

## Red, Rank, and Romance in Women Viewing Men

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In many nonhuman species of vertebrates, females are attracted to red on male conspecifics. Red is also a signal of male status in many nonhuman vertebrate species, and females show a mating preference for high-status males. These red–attraction and red–status links have been found even when red is displayed on males artificially. In the present research, we document parallels between human and nonhuman females' response to male red. Specifically, in a series of 7 experiments we demonstrate that women perceive men to be more attractive and sexually desirable when seen on a red background and in red clothing, and we additionally show that status perceptions are responsible for this red effect. The influence of red appears to be specific to women's romantic attraction to men: Red did not influence men's perceptions of other men, nor did it influence women's perceptions of men's overall likability, agreeableness, or extraversion. Participants showed no awareness that the research focused on the influence of color. These findings indicate that color not only has aesthetic value but can carry meaning and impact psychological functioning in subtle, important, and provocative ways.

*Keywords:* color, red, attractiveness, status, attraction

What influences women's physical attraction to men? Women's romantic preferences are of great interest to the general public and the scientific community alike, and although the popular media often portrays female sexuality as a mystery, scientific research has revealed several factors that influence women's attraction to men. Women find men more attractive when they have average,

symmetrical facial features that display certain masculine qualities (a prominent chin and cheekbones) and a body that is symmetrical and muscular (but not muscle bound), with the shoulders somewhat wider than the hips. Men who are slightly taller than average and who have a relatively deep voice are also preferred by women (for reviews, see Buss, 2008; Gangestad & Scheyd, 2005; Sugiyama, 2005; Weeden & Sabini, 2005). Research focused on nonphysical characteristics has shown that women find men more attractive when they are kind (Sprecher & Regan, 2002), agreeable (Jensen-Campbell, Graziano, & West, 1995), intelligent (Hatfield & Sprecher, 1995), high in status (Townsend & Levy, 1990b), emotionally stable (Buss et al., 1990), and good-humored (Bressler, Martin, & Balshine, 2006).

In the present research we investigate color, specifically the color red, as a novel factor that may influence women's attraction to men. Red carries amorous meaning in the context of heterosexual interaction. Research on color associations indicates that people across cultures link red to love and passion (Aslam, 2006; Jacobs, Keown, Worthley, & Gyhm, 1991; Neto, 2002), and red often appears as a symbol of eros, lust, and fertility in ancient mythology, folklore, and ritual (Hutchings, 2004; Jobes, 1962; Kohn, 1999). Interestingly, in both ancient and modern times, red primarily carries the meaning of sex and romance with regard to women (e.g., lingerie; lipstick and nail polish; red-light districts;

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This research was supported by a grant from the Alexander-von-Humboldt Foundation and an Excellence Guest Professorship from the University of Munich to Andrew J. Elliot, and by grant GR 1882/12-1 from the German Research Foundation to Tobias Greitemeyer.

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the red dress in literature, on the stage, and in films; Elliot & Niesta, 2008; Greenfield, 2005); there is no male equivalent to the "lady in red." Thus, there are general, but not male-specific, cultural associations that link red and romance.

In many species of animals, however, male red appears to carry an amorous meaning for females, because females prefer (e.g., solicit copulation from) male conspecifics displaying the most and most intense red coloration. This female attraction to male red has been found in crustaceans (e.g., amphipods; Iyengar & Starks, 2008), fish (e.g., sticklebacks; Milinski & Bakker, 1990), birds (e.g., finches; Burley, 1981), and nonhuman primates (e.g., rhesus macaques; Waite et al., 2003; for reviews see G. E. Hill, 1999; Setchell, 2005). Even artificial red displays (e.g., red aluminum leg bands) that extend beyond natural bodily processes increase females' attraction to male conspecifics (Burley, 1981; Yasukawa, Butler, & Enstrom, 2009). The present research tests the hypothesis that viewing red leads women to perceive men as more attractive and more sexually desirable. Furthermore, we posit that this red effect occurs because ladies see a "gentleman in red" as higher in status.

### Red and High Status

Research examining associations to color words and color stimuli has demonstrated that red is linked to strength, power, and competitive dominance (Little & Hill, 2007; Schaie, 1961; Wexner, 1954; for reviews, see Adams & Osgood, 1973; Ball, 1965). This red-potency association appears to be present across cultures (Oyama, Tanaka, & Chiba, 1962; J. E. Williams, Moreland, & Underwood, 1970) and age groups (J. E. Williams & McMurtry, 1970). Historically, red has been used as a symbol of authority, wealth, and status. In primitive societies, sacred objects were painted or coated in red to enhance their potency and convey a sense of great importance (Taçon, 2008; Wreschner, 1981); red was also used in body decoration and worn on necklaces to symbolize high rank in rituals and ceremonies (Orchardson-Mazrui, 1998; Pickenpaugh, 1997). In ancient China, Japan, and sub-Saharan Africa, red was viewed as a symbol of prosperity and high status (Donkin, 1977). Classical Romans called the most powerful men in the city *coccinati*—"the ones who wear red" (Greenfield, 2005)—and red was the color of regalia and ceremonial clothing throughout Central America, South America, and the Pacific Islands (Pickenpaugh, 1997). Beginning in the late 12th century, the Christian church adopted red as a symbol of its authority (using a red cross on a white shield as its emblem), and red was the color of nobility and rank in medieval Europe, worn by kings, cardinals, and judges (Gage, 1999; Munro, 1983). Indeed, in various parts of Europe and Asia, red clothing in general conveyed wealth and status, and the privilege of wearing red was reserved for the upper class (Ewing, 2006; Munro, 2007; Yau, 1994). In contemporary times, a red tie is used in the business world to indicate power, a "red letter day" is a day of great significance, and "rolling out the red carpet" signifies special treatment typically reserved for celebrities or dignitaries.

It is possible that this link between red and high status is a product of social learning alone, but there is reason to believe that it may have roots in our biological heritage. If so, a link between red and high status should be observed in other animals, including other primates. Status hierarchies are present across the animal

kingdom (Eibl-Eibesfeldt, 1989), and in many species, male red is an indicator of high status. For example, male mandrills display red on their face, rump, and genitalia; this red is expressed most extensively and intensely in alpha males, and males that gain in rank exhibit an increase in red coloration (Setchell & Dixon, 2001). Red is also an indicator of male status in amphipods (Iyengar & Starks, 2008), sticklebacks (Bakker & Sevenster, 1983), lizards (Healey, Uller, & Olsson, 2007), and various bird species (e.g., finches; Pryke & Griffith, 2006), as well as other primates (e.g., gelada baboons; Dunbar, 1984). This red status coloration is typically displayed most conspicuously during the mating season, as well as both prior to and following male-male competition for mates or territory (Andersson, 1994). Artificial red displays that mimic natural red coloration (e.g., red facial paint) have also been shown to be effective signals of male status (Cuthill, Hunt, Cleary, & Clark, 1997; Healey et al., 2007).

Existing research on the physiology of these red status displays indicates that they are androgen-dependent. Status is associated with testosterone in many vertebrates, including primates (Mehta, Jones, & Josephs, 2008; Muller & Wrangham, 2004; Setchell, Smith, Wickings, & Knapp, 2008). Males high in status possess greater amounts of testosterone prior to intrasex competition, and winning such competitions increases testosterone levels (Contreras-Garduño, Buzatto, Serrano-Meneses, Nájera-Cordero, & Córdoba-Aguilar, 2008; Sapolsky, 1991; Setchell & Wickings, 2004). Testosterone has been implicated in peripheral vascular processes in male vertebrates, and it appears to increase blood flow within sex skin regions (Blas, Perez-Rodriguez, Bortolotti, Vinuela, & Marchant, 2006; Rhodes et al., 1997; Vandemburgh, 1965). Red displays are a function of pigmentation, as well as vascular processes. Greater skin redness is produced by higher carotenoid (G. E. Hill, 2002; McGraw, Adkins-Regan, & Parker, 2002) and, perhaps, higher oxygenated hemoglobin (Juola, McGraw, & Dearborn, 2008) levels in the blood. Red coloration may be an accurate indicator of physiological health, because testosterone-induced skin vascularization is costly to produce in terms of energy (Bardin, 1996; Beehner, Bergman, Cheney, Seyfarth, & Whitten, 2006) and immunocompetence (Folstad & Karter, 1992; Toral, Figuerola, & Negro, 2008), and high carotenoid and oxygenated blood levels can be maintained only by organisms in good physical condition (Changizi, Zhang, & Shimojo, 2006; Negro, Sarasola, Fariñas, & Zorilla, 2006).

Striking parallels exist between human males and other male vertebrates regarding status, testosterone, vascular processes, and pigmentation. Male-status hierarchies have been present in nearly all human societies (Sadalla, Kenrick, & Versure, 1987; Wilson, 1975; cf. Knauff, 1991). Status and testosterone appear to be positively associated in men, particularly in contexts involving competition and more generally in normative evaluation (Archer, 2006; Mazur & Booth, 1998; Mehta et al., 2008). Prior to such events, the testosterone level of those confident in success increases, and testosterone is elevated following success; these patterns have been observed for both physical tasks (e.g., tennis; Elias, 1981; Mazur & Lamb, 1980) and mental tasks (e.g., chess; Gladue, Boechler, & McCaul, 1989; Mazur, Booth, & Dabbs, 1992) and for both face-to-face competitive victory (Booth, Shelley, Mazur, Tharp, & Kittok, 1989; Mazur, Susman, & Edelbrock, 1997) and individual normative success (Mazur & Lamb, 1980; Pound, Penton-Voak, & Surridge, 2009). Testosterone has been

shown to promote peripheral vasodilation in men, increasing blood flow in visible areas of the skin (Edwards, Hamilton, Duntley, & Hubert, 1941; Frost, 2005). Anger and fear have been linked to facial flushing and pallor, respectively, in challenging situations (Drummond, 1997; Levenson, 2003), and facial flushing has also been linked to the joy of receiving positive competence feedback (Drummond, 1994). Higher levels of oxygenated hemoglobin in the blood also produce greater redness of visible skin (Changizi et al., 2006; Edwards, 1953). Red coloration may signal physiological strength and fitness, because testosterone-induced skin vascularization may incur some energetic or immunocompetence costs (Muehlenbein & Bribiescas, 2005), and highly oxygenated hemoglobin levels are associated with health and vigor, whereas deoxygenated hemoglobin levels are associated with several different forms of disease and illness (Changizi, 2009; Stephen, Coetzee, Law-Smith, & Perrett, 2009). Parenthetically, red coloration is also present during embarrassment, but the situational elicitors, duration, and presentation of embarrassment-based coloration differs from the competence- and fitness-based coloration focused on herein (see Leary, Britt, Cutlip, & Templeton, 1992).

In light of these parallels, it seems reasonable to posit that women, like their more primitive female relatives, are biologically predisposed to interpret a display of red by a male conspecific as an indicator of high status. Several possibilities could account for this predisposition. First, competition, especially in the form of both formal and informal normative evaluation, is ubiquitous in daily life (Elliot, 1999; Mussweiler, Rüter, & Epstude, 2004), as individuals strive to obtain raises and promotions, to outperform others on tests and games of ability, to show others their knowledge and wit, and so on. Engaging in these everyday events and responding to the successes and failures therein may be accompanied by testosterone-induced changes that produce subtle shifts in facial blood flow (see R. A. Hill & Barton, 2005, for a similar line of reasoning). As such, successful, high-status men may display red coloration more often in normative evaluative contexts than do unsuccessful, low-status men. A second possibility is that men with greater physiological health and vitality are able to exhibit red more clearly and intensely in general, due to enhanced skin vascularization and/or oxygenated hemoglobin. Women may presume that healthier, more vital men are also more likely to successfully negotiate the challenges of the status hierarchy and to obtain a high social position. A third possibility is that red coloration once served as an indicator of male status in an ancestral environment but no longer does so today. Women may nevertheless continue to respond to red displays as though they convey information about a man's status, despite their unreliability in the present era (a vestigial effect; Durrant & Ellis, 2003; see Buss, Haselton, Shackelford, Bleske, & Wakefield, 1998, for conceptual parallels). In short, each of these possibilities leads to the same hypothesis—that women view red as a signal of high status in men, regardless of whether this signal is accurate.

Status hierarchies in nonhuman animals typically revolve around direct aggressive encounters involving physical dominance or the threat thereof. Status acquisition in humans can certainly involve physical displays of dominance (from subtle facial, postural, or linguistic expressions to explicit aggressive actions; Mazur, 1985; Weisfeld & Beresford, 1982), but the modal way in which humans attain status is through the cultivation of skills and abilities and through the ambitious toiling that leads to economic success and a

high social position (Buss, 2008; Lukas et al., 2004). Thus, striving for status may be seen as rooted in competition for limited, valued resources across phylogeny, but the typical way in which status is acquired and manifested is different in different species (Barkow, 1975; Magee, 2009; Mazur, 2005). In the present research we focus on the most salient manifestation of status in human societies—normative financial and social success.

### High Status and Attraction

Status and physical attractiveness are viewed by theorists across disciplines as distinct, core aspects of mate evaluation (for reviews, see Buss, 2008; Fletcher, 2002; Gangestad & Scheyd, 2005; Geary, Vigil, & Byrd-Craven, 2004; Gerald, 2003; G. E. Hill, 1999; Sugiyama, 2005; Symons, 1979; Townsend, 1998; Wilson, 1975). Considerable empirical work has validated this premise. Most directly, perceptions of status and attractiveness load separately in factor analytic research with human participants, regardless of how these perceptions are measured (e.g., as ideals or actual judgments; with preexisting items or open-ended questions; Boyes & Fletcher, 2007; Fletcher, Simpson, Thomas, & Giles, 1999; Fletcher, Tither, O'Loughlin, Friesen, & Overall, 2004; Kenrick, Sadalla, Groth, & Trost, 1990; Muscarella & Cunningham, 1996; Overall, Fletcher, & Simpson, 2006; Parmer, 1998; Regan, Levin, Sprecher, Christopher, & Cate, 2000). This has been documented both within and across sex, with diverse participant samples (including high school students, undergraduates, and community-based adults) and in a multitude of countries (40 in total, including Australia, Brazil, China, Ecuador, Finland, Greece, Iran, Japan, Nigeria, Poland, South Africa, Taiwan, the United States, Venezuela, and Zambia; Kline & Zhang, 2009; Pillsworth, 2008; Shackelford, Schmitt, & Buss, 2005).

The same theorists who emphasize the centrality of status and physical attractiveness in mate evaluation portray male status as an antecedent of female attraction (for reviews, again see Buss, 2008; Fletcher, 2002; Gangestad & Scheyd, 2005; Geary et al., 2004; Gerald, 2003; G. E. Hill, 1999; Sugiyama, 2005; Symons, 1979; Townsend, 1998; Wilson, 1975). A great deal of existing research supports the idea that women view high-status men as particularly attractive and desirable. Experimental inductions of status have been shown to enhance women's perceptions of male attractiveness and desirability (DeWall & Maner, 2008; Sadalla et al., 1987; Townsend & Levy, 1990a). Women asked to indicate the characteristics they value in dates and mates rate status indicators (e.g., financial prospects, social position) as important (or moderately important, at minimum), and this pattern is found across diverse cultures (Buss, 1989; Hatfield & Sprecher, 1995; Shackelford et al., 2005). Li, Bailey, Kenrick, and Linsenmeier (2002) have shown that women construe social status as a necessity rather than a luxury in partners. Analyses of personal advertisements reveal that women have a strong preference for men with high status potential (Greenlees & McGrew, 1994; Waynforth & Dunbar, 1995; Wiedermann, 1993). A study by Pérusse (1993) documented that higher status males have sex more frequently and with a greater number of partners than do lower status males, and a host of studies have shown that various indicators of male status (e.g., occupational prestige, wealth) are positive predictors of reproductive success, across both cultures and types of societal structures (for reviews,

see B. J. Ellis, 1992; Hopcroft, 2006; Weeden, Abrams, Green, & Sabini, 2004).

One explanation for women's robust preference for high-status men is based in sociocultural factors, namely sex role expectations and structural inequality. In most human cultures, status striving is more integral to the male than the female role, and opportunities for advancement in the workplace are more plentiful for men than for women (Buller, 2005; Wood & Eagly, 2007). As a result, men tend to have greater access to valued resources than do women. Thus, women prefer high-status men who can help them gain access to such resources, and women's date and mate preferences may be seen as a means by which they seek to overcome societal constraints and maximize their social and economic outcomes (Caporael, 1989; Hrdy, 1997). Data testing this explanation are mixed. Some studies seem to indicate that the preference for high-status men is somewhat weaker in women with less traditional sex-role attitudes (Eagly & Wood, 1999; Eastwick et al., 2006; Johannesen-Schmidt & Eagly, 2002) and in cultures more supportive of opportunities for women (Kasser & Sharma, 1999; Moore & Cassidy, 2007), but others show a strong preference for high-status men among economically self-sufficient women (Gil-Burmann, Peláez, & Sánchez, 2002; Townsend, 1989; Wiedermann & Allgeier, 1992) and in cultures supporting women's empowerment (Moore & Cassidy, 2007).

It seems likely that sociocultural factors contribute to women's preference for high-status men, but we suspect that sexual selection may also be implicated at the more distal level of explanation (on the compatibility of proximal and distal levels of explanation, see Kenrick, Trost, & Sundie, 2004; Simpson & Gangestad, 2001; Wood & Eagly, 2007). From this perspective, women's mate preferences are the product of evolved mechanisms that were selected because they maximized women's reproductive success (Darwin, 1871; Symons, 1979). Mammalian females must carry, birth, nurture, and protect their offspring, and they can produce only a limited number of offspring in their lifetime (Trivers, 1972). High-status males represent optimal mating partners because they provide the female with social and material resources (e.g., physical protection, food) that enhance the viability of her progeny. In addition, such males confer a genetic advantage to their male offspring by passing along characteristics associated with high status (Buss, 1989; Gangestad & Simpson, 2000; Sadalla et al., 1987). This biologically based explanation is supported by data indicating that mammalian females in many (although by no means all) species show a preference for mating with high-status males (Brauch et al., 2008; Klinkova, Hodges, Fuhrmann, de Jong, & Heistermann, 2005; Kruczek & Zatorska, 2008). Furthermore, although the relation between male status and reproductive success is complicated by many factors (e.g., male and female reproductive strategies and tactics), a voluminous literature indicates that higher ranking males sire a disproportionate number of offspring in many primate species as well as a diversity of other vertebrate and invertebrate taxa (for reviews, see Di Fore, 2003; Dixon, 1998; L. Ellis, 1995).

### The Present Research

In the present research we examined the hypothesis that red enhances women's attraction to men and does so by increasing the woman's perception of the man's status, which enhances her

attraction to him. In the nonhuman animal literature, the idea that male red serves as an attractant for females (i.e., red as *ornament*; Andersson, 1994) is typically studied separately from the idea that male red serves as a signal of high status for females (Berglund, Bisazza, & Pilastro, 1996). Only a few studies have documented the ornamental and status-signal functions of red at the same time within the same species (Graves, Hable, & Jenkins, 1985; Holder & Montgomerie, 1993), and no research has tested the idea that red's ornamental function is mediated by red's status-signal function. This is our aim herein, focusing on human females and males and using two different approaches to mediation: the experimental-causal-chain (also called double randomization) approach and the measurement-of-mediation approach (see MacKinnon, Fairchild, & Fritz, 2007; Spencer, Zanna, & Fong, 2005).

Although our hypotheses may be derived by considering the societal associations and uses of red alone or by drawing exclusively on homologies across phylogeny suggestive of a biological predisposition to red, we suspect that societal and biological factors jointly contribute to the proposed effects. For example, we contend that the link between red clothing and high status observed throughout human history is not random but emerged from the biologically based link between male red ornamentation and high status observed in many species throughout the animal kingdom. This societal use of red may be seen as not only reinforcing the biologically based use of red but also as extending it beyond natural bodily processes. Consequently, red may not need to be natural or observed on the body to be influential; artificial red displayed in close proximity to the body (e.g., red clothing or a red background) may be sufficient to produce ornament and status effects. It is this extended type of red display that we investigate in the present research.

The present research comprises seven experiments. Experiments 1–4 tested the hypothesized red effect and attended to alternative explanations. Experiments 5–7 examined mediation of the red effect using two different methodologies.

### General Method

Participants in each experiment were informed that the experiment focused on first impressions of others. In each experiment, a photo of a moderately attractive man was presented, typically for 5 s, and then participants provided their responses. A photo of a different man was used in each of Experiments 2 through 7, and color was manipulated on either the background of the photo or the man's shirt. Each experiment used a single male target and a between-subjects color manipulation (with random assignment) so that participants would not see repeated color presentations that could alert them to the purpose of the experiment. All experimenters were blind to participants' color condition throughout the experiment. Participation was restricted to individuals who did not have an experiment-relevant (red–green and/or blue–yellow) color deficiency and, from Experiment 2 on, to heterosexual and bisexual individuals.

For each male target photo, a pilot test with an independent sample of women ( $n \geq 15$ ) was conducted. The attractiveness ratings ranged from 1 (*not at all attractive*) to 9 (*extremely attractive*), and mean ratings ranged from 4.73 to 6.33, indicating moderate attractiveness. In all experiments (except 5a), the color manipulations were created using Epson Enhanced Matte white paper



and an Epson Stylus Photo R800 color printer (in 5a the color stimuli were presented on a computer monitor). A GretagMacBeth Eye-One Pro spectrophotometer was used to determine the parameters of the colors from the spectral data. Lightness and chroma were matched across hues within one unit in each experiment. At the end of each experiment, participants were asked to guess the purpose of the experiment; a correct guess was defined as any mention of color and any mention of one or more of the dependent measures in the experiment. Then participants were debriefed and dismissed.

### Experiment 1

In Experiment 1, we examined the effect of the colors red and white on women's perceptions of a man's attractiveness. White was selected as the contrast to red because white is the most unobtrusive of the achromatic (i.e., neutral) colors in this experimental paradigm.

#### Method.

**Participants.** Twenty-one female undergraduates in the United States participated voluntarily or for course extra credit. The mean age of participants was 20.19 years (range = 18–25). Participant ethnicity was as follows: 14 Caucasian, 2 African American, 3 Asian, and 2 unspecified.<sup>1</sup>

**Design, procedure, and materials.** Participants viewed a black-and-white photo of a man on a red ( $n = 10$ ) or white ( $n = 11$ ) background for 5 s (see Figure 1A) and then reported their perceptions of the man's attractiveness. The photo was a 4-in.  $\times$  6-in. head and upper torso shot of a moderately attractive young Caucasian man with brown hair wearing a plain button-down shirt; it was selected from a standard photo set (Corneille, Monin, & Pleyers, 2005). The photo was centered on an 8.5-in.  $\times$  11-in. page, and color was placed on the area surrounding the photo. The parameters for red were LCh(49.6, 58.8, 30.4); white was simply the absence of additional color on the white background.

#### Measure.

**Perceived attractiveness.** Perceived attractiveness was assessed with three face-valid items: "How attractive do you think this person is?" "How pleasant is this person to look at?" and "If I were to meet the person in this picture face to face, I would think he is attractive." The items were rated on 9-point scales ranging from, for example, 1 (*not at all attractive*) to 9 (*extremely attractive*), and scores were averaged to form a composite index ( $\alpha = .84$ ).

**Results and discussion.** An independent-samples  $t$  test examining the influence of color condition on perceived attractiveness revealed a significant color effect,  $t(20) = 2.18$ ,  $p < .05$ ,  $d = 0.95$  (see Figure 1B). Participants in the red condition, compared with those in the white condition, rated the target man as more attractive ( $M = 6.79$ ,  $SD = 1.00$ , and  $M = 5.67$ ,  $SD = 1.34$ , respectively). None of the participants correctly guessed the purpose of the experiment. Thus, the results from this experiment supported our hypothesis and suggested that color influences participants' ratings without their awareness.

### Experiment 2

In Experiment 2, we examined whether the red effect is specific to women rating men or generalizes to men rating other men. This

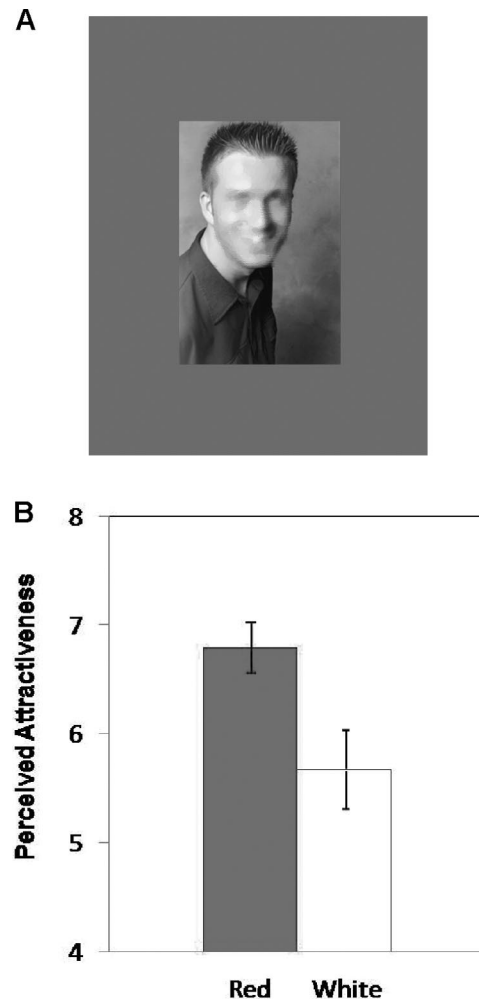


Figure 1. A: The picture used in the color manipulation of Experiment 1 (the face of the male target was intact in the experiment but is blurred here to protect privacy). The border of the picture was red or white. B: Perceived attractiveness as a function of color. Standard errors in Panel B are indicated by vertical lines.

use of male raters allowed us to test whether the observed effect is simply due to any of a variety of general processes equally applicable to both women and men. One possibility is that viewing red increases general activation in both women and men (Goldstein, 1942), which leads both sexes to exacerbate their initial perception of a moderately attractive male (Hull, 1943). A second possibility is that both women and men prefer chromatic to achromatic stimuli (Axelsson, 2007), and in the red (chromatic) condition, this preference is transferred to the target person for both sexes (Huber, Shiffrin, Lyle, & Quach, 2002). A third possibility is that long

<sup>1</sup> Although participant ethnicity was not a central focus of the present research, and in all but Experiment 4 most participants were Caucasian, there was sufficient ethnic diversity (i.e., nonempty cells) to examine a Color  $\times$  Ethnicity (Caucasian vs. not-Caucasian) interaction in four of the experiments (Experiments 1, 2, 3, and 6). No significant interactions were observed (all  $F$ s  $< .47$ ,  $p$ s  $> .54$ ).

wavelength colors such as red appear slightly nearer to the perceiver than do short wavelength or achromatic colors due to differences in light refraction in the eye (Marcos, Burns, Moreno-Barriuso, & Navarro, 1999), and closer stimuli may be preferred by both sexes (L. E. Williams & Bargh, 2008). If red merely influences evaluation on the basis of one or more of the aforementioned general process accounts, then the red effect should be observed for male as well as female perceivers. However, if, as posited, red is an interspecific signal that conveys a sexual message, then the red effect should be observed for female perceivers only.

#### Method.

**Participants.** Fifty-seven (25 male and 32 female) undergraduates in England participated for course credit. The mean age of participants was 20.46 years (range = 18–43). Participant ethnicity was as follows: 45 Caucasian, 2 Black, 6 Asian, and 4 “other.”

**Design, procedure, and materials.** Participants viewed a black-and-white photo of a Caucasian man on a red ( $n = 31$ ) or white ( $n = 26$ ) background for 5 s and then reported their perceptions of the man’s attractiveness. The photo and colors were the same as those used in Experiment 1.

#### Measure.

**Perceived attractiveness.** The perceived attractiveness measure ( $\alpha = .83$ ) was the same as that used in Experiment 1.

**Results and discussion.** A 2 (color condition)  $\times$  2 (sex of participant) between-groups analysis of variance was conducted on perceived attractiveness. The analysis revealed a main effect of color that approached significance,  $F(1, 53) = 3.35, p < .10, \eta_p^2 = .059$ , with participants in the red condition, compared with those in the white condition, tending to rate the target man as more attractive ( $M = 6.67, SD = 0.93$ , and  $M = 6.19, SD = 0.94$ , respectively); the main effect of sex was significant,  $F(1, 53) = 5.21, p < .05, \eta_p^2 = .090$ , with women, compared with men, rating the target man as more attractive ( $M = 6.70, SD = 0.95$ , and  $M = 6.13, SD = 0.88$ , respectively). More importantly, the analysis revealed a significant Color  $\times$  Sex interaction,  $F(1, 53) = 4.89, p < .05, \eta_p^2 = .084$ .

Two sets of planned comparisons were used to examine the specific effects contributing to the interaction. First, the simple effect of color condition on perceived attractiveness was examined within each sex. These analyses revealed a significant color effect for women,  $t(53) = 3.06, p < .01, d = 1.11$ , but not men,  $t(53) = 0.25, p > .80$ . As displayed in Figure 2, women in the red

condition rated the target man as more attractive than did women in the white condition, whereas no color difference was observed for men. Second, the simple effect of sex on perceived attractiveness was examined within each color condition. These analyses revealed a significant sex effect in the red condition,  $t(53) = 3.37, p < .01, d = 1.31$ , but not the white condition,  $t(53) = 0.06, p < .95$ . As displayed in Figure 2, in the red condition women rated the target man as more attractive than did men, whereas in the white condition no difference was observed between men and women.<sup>2</sup> None of the participants correctly guessed the purpose of the experiment.

In sum, the results from this experiment supported our hypotheses. Women who viewed a man on a red, relative to a white, background perceived him to be more attractive; this effect was not present for men rating another man. In addition, a sex of participant effect was observed within the red, but not the white, condition. Participants appeared to be unaware of the influence of color on their responses.

### Experiment 3

In Experiments 3–7, we shifted our focus back to women participants alone. Experiment 3 addressed three important issues. First, we examined the effect of red relative to a different achromatic color, gray. Unlike white (which is inherently high in lightness), gray can vary considerably in lightness. As such, red and gray may be equated on lightness, enabling us to address whether our findings are driven by lightness differences rather than hue differences. Second, we examined whether the effect of red extends beyond attractiveness perceptions to sexual attraction, as indexed by desired sexual behavior. An attractiveness perception is a form of liking based on a hedonic assessment of physical appearance, whereas sexual attraction is a form of wanting based on physical desire. Liking and wanting typically co-occur in appetitive evaluation (Berridge, 2004), as do perceptions of attractiveness and sexual attraction (Levesque, Nave, & Lowe, 2006), and we predicted that red would influence sexual attraction, as well as perceptions of attractiveness. Third, we examined whether the effect of red extends beyond attractiveness perceptions to overall likability judgments. Perceptions of overall likability are a different form of liking from perceptions of attractiveness, in that the former are based on a person’s general positive characteristics and the latter are based on physical appearance. Our theoretical analysis is relevant to the attractiveness form of liking per se; thus we predicted that red would influence perceived attractiveness but not

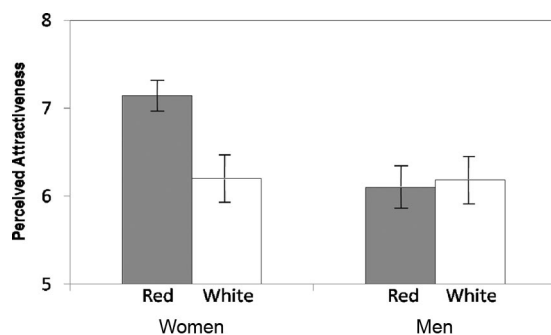


Figure 2. Perceived attractiveness as a function of color and sex of participant in Experiment 2. Standard errors are indicated by vertical lines.

<sup>2</sup> Power was adequate to find a red effect for men (based on a sample of 25, the effect size observed for women, and a one-tailed alpha of .05, power was .85); if anything, however, the data evidenced a trend in the opposite direction. In addition, a Levene’s test for equality of variances indicated that the variance of the perceived attractiveness score for male participants was not significantly different from that for female participants in either the red condition ( $F = 0.52, p = .478$ ) or the white condition ( $F = 0.12, p = .728$ ), and the variance likewise did not significantly differ for male participants across conditions ( $F = 0.27, p = .610$ ). Thus, the null effect for male participants is not attributable to a lack of power or to greater variability in the data (for prior work showing the comparability of male and female attractiveness ratings for male and female targets, see Hönckopp, 2006; Langlois et al., 2000).

overall likability and that the predicted effect of red would hold with overall likability controlled.

#### Method.

**Participants.** Thirty-three female undergraduates in the United States participated for extra course credit. The mean age of participants was 19.64 years (range = 18–25). Participant ethnicity was as follows: 26 Caucasian, 2 Asian, 2 African American, and 3 unspecified.

**Design, procedure, and materials.** Participants viewed a black-and-white photo of a man on a red ( $n = 16$ ) or gray ( $n = 17$ ) background for 5 s and then reported their perceptions of the man's attractiveness, their sexual attraction to him, and their overall liking of him. The photo was a 4-in.  $\times$  6-in. head and upper torso shot of a moderately attractive young Latino man with brown hair wearing a striped sweater; it was selected from a standard photo set (Corneille et al., 2005). The photo was centered on an 8.5-in.  $\times$  11-in. page, and color was placed on the area surrounding the photo. The parameters for red were LCh(50.0, 59.6, 31.3) and for gray were LCh(50.0, –, 69.1; chroma is not relevant for gray, an achromatic color).

#### Measures.

**Perceived attractiveness.** The perceived attractiveness measure ( $\alpha = .94$ ) was the same as that used in Experiments 1 and 2.

**Sexual attraction.** Two items from Greitemeyer's (2005) sexual receptivity measure were used to assess desired sexual behavior. The full measure focuses on a range of behaviors (e.g., date, kiss, have sexual intercourse) that participants might want to do with the target person; we assessed the date and kiss items only in this study (e.g., "Would you want to date this person?"). The items were rated on a 1 (*no, definitely not*) to 9 (*yes, definitely*) scale, and scores were averaged to form a composite index ( $\alpha = .88$ ).

**Perceived likability.** Jones et al.'s (2004) six-item likability measure was used to assess perceptions of overall likability. The measure focuses on the target person's positive characteristics and general degree of likability (e.g., "How honest do you think this person is?"). The items were rated on a 1 (*not at all*) to 9 (*very much*) scale, and scores were averaged to form a composite index ( $\alpha = .87$ ).

**Results and discussion.** An independent-samples  $t$  test examining the influence of color condition on perceived attractiveness revealed a significant color effect,  $t(32) = 2.44, p < .05, d = 0.86$ . Participants in the red condition, compared with those in the gray condition, rated the target man as more attractive ( $M = 6.69, SD = 1.22$ , and  $M = 5.27, SD = 2.04$ , respectively).

In addition, an independent-samples  $t$  test examining the influence of color condition on desired sexual behavior revealed a significant color effect,  $t(32) = 2.43, p < .05, d = 0.85$ . Participants in the red condition, compared with those in the gray condition, wanted to date/kiss the man more ( $M = 5.41, SD = 2.18$ , and  $M = 3.81, SD = 1.52$ , respectively).

Next, an independent-samples  $t$  test was used to examine the effect of color condition on perceived likability. The analysis yielded a null effect ( $p > .63$ ). Furthermore, the color effects on perceived attractiveness and desired sexual behavior remained significant when the analyses were repeated with perceived likability as a covariate.

One participant correctly guessed the purpose of the experiment. When we omitted this person from the data set and repeated the

aforementioned analyses, all of the findings reported in this experiment remained the same.

In sum, the results from this experiment supported our hypotheses. Women who viewed a man on a red, relative to a gray, background perceived him to be more attractive and were more sexually attracted to him. Color did not affect overall likability judgments, and the hypothesized red effect was shown to be independent of perceived likability. Again, color seemed to influence participants' ratings without their awareness.

## Experiment 4

In Experiment 4, we changed the comparison color from achromatic to chromatic, specifically from gray to green. Red and green are opposite colors in several well-established color models, and green should provide a conservative contrast to red because it tends to have positive associations in general (Adams & Osgood, 1973; Kaya & Epps, 2004) and means "go" in traffic lights. Importantly, red and green can be equated on chroma as well as lightness, so this contrast allows a highly controlled test of the effect of hue holding the other two color properties constant. We shifted the color manipulation from the background of the photo to the shirt of the target man in this and all subsequent experiments; this yielded a color stimulus more commonly encountered by women in daily life. In this experiment we also examined whether the effect of red extends to agreeableness and extraversion—two basic, positive traits that women desire in an ideal romantic partner (Figueredo, Sefcek, & Jones, 2006). Our theoretical analysis is relevant to attractiveness/attraction, not general positive characteristics. Thus, we predicted that red would influence perceptions of attractiveness and sexual attraction but not perceptions of agreeableness and extraversion and that the predicted effect of red would hold with these other positive characteristics controlled. Finally, we conducted this experiment in a country in the East, China, to see whether the red effect generalizes beyond Western countries.

#### Method.

**Participants.** Fifty-five female undergraduates in China participated for extra course credit. The mean age of participants was 20.60 years (range = 18–25). All participants were Chinese.

**Design, procedure, and materials.** Participants viewed a color photo of a man in a red ( $n = 27$ ) or green ( $n = 28$ ) shirt for 5 s and then reported their perceptions of the man's attractiveness, their sexual attraction to him, and their perceptions of his agreeableness and extraversion. The photo was a 4-in.  $\times$  6-in. head and upper torso shot of a moderately attractive young Chinese man with black hair wearing a plain short-sleeved T-shirt; the man was a local undergraduate student. The photo was centered on an 8.5-in.  $\times$  11-in. page. The parameters for red were LCh(51.3, 51.7, 30.1) and for green were LCh(51.5, 51.6, 136.6).

#### Measures.

**Perceived attractiveness.** Mehrabian and Blum's (1997) four-item general attractiveness measure was used to assess perceived attractiveness. The measure asks participants to rate the target person on various aspects of attractiveness (e.g., facial attractiveness, bodily attractiveness) on a scale ranging from 1 (*very unattractive*) to 9 (*very attractive*). Scores were averaged to form a composite index ( $\alpha = .92$ ).

**Sexual attraction.** The full set of items from Greitemeyer's (2005) five-item sexual receptivity measure were used to assess desired sexual behavior. These items extended the range of behaviors beyond dating and kissing to include making out and having sexual intercourse with the target person (e.g., "Would you want to have sexual intercourse with the person?"). The items were rated on a scale ranging from 1 (*no, definitely not*) to 9 (*yes, definitely*), and scores were averaged to form a composite index ( $\alpha = .89$ ).

**Perceived agreeableness.** The three items from Kenrick, Groth, Trost, and Sadalla's (1993) agreeableness scale were worded with reference to the target person to assess perceived agreeableness. The items (e.g., "How easygoing do you think this person is?") were rated on a scale ranging from 1 (*not at all*) to 9 (*very*), and scores were averaged to form a composite index ( $\alpha = .94$ ).

**Perceived extraversion.** The four items from Donnellan, Oswald, Baird, and Lucas' (2006) extraversion scale were worded with reference to the target person to assess perceived extraversion. The items (e.g., "He is the life of the party") were rated with regard to how well they described the target person on a scale ranging from 1 (*not at all*) to 9 (*very well*), and scores were averaged to form a composite index ( $\alpha = .83$ ).

**Results and discussion.** An independent-samples *t* test examining the influence of color condition on perceived attractiveness revealed a significant color effect,  $t(53) = 2.03, p < .05, d = 0.56$ . Participants in the red condition, compared with those in the green condition, rated the target man as more attractive ( $M = 6.32, SD = 1.09$ , and  $M = 5.50, SD = 1.50$ , respectively).

In addition, an independent-samples *t* test examining the influence of color condition on desired sexual behavior revealed a significant color effect,  $t(53) = 2.25, p < .05, d = 0.62$ . Participants in the red condition, compared with those in the green condition, had a stronger desire to engage in sexual behavior with the target man ( $M = 4.14, SD = 1.76$ , and  $M = 2.95, SD = 1.78$ , respectively).

Next, a set of independent-samples *t* tests was used to examine the effect of color condition on perceived agreeableness and extraversion. Both of these analyses yielded a null effect ( $ps > .60$ ). Furthermore, the color effects on perceived attractiveness and desired sexual behavior remained significant when the analyses were repeated with perceived agreeableness or extraversion as a covariate. None of the participants correctly guessed the purpose of the experiment.

Thus, the results from this experiment supported our hypotheses. Women who viewed a man in a red, relative to a green, shirt perceived him to be more attractive and were more sexually attracted to him. Color did not affect perceptions of agreeableness or extraversion, and the hypothesized red effect was shown to be independent of perceived agreeableness and extraversion. These findings were obtained with Chinese participants, and participants appeared to be unaware of the influence of color on their responses.

### Experiments 5a and 5b

In Experiments 5a and 5b we examined status as a mediator of the influence of red on women's attraction to men using the experimental-causal-chain approach to mediation (MacKinnon, Fairchild, & Fritz, 2007; Spencer et al., 2005). In this approach, the

documentation of a direct effect is followed by two additional experiments: A first experiment manipulates the independent variable (color) and tests the effect on the candidate mediator (status), and a second experiment manipulates the candidate mediator and tests the effect on the dependent variable(s) (attractiveness/attraction). Establishing both links in this causal chain indicates that the candidate mediator accounts for the observed direct effect. We assessed status two ways, by focusing on both present status and status potential. We also examined an alternative mediator candidate, stability, a characteristic that women find highly appealing in men (Sadalla et al., 1987). Our theoretical analysis is relevant to status but not to general positive characteristics. As such, we predicted that red would influence perceptions of status but not stability and that the predicted effect of red would hold with perceived stability controlled. Experiment 5a examined the first link in the mediational model, and Experiment 5b examined the second link.

### Experiment 5a

Experiment 5a contrasted red versus gray in examining the first link in the proposed mediational chain. It also examined perceived stability as an alternative mediational candidate.

#### Method.

**Participants.** Twenty female undergraduates in Germany participated for a small monetary sum. The mean age of participants was 20.90 years (range = 19–31). All participants were Caucasian.

**Design, procedure, and materials.** Participants viewed a color photo of a man in a red ( $n = 10$ ) or gray ( $n = 10$ ) shirt for 5 s on a computer monitor and then reported their perceptions of the man's status and stability. The photo was a 7-in.  $\times$  9-in. head and shoulder shot of a moderately attractive young Caucasian man with brown hair wearing a plain T-shirt; the picture was taken from the website [www.beautycheck.com](http://www.beautycheck.com). The photo was centered on the computer monitor. The parameters for red were LCh(59.2, 104.9, 44.1) and for gray were LCh(59.3, –, 100.4; chroma is not relevant for gray, an achromatic color).

#### Measures.

**Perceived status.** We created a two-item face-valid measure that assessed perceptions of present status (e.g., "How high in status do you think this person is?"). The items were rated on a 9-point scale ranging from 1 (*not at all*) to 9 (*extremely/very much*), and scores were averaged to form a composite index ( $\alpha = .85$ ).

In addition, we created a four-item measure of perceived status potential focused on the status-based characteristics that women across cultures report valuing in men (Geary et al., 2004). Specifically, the items focused on status per se, social position, high earnings, and success (e.g., "I think that this person has the potential to have a great deal of status"). The items were rated on a 9-point scale ranging from 1 (*not at all*) to 9 (*very much*), and scores were averaged to form a composite index ( $\alpha = .82$ ).

**Perceived stability.** Sadalla et al.'s (1987) three-item stability scale was used to assess the degree to which the target person was perceived as stable (e.g., "Emotionally unstable" to "Emotionally stable"). The items were scaled so that the unstable option was represented by 1 and the stable option was represented by 9, and scores were averaged to form a composite index ( $\alpha = .70$ ).



**Results and discussion.** An independent-samples *t* test examining the influence of color condition on perceptions of present status revealed a significant color effect,  $t(19) = 2.17, p < .05, d = 1.11$ . Participants in the red condition, compared with those in the gray condition, rated the target man as higher in status ( $M = 5.35, SD = 0.94$ , and  $M = 4.35, SD = 1.11$ , respectively).

An independent-samples *t* test examining the influence of color condition on perceived status potential revealed a significant color effect,  $t(19) = 2.94, p < .01, d = 1.35$ . Participants in the red condition, compared with those in the gray condition, rated the target man as having higher status potential ( $M = 5.33, SD = 0.85$ , and  $M = 3.95, SD = 1.17$ , respectively).

Next, an independent-samples *t* test was used to examine the effect of color condition on perceived stability. This analysis yielded a null effect ( $p > .47$ ). Furthermore, the color effects on the status measures remained significant when the analyses were repeated with perceived stability as a covariate. None of the participants correctly guessed the purpose of the experiment.

Thus, the results from this experiment supported our hypotheses. Women who viewed a man in a red, relative to a gray, shirt perceived him to have higher status and higher status potential. Color did not affect perceived stability, and the hypothesized red effect was shown to be independent of stability perceptions. Participants appeared to be unaware of the influence of color on their responses.

### Experiment 5b

Experiment 5b contrasted high versus low status in examining the second link in the proposed mediational chain.

#### Method.

**Participants.** Twenty undergraduates in Germany participated for a small gift. The mean age of participants was 21.34 years (range = 18–24). All participants were Caucasian.

**Design, procedure, and materials.** Participants viewed a black-and-white photocopy of the target man from Experiment 5a for 10 s. The photo was accompanied by a description of the man as high ( $n = 10$ ) or low ( $n = 10$ ) in status; these descriptions (see Table 1) were based directly on a status manipulation used by Greitemeyer (2007) in prior research. Following the status manipulation, participants reported their perceptions of the man's attractiveness and their sexual attraction to him.

#### Measures.

**Perceived attractiveness.** The perceived attractiveness measure ( $\alpha = .83$ ) was the same as that used in Experiments 1–3.

**Sexual attraction.** The desired sexual behavior measure ( $\alpha = .83$ ) was the same as that used in Experiment 4.

**Results and discussion.** An independent-samples *t* test examining the influence of status condition on perceived attractiveness

revealed a significant status effect,  $t(19) = 4.26, p < .05, d = 1.96$ . Participants in the high-status condition, compared with those in the low-status condition, rated the target man as more attractive ( $M = 5.60, SD = 0.94$ , and  $M = 3.87, SD = 0.88$ , respectively).

In addition, an independent-samples *t* test examining the influence of status condition on desired sexual behavior revealed a significant status effect,  $t(19) = 3.67, p < .01, d = 1.68$ . Participants in the high-status condition, compared with those in the low-status condition, had a stronger desire to engage in sexual behavior with the target man ( $M = 3.02, SD = 0.82$ , and  $M = 1.38, SD = 0.43$ , respectively).

Thus, the results from this experiment supported our hypotheses. Women who viewed a man described as high, relative to low, in status perceived him to be more attractive and were more sexually attracted to him. The results of Experiments 5a and 5b together clearly support mediation via the experimental-causal-chain approach.

### Experiments 6a and 6b

In Experiments 6a and 6b we sought to replicate the experimental-causal-chain mediation shown in Experiments 5a and 5b using blue as the contrast color and using a different status manipulation. Blue, like green, is a conservative contrast to red, because blue is the most commonly selected color in studies of young adult and adult color preference (McManus, Jones, & Cottrell, 1981). Also like green, blue is a chromatic color, meaning that red and blue can be equated on chroma as well as lightness, thereby affording another highly controlled test of the effect of hue with the other two color properties held constant.

### Experiment 6a

Experiment 6a contrasted red versus blue in examining the first link in the proposed mediational chain.

#### Method.

**Participants.** Thirty-seven female undergraduates in England participated for extra course credit. The mean age of participants was 20.19 years (range = 18–30). Participant ethnicity was as follows: 27 Caucasian, 3 Asian, 1 African, and 6 unspecified.

**Design, procedure, and materials.** Participants viewed a color photo of a man in a red ( $n = 19$ ) or blue ( $n = 18$ ) shirt for 5 s and then reported their perceptions of the man's status. The photo was a 7-in.  $\times$  9-in. head and upper torso shot of a moderately attractive young Caucasian man with black hair wearing a plain short-sleeved T-shirt; the man was a local undergraduate student. The photo was centered on an 8.5-in.  $\times$  11-in. page. The parameters for red were LCh(52.3, 46.3, 29.0) and for blue were LCh(52.9, 46.1, 276.9).

#### Measure.

**Perceived status.** The perceptions of present status measure was the same as that used in Experiment 5a ( $\alpha = .93$ ).

**Results and discussion.** An independent-samples *t* test examining the influence of color condition on perceived status revealed a significant color effect,  $t(35) = 2.23, p < .05, d = 0.74$ . Participants in the red condition, compared with those in the blue condition, rated the target man as higher in status ( $M = 5.42, SD = 1.42$ , and  $M = 4.47, SD = 1.14$ , respectively). None of the participants correctly guessed the purpose of the experiment. Thus,

Table 1  
Status Manipulation in Experiment 5b

Status	Description
High	Stefan (the person in the photograph) works as a medical doctor for an annual salary of 58,000 euros.
Low	Stefan (the person in the photograph) works as a street cleaner for an annual salary of 12,000 euros.

the results from this experiment supported our hypothesis, and participants seemed to be unaware of the influence of color on their responses.

## Experiment 6b

Experiment 6b contrasted high versus low status in examining the second link in the proposed mediational chain.

### Method.

**Participants.** Thirty-eight undergraduates in England participated for a small monetary sum. The mean age of participants was 21.87 years (range = 18–33). All participants were Caucasian.

**Design, procedure, and materials.** Participants viewed a black-and-white photo of the target man from Experiment 6a for 10 s. The photo was accompanied by a description of the man as high ( $n = 18$ ) or low ( $n = 20$ ) in status (see Table 2). Following the status manipulation, participants reported their perceptions of the man's attractiveness and their sexual attraction to him.

### Measures.

**Perceived attractiveness.** The perceived attractiveness measure ( $\alpha = .94$ ) was the same as that used in Experiments 1–3 and 5a.

**Sexual attraction.** The desired sexual behavior measure ( $\alpha = .88$ ) was the same as that used in Experiments 4 and 5b.

**Results and discussion.** An independent-samples  $t$  test examining the influence of status condition on perceived attractiveness revealed a significant status effect,  $t(36) = 2.82, p < .01, d = 0.94$ . Participants in the high-status condition, compared with those in the low-status condition, rated the target man as more attractive ( $M = 5.82, SD = 1.45$ , and  $M = 4.56, SD = 1.32$ , respectively).

In addition, an independent-samples  $t$  test examining the influence of status condition on desired sexual behavior revealed a significant status effect,  $t(36) = 2.10, p < .05, d = 0.70$ . Participants in the high-status condition, compared with those in the low-status condition, had a stronger desire to engage in sexual behavior with the target man ( $M = 2.81, SD = 1.91$ , and  $M = 1.91, SD = 1.11$ , respectively).

Thus, the results from this experiment supported our hypotheses. Women who viewed a man described as high, relative to low, in status perceived him to be more attractive and were more sexually attracted to him. The results of Experiment 6a and 6b together clearly support mediation via the experimental-causal-chain approach and replicate the findings of Experiment 5 using an achromatic contrast color and a different status manipulation.

Table 2  
Status Manipulation in Experiment 6b

Status	Description
High	<i>The person in the picture is named John. He is 20 years old and was born in November. He is from Coventry, but now lives in Sheffield. Those who know him think that he is relatively high in status.</i>
Low	<i>The person in the picture is named John. He is 20 years old and was born in November. He is from Coventry, but now lives in Sheffield. Those who know him think that he is relatively low in status.</i>

## Experiment 7

In Experiment 7 we sought to document mediation using a different approach than that used in Experiments 5 and 6, namely the measurement-of-mediation approach (see Baron & Kenny, 1986). In this approach, both links in the proposed mediational model are tested within the same experiment: The effect of the manipulated independent variable (color) on the candidate mediator (perceived status) is examined, and the relation between the candidate mediator and the dependent variable(s) (perceived attractiveness/sexual attraction) is examined with the independent variable controlled. Furthermore, the degree to which the candidate mediator accounts for the direct effect of the independent variable on the dependent measure(s) is investigated. Experiment 7 contrasted red versus blue in examining the proposed mediational model.

### Method.

**Participants.** Twenty-seven female undergraduates in England participated for extra course credit. The mean age of participants was 19.44 years (range = 18–25). Participant ethnicity was as follows: 23 Caucasian and 4 unspecified.

**Design, procedure, and materials.** Participants viewed a color photo of a man in a red ( $n = 12$ ) or blue ( $n = 15$ ) shirt for 5 s (see Figure 3A), and then reported their perceptions of the man's status. Then, after completing two pages of filler items, participants reported their perceptions of the man's attractiveness and their sexual attraction to him. The photo was a 3-in.  $\times$  6-in. head and upper torso shot of a moderately attractive young Caucasian man with black hair wearing a plain short-sleeved T-shirt; the man was a local undergraduate student. The photo was centered on an 8.5-in.  $\times$  11-in. page. The parameters for red were LCh(54.8, 43.2, 30.3) and for blue were LCh(55.1, 43.7, 283.0).

### Measures.

**Perceived attractiveness.** Maner et al.'s (2003) single-item perceived attractiveness measure was used to assess perceived attractiveness.

**Sexual attraction.** The desired sexual behavior measure was the same as that used in Experiments 4, 5b, and 6b ( $\alpha = .90$ ).

**Perceived status.** The perceived status potential measure was the same as that used in Experiment 5a ( $\alpha = .78$ ).

**Results and discussion.** A series of multiple regression analyses was used to test for direct and mediated effects (see Baron & Kenny, 1986, for the steps required to document mediation via the measurement-of-mediation approach).

Regressing perceived attractiveness on color condition (red =  $-1$ , blue =  $+1$ ) revealed a significant effect of color ( $\beta = .40$ ),  $F(1, 25) = 4.81, p < .05$ , indicating that participants in the red condition rated the target man as more attractive than did those in the blue condition (see Figure 3B). Regressing desired sexual behavior on color condition also revealed a significant effect of color ( $\beta = .43$ ),  $F(1, 25) = 6.43, p < .05$ , indicating that participants in the red condition had a stronger desire to engage in sexual behavior with the target man than did those in the blue condition (see Figure 3C). Regressing perceived status on color condition revealed a significant effect of color ( $\beta = .42$ ),  $F(1, 25) = 5.24, p < .05$ , indicating that participants in the red condition rated the target man as higher in status than did those in the blue condition (see Figure 3D).

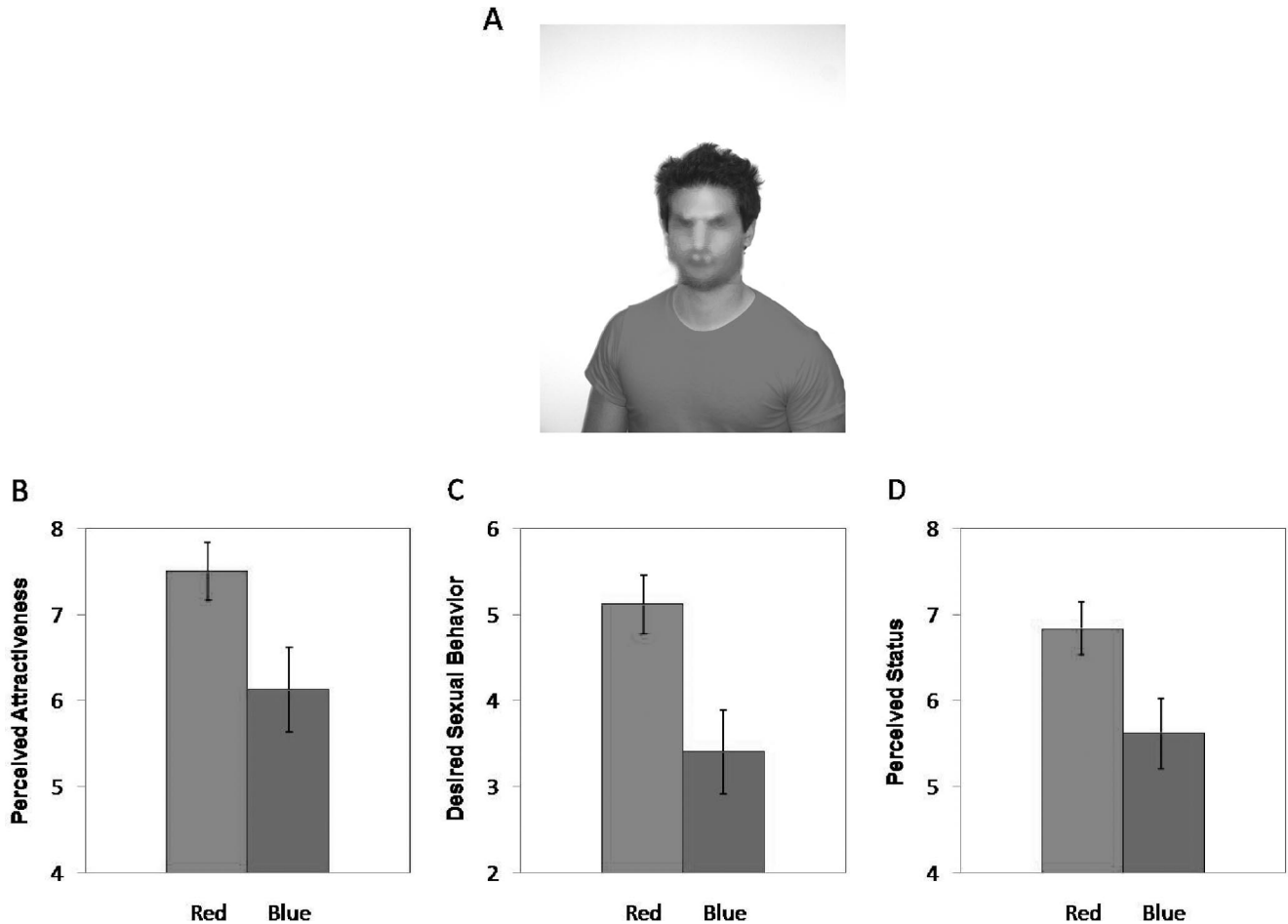


Figure 3. A: The picture used in the color manipulation of Experiment 7 (the face of the male target was intact in the experiment but is blurred here to protect privacy). The shirt on the male was red or blue. B: Perceived attractiveness as a function of color. C: Desired sexual behavior as a function of color. D: Perceived status as a function of color. Standard errors in Panels B–D are indicated by vertical lines.

Next, we tested the indirect effect of color condition on perceived attractiveness via perceived status by regressing perceived attractiveness on color condition with perceived status also in the equation. The analysis revealed a significant influence of perceived status on perceived attractiveness ( $\beta = .40$ ),  $F(1, 24) = 4.60$ ,  $p < .05$ , indicating that those who rated the target man as higher in status perceived him to be more attractive. Color condition was no longer a significant predictor of perceived attractiveness ( $\beta = .23$ ,  $p = .23$ ), and the inclusion of perceived status in the regression equation resulted in a 66.2% decrease in variance accounted for. We used MacKinnon, Fritz, Williams, and Lockwood's (2007) PRODCLIN program to generate confidence intervals for the two-path mediated effect. The lower (0.023) and upper (1.42) limits that were obtained did not include 0, further validating the indirect influence of color condition on perceived attractiveness via perceived status (see Table 3).

We then tested the indirect effect of color condition on desired sexual behavior via perceived status by regressing desired sexual behavior on color condition with perceived status also in the

equation. The analysis yielded a null result for perceived status ( $\beta = .10$ ,  $p = .59$ ), indicating that perceived status did not directly influence desired sexual behavior. We then tested whether perceived status influences desired sexual behavior through its influence on perceived attractiveness by regressing desired sexual behavior on color condition, perceived status, and perceived attractiveness. The analysis revealed a significant influence of perceived attractiveness on desired sexual behavior ( $\beta = .70$ ),  $F(1, 23) = 17.76$ ,  $p < .01$ , indicating that those who rated the target man as more attractive had a stronger desire to engage in sexual behavior with him. Color condition was no longer a significant predictor of desired sexual behavior ( $\beta = .24$ ,  $p = .14$ ), and the inclusion of perceived status and perceived attractiveness in the regression equation resulted in a 71.0% decrease in variance accounted for. Following Taylor, MacKinnon, and Tein (2008; see also MacKinnon, Lockwood, & Williams, 2004), we used percentile bootstrapping to generate confidence intervals for the three-path mediated effect. The lower (0.032) and upper (1.51) limits that were obtained did not include 0, further validating the indirect influence of color condition on desired sexual behavior via per-

Table 3  
Summary of Mediation Results for Experiment 7

Model	Path		Direct effect $c'$	Mediated effect $ab$	95% CL of mediated effect	
	$a$	$b$			Lower	Upper
Two-path mediation	0.993* (0.434)	0.576* (0.269)	0.795	0.572*	0.023	1.42
	$b_1$	$b_2$		$b_1b_2b_3$		
Three-path mediation	0.993* (0.434)	0.576* (0.269)	1.261	0.442*	0.032	1.51
		$b_3$				

Note. Unstandardized path coefficients are reported, with standard errors in parentheses. For the two-path model:  $a$  = the path coefficient from color condition to perceived status;  $b$  = the path coefficient from perceived status to perceived attractiveness with color condition in the equation;  $ab$  = the mediated effect. For the three-path model:  $b_1$  = the path coefficient from color condition to perceived status;  $b_2$  = the path coefficient from perceived status to perceived attractiveness with color condition in the equation;  $b_3$  = the path coefficient from perceived attractiveness to desired sexual behavior with color condition and perceived status in the equation;  $b_1b_2b_3$  = the mediated effect. For both models:  $c'$  = the direct effect of color condition on the outcome not transmitted through the mediator(s); CL = confidence limits (limits that do not include zero indicate a significant mediated effect).

\* $p < .05$ .

ceived status and perceived attractiveness (see Table 3). None of the participants correctly guessed the purpose of the experiment.

In sum, the results from this experiment supported our hypotheses. Women who viewed a man in a red, relative to a blue, shirt perceived him to be higher in status and to be more attractive, and they were more sexually attracted to him. Mediation was documented via the measurement-of-mediation approach: Color enhanced perceived attractiveness by enhancing perceptions of status, and color enhanced desired sexual behavior by enhancing both perceptions of status and perceptions of attractiveness. Again, participants appeared to be unaware of the influence of color on their responses.

### General Discussion

The seven experiments of the present research provide strong support for the hypothesized red effect and the mechanism responsible for it. The red effect was observed in four different countries (in both the East and West), with two different types of color presentation (both background color and clothing color), with four different contrast colors (both achromatic and chromatic), with six different target men, and with two different measures of attraction (both perceived attractiveness and sexual attraction). The effect was present for female but not male perceivers, and it was observed on attraction variables but not other positively valenced variables. Mediation via status was documented using two different methodologies (both the experimental-causal-chain and measurement-of-mediation approaches), with two different contrast colors (both achromatic and chromatic), with three different target men, and with two different types of status variables (both present status and status potential). Participants were not aware that the research focused on the influence of color, but color nevertheless had a considerable influence on their responses.

An important aspect of this research is our examination of whether the red effect is specific to women's attraction to men. We found that red influences women's perceptions of the attractiveness of men but does not influence men's perceptions of the attractiveness of other men or women's judgments of men's overall likability, agreeableness, or extraversion. This specificity of the red effect with regard to both sex of perceiver and type of positive evaluation suggests that red functions as a sexual signal in this

context. Both of these types of specificity are noteworthy, in that both emerged from quite stringent tests of the red effect. The specificity regarding sex of perceiver required working against general psychological processes (e.g., people prefer chromatic colors over achromatic colors; Axelsson, 2007) that could have produced a red effect for men and women participants alike.

Existing research on women's attraction to men has identified several different facial features, bodily features, and psychological characteristics that women find appealing. The present research extends this literature by documenting the color red as a novel determinant of women's preference and desires. Red is not only novel in being a unique factor influencing women's perceptions and desires, but it is novel in being a unique type of factor altogether. That is, unlike other factors, red may be viewed by women in many different formats, such as on a man's skin, on a man's clothes, or on the background of a male photo. Furthermore, red is flexible in that it may be seen in dynamic (e.g., enhanced vascularization in response to normative success) or static (e.g., enduring coloration as a marker of physiological health) form. In the present research we documented the influence of red as displayed on clothing and the background of photos in static fashion; future work is needed to test the influence of red as displayed on the skin in dynamic fashion. Such research would be technically challenging but well worth conducting to determine the generalizability of the present results. We fully expect our findings to generalize to dynamic skin displays, because female primates, including women, are extremely adept at detecting and decoding blood flow changes in the face (Changizi et al., 2006), and women have been shown to be more sensitive to the perception of red stimuli than are men (Hurlbert & Ling, 2007). As such, women seem particularly well equipped to pick up subtle, shifting, red coloration displayed on men's faces.

Recent research has revealed interesting effects of women's ovulatory cycle on their perceptions of men's attractiveness. Penton-Voak et al. (1999), for example, showed that women exhibit a stronger preference for masculine facial characteristics when they are at the most fertile point of their cycle. This raises the question of whether red has its strongest influence on women's attraction to men when women are ovulating. On a related note, in some species of vertebrates in which males show signal coloration,



females' sensitivity to red stimuli is highest when their likelihood of conception is highest (Boulcott & Braithwaite, 2007; Cronly-Dillon & Sharma, 1968). This raises the question of whether women are particularly adept at perceiving fluctuations in men's coloration at the midpoint of their cycle. In addition to cycle status, other variables such as sociosexuality (Simpson & Gangestad, 1991) and the perceiver's own degree of attractiveness (Buston & Emlen, 2003) have been shown to moderate women's amorous inclinations toward men, and these also warrant consideration with regard to the red effect.

A clear strength of this research was our documentation of mediation and, furthermore, our dual documentation of mediation. Different approaches to mediation have different strengths and weaknesses (Spencer et al., 2005), and we were able to document mediation herein using different approaches that nicely complement each other. The experimental-causal-chain approach has the strength of testing each aspect of the mediational model using experimental manipulation but has the weakness of being able to test the links in the model in only piecemeal fashion. The measurement-of-mediation approach has the strength of testing the links in the model simultaneously but has the weakness of being able to document the link between the mediator and the dependent variable in only correlational fashion. Documenting mediation via both of these approaches nicely addresses the weaknesses of each approach while at the same time capitalizing on the strength of each approach.

In the present research, we focused on perceived status as an antecedent of attraction because this is the direction of causality assumed in theory and research in the mate evaluation literature. Our experimental-causal-chain experiments allowed us to establish this effect quite clearly, and our measurement-of-mediation experiment provided additional supporting evidence. Importantly, however, establishing this effect in no way precludes the possibility that attraction may also serve as an antecedent of perceived status. Person perception researchers have found that attractive individuals benefit from a "beautiful is good stereotype," whereby perceivers assume that these individuals possess additional positive characteristics such as social competence, intelligence, and mental health (for reviews, see Eagly, Ashmore, Makhijani, & Longo, 1991; Feingold, 1992). To date, conceptual and empirical work on this stereotype has focused on (and found) sex-general effects, but we think it would be interesting to apply this line of research to the domain of heterosexual attraction. Most relevant to the present work, research on the possibility of a reciprocal relation between perceived status and physical attraction for women viewing men would be interesting to conduct. If such a relation were documented, it would nicely extend the literature by suggesting a more intricate set of dynamics between status and attraction than that currently considered.

Status and dominance are often discussed together and are sometimes used as synonymous terms in the literature, but we think it is important to keep them separate. We view status as rank or normative position with regard to valued resources (B. J. Ellis, 1992; Townsend, 1998), and we view dominance as a particular type of status, one involving forcefulness, assertiveness, and often physical or psychological aggression (Gough, 1987; Wilson, 1975). In reference to human males and females, the term *status* tends to carry a purely positive connotation, whereas the term *dominance* carries a more mixed connotation (Dunning &

McElwee, 1995) and can be construed negatively in attraction contexts (Burger & Cosby, 1999; Buss & Barnes, 1986). Research has suggested that women desire dominant men, but only when dominance is coupled with other characteristics such as kindness and agreeableness (Jensen-Campbell et al., 1995). As such, we focused on the more straightforward status construct herein rather than the more complex dominance construct, leaving open the question of whether red enhances women's perceptions of male dominance in humans.

Red displays by men may not only influence others' perceptions but may influence self-perceptions as well. This seems particularly likely with regard to artificial red (e.g., red clothing) that the individual is clearly cognizant of displaying. Wearing red may subtly enhance a man's sense of his status or power in a given situation, which in turn could influence his thoughts, feelings, and actions in that situation. Thus, a man in a red tie may give a more confident business presentation, a man wearing a red football jersey may play more aggressively (see Attrill, Gresty, Hill, & Barton, 2008), and a man wearing a red shirt on a date may be more forward and assertive. In fact, in many instances, red likely exerts an influence on self-perception and other-perception in joint fashion. For example, the red shirt that Tiger Woods typically adorns on the final day of golf tournaments likely provides him with a confidence-boosting reminder of his alpha status in the golf world as it simultaneously reminds his competitors that they are probably facing another long day on the course. Interestingly, the results of our research suggest that Tiger Woods' choice of apparel may make the ladies in the gallery swoon, as well as the competitors on the course wilt.

The factors that influence women's attraction to men are sometimes the same as those that influence men's attraction to women, and sometimes they are different (for reviews, see Buss, 2008; Gangestad & Scheyd, 2005; Geary et al., 2004). Red appears to be a factor that has the same influence on attraction in the two sexes: Here we have shown that red enhances women's attraction to men, and Elliot and Niesta (2008) have recently shown that red enhances men's attraction to women. In the present research, we obtained empirical evidence for perceived status as the mechanism responsible for the red effect in women's attraction to men; Elliot and Niesta (2008) did not examine mediation in their research. This leads to the intriguing question of whether one mechanism is responsible for the red effect in the two sexes or whether the effect is produced by a different mechanism in each sex. Parsimony favors a single mechanism account, and this should be assumed until demonstrated otherwise. In the following, we consider the one- and two-mechanism possibilities in more detail.

To validate a one-mechanism account of the red effect would require documenting that red carries the meaning of status for males viewing females (much as has been shown herein for women viewing men) and that status is an attractant for males viewing females (much as has been shown herein for women viewing men). At present, there is no theoretical or empirical work on primates suggesting that female red signals status to males; however, an association between red and status is present in many human cultures (see the Red and High Status section of our introduction). Empirical work on primates indicates that high status in females leads to greater reproductive success (Dunbar & Dunbar, 1977; Pusey, Williams, & Goodall, 1997; Setchell & Wickings, 2006; van Noordwijk & van Schaik, 1999), which is

sensible from a number of different theoretical perspectives (Cote & Festa, 2001; L. Ellis, 1995; Pusey et al., 1997; Robbins, Robbins, Gerald-Steklis, & Steklis, 2007). In humans, the evidence to date indicates that female dominance and status has a null or negative effect on male attraction (Brown & Lewis, 2004; Greitemeyer, 2007; Sadalla et al., 1987; Townsend, 1998), but this research has been conducted exclusively with undergraduates and has yet to take into account the important point that women can express dominance/status differently from men (Buss, 2008; Eagly & Karau, 1991; Honey & Coulombe, 2009). In short, extant theory and data neither clearly support nor rule out perceived status as a mediational candidate for men viewing women; what is clear is that a direct test of this possibility is needed.

With regard to a two-mechanism account of the red effect, validation would require documenting that a variable other than perceived status is responsible for the effect in men viewing women. Although, as just noted, Elliot and Niesta (2008) did not examine mediation, they did offer speculation that women's sexual receptivity may be the mechanism that leads men to view women in red as more attractive. Research is needed to test this possibility. A final possibility is that perceived status and sexual receptivity are simultaneous mediators of the red effect for either or both sexes. This seems implausible in the case of women viewing men; status has been documented as a mediator in the present research, but there is no theory or research suggesting that male sexual receptivity is an attractant for women. This seems more plausible, and worthy of empirical testing, in the case of men viewing women, because a conceptual case can be made for both status (as we have done herein) and sexual receptivity (see Elliot & Niesta, 2008) as mediational variables.

Red has recently received empirical attention in the achievement domain, as well as the attraction domain, where it has been shown to evoke avoidance motivational processes that undermine intellectual performance (Elliot, Maier, Moller, Friedman, & Meinhardt, 2007; Maier, Elliot, & Lichtenfeld, 2008) and facilitate error detection (Mehta & Zhu, 2009) for both sexes. Statements about red, and color more generally, regularly appear in the popular media and, to a (much) lesser extent, the scholarly literature, and in both cases these statements are typically general and context-free (e.g., red is a warm color, red is energizing). The new, emerging research on color suggests that such statements are overly simplistic and often wrong altogether and that research on color and psychological functioning must be theoretically grounded and carefully nuanced if it is to bear fruit.

Our findings establish, for the first time, clear parallels in the way that human and nonhuman females respond to male red. This suggests that women's thoughts and feelings toward men are, at least in part, primitive. The question "What do women want?" with regard to sexual attraction and desire has puzzled men and preoccupied scholars for many years. Our research, coupled with work on menstrual cycle effects (Gangestad & Simpson, 1998) and symmetry effects (Grammer & Thornhill, 1994), suggests that the answer may be less elusive, but perhaps more provocative, than anticipated.

In closing, red is typically thought of as a "sexy" color for women only, but our findings indicate that a red-sex link is also applicable to men. In documenting this link, our research illustrates the fascinating way in which red is used in communication between the sexes, conveying important information in subtle, and

perhaps even automatic, ways. Color is a ubiquitous perceptual stimulus in daily life, yet little is known about how individuals are affected by color. Color is typically thought of in terms of aesthetics alone, but it appears that color can also carry meaning and impact individuals' psychological functioning. Simply put, the role of color in intraspecific communication seems a promising and understudied area of research, one that we think will yield many provocative insights in the years to come.

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Received October 9, 2009

Revision received March 26, 2010

Accepted March 26, 2010 ■

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