Why Is Muscularity Sexy? Tests of the Fitness Indicator Hypothesis

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*Evolutionary scientists propose that exaggerated secondary sexual characteristics are cues of genes that increase offspring viability or reproductive success. In six studies the hypothesis that muscularity is one such cue is tested. As predicted, women rate muscular men as sexier, more physically dominant and volatile, and less committed to their mates than nonmuscular men. Consistent with the inverted-U hypothesis of masculine traits, men with moderate muscularity are rated most attractive. Consistent with past research on fitness cues, across two measures, women indicate that their most recent short-term sex partners were more muscular than their other sex partners (*ds *= .36, .47). Across three studies, when controlling for other characteristics (e.g., body fat), muscular men rate their bodies as sexier to women (partial* rs *= .49-.62) and report more lifetime sex partners (partial* rs *= .20-.27), short-term partners (partial* rs *= .25-.28), and more affairs with mated women (partial* r *= .28).*

Keywords: *body image; evolutionary psychology; mate preferences; muscularity; sexual selection*

Psychological research on physical attractiveness has largely focused on the importance of female attractiveness to men and the aspects of the female body men find most desirable in mates (e.g., Fink, Grammer, & Thornhill, 2001; Scutt, Manning, Whitehouse, Leinster, & Massey, 1997; Singh, 1993; Symons, 1995). Evolutionary psychologists have generally concurred that men possess strong preferences for female beauty because attractive attributes are cues of fertility, and fertility varies considerably between women and within individual women over time (for a review, see Sugiyama, 2005). In contrast, researchers have contended that men's desirability as mates is determined by earning potential and commitment, and less so by physical attractiveness (e.g., Buss & Schmitt, 1993; Pawlowski & Dunbar, 1999).

In the literature on nonhuman animals, however, there is much research on male attractiveness and far less on female attractiveness (e.g., Alcock, 2005; Andersson, 1994). Indeed, across species, females tend to be the sex that invests more in offspring and therefore they are more selective in choosing mates (Trivers, 1972). Females appear to value male attractiveness because it is a cue of genes that confer fitness benefits to offspring through increased viability or reproductive success (e.g., Kokko, Brooks, Jennions, & Morley, 2003; Moller, 1997). If specific cues index heritable quality, females should come to value them in mates, and they should exercise this preference in mate selection.

Might male attractiveness also play heavily in the mating decisions of human females? Recent studies suggest that women discriminate between men on the basis of hypothesized fitness cues, including facial masculinity

Authors' Note: The authors are grateful to the University of California, Los Angeles (UCLA) Graduate Division; the FPR-UCLA Center for Culture, Brain, and Development; and the Departments of Psychology and Communication Studies for providing financial support to the first author. For additional papers on body image and body type preferences, please refer to the Web site of the first author (http://dfred.bol.ucla.edu). We would like to thank Clark Barrett, Daniel Fessler, Gordon Gallup, Andrew Galperin, Kristina Grigorian, Kelsey Laird, Andrea Niles, Joshua Poore, Taylor Rhoades, Letitia Anne Peplau, Steven Platek, Leila Sadeghi-Azar, and the UCLA Experimental Biological Anthropology Lab for their helpful comments on this manuscript and project. Correspondence should be addressed to David A. Frederick, 1285 Franz Hall, Department of Psychology, Third Floor Mailroom, University of California, Los Angeles, CA 90095-1563; e-mail: enderflies1@aol.com.

PSPB, Vol. XX No. X, Month XXXX xx-xx
DOI: 10.1177/0146167207303022

(e.g., Johnston, Hagel, Franklin, Fink, & Grammer, 2001; Penton-Voak & Perrett, 2000; Penton-Voak et al., 1999) and body scents associated with symmetry (Gangestad & Thornhill, 1998). We examined whether women find muscular male bodies sexy and, if so, whether this preference may also be a product of sexual selection.

SEXUAL SELECTION AND BODY MORPHOLOGY

Some traits are fitness cues because they demonstrate that a male is in good condition. Life history theorists think of organisms as entities that capture energy from the environment and then convert it to survival and reproduction-enhancing activities, including by developing metabolically expensive physical features that are attractive to the opposite sex (for a review, see Kaplan & Gangestad, 2005). Because of differences in genetic makeup, combined with the challenges faced during development, individuals differ in their ability to allocate energy to generating costly traits that are attractive to the other sex. Zahavi (1975) proposed that males who display traits that are costly to maintain (e.g., the peacock's tail) are attractive to females precisely because they are costly and thus demonstrate that the male is in good enough condition to produce them. Females who mate with these males would pass on the attractive traits to their offspring, increasing their viability or reproductive success, or both.

SEXUAL SELECTION AND TESTOSTERONE-LINKED TRAITS

As an extension of Zahavi's (1975) hypothesis, Folstad and Karter (1992) introduced the immunocompetence signaling hypothesis. This hypothesis suggests that secondary sexual characteristics are reliable indicators of mate quality because the reproductive hormones required for their development, including testosterone, suppress the immune system (e.g., Peters, 2000; Rantala, Vainikka, & Kortet, 2003). The expression of testosterone-linked traits reveals that men are in good enough condition to withstand the deleterious effects of immunosuppression, and women who selected these men as mates would have transmitted features associated with good condition to their offspring.

An alternative perspective suggests that testosterone-linked traits are costly signals for reasons other than immunocompetence (see Kaplan & Gangestad, 2005; Kokko et al., 2003). In this view, fit males benefit more than other males from devoting a greater share of their energy budget to mating effort (competing for mates, displaying attributes desired by mates). Higher testosterone is associated with effort allocated to mating (McIntyre et al., 2006) as well as with greater size and muscle mass (Bhasin, 2003). Effort allocated to developing and maintaining these attributes can reduce budget of effort available for maintaining other attributes (e.g., immunocompetence, somatic upkeep) and can increase other energy demands (e.g., increased metabolism; Buchanan, Evans, Goldsmith, Bryant, & Rowe, 2001). This view suggests that there is a wider array of costs beyond simply immunosuppression that causes these traits to be honest signals of quality.

In both the immunocompetence and the more general cost models, however, the prediction is the same: Traits produced by high levels of testosterone are cues of heritable fitness or good condition because they indicate that the male can afford to generate these costly traits. Selection should have shaped a female preference for these traits because, all else equal, males displaying them sire more viable offspring.[1]

THE COSTLY SIGNALING HYPOTHESIS AND PREFERENCES FOR MUSCULARITY

We propose that the metabolic expense and levels of testosterone necessary to build and sustain muscle mass make muscularity a fitness cue. Numerous studies indicate that increased muscle strength is associated with naturally occurring levels of testosterone, as well as with testosterone treatments in normal, hypogonadal, adolescent, and older male patients (e.g., Storer et al., 2003; Wang et al., 2000; for a review, see Bhasin, 2003). Thus, men who are more muscular are exposed to greater levels of testosterone than other men.

For women to gain some genetic benefit by mating with muscular men, however, muscularity must be heritable. Estimates of the heritability of traits associated with muscularity indicate that extremity circumferences (e.g., bicep circumference), static strength (e.g., how much weight a person can hold in place), and explosive strength (e.g., vertical jump) range from 20% to 80% depending on the given trait (Loos et al., 1997; Thomis, Beunen, Maes, et al., 1998; Thomis, Beunen, Van Leemputte, et al., 1998; Thomis et al., 1997). One twin study assessing gains in strength across a 10-week training period also found that the ability to add muscle mass beyond one's baseline degree of muscularity is heritable (Thomis, Beunen, Maes, et al., 1998). The finding that there are underlying genetic differences related to muscle mass indicates that muscularity, along with the suite of traits correlated with it, can be passed on to offspring. This provides offspring with the advantage of developing traits that are attractive to females, further enhancing the women's reproductive success in later generations.

STRATEGIC PLURALISM AND WOMEN'S PREFERENCE FOR FITNESS INDICATORS

Effects of Mating Context

The perspective described previously predicts that women should find muscular men sexually desirable. However, if muscular men are sexually desirable but less likely to commit to their partners, women's attraction to muscularity should differ depending on mating context. According to strategic pluralism theory (Gangestad & Simpson, 2000), men have evolved to pursue reproductive strategies that are contingent on their value on the mating market. More attractive men accrue reproductive benefits from spending more time seeking multiple mating partners and relatively less time investing in offspring. In contrast, the reproductive effort of less attractive men, who do not have the same mating opportunities, is better allocated to investing heavily in their mates and offspring and spending relatively less time seeking additional mates.

From a woman's perspective, the ideal is to attract a partner who confers both long-term investment benefits and genetic benefits. Not all women, however, will be able to attract long-term investing mates who also display heritable fitness cues. Consequently, women face trade-offs in choosing mates because they may be forced to choose between males displaying fitness indicators or those who will assist in offspring care and be good long-term mates (Gangestad & Simpson, 2000). The most straightforward prediction that follows is that women seeking short-term mates, when the man's only contribution to offspring is genetic, should prefer muscularity more than women seeking long-term mates.

Preferences in Extrapair Mates

As a partial solution to the problem of trade-offs, women may have evolved to pursue a dual-mating strategy by securing investment from a long-term mate and obtaining genetic benefits from extrapair mates (Haselton & Gangestad, 2006). Several lines of evidence support this proposal. Although estimates vary, the human extrapair paternity rate is approximately 2% to 4% (for a review, see Anderson, 2006). Thus, a substantial portion of men raise offspring who are not genetically their own. Men also appear to possess anticuckoldry mechanisms that lead them to detect the degree of resemblance between babies' faces and their own and adjust their investment accordingly (Platek et al., 2003). Last, women are most attracted to men other than their primary mate when fertility is high within the ovulatory cycle (and thus the benefits of extrapair mating for genetic benefits are highest; Gangestad, Thornhill, & Garver-Apgar, 2005). This is especially true for women whose primary mates lack sexual attractiveness—the women who, in theory, have the most to gain from extrapair mating with men who display costly fitness indicators (Gangestad et al., 2005; Haselton & Gangestad, 2006; Pillsworth & Haselton, 2006).

One prediction that follows from the dual-mating logic is that men who display cues of fitness should be chosen most often as affair partners. Symmetry is a purported index of fitness (see Moller, 1997); therefore, Thornhill and Gangestad (1994) examined partner number in men varying in symmetry. As predicted, more symmetrical men reported having a greater overall number of sex partners, more sexual affairs, and a greater number of sex partners who were themselves mated to other men at the time of the affair. Hughes and Gallup (2003) found a similar pattern in men with higher shoulder-to-hip ratios, a trait that may be linked with testosterone. In sum, both theory and existing evidence suggest that women attend to cues of fitness when selecting sex partners, particularly short-term mates and affair partners.

THE INVERTED-U HYPOTHESIS OF MASCULINE TRAITS

When individuals consider others as mates, is more of a valued trait always better? Recent work by Kenrick and colleagues provided compelling evidence that the answer is no. For example, there comes a point where possessing additional income does not make one significantly more desirable as a mate (Kenrick, Sundie, Nicastle, & Stone, 2001). Having more money, however, does not decrease one's attractiveness on the mating market.

In contrast to financial resources, there is reason to believe that high levels of masculine physical features, including extreme muscularity and facial masculinity, can decrease a man's desirability as a mate (Dixson, Halliwell, East, Wignarajah, & Anderson, 2003; Johnston et al., 2001). In a study by Johnston et al. (2001), women rated the behaviors and dispositions of men varying in facial masculinity. Facial masculinity was positively correlated with sexual desirability, but the relationship was nonlinear, with the most masculine faces perceived as being somewhat less sexually desirable, trustworthy, and sensitive than less masculine faces. Highly masculine faces were also rated as being more dominant, volatile, selfish, and impulsive than somewhat less masculine faces. Johnston et al. concluded that "the aesthetic preference of human females could be viewed as an adaptive compromise between the positive attributes associated with higher-than-average testosterone (health cues) and the negative attributes associated with more extreme masculinization" (p. 262).

We term this proposal the *inverted-U hypothesis of masculine traits:* Women will not prefer mates with extremely high and extremely low levels of masculinity (e.g., muscularity, facial masculinity, shoulder-to-hip ratio, and chest-to-waist ratio). Very high levels will be viewed as unattractive because these men are viewed as volatile and threatening, perhaps presenting a direct danger to the woman. Low levels will be viewed as unattractive because these men are viewed as weak and submissive. Men with moderate to high levels should be preferred most as mates.

HYPOTHESIS AND PREDICTIONS

We hypothesized that women possess context-sensitive preferences for muscularity owing in part to an underlying evolved psychology shaped by sexual selection. To investigate this hypothesis, we tested the following predictions.

Attraction to Muscularity

If muscularity is a cue of fitness, women should be more attracted to muscular men than to nonmuscular men. Past research generally supports this prediction. In questionnaire-based studies, women in Western societies indicated that men with muscularity or high waist-to-chest ratios were attractive (e.g., Dixson et al., 2003; Franzoi & Herzog, 1987; Li & Kenrick, 2006; Maisey, Vale, Cornelissen, & Tovee, 1999; Swami & Tovee, 2005) but not if they were highly muscular (Dixson et al., 2003). Although there has been little cross-cultural research on women's preferences for muscularity, some evidence in non-Western societies suggests that women prefer men with powerful body builds (Cassidy, 1991; Dixson et al., 2003; for an exception, see Swami & Tovee, 2005). In parallel, men in societies spanning four continents believe that women are attracted to men who are more muscular than average (Taiwan: Yang, Gray, & Pope, 2005; Samoa: Lipinski & Pope, 2002; Austria and France: Pope et al., 2000; Kenya: Campbell, Pope, & Filliault, 2005; Ghana and the Ukraine: Frederick et al., in press; and the United States: Frederick et al., in press; Olivardia, Pope, Borowiecki, & Cohane, 2004). The majority of these studies, however, presented women with crude hand-drawn silhouettes of men. In Study 1, we tested whether women find muscular men more sexually desirable than nonmuscular men when evaluating relatively realistic computer-generated stimuli of men.

The Inverted-U Hypothesis of Masculine Traits

We predicted that the extent to which women find muscularity attractive would follow an inverted-U shape, with muscular men being more attractive and desirable than nonmuscular and very muscular men. Furthermore, we predicted that women would infer that very muscular men would be more likely to be physically dominant and volatile compared with less muscular men. Last, consistent with the mating trade-off hypothesis (Gangestad & Simpson, 2000), we predicted that women would rate muscular men as less committed to their partners. These predictions were tested in Studies 1 and 2 by examining women's ratings of the attractiveness of computer-generated images and silhouettes of men varying in level of muscularity.

Women's Preference for Muscular Short-Term Partners

If muscularity is a cue of fitness, it should be more important to women selecting a short-term mate, when the man's only contribution to offspring might be genetic (Gangestad & Simpson, 2000). Although women may also desire muscularity in long-term mates, strategic pluralism theory predicts that not all women will be able to secure attractive mates as long-term partners. We predicted that women would report preferring a more muscular short-term partner than long-term partner. This prediction was tested in Study 2. Furthermore, we predicted that women would report that their recent short-term sex partners were more muscular than their other sex partners. This prediction was tested in Study 3.

Muscularity Associated With Male Partner Number and Self-Perceived Desirability

If women prefer muscularity in short-term mates, muscular men should be able to capitalize on this preference and successfully attract multiple sex partners. Thus, muscular men should report more lifetime sex partners, brief sexual affairs, and affairs with mated women than less muscular men. Male muscularity should also be positively associated with self-rated attractiveness to women. These predictions were tested in Studies 4, 5, and 6.

STUDY 1: SOCIAL PROFILES OF SIX COMUPTER-GENERATED IMAGES OF MEN

This study investigated whether women believe muscular men are more sexually desirable, more physically dominant, more volatile, and less committed to their romantic partners than less muscular men. We predicted that women's ratings of the physical attractiveness and sexual desirability of muscular men would show an inverted-U pattern, with nonmuscular and very muscular men being rated as less attractive than moderately

muscular men. These predictions were tested by examining women's ratings of six computer-generated images of men.

Method

Participants. A total of 141 undergraduate women with a mean age of 20.44 (*SD* = 3.59) from the University of California, Los Angeles (UCLA), participated in exchange for extra credit as part of their psychology or communication studies course.

Stimuli. The stimuli were images of shirtless men created using MyVirtualModel.com, a program that allows manipulation of physical features (see Appendix A). Aside from muscularity and body weight, all features of the models were held constant, and height was set at 6 ft 0 in. The first dimension varied was defined as muscular versus nonmuscular by the program. The second dimension was defined as total body weight by the program: large (230 lb), medium (190 lb), or small (150 lb). The program also offers a limited ability to control shoulder and waist proportions, and we attempted to standardize shoulder-to-hip ratio across images.

There were six images in total: brawny (large, muscular), built (medium, muscular), toned (small, muscular), slender (small, nonmuscular), typical (medium, nonmuscular), and chubby (large, nonmuscular). Participants were not exposed to these labels, only the images. These levels were chosen because of their face validity; they appeared to differ systematically in body fat and muscularity. The validity of this manipulation was tested by presenting the images to 21 judges who rated how muscular and how fat each of the images appeared using a 0-100 scale (0 = *not at all,* 25 = *a little,* 50 = *somewhat,* 75 = *very,* 100 = *extremely*). Planned comparisons conducted within the context of one-way ANOVAs revealed the following patterns of results for muscularity (brawny > built > toned > slender = typical = chubby) and for body fat (brawny = built = toned = slender < typical < chubby) using $p < .001$ as the significance criterion. Thus, to participants, there appeared to be four levels of muscularity at the same level of body fat: slender (small, nonmuscular), toned (small, muscular), built (medium, muscular), and brawny (large, muscular). As a preliminary test of the inverted-U hypothesis, we were interested in whether women found men with moderate muscularity (toned, built) to be more sexually desirable than men with very low or very high levels of muscularity (slender, brawny).

To test whether the images differed in shoulder-to-hip ratio, a graphics designer unaffiliated with the project measured the length of the shoulders and hips using a graphics program. The ratios (shoulder length divided by hip length) were similar among built (1.26), toned (1.24), and slender (1.24) individuals; slightly larger for the brawny individual (1.32); and slightly smaller among typical (1.15) and chubby (1.13) individuals. Finally, in an attempt to remove ethnic and racial cues, faces were covered with a small black oval and the images were printed on a laser printer in black and white to yield images with ambiguous skin color.

Procedure. Participants were asked 10 questions about each image and made all ratings using a 9-point Likert scale (1 = *not at all,* 3 = *a little,* 5 = *somewhat,* 7 = *very,* 9 = *extremely*). The question stem for each item was "How likely is it that this man . . ." The participants rated his physical dominance ("is physically intimidating to other males"), his commitment to his partner ("would remain sexually faithful to you" and "would be sensitive to your emotional needs"), his volatility ("has a bad temper" and "would be abusive"), and his sexual desirability ("would be sexually exciting," "would be a good sexual partner," and "would be able to satisfy your sexual desires"). The sexual desirability category also included the item "How physically attractive is this man?" All Cronbach's alphas for each category with more than one item, for each of the six images, were greater than .70. We therefore computed the category means for each image.

Results and Discussion

To examine differences in how women rated each body for each dimension (sexual desirability, dominance, commitment, and volatility), we conducted a one-way ANOVA with body type (brawny, built, toned, slender, typical, chubby) as the independent variable followed by planned comparisons of each cell. The means are summarized in Figure 1 and Table 1. Because our predictions pertained to differences between particular cell means, we report the results of planned comparisons among women's ratings of each image rather than the results of the omnibus tests. Because we conducted multiple pairwise comparisons, we used a conservative alpha level of .001. All differences were significant at this level unless otherwise noted.

In support of the inverted-U hypothesis, brawny and slender men were rated as less sexually desirable than built men. They were also rated as less desirable than toned men, although the difference between brawny and toned was marginally significant ($p = .004$). In support of the predictions, each of the muscular men (toned, built, and brawny) was rated as more dominant than each of the nonmuscular men (slender, typical, and chubby). Among the muscular men, the brawny man was rated the most dominant and the toned man was

TABLE 1: Women's Ratings of Men Varying in Muscularity and Body Fat in Study 1

	Sexual Desirability		*Physical Dominance*		*Commitment*		*Volatility*	
	M	SD	M	SD	M	SD	M	SD
Brawny	6.37	1.61	8.01	1.45	4.02	1.51	6.04	1.59
Built	6.97	1.42	7.18	1.54	4.58	1.33	5.37	1.42
Toned	6.87	1.31	5.70	1.53	5.16	1.25	4.37	1.42
Slender	5.42	1.59	2.99	1.79	5.88	1.31	3.45	1.52
Typical	4.28	1.35	3.98	1.66	5.84	1.37	3.84	1.49
Chubby	2.95	1.32	3.94	2.01	5.90	1.62	3.86	1.73

NOTE: Ratings of six computer-generated images of men were made on a 9-point Likert scale (1 = *not at all,* 9 = *extremely*) in Study 1. Women reported that muscular men were more sexually desirable than nonmuscular men and that moderately muscular men (built, toned) were most desirable. Women also reported that muscular men are more physically dominant and volatile but less likely to be committed to their partners.

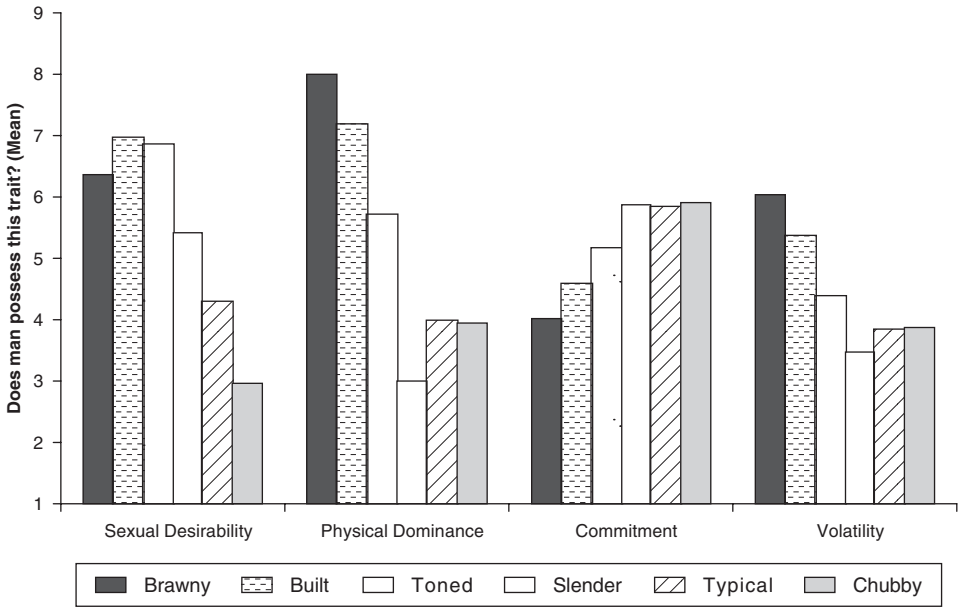


Figure 1 Association of body type with women's social ratings of men.
NOTE: Ratings of six computer-generated images of men were made on a 9-point Likert scale (1 = *not at all,* 9 = *extremely*) in Study 1. Women reported that muscular men were more sexually desirable than nonmuscular men and that moderately muscular men (built, toned) were most desirable. Women also reported that muscular men are more physically dominant and volatile but less likely to be committed to their partners.

rated as the least dominant. We observed the same pattern of results for ratings of volatility, except that the ratings of the slender and toned men only differed at a marginally significant level ($p = .004$). In support of the mating trade-off hypothesis, each of the muscular men (toned, built, and brawny) was rated as being less committed than each of the nonmuscular men (slender, typical, chubby), and brawny men were perceived as least likely to be committed (all ps $< .001$).

This pattern of results suggests that much like facial masculinity, increased muscularity is associated with inferences that a man is more physically dominant, more volatile, and less committed to his partner. Also similar to facial masculinity, women rated men with moderate muscularity rather than low or high muscularity as most attractive, perhaps because men with low muscularity are believed to possess too little dominance and men with high muscularity are believed to exhibit too much.

STUDY 2: THE INVERTED-U HYPOTHESIS OF MASCULINE TRAITS

Study 1 found some support for the prediction that preferences for muscularity follow an inverted-U pattern. However, the ability to test this hypothesis was

limited by the fact that only four levels of muscularity were presented to participants. In this study we tested the inverted-U hypothesis more directly by examining women's preferences for muscularity across eight silhouette drawings of men varying in muscularity. Additionally, we tested a prediction derivable from mating trade-off theory: that women's preferences for muscularity will be stronger when they consider men as short-term rather than long-term mates.

Method

Participants. A total of 286 women from UCLA with a mean age of 18.79 (*SD* = 1.40) volunteered to complete a brief survey at the end of a lower-division psychology class.

Stimuli. To assess women's preferences for male body types, women completed the Muscle Silhouette Measure (MSM; Frederick et al., in press; see Appendix B). The MSM presents eight silhouettes of men varying from slender and nonmuscular to slender and extremely muscular. The MSM has also been used to assess body satisfaction in the United States, Ukraine, and Ghana, and has 1-month test–retest reliabilities exceeding r = .70 for men's ratings of their current and desired bodies (Frederick et al., in press). It has also been used to discriminate between levels of muscularity represented in popular male-audience, female-audience, and bodybuilder-audience magazines (Frederick, Fessler, & Haselton, 2005). In Studies 3-6 of this article, a corresponding measure to the MSM was also used: the Fat Silhouette Measure (FSM; see Appendix C). The FSM presents eight silhouettes of men varying from slender and nonmuscular to obese and nonmuscular. It was also used to examine body satisfaction among men in the United States, Ukraine, and Ghana (Frederick et al., in press). Men's self-ratings of their current body on this form are highly correlated with body mass index (BMI; r = .69), a rough estimate of body fat level calculated from self-reported height and weight (Frederick et al., in press).

Procedure. The images were labeled 1-8, and intervals of .5 were included so participants could indicate intermediate values if they felt their answer lay between two images (1, 1.5, 2, 2.5, etc.). Women were first asked, "Which man would make the best short-term sexual partner/brief sexual affair for you?" and "Which man would make the best long-term dating partner for you?" They were then asked, "How attractive do you find each person above?" Women rated each image using a 9-point Likert scale: (1 = *not at all,* 3 = *a little,* 5 = *somewhat,* 7 = *very,* 9 = *extremely*).

Results and Discussion

Inverted-U hypothesis of masculine traits. A within-subjects ANOVA with linear and curvilinear (quadratic) contrasts was conducted to examine how the men's muscularity on the MSM related to women's ratings of their physical attractiveness. Because we conducted multiple comparisons, we set a conservative alpha level of .001. As shown in Figure 2, there was a significant effect of muscularity, indicating that women's ratings differed across the various levels of muscularity, $F(7, 1995) = 218.65$, $p < .001$. Pairwise comparisons indicated that most images differed from each other at the $p < .001$ level, although some comparisons were only marginally significant at the $p < .05$ level (Images 1 vs. 5 and Images 3 vs. 5). Images 1 and 7, however, did not differ ($p = .595$). There was a weak, marginally significant linear effect of muscularity, $F(1, 285) = 9.17$, $p = .003$, partial $\eta^2 = .031$. Specifically, there was a modest tendency for increased muscularity to be associated with lower ratings of attractiveness, which is explicable by the fact that the extremely muscular men (Images 7-8) were rated particularly unattractive. In support of the inverted-U hypothesis of masculine traits, however, women's ratings of muscularity followed a strong curvilinear relationship $F(1, 285) = 1{,}189.68$, $p < .001$, partial $\eta^2 = .807$. These findings support the inverted-U hypothesis that increased muscularity is attractive up to a point, with high and low levels of muscularity being less appealing to women.

Short-term versus long-term partner preferences. Consistent with the prediction derived from mating trade-off theory, women reported that the best short-term partner for them ($M = 4.88$, $SD = 1.10$) was more muscular than the best long-term partner for them ($M = 4.39$, $SD = 1.02$), $t(279) = 9.15$, $p < .001$, $d = .46$.

STUDY 3: MUSCULARITY OF WOMEN'S PAST SEXUAL PARTNERS

The findings of Study 1 show that women find muscular men sexually attractive but believe they are less likely to be committed, and the findings of Study 2 suggest women prefer less muscularity in a long-term partner. These findings are consistent with the mating trade-off hypothesis, which suggests that women should have stronger preferences for men displaying cues to heritable fitness, particularly when considering men as short-term mates. In parallel, men possessing these cues may be more likely to pursue a short-term mating strategy. Thus, we predicted that women's past short-term sex partners would be more muscular than their other (longer term) sex partners. We tested this prediction by asking women to rate the muscularity and athleticism of both their most

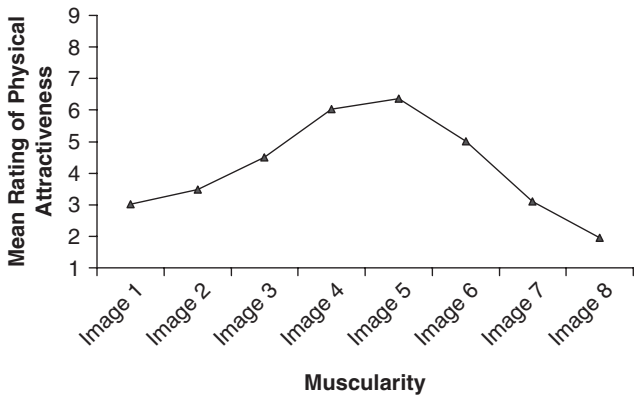


Figure 2 Association of men's muscularity with women's ratings of physical attractiveness.
NOTE: Image 1 represents a nonmuscular man on the Muscle Silhouette Measure (MSM), whereas Image 8 represents an extremely muscular man (Frederick et al., in press; see Appendix B). Women rated the physical attractiveness of each man on a 9-point Likert scale (1 = *not at all,* 9 = *extremely*). Consistent with the inverted-U hypothesis of masculine traits, women's ratings of the physical attractiveness of men varying in muscularity followed a strong curvilinear pattern.

recent sex partner and their most recent short-term sex partner.

Method

Participants. Participants were drawn from a set of 470 women from UCLA who participated in a larger study on personality in which the target items for Study 3 were embedded. Participants received research credit as part of a psychology or communication course, or were entered in three lotteries for $50 each. A subset of 82 women who indicated having a past short-term sex partner, as well as another sex partner, completed a dating behavior survey and were included in the current study (M age = 22.35, SD = 5.23).

Stimuli. Women reported their past partner's muscularity and body fat using the MSM and FSM described in Study 2.

Procedure. Women were asked to report several pieces of information about their most recent sex partner, followed by their most recent short-term sex partner, who was defined as a person "whom you have had a brief sexual affair or one-night stand with." Women whose most recent sex partner was also their most recent short-term sex partner reported information about their second-most-recent sex partner.

For both partners, women were asked, "How old were you the first time you had intercourse with this person?" They were then asked, "How long did you know the person before you had intercourse?" and "How long were you dating the person before you had intercourse?" Participants specified their answers in terms of weeks, months, and years, and all responses were converted to length of time in weeks. They were then asked, "Before the first time you had sex . . . "how emotionally close were you to this person?" "how romantic was this person?" and "how much did you trust this person?" Responses were made on a 9-point Likert scale (1 = *not at all,* 3 = *a little,* 5 = *somewhat,* 7 = *very,* 9 = *extremely*). Women were also asked, "Compared to the average man your age . . . "how muscular was this person?" and "how athletic was this person?" Responses were made on a 9-point Likert scale (1 = *much less,* 3 = *somewhat less,* 5 = *equally,* 7 = *somewhat more,* 9 = *much more*). Finally, they recorded the muscularity and body fat levels of these partners using the MSM and the FSM, respectively.

Results and Discussion

Results are presented in Table 2. In support of the prediction, women reported that their short-term partners were more athletic and more muscular than their other recent sex partners on both the Likert scale measure and the MSM. Women also reported they dated their short-term partners for less time than their other recent sex partners before having sex (1 week vs. 12 weeks), thus validating the temporal distinction between short-term partners and "other" partners. Relative to reports for other partners, women also trusted their short-term partners less, felt less emotionally close to them, and reported they were less romantic.

One consequence of our method was that it was biased against the hypothesis because some of the individuals in the "other recent sex partner" category may also have been short-term partners. The fact that women reported dating the short-term partners for significantly less time than their other recent partners gives us confidence that we were primarily comparing short-term to long-term partners. However, to confirm that our results were robust, we conducted all of the analyses after eliminating anyone who indicated that she dated her most recent sex partner for less than 1 week before having intercourse with him (n = 15). This did not change the pattern of significant results.

Our finding that women reported greater muscularity in their short-term partners than in their other partners is consistent with the hypothesis that muscularity is a cue of fitness. Furthermore, it is noteworthy that women felt less emotionally close to their short-term partners than to their long-term partners before sex. One interpretation of this finding is that women were biased to recall short-term partners more negatively than other partners. A second interpretation, consistent

TABLE 2: Characteristics of Past Sex Partners Reported in Study 2

	Short Term (ST)		*Most Recent (MR)*		t	p	d	*% ST > MR*	*% MR > ST*
Muscle (MSM)	3.76	(1.54)	3.23	(1.37)	2.85	.006	.36	61	28
Fat (FSM)	3.16	(1.14)	3.28	(1.30)	–0.61	.545	–.10	38	46
Muscular	6.40	(1.93)	5.51	(1.87)	3.43	.001	.47	59	24
Athletic	6.23	(1.98)	5.81	(1.96)	2.06	.001	.33	59	25
Long dated	0.90	(2.05)	11.67	(21.23)	–4.63	.001	–.71	6	76
Long known	48.49	(103.40)	45.12	(79.35)	0.26	.800	.04	37	60
Age	19.71	(3.78)	19.96	(3.93)	–0.94	.349	–.06	32	38
Romantic	4.00	(2.34)	5.90	(2.34)	–5.80	.001	–.82	18	67
Trust	4.51	(2.32)	6.54	(2.09)	–6.28	.001	–.92	18	68
Emotionally close	3.45	(2.43)	5.51	(2.35)	–6.34	.001	–.86	17	71

NOTE: The first two categories report women's descriptions of their most recent short-term sex partners and other most recent partners, followed by tests of whether these partners differed from each other on traits such as muscularity. The second-to-last column indicates the percentage of women who reported that their short-term sex partner scored higher on a trait (e.g., muscularity) than their most recent partner. The last column indicates the percentage of women who reported that their most recent sex partner scored higher on a trait than their other recent partners. MSM = Muscle Silhouette Measure; FSM = Fat Silhouette Measure.

with the mating trade-off hypothesis, is that women were more willing to have short-term relations with muscular men without the requirement that they demonstrate characteristics particularly desired in long-term mates (trustworthiness, emotional closeness, etc.), possibly because these men possessed physical indicators of genetic fitness.

STUDY 4: GREATER SEX PARTNER NUMBER AMONG MUSCULAR MEN

The previous three studies revealed that women find muscular men sexually desirable and that women's short-term sex partners were more muscular than their other sex partners. These findings are congruent with the hypothesis that men with fitness cues are selected more often as sex partners. Here we test a corresponding prediction about men's reports of their own sexual histories: that muscular men would report having more lifetime sex partners than nonmuscular men.

Method

Participants. The participants in this study were first photographed and then completed a survey on relationships and sexuality. Men in this study ($N = 115$) were asked the following question as part of their survey: "In your life so far, how many different people have you had sexual intercourse with?" Sixteen of the participants declined to be photographed, did not answer sex partner question, or both. The final sample included 99 men with a mean age of 21.26 ($SD = 2.35$).

Stimuli. All of the men posed for standing full-body digital photographs with their hands placed at their sides (Canon PowerShot S410, 4.0 Megapixels). Photographs were taken in the same location under standardized lighting conditions against a plain blue background.

Procedure. Four judges (3 women and 1 man) blind to the purpose of the study coded the photographs. They were instructed to first look at all of the photographs to get a sense of the range of body types. They then coded the men for muscularity and body fat using a 9-point Likert scale (1 = *much less than average,* 3 = *less than average, 5 = average, 7 = more than average,* 9 = *much more than average*). They then coded the men's muscularity and body fat using the MSM and FSM described in Study 2. The judges' ratings were averaged for each item because the alphas were greater than .70.

Results and Discussion

Consistent with the predictions, greater muscularity, as coded by independent judges, was associated with greater lifetime partner number (see Table 3), though this association was not statistically significant ($p > .05$). However, when we controlled for two important confounds, age and body fat level, the association between muscularity and partner number was statistically significant (see Table 3). This pattern was obtained across each measure of muscularity (Likert scale and MSM). This finding supports the prediction that muscular men have more mating opportunities. One limitation of this study, however, was that the participants were fully clothed, which may have obscured true differences between men and perhaps reduced associations between muscularity and partner number. Studies 5 and 6 partly addressed this limitation by asking men to self-rate their level of muscularity.

TABLE 3: Correlations Between Self-Reported Muscularity (MSM), Attractiveness, and Sexual History

	Muscularity r	p	*Partial* r	r	*Partial-2* r	p
Study 4						
Lifetime sex partners (Muscularity 1-9)	.09	.362	.27	.008		
Lifetime sex partners (MSM)	.06	.553	.20	.046		
Participants (*N*)	99		94			
Study 5						
Sexy to average women	.54	.001	.58	.001	.49	.001
Sexy to very attractive women	.69	.001	.62	.001	.55	.001
Number of lifetime sex partners	.27	.003	.24	.008	.26	.005
Number of short-term sex partners	.20	.034	.18	.058	.25	.009
Participants (*N*)	112-123		108-119		107-118	
Study 6						
Sexy body to women	.60	.001	.62	.001		
Number of lifetime sex partners	.25	.063	.27	.052		
Number of short-term sex partners	.32	.018	.33	.015		
Number of affairs with mated women	.27	.044	.28	.037		
Participants (*N*)	56		52			

NOTE: "Muscularity *r*" refers to the first-order correlations with muscularity on the Muscle Silhouette Measure (MSM) and other variables. The only exception is that muscularity was also assessed on a Likert scale ranging from 1 to 9 in Study 4 (1 = *much less than average*, 9 = *much more than average*). In Study 4, body fat and muscularity were determined by codings of participant photographs made by judges. In Studies 5 and 6, body fat and muscularity were self-reported by participants. "Partial *r*" refers to the correlation between muscularity and the other variables, controlling for body fat level and age. In Study 5, "Partial-2 *r*" also includes self-esteem as a control.

Studies 5 and 6: Greater sex partner number and self-rated attractiveness among muscular men. Study 4 found that men who were more muscular reported more lifetime sex partners. However, our muscularity hypothesis also predicts that increased muscularity will specifically be associated with increased opportunities for short-term sexual affairs. In Study 5, we tested the prediction that muscular men would report having more lifetime sex partners and short-term sex partners than nonmuscular men, as well as greater self-reported attractiveness to women. In Study 6, we attempted to replicate these findings and to test the prediction that muscular men would report having more affairs with women who already have a primary mate. This prediction follows from the mating trade-off hypothesis, which proposes that women will seek extrapair mates displaying fitness cues if their long-term partners lack such cues.

Method

Participants. In Study 5, heterosexual male students ($N = 124$) from UCLA with a mean age of 20.90 ($SD = 2.98$) completed measures of past sexual history in exchange for extra credit as part of a psychology or communication studies class. In Study 6, heterosexual college men ($N = 56$) from UCLA with a mean age of 21.80 ($SD = 6.92$) participated in exchange for credit as part of a psychology class.

Stimuli. The stimuli for Studies 5 and 6 were the MSM and FSM described in Study 2.

Procedure. In Studies 5 and 6, men were asked to indicate their level of muscularity and body fat on the silhouette scales. In both studies, they also completed items using a 9-point Likert scale (1 = *not at all*, 3 = *a little*, 5 = *somewhat*, 7 = *very*, 9 = *extremely)* designed to assess how attractive they believed women found their bodies. In Study 5 the items were "How sexy is your body to the average woman?" and "How sexy is your body to very attractive women?" In Study 6 the item was "How sexy is your body to women?" Men also reported on their past dating history. In Studies 5 and 6 they were asked, "How many individuals have you had sexual intercourse with?" and "How many brief sexual affairs or one-night stands have you had?" In Study 6 they were also asked, "How many times have you had sex with a woman who had a boyfriend or husband at the time you had sex with her?" Finally, in Study 5, participants completed a measure of general self-esteem (Rosenberg, 1965) using a 4-point Likert scale, where higher scores represent greater self-esteem.

Results and Discussion

Results for both studies are summarized in Table 3. As predicted, compared with less muscular men, muscular

men rated their bodies as sexier to women in each study. Similarly, muscular men reported more lifetime sex partners, more short-term sex partners, and more affairs with mated women at significant or marginally significant levels. We then conducted partial correlations controlling for participants' age and self-reported body fat level on the FSM to better isolate the association of muscularity to self-rated attractiveness and sex partner number. The pattern of results remained essentially unchanged, although the association between muscularity and number of brief sexual affairs in Study 5 dropped to marginally significant ($p = .058$). In Study 5, we also included self-esteem as a control to rule out the possibility that general self-confidence was driving the association between self-reported muscularity and sex partner number. Despite the fact that self-reported muscularity and self-esteem were positively related ($r = .39$, $p < .001$), when self-esteem was added as a control, muscularity was still a significant predictor of past number of sex partners and self-rated attractiveness.[2]

GENERAL DISCUSSION

The results across six studies support the hypothesis that muscularity is a sexually selected fitness cue. Women rated muscular men as more sexually desirable than both nonmuscular men and very muscular men, as predicted by our inverted-U hypothesis of masculine traits (Studies 1 and 2). Also consistent with our predictions, women inferred that muscular men were more physically dominant, more volatile, and less likely to show commitment than less muscular men, a pattern consistent with research on other testosterone-linked fitness indicators such as facial masculinity (Johnston et al., 2001).

If muscularity is a cue of fitness, muscular men should have more mating opportunities. In Studies 3-6, we found evidence supporting this prediction. Women reported that their past short-term sex partners were more muscular than their most recent sex partners across two measures of muscularity. Consistent with past research on fitness cues (Hughes & Gallup, 2003; Thornhill & Gangestad, 1994), muscular men rated their bodies as sexier to women, reported more lifetime and short-term sex partners, and reported more affairs with mated women when controlling for other variables (age, body fat level, and self-esteem).

Limitations and Strengths

One limitation of these studies was that all of the participants were young college students who may have preferences and mating patterns that differ from those of other populations. Nonetheless, in examining mate preferences, a college-aged population is an appropriate place to begin because members of this population are actively seeking and evaluating mates. Future research is needed to examine how well the body types represented in this study actually map onto the levels of muscularity present in traditional hunter–gatherer societies. Furthermore, an interesting question to explore is whether women's preferences for muscularity are relatively fixed or variable in response to local variation in body types and ecological conditions.

A second limitation is that men's level of muscularity was reported by participants in Studies 5 and 6 and was not objectively measured by researchers. When muscularity was coded by independent judges in Study 4, rather than relying on participant self-reports, muscularity was significantly associated with lifetime sex partner number when controlling for age and body fat level. This indicates that muscularity is a good predictor of lifetime sex partner number regardless of whether it is self-reported or coded by independent judges. Future research could better estimate the strength of the associations between muscularity and partner number by photographing men with their upper torsos exposed.

One strength of this study was that conclusions about preferences for different body types were based on computer-generated images of men in Study 1. Using computer-generated images minimizes confounds associated with images of real men and offers the ability to systematically vary levels of muscularity. These images were also more realistic than the hand-drawn silhouettes commonly used in studies of preferences for male body types (e.g., Campbell et al., 2005; Dixson et al., 2003; Fallon & Rozin, 1985; Frederick et al., in press; Lipinksi & Pope, 2002; Pope et al., 2000; Yang et al., 2005). It is possible, however, that women express different preferences when evaluating computer-generated images than when evaluating real men. In our previous research we asked women to rate unaltered photographs of men varying in degrees of muscularity using methods similar to those outlined in Study 1 (Frederick, Haselton, Buchanan, & Gallup, 2003). Consistent with the findings in Study 1, greater muscularity was associated with ratings of more dominance, more volatility, and less commitment, and ratings of sexual desirability followed an inverted-U pattern. Thus, our results using computer-generated images were cross-validated by results involving photographed men.

Finally, multiple methods were used to test the hypothesis that muscularity is a cue of fitness. For example, women reported that muscular men were desirable as sex partners and physically attractive. This was paralleled by women's reports that they had stronger preferences for muscularity in a short-term sex partner than in a long-term partner and that their short-term

partners were more muscular than their other partners. That women actually do choose muscular short-term partners was supported by the finding that muscular men reported having more sex partners, brief sexual affairs, and affairs with mated women. These pieces of evidence converge to indicate that muscularity is sexually attractive and is possibly a cue of fitness.

The Evolution of Social Prestige and Body Type Preferences

The preceding arguments suggest that women possess evolved preferences specifically for muscularity. One impressive feature of human psychology, of course, is that humans appear to have evolved adaptations for attending to, communicating, and processing socially and culturally transmitted information (e.g., Boyd & Richerson, 2005). A competing perspective to the one we have articulated would suggest that these preferences are shaped solely or primarily by culturally transmitted information about what body types are desirable (e.g., through the popular media). Although this is possible, in our view this competing explanation begs the question of why certain body types become the subject of culturally transmitted information. Furthermore, it is not clear that these competing explanations would have predicted our specific pattern of findings. For example, whereas the mating trade-off theory (Gangestad & Simpson, 2000) explicitly predicts that women have different preferences for short-term and long-term mates, it is not clear that theories focusing solely on culturally transmitted values would have predicted this effect.

Future research is needed to fully test between these competing models. One view that incorporates aspects of both of these models has recently been advanced to explain why muscular bodies are featured in the popular media. Frederick et al. (2005) proposed that selection attached heightened importance to some aspects of bodies because of their association with fertility or virility, including muscularity. This enhances the likelihood that these aspects will be featured in the media of cultural transmission (e.g., magazines, television, and movies) and seized on as avenues for prestige competition (see Frederick et al., 2005). More generally, future research should examine how evolutionarily relevant factors might shift the importance of muscularity to women and their preferred level of muscularity (e.g., ecological factors, individual differences, parasite prevalence, degree of warfare).

Other Routes to the Evolution of Preferences for Muscularity

Genetic benefits, direct benefits, and intrasexual competition? These studies were motivated by a specific evolutionary theory of mate choice. This theory states that women prefer men with exaggerated secondary sexual characteristics because these traits are cues of fitness; therefore, women who were attracted to these men in our ancestral past would have had greater reproductive success than other women. However, unlike hypothesized fitness cues that only have value as a social cue (e.g., facial masculinity), other evolutionary forces may have played a major role in shaping women's preference for muscularity. Muscularity itself is likely to be directly useful in activities such as resource gathering and providing protection. Therefore, the preference for muscularity may have evolved in women, in part, because of the direct benefits muscular men provided to their mates. Although we have focused on the genetic benefits underlying women's preferences for muscularity, we do not rule out the influence of sexual selection for direct benefits. Indeed, we concur with Wong and Candolin (2005), who observe,

> Mate choice can present choosy individuals with both direct material gains that increase their fecundity and/or survival, as well as indirect benefits that improve offspring viability and/or attractiveness. Competitive ability may correlate with some of these benefits if, for example, males that are adept in competition also monopolise the best resources or territories. . . . Moreover, dominance could correlate with genetic benefits if sons inherit their father's competitive prowess, resulting in dominant males siring successful sons. (p. 2)

Like dominance, muscularity could be preferred because it is associated with both indirect (genetic) and direct mating benefits.

Genetic or direct benefits? Examining the contexts that accentuate preferences for muscularity could prove useful in determining whether women's preferences are in fact due, at least in part, to genetic benefits. The strategy employed in this article was to examine whether muscular men were chosen more often than less muscular men as short-term sex partners and for affairs. It is not clear that a direct benefits perspective would predict this association; thus, we view the data as providing some support for the fitness indicator hypothesis.

A further test of the genetic versus direct benefits proposals would be to examine changes in women's preferences for muscularity across the ovulatory cycle. Past research has found that women's preferences for fitness indicators such as facial masculinity peak during the high-fertility phase of the menstrual cycle, presumably because this is when women would benefit most from mating with men who possess fitness indicators (e.g., Johnston et al., 2001; Penton-Voak & Perrett, 2000; Penton-Voak et al., 1999). If muscularity is a

sexually selected fitness cue, preferences for muscularity may also peak during the high-fertility phase of the ovulatory cycle. The direct benefits perspective makes no such prediction. In a recent study, Gangestad, Garver-Apgar, Simpson, and Cousins (2006) asked women to watch videotapes of men varying on several dimensions (symmetry, facial masculinity, muscularity, etc.). The researchers found that women preferred muscular men as short-term partners more during high-fertility than during low-fertility phases of the ovulatory cycle. A limitation of this study is that it is unknown whether the effect was driven by muscularity, per se, or another feature that might correlate with muscularity in natural populations (e.g., facial masculinity). Future work in this area using more controlled stimuli that vary only in muscularity is needed to test fully this prediction.

The Relative Value of Muscularity as a Cue

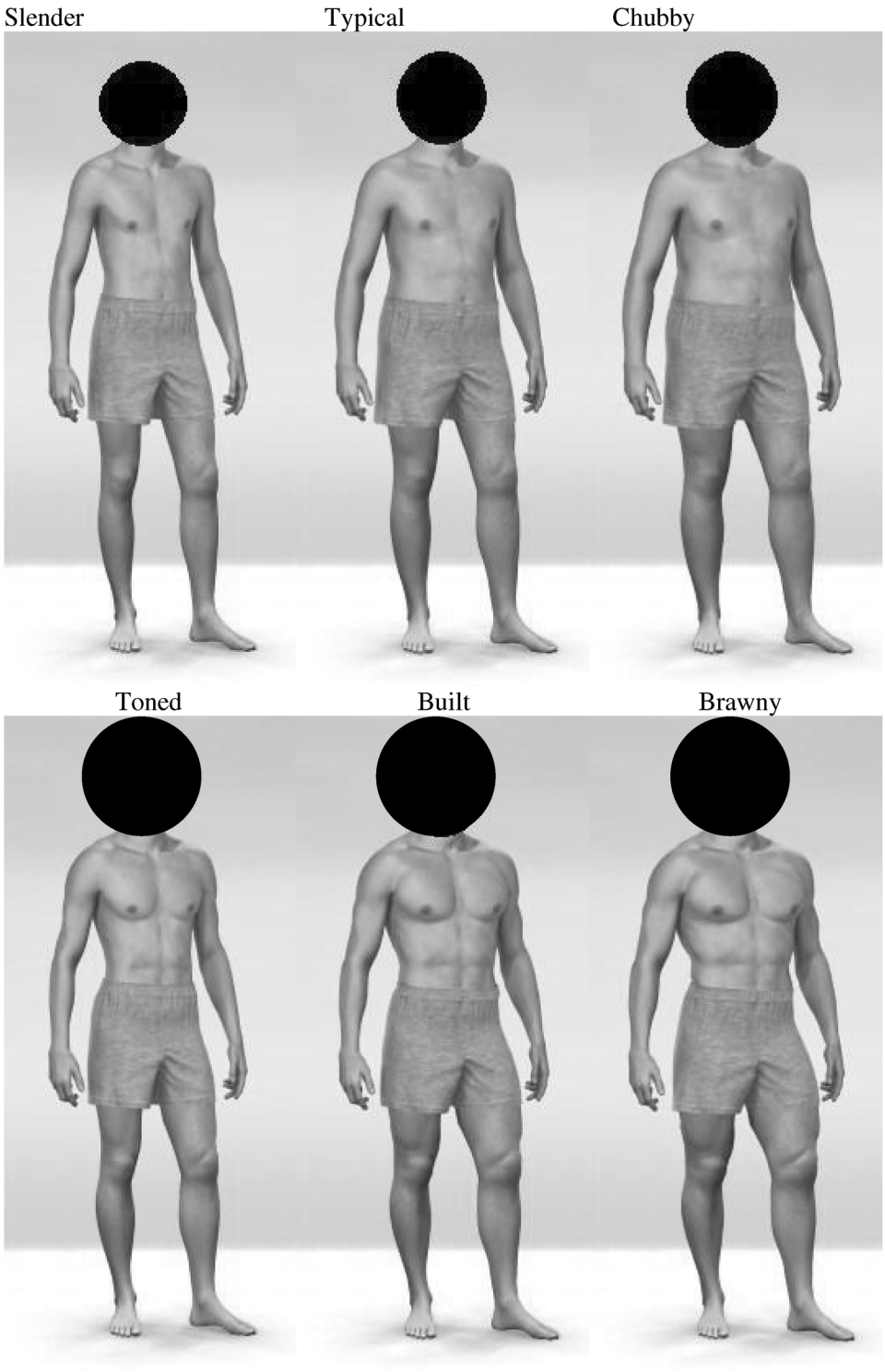
The studies examined in this article suggest that muscularity is one cue women use to assess men's desirability as mates. Muscularity may partially covary with other traits, such as facial masculinity, symmetry, intrasexual competitiveness and dominance, shoulder-to-hip ratio, waist-to-hip ratio, height, self-confidence, prestige, and socioeconomic status. Thus, research assessing the relative value of muscularity in predicting men's desirability as mates is also needed. For example, among men with similar shoulder-to-hip ratios, does increased muscle definition (e.g., in the arms, abdomen, chest, and legs) have additional value as a cue of genetic or direct benefits (e.g., hunting ability)? One possibility is that traits that are potentially more stable in adulthood than muscularity (e.g., height) provide evidence that a person was able to invest resources in somatomorphic development during adolescence by developing a large body frame. Other physical traits, such as athleticism and degree of muscularity, provide information not only about past ability to invest in somatomorphic development but also one's current ability to invest energy in maintaining a metabolically expensive body type over an extended period. This malleable property of muscularity may make it a particularly valuable cue, as it provides evidence of a continued ability by men to maintain good condition and to devote resources to maintaining body size.

Conclusion

Although past research has focused primarily on the factors that make women physically attractive to men, these studies suggest that men's physical features are related not only to women's expressed preferences for mates but also to men's and women's past mate choices and sex behaviors. From a sexual selection perspective, this makes sense—these traits may be cues of heritable fitness and women who expressed these preferences would have had greater reproductive success than women who did not. These findings expand on a growing body of literature suggesting that traits that are costly to develop are important components of male physical attractiveness. These findings also support the conclusion that male physical attractiveness plays a previously underappreciated role in women's mate choices—and perhaps in how men compete with each other to attract women's attention.

APPENDIX A

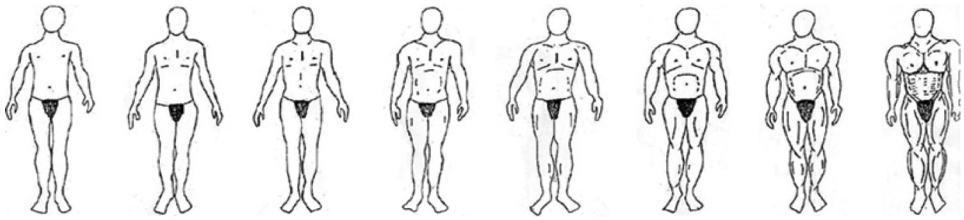
Images Representing Men Varying in Body Fat and Muscularity, Used in Study 1



NOTE: The images were created using MyVirtualModel.com.

APPENDIX B

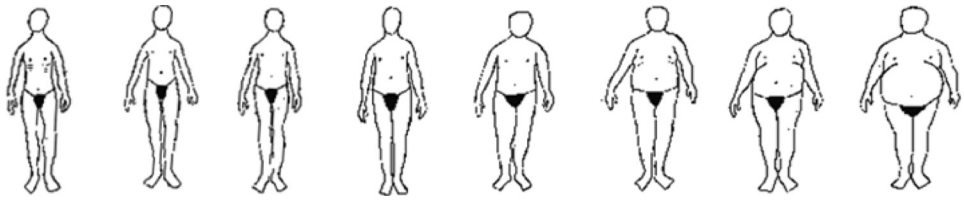
Images Representing Men Varying in Muscularity, Used in Studies 2-6



NOTE: The figures are from the Muscle Silhouette Measure (Frederick et al., in press).

APPENDIX C

Images Representing Men Varying in Body Fat Level, Used in Studies 3-6



NOTE: The figures are from the Fat Silhouette Measure (Frederick et al., in press).

NOTES

1. Some theorists propose that fitness indicators should be associated with good health (e.g., Rhodes et al., 2001). It is possible that hypothesized fitness indicators such as muscularity or other masculine features could be associated with good health, but a necessary association does not follow from sexual selection theory. For example, when there is strong within-sex competition, it may be advantageous for individuals with relatively large energy budgets to spend extravagantly in signaling to attract mates, even if this compromises their long-term health or chances of survival. Individuals with smaller budgets, on the other hand, may benefit more by pursuing a strategy of lower resource expenditure, leading them to have better long-term health than other individuals. Furthermore, some costly signals may also be useful for intrasexual competitions and intimidating rivals (e.g., large horns or body size); thus, it may benefit some males to develop very expensive features even if it drives their long-term health below that of the average male. For more discussion of these issues, please refer to reviews of the literature (e.g., Getty, 2002, 2006; Kaplan & Gangestad, 2005).

2. One interesting point to consider is whether the association between muscularity and sex partner number might also be curvilinear. If women find men with moderate muscularity most desirable, as suggested by the inverted-U hypothesis, might moderate levels of muscularity be associated with the highest number of sex partners? We tested the curvilinear effect by entering the squared values of the *z*-scored muscularity (Muscle Silhouette Measure) variable as predictor of sex partner number. This had the effect of recoding low muscularity and high muscularity with high values, so that a significant effect would indicate a curvilinear association. Also included as predictors were age, body fat (Fat Silhouette Measure), and the linear effect of muscularity as control variables. In Studies 4-6, there were no significant curvilinear effects of muscularity on lifetime sex partner number, brief sexual affairs, affairs with mated women, or self-rated attractiveness to women (all *p*s > .05). One reason for the lack of association could be that there are simply not enough extremely muscular men in our sample to detect a significant curvilinear relationship. On the other hand, although highly muscular men might be less attractive to women, they may be more dominant, volatile, persistent, confident, coercive, narcissistic, and so on, which would lead them to have more sex partners.

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Received June 19, 2006
Revision accepted December 17, 2006