dependent features over ontogeny. This selectivity was further established by analyses demonstrating that the associations of strength and attractiveness with uncommitted mating orientation were significantly larger among men than women. In addition, physical strength (in men only) and physical attractiveness (in both sexes) were positively associated with participants' number of sex partners and one-night stands. Finally, path analyses indicated that the associations of men's strength and attractiveness with their number of sex partners were mediated via uncommitted mating orientation, whereas women's attractiveness had only a direct effect on their number of sex partners.

These results extend findings from previous studies in a number of ways. Importantly, this is the only study to examine condition-dependent physical features separately in relation to uncommitted mating orientation, committed mating orientation, and past sexual behavior. In this regard, it is noteworthy that women's attractiveness was uncorrelated with their uncommitted mating orientation, but was nonetheless positively correlated with their number of sex partners and one-night stands. To the extent that a similar pattern holds in the extant literature, this would imply that the widespread practice in previous research of operationalizing mating orientations by aggregating items assessing strategic mating motivations and past sexual behavior (or solely relying on the latter) could easily have produced the misleading impression that women's attractiveness positively predicts their *motivation* to engage in uncommitted mating. If so, these findings may serve to validate the arguments of recent theorists that past sexual behavior can reflect factors other than strategic mating motivations (Jackson & Kirkpatrick, 2007; Penke & Asendorpf, 2008; Webster & Bryan, 2007). Why attractive women have more sex partners and one-night stands than less attractive women, despite the fact that they are not higher in uncommitted mating orientation, is an important question for future research.

Men's condition-dependent features positively predicted both their uncommitted mating orientation and their number of past sex partners. These effects have often but not always emerged in prior research, and it is therefore important that the current study's findings are likely more reliable than those from any individual study in the extant literature. As reviewed above, prior studies have tended to be somewhat underpowered to detect the predicted correlations. In contrast, our conclusions were based on meta-analyses of data from multiple samples that collectively contained over 500 participants. Although the sample was effectively somewhat smaller due to missing data points, our sex-specific sample sizes for most analyses nonetheless approached or (for men) surpassed those deemed ideal for reliable estimation of small-to-moderate correlations (Schonbrodt & Perugini, 2013). In this context, it is important that the associations of men's physical features with their uncommitted mating orientation and their number of sex partners, respectively, were fairly similar in magnitude. This ran somewhat counter to our speculation that men's strength and attractiveness might show larger associations with their uncommitted orientation than with their past sexual behavior (although the predicted interaction did obtain for men's strength). As such, these findings suggest that the practice of combining items assessing mating motivation and sexual behavior may not be generally problematic for detecting correlations between physical traits and mating strategies among men (as it likely is among women, for reasons discussed above).

This study provided the first empirical test of the hypothesis that associations of men's condition-dependent features with their number of sex partners are mediated via their uncommitted mating orientation. Indeed, results demonstrated that such mediation was present for both physical strength and attractiveness among men. Although strength and attractiveness each had independent effects on men's uncommitted mating orientation, the effect of strength on number of sex partners was mediated through the effects of attractiveness (rather than through strength's direct effect on uncommitted mating orientation). This suggests that physically stronger men may have more sex partners because they are more attractive. Interestingly, this result is at odds with the recent finding that traits related to men's formidability and intrasexual dominance predicted their number of sex partners, whereas attractiveness to female acquaintances explained no unique variance in their number of sex partners (Hill et al., 2013). As these authors argue, this pattern is consistent with the idea that intrasexual contest competition is more important than female choice in determining men's mating success (see Hill et al., 2013; Puts, 2010). However, the current findings would seem more consistent with the inverse conclusion—that attractiveness is more important than intrasexual contests in explaining why more physically formidable men experience greater mating success than weaker men (see Frederick & Haselton, 2007). These discrepant patterns could reflect methodological differences between the two studies, or could reflect differences in study populations. Given these conflicting results, it will be important for research to further test whether physically formidable men pursuing uncommitted sex achieve greater mating success via intrasexual contests, female choice, or (perhaps more likely) some variable combination of these mechanisms. Regardless of these issues, the current findings support the hypothesis that stronger and more attractive men have more sex partners in part *because* these men are calibrated toward the pursuit of uncommitted mating opportunities.

This study was limited in ways that might inform or motivate future research. First, our subject samples were all drawn from post-industrial, western populations. It is important to determine whether these findings generalize to other cultural contexts and age groups. Second, although physical strength and attractiveness are commonly hypothesized as condition-dependent features in humans, it is important for future tests of the condition-dependent calibration hypothesis to include more direct measures of phenotypic condition; for example, fluctuating asymmetry or markers of oxidative stress (see Gangestad et al., 2010). Third, the current study demonstrated that condition-dependent features do not predict committed mating orientation in either sex, but it leaves to future research the question of what factors *do* underlie individual differences in the orientation toward commitment (e.g., cues to high mortality or social instability that cause people to adopt a fast life history strategy; Daly & Wilson, 2005). Most importantly, the hypotheses under evaluation posit a *causal* effect of physical features on men's uncommitted mating orientation. Future prospective or experimental studies are needed to more conclusively evaluate this causal hypothesis.

In sum, this study provided the most extensive and multi-faceted support to date for the condition-dependent calibration hypothesis as applied to physical strength and physical attractiveness. The results not only clarify inconsistent findings from previous studies, but also reveal heretofore-unknown patterns of sex-specificity in the links among phenotypic condition, mating orientations, and past sexual behavior. More generally, the data support key tenets of Strategic Pluralism Theory (Gangestad & Simpson, 2000) and suggest important avenues for future research on the causes and consequences of individual differences in strategic mating orientations.

5. Author note

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Supplementary Materials

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.evolhumbehav.2014.03.002.

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