

Romantic Red: Red Enhances Men's Attraction to Women

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In many nonhuman primates, the color red enhances males' attraction to females. In 5 experiments, the authors demonstrate a parallel effect in humans: Red, relative to other achromatic and chromatic colors, leads men to view women as more attractive and more sexually desirable. Men seem unaware of this red effect, and red does not influence women's perceptions of the attractiveness of other women, nor men's perceptions of women's overall likeability, kindness, or intelligence. The findings have clear practical implications for men and women in the mating game and, perhaps, for fashion consultants, product designers, and marketers. Furthermore, the findings document the value of extending research on signal coloration to humans and of considering color as something of a common language, both within and across species.

Keywords: color, red, attractiveness, attraction, evaluation

What factors influence men's physical attraction to women? This question has been of interest to scholars across disciplines for millennia (Sugiyama, 2005) and has received a significant amount of empirical attention in the past few decades. Research addressing this question has documented several facial and bodily features as important influences; for example, men are most attracted to women with sexually dimorphic (i.e., highly feminine), symmetrical, and average facial features and a relatively low waist-to-hip ratio and body mass index (Gangestad & Scheyd, 2005; Rhodes, 2006; Symons, 1995; Weeden & Sabini, 2005). Although the predominant focus has been on women's physical characteristics, some attention has also been allocated to nonphysical factors that influence men's attraction to women (Kniffen & Wilson, 2004). Researchers have found, for example, that men find extraverted (Swami, Greven, & Furnham, 2007), honest (Paunonen, 2006), and provocatively clad (E. M. Hill, Nocks, & Gardner, 1986) women more attractive and find women in general more attractive when the bar is closing (Gladue & Delaney, 1990).

In the present research, we seek to expand the scope of the existing literature on female attractiveness by literally and figuratively adding color. That is, our research focuses on color as a novel factor that can influence men's attraction to women. Specifically, our research is designed to examine the hypothesis that the color red leads men to view women as more attractive and more sexually desirable.

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Color in Context

Color is usually considered in terms of aesthetics alone. However, in recent work, Elliot, Maier, Moller, Friedman, and Meinhart (2007) have proposed that colors can also carry specific meanings that have important implications for psychological functioning. Elliot et al. argued that when a color carries a particular meaning, the mere perception of that color is sufficient to produce affect, cognition, and behavior consistent with that meaning. Thus, color is presumed to have functional value as well as aesthetic value.

In their empirical work, Elliot et al. (2007) focused on the influence of the color red on performance in achievement situations. They posited that red carries the meaning of failure in achievement situations and, therefore, evokes avoidance motivation in such situations. Avoidance motivation is inimical for performance in most achievement settings, thus viewing red before an achievement test was predicted to undermine performance attainment. Support for the hypothesized deleterious effect of red on performance was obtained in a series of experiments.

Although red can have inimical implications for psychological functioning, we do not think that this is always the case. More generally, we posit that color meanings and their corresponding implications are not invariant across situations, but instead vary according to the psychological context. Indeed, we propose that the same color can have opposite meanings and, therefore, opposite implications in different contexts. Elliot et al. (2007) showed that red can have negative, aversive implications in an achievement context; in the present work, we sought to show that red can have positive, appetitive implications in a relational context.

Romantic Red

As indicated earlier, our primary hypothesis is that red leads men to view women as more attractive and more sexually desirable. Red is hypothesized to serve as an aphrodisiac for men because it carries the meaning of sex and romance in the context of heterosexual interaction. Empirical work has supported the idea

that red has amorous meaning, as studies of color associations have indicated that people tend to connect red to carnal passion, lust, and romantic love (Aslam, 2006; Jacobs, Keown, Worthley, & Gyhmn, 1991; Kaya & Epps, 2004; Neto, 2002). For ease of communication, we refer to this amorous meaning of red as the red–sex link. We view this red–sex link as emerging from two basic, nonindependent sources.

The first source is conditioning based on societal use of red. The pairing of red and sex in society has a long history that continues to the present. In some of the earliest rituals known to anthropologists, red ochre was used as face and body paint on females to symbolize the emergence of fertility (Knight, Powers, & Watts, 1995; Kohn, 1999; Lee, 2006). Red often appears as a symbol of passion, lust, and fertility in ancient mythology and folklore (Barua, 1962; Erdoes & Ortiz, 1984; Hupka, Zaleski, Otto, Reidl, & Tarabrina, 1997; Hutchings, 2004; Jobes, 1962). In literature, red has repeatedly been associated with female sexuality, especially illicit sexuality, most famously in Nathaniel Hawthorne's classic work *The Scarlet Letter*. Likewise, in popular stage and film, there are many instances in which red clothing, especially a red dress, has been used to represent passion or sexuality (e.g., *A Streetcar Named Desire*, *Dial M for Murder*, and *Jezebel*; Greenfield, 2005). Red is paired with hearts on Valentine's Day to symbolize romantic affection and is a highly popular color for women's lingerie. Red has been used for centuries to signal sexual availability or "open for business" in red-light districts. Women commonly use red lipstick and rouge to heighten their attractiveness, a practice that has been in place at least since the time of the ancient Egyptians (10,000 BCE; Regas & Kozlowski, 1998).

Although it is possible that the red–sex link is a product of societal conditioning alone, there is reason to believe that it may also have roots in our biological heritage. Many nonhuman female primates display red on their genitals, perineum, chest, or face when nearing ovulation (Dixson, 1983; Gerald, 2003; Hrdy & Whitten, 1987; Setchell, Wickings, & Knapp, 2006). This reddening of the skin is due to elevated estrogen (relative to progesterone) levels; increased estrogen enhances vascular blood flow under the skin surface that is manifested as red coloration (Dixson & Herbert, 1977). In some species, these displays are highly conspicuous, such as the exaggerated red swelling of the perineum in baboons, chimpanzees, and macaques, whereas in other species these displays are far less prominent, as in the slight reddening of the vulva in gibbons, gorillas, and strepsirrhines (Barelli, Heistermann, Boesch, & Reichard, 2007; Sillen-Tullberg & Moller, 1993). The precise function of red coloration in female primates, both across species and across various manifestations, remains a matter of debate (Nunn, 1999; Setchell & Wickings, 2004; Stallman & Froehlich, 2000), but there is widespread consensus that it represents a sexual signal designed to attract mates (Deschner, Heistermann, Hodges, & Boesch, 2004). Research has shown that male primates are indeed particularly attracted to female conspecifics exhibiting red, as indicated by increased masturbation and copulation attempts (Bielert, Girolami, & Jowell, 1989; Waitt, Gerald, Little, & Krasielburd, 2006).

For human females, ovulation is not advertised in a conspicuous manner, but researchers are beginning to document the presence of subtle physiological, psychological, and behavioral markers of reproductive status. As with other female primates, women's estrogen–progesterone ratio is elevated near ovulation, which en-

hances blood flow (Fortney et al., 1988; Lynn, McCord, & Halliwell, 2007). In addition, women's general skin tone lightens mid-cycle (Van den Berghe & Frost, 1986), and women near ovulation tend to wear clothing that leaves more skin visible (Grammer, Renninger, & Fischer, 2005; Haselton, Mortezaie, Pillsworth, Bleske-Rechek, & Fredrick, 2007). Furthermore, women at mid-cycle report more sexual interest and are more easily sexually aroused (Bullivant et al., 2004; Slob, Bax, Hop, Rowland, & van der Werflen Bosch, 1996), meaning the red blush of flirtation (on the face, neck, and upper chest; Eibl-Eiblsfeldt, 1989; Keltner & Buswell, 1997) and the red flush of sexual excitation (which begins on the lower chest and spreads to the upper chest, neck, and face as excitation increases; Katchadourian, 1984) are more prevalent at this time. As such, it is likely that women, like other female primates, display red more often and more prominently when nearing ovulation. We also think it reasonable to posit that men, like their more primitive male relatives, are predisposed to interpret a display of red by a female conspecific as a sexual signal and to respond accordingly.

In sum, red is clearly linked to sex in the context of heterosexual interaction, and this link is viewed as emerging from both societal use of red and a biologically engrained predisposition to red. These two sources may contribute to the red–sex link in joint fashion. That is, we posit that the societal use of red is not random, but actually derives from the biologically based predisposition to perceive red as a sexual signal. For example, the aforementioned use of red lipstick and rouge may represent, at least in some instances, an attempt to mimic the vascularization present during ovulation and sexual excitation (Low, 1979). Likewise, red may be used in red-light districts because it is the color that appears on the sexually aroused female body (not only in the publicly visible sexual flush, but, more intimately, in the engorgement of the labia minora; Luria, Friedman, & Rose, 1987). As these examples illustrate, the societal use of red can be seen as not only reinforcing the inherent meaning of red, but also as extending the application of this meaning beyond the tether of natural bodily processes. Thus, we posit that for men, red not only carries sexual meaning when displayed on a woman's body via vascularization, but also when displayed artificially on a woman's body with cosmetics and when exhibited on her clothing, accessories, or even in close proximity to her person. It is this latter, extended use of red that we investigate in the experiments reported in this article.

Implications of the Red–Sex Link for Appetitive Evaluation

The present research focuses on the implications of the red–sex link for men's appetitive evaluation of women. Two forms of appetitive evaluation may be distinguished in this context: perceived physical attractiveness and sexual attraction (Foster, Witcher, Campbell, & Green, 1998). *Perceived physical attractiveness* refers to a positive judgment regarding the target's physical appearance, whereas *sexual attraction* refers to a felt desire to become romantically involved with the target. Our experiments examine the influence of red on both of these aspects of appetitive evaluation.

Regardless of whether one emphasizes the biological or societal roots of the red–sex link, it seems straightforward to subsequently posit that red facilitates men's appetitive evaluation of women.

From the biological predisposition standpoint, men, like other primates, interpret red as a sexual signal, to which they are inherently inclined to respond in appetitive fashion. In essence, red may be viewed as a sign stimulus that directly incites sexual attraction (for an analog in a different domain, see Öhman, Flykt, & Esteves, 2001). From the societal learning standpoint, men possess strong associations between red and sex in relational contexts, such that the sight of red automatically activates sexual content in memory. A "lady in red" will therefore be seen in sexual terms, and a sexy woman is likely to be perceived as more physically attractive and desirable (for an analog in a different domain, see Bargh, Raymond, Pryor, & Strack, 1995). It should be noted that from both standpoints, red would be expected to enhance both the perceived attractiveness of and felt sexual desire toward women.

In general, people tend to have limited knowledge of the sources of their preferences and predilections (Wilson, 2002). This is likely to particularly be the case for evaluations that emerge from deeply engrained or automatic processes (Schmitt & Buss, 1996). Accordingly, we posit that men are largely unaware of the effect that red has on their perceptions of and desires toward women.

Overview of the Present Research

The present research consists of five experiments designed to put the hypothesized red effect to systematic empirical test. In Experiment 1, we presented male participants with a female photo on a red or a white background and examined whether they would perceive the woman placed on the red background as more attractive. In Experiment 2, we tested whether the red effect is specific to men rating the attractiveness of women or generalizes to women rating the attractiveness of other women. In Experiments 3–5, we tested the influence of red relative to a variety of other colors, achromatic and chromatic alike. Experiments 3–5 also extended the focus of our work beyond perceptions of attractiveness to sexual attraction. In Experiments 3 and 4, we examined whether the red effect is specific to attractiveness and attraction or generalizes to overall likeability, kindness, or intelligence. In Experiment 5, we shifted the placement of the color presentation to the shirt of the target woman and included an examination of intentions regarding dating and spending money on the target woman. Finally, in all experiments we examined the degree to which men were aware of the influence of red on their perceptions of and desires toward the various target women they encountered.

Experiment 1

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

Method

Participants

Twenty-seven male undergraduates in the United States participated voluntarily or for extra course credit. Participation in this and all subsequent experiments was restricted to individuals who did not have a red–green color deficiency. The mean age of

participants was 20.52 years ($SD = 1.83$). Participant ethnicity was as follows: 22 Caucasian, 2 African American, 1 Asian, 1 Hispanic, and 1 unspecified.

Design, Procedure, and Materials

Participants were randomly assigned to one of two between-subjects color conditions: the red condition ($n = 15$) or the white condition ($n = 12$). The experimenters in this and all subsequent experiments were unaware of participants' condition and remained unaware of the hypotheses being tested throughout data collection.

On arrival for the experiment, participants were informed that the experiment was on first impressions of the opposite sex. A manila folder was placed faced down on the desk in front of participants; the folder contained a black-and-white photo of a woman on a red or white background, followed by a questionnaire. Participants were instructed to turn the folder over and to open the folder and look at the picture for 5 s. The experimenter remained unaware of color condition by turning away from participants as they viewed the photo. When 5 s had elapsed, participants were told to remove the questionnaire that was behind the picture, to close the folder, and to put the folder face down on the desk. Then participants completed the questionnaire, which contained a perceived attractiveness measure, several demographics items, a question asking them to guess the purpose of the experiment,¹ and a probe for awareness of the effect of color. Participants were then debriefed and dismissed.

The female photo was selected from a standard set of black-and-white photos compiled by Corneille, Monin, and Pleyers (2005). The photo was a 4-in. \times 6-in. (10.2 cm \times 15.2 cm) yearbook-like head and upper torso shot of a moderately attractive young adult woman with brown hair. She wore a striped button-down shirt and had a pleasant smile on her face. In a pilot test with a separate sample of men, this woman received a mean attractiveness rating of 6.73 ($SD = 0.88$) on a scale from ranging 1 (*not at all attractive*) to 9 (*extremely attractive*).²

For the experiment, the female photo was centered on an 8.5-in. \times 11-in. (21.6 cm \times 27.9 cm) page, and color was manipulated by varying the color of the area surrounding the photo. In the white condition, the photo was simply printed on Epson enhanced matte white paper, so white was the color surrounding the photo. In the red condition, before printing the photo on this paper, Adobe Photoshop was used to fill in the area surrounding the photo with the color red (this presentation of red corresponds to the way that red is displayed in Amsterdam's famous red-light district). An Epson Stylus Photo R800 color printer was used to produce the picture stimuli.

The color for the red condition was selected using the CIELCh color model, which defines color in terms of three parameters: lightness, chroma, and hue (Fairchild, 2005). A standard red color was selected, and a GretagMacBeth Eye-One Pro spectrophotom-

¹ A correct guess was defined as any mention of color and attractiveness; neither a specific color nor a type of relation between color and attractiveness was necessary, but mere mention of color alone or attractiveness alone was deemed insufficient.

² The pilot data for this and all subsequent experiments were collected from at least 15 undergraduate U.S. men (ages 18–22) who did not participate in the corresponding experiment.

eter was used to determine the precise parameters of the printed color from the spectral data (LCh[50.3, 58.8, 29.9]). For this and all subsequent experiments, a pilot study with a separate sample of men was conducted to ensure that the colors used in the manipulation were recognizable, standard colors. The results from this pilot study and each of the other pilot studies conducted indeed indicated that each of the colors used was (a) recognized as the designated color, (b) viewed as a typical representation of the color, and (c) did not differ from the other color in the experiment in the extent to which it was viewed as a typical representation of the color.³

Measures

Perceived attractiveness. Perceived attractiveness was assessed with two items: “How attractive do you think this person is?” and “How pretty do you think this person is?” The items were rated on scale ranging from 1 (*not at all*) to 9 (*extremely*), and scores were averaged to form a composite index ($\alpha = .82$).

Awareness probe. Jones, Pelham, Carvallo, and Mirenberg’s (2004) procedure was used to probe for participants’ awareness of the effect of color. Participants were asked to indicate the extent (1 = *not at all*, 9 = *extremely*) to which three specific factors influenced their rating of the woman: (a) “the woman’s facial expression,” (b) “the way the woman was dressed,” and (c) “the color on which the picture was placed.”

Results and Discussion

We used an independent-samples *t* test to examine the effect of color condition (red vs. white) on perceived attractiveness. The analysis revealed a significant effect of color, $t(25) = 2.88$, $p < .01$, $d = 1.11$. As displayed in Figure 1, participants in the red condition rated the target woman as more attractive than did those in the white condition.

None of the participants was able to correctly guess the purpose of the experiment. In addition, in the awareness probe, color was viewed as having the least impact of the three factors: $M_{\text{facial expression}} = 6.70$ ($SD = 1.54$), $M_{\text{dressed}} = 5.89$ ($SD = 1.83$), and $M_{\text{color}} = 3.48$ ($SD = 2.17$); paired-samples *t* tests indicated that the rating for color was significantly lower than the ratings for the woman’s facial expression, $t(26) = 6.28$, $p <$

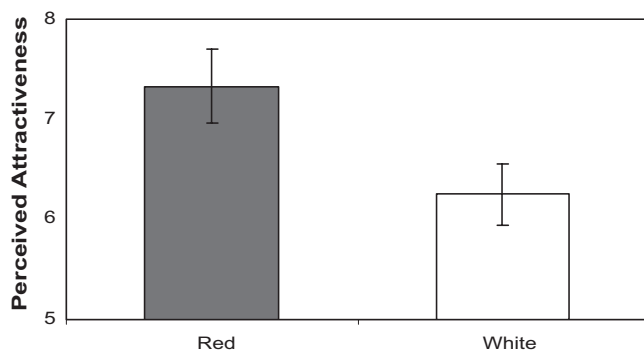


Figure 1. Perceived attractiveness as a function of color in Experiment 1. Confidence intervals (95%) are indicated by vertical lines.

.001, and the way the woman was dressed, $t(26) = 4.44$, $p < .001$.

In sum, the results from this experiment supported our hypotheses. Men who viewed a woman on a red, relative to a white, background perceived her to be more attractive. Participants were unaware of the fact that the experiment focused on color and attractiveness, and they indicated that color had a minimal influence on their rating of the woman.

Experiment 2

In Experiment 2, we examined whether the observed effect is specific to men rating women or generalizes to women rating women. This use of female raters allowed us to test whether the red effect is grounded in an appetitive sexual process, as posited, or is simply grounded in any of a variety of general processes equally applicable to men and women.⁴ One possibility is that the perception of red increases general activation in both men and women (Goldstein, 1942), which leads both sexes to exacerbate their initial evaluative tendencies toward a moderately attractive female (Hull, 1943; Pastor, Mayo, & Shamir, 2007).⁵ Another possibility is that both men and women prefer chromatic to achromatic stimuli (Axelsson, 2007), and in the red condition this preference is transferred to the target woman for both sexes (Camacho, Higgins, & Luger, 2003; Huber, Shiffrin, Lyle, & Quach, 2002). Still another possibility is that stimuli containing long-wavelength colors such as red appear to be slightly nearer to the perceiver than

³ The pilot study for this and all subsequent experiments was conducted with undergraduate U.S. men (ages 18–22) who did not participate in the corresponding experiment. In each pilot study, participants were randomly assigned to a between-subjects color condition (at least 8 per cell) and asked two questions to examine whether they recognized the assigned color as the designated color: “To what degree is the color red?” and “To what degree is the color [the applicable contrast color]?” They responded on a scale ranging from 1 (*not at all*) to 5 (*very much*). In each pilot study, independent-samples *t* tests for each question revealed that participants indeed made accurate color categorizations ($t_s \geq 4.18$, $ps \leq .001$). Participants were also queried, “To what degree is the color a typical example of that color?” and responded on a scale ranging from 1 (*not at all*) to 5 (*very much*). In each pilot study, the mean for each color condition was above the midpoint of the scale, and the conditions did not differ in their degree of perceived typicality ($ps > .27$).

⁴ As with all other experiments in this article, the primary focus of Experiment 2 was on men rating women; the female participants in this experiment were simply used to examine the alternative accounts of the results obtained in Experiment 1 for male participants. The question of whether red influences women’s ratings of men is also of great interest, but is a completely independent question that focuses on female sexuality and that must be investigated in a separate series of experiments (see the General Discussion section for more on this issue).

⁵ It should be noted that this general activation account of the red effect is actually grounded in a popular misconception about the color red. Many laypersons and even those in the applied color literature are advocates of Goldstein’s (1942) hypothesis that long wavelength colors such as red are more arousing or activating than short wavelength colors. However, there is no scientific basis for this hypothesis; well-controlled experiments testing this premise have yielded null results (Caldwell & Jones, 1985; Fehrman & Fehrman, 2004; Mikellides, 1990). Nevertheless, the general activation account is addressed herein because of the widespread nature of this misconception about red.

achromatic or short-wavelength stimuli (because of differences in light refraction in the lens of the eye; Marcos, Burns, Moreno-Barrisop, & Navarro, 1999), and closer stimuli are preferred by perceivers of both sexes (Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005; Williams & Bargh, 2008). Research has shown that male and female participants tend to rate female targets similarly on attractiveness under standard conditions (Marcus & Miller, 2003); according to each of the aforementioned general process accounts, including red should lead both male and female participants to rate a female target as more attractive. If, however, as posited, red is an interspecific signal that conveys a sexual message, the red effect should be observed for male participants only.

Method

Participants

Sixty-three (31 male and 32 female) undergraduates in the United States participated for extra course credit. The mean age of participants was 19.27 years ($SD = 1.79$). Participant ethnicity was as follows: 50 Caucasian, 2 African American, 6 Asian, 2 Hispanic, 2 other, and 1 unspecified.

Design, Procedure, and Materials

Male and female participants were randomly assigned to one of two between-subjects conditions: the red condition ($n = 32$) or the white condition ($n = 31$). The presentation of experimental materials to participants was the same as in Experiment 1, except that participants were informed that the experiment was on how people form impressions of others. A different female photo from the Corneille et al. (2005) set was used in this experiment. The photo was a 4-in. \times 6-in. (10.2 cm \times 15.2) yearbook-like head and upper torso shot of a moderately attractive young adult woman with blonde hair. She wore a plain blouse covered by a plain jacket and had a pleasant smile on her face. In a pilot test with a separate sample of men, this woman received a mean attractiveness rating of 5.56 ($SD = 1.55$) on a scale ranging from 1 (*not at all attractive*) to 9 (*extremely attractive*). The parameters of the printed red color were LCh(55.5, 78.0, 28.0).

Measures

The perceived attractiveness measure ($\alpha = .91$) and the awareness probe were the same as those used in Experiment 1.

Results and Discussion

We conducted a 2 (color condition: red vs. white) \times 2 (sex of participant: male vs. female) between-groups analysis of variance (ANOVA) on perceived attractiveness. The analysis revealed a significant Color \times Sex interaction, $F(1, 59) = 5.20, p < .05, \eta_p^2 = .08$. The main effect of sex was marginally significant ($p < .06$), with men ($M = 6.58$) tending to rate the target woman as more attractive than did women ($M = 5.94$); the main effect of color was not significant ($p > .58$).

We used two sets of planned comparisons to examine the specific effects. First, we examined the effect of color on perceived attractiveness for male and female participants separately. These

analyses revealed a significant effect of color for men, $t(29) = 2.13, p < .05, d = 0.77$, but not for women ($p > .26$). As seen in Figure 2, men in the red condition rated the target woman as more attractive than did men in the white condition, whereas a nonsignificant trend in the opposite direction was observed for women. Second, we examined the effect of sex on perceived attractiveness in the red and white conditions separately. These analyses revealed a significant effect of sex in the red condition, $t(30) = 3.54, p < .01, d = 1.28$, but not in the white condition ($p > .83$). As displayed in Figure 2, in the red condition men rated the target woman as more attractive than did women, whereas in the white condition there was no difference between men and women.

One participant correctly guessed that the experiment focused on color and attractiveness. All of the above results remained the same when this participant was omitted from the analyses. In addition, in the awareness probe, color was viewed as having the least impact of the three factors: $M_{\text{facial expression}} = 6.44$ ($SD = 1.73$), $M_{\text{dressed}} = 4.86$ ($SD = 1.93$), and $M_{\text{color}} = 2.97$ ($SD = 2.03$); paired-samples t tests indicated that the rating for color was significantly lower than the ratings for the woman's facial expression, $t(62) = 10.61, p < .001$, and the way the woman was dressed, $t(62) = 5.60, p < .001$.

In sum, the results from this experiment supported our hypotheses. Men who viewed a woman on a red relative to a white background perceived her to be more attractive; this effect was not present for women. In addition, a differential pattern was observed for men and women within the red but not the white condition. Thus, this experiment replicated the red effect with a different target woman and ruled out several alternative explanations for the effect based in general processes across sex. In general, participants were unaware of the fact that the experiment focused on color and attractiveness, and they indicated that color had a minimal influence on their rating of the woman.

Experiment 3

In Experiment 3, we shifted our focus back to male participants alone and 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 be made to vary considerably in lightness. As such, red and gray may be

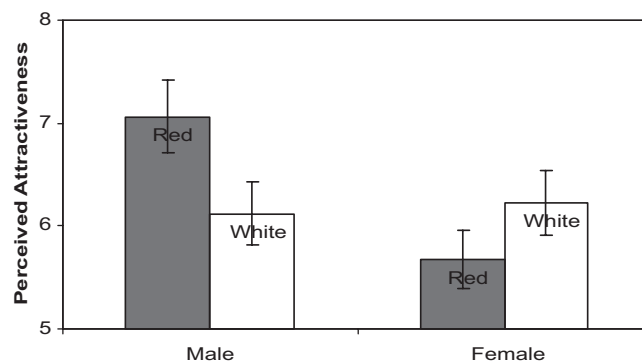


Figure 2. Perceived attractiveness as a function of color and sex of participant in Experiment 2. Confidence intervals (95%) are indicated by vertical lines.

equated on lightness, which allows 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 judgments to sexual attraction. As indicated earlier, an attractiveness judgment represents an evaluation of a target person's physical appearance, whereas sexual attraction represents the desire to become physically involved with the target person. Our hypothesis regarding red seems at least as applicable to sexual attraction, if not more so; thus, we predicted that red would not only influence perceptions of attractiveness, but would also influence sexual attraction. Third, we examined whether the effect of red extends beyond attractiveness judgments to overall likeability judgments. Perceptions of overall likeability represent a different form of liking than 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 overall likeability, and that the predicted effect of red would hold with overall likeability controlled.

Method

Participants

Given the focus on sexual attraction in this and all subsequent experiments, participation was restricted to heterosexual and bisexual individuals. We measured sexual orientation with two items, one that assessed degree of attraction to individuals of the same sex and another that assessed degree of attraction to individuals of the opposite sex (1 = *not at all attracted*, 9 = *extremely attracted*). We used Storms's (1980) two-dimensional model to categorize participants' sexual orientation on the basis of their scores on these items.

Thirty-seven male undergraduates in the United States participated for extra course credit. The mean age of participants was 20.00 years ($SD = 1.70$). Participant ethnicity was as follows: 28 Caucasian, 6 Asian, 2 Hispanic, and 1 other.

Design, Procedure, and Materials

Participants were randomly assigned to one of two between-subjects conditions: the red condition ($n = 20$) or the gray condition ($n = 17$). The presentation of experimental materials to participants was the same as in Experiment 1 except that participants were shown two female photos for an unlimited amount of time and completed a separate questionnaire for each. The two photos were those used in Experiments 1 and 2, and the order of the photos was counterbalanced.

In both the red and the gray conditions, Adobe Photoshop was used to fill in the area surrounding the photos with color before they were printed on Epson enhanced matte white paper. An Epson Stylus Photo R800 color printer was used to produce the picture stimuli. The colors were selected using the CIELCh color model and a GretagMacBeth Eye-One Pro spectrophotometer. A trial-and-error process was used to find standard red and gray colors that were equivalent on lightness when printed. The parameters for the printed red color were LCh(50.0, 58.7, 30.3) and for the printed

gray color were LCh(50.0, —, 52.6; chroma is not relevant for gray, an achromatic color).

Measures

Perceived attractiveness. We used two items to assess perceived attractiveness: "How attractive do you think this person is?" (1 = *not at all*, 9 = *extremely*) and "If I was to meet the person in this picture face to face, I would think she is attractive" (1 = *no, definitely not*, 9 = *yes, definitely*). Scores were averaged to form a composite index ($\alpha = .95$).

Sexual attraction. We assessed sexual attraction with measures of both sexual desire and desired sexual behavior. Four items were used to assess sexual desire (e.g., "How much do you find this person sexually desirable?" and "How much do you find this person sexually appealing?"). The items were rated on a scale ranging from 1 (*not at all*) to 9 (*extremely*), and scores were averaged to form a composite index ($\alpha = .88$).

We adjusted the five items from Greitemeyer's (2005) sexual receptivity measure slightly to assess desired sexual behavior. The measure focuses on a range of behaviors (e.g., making out and having sexual intercourse), and we worded the items in terms of what participants wanted to do 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 ($\alpha = .92$).

Perceived likeability. We used Jones et al.'s (2004) six-item likeability measure to assess overall likeability. The measure focuses on the target person's positive characteristics and general degree of likeability (e.g., "How honest do you think this person is?" and "How much do you think you would like this person if you got to know her?"). The items were rated on a scale ranging from 1 (*not at all*) to 9 (*very much*), and scores were averaged to form a composite index ($\alpha = .90$).

Awareness probe. The awareness probe was the same as that used in the prior experiments.

Results and Discussion

We conducted a 2 (color condition: red vs. gray) \times 2 (picture order) \times 2 (picture type) mixed model ANOVA on the dependent measures. Color and picture order were between-subjects variables and picture type was a within-subjects variable in the analysis. Preliminary analyses revealed no picture order main effects or picture order interactions involving color, so this variable was omitted from further consideration.

The analysis on perceived attractiveness revealed a main effect for color, $F(1, 35) = 4.24$, $p < .05$, $\eta_p^2 = .11$. As displayed in Figure 3a, participants in the red condition rated the target women as more attractive than did those in the gray condition. None of the other effects were significant in the analysis (although the main effect for picture type was $p = .09$, indicating a trend for one woman to be perceived as more attractive than the other).

The analysis on sexual desire revealed a main effect for color, $F(1, 35) = 8.24$, $p < .01$, $\eta_p^2 = .19$. As displayed in Figure 3b, participants in the red condition reported that the target women were more sexually desirable than did those in the gray condition. None of the other effects were significant ($p > .48$).

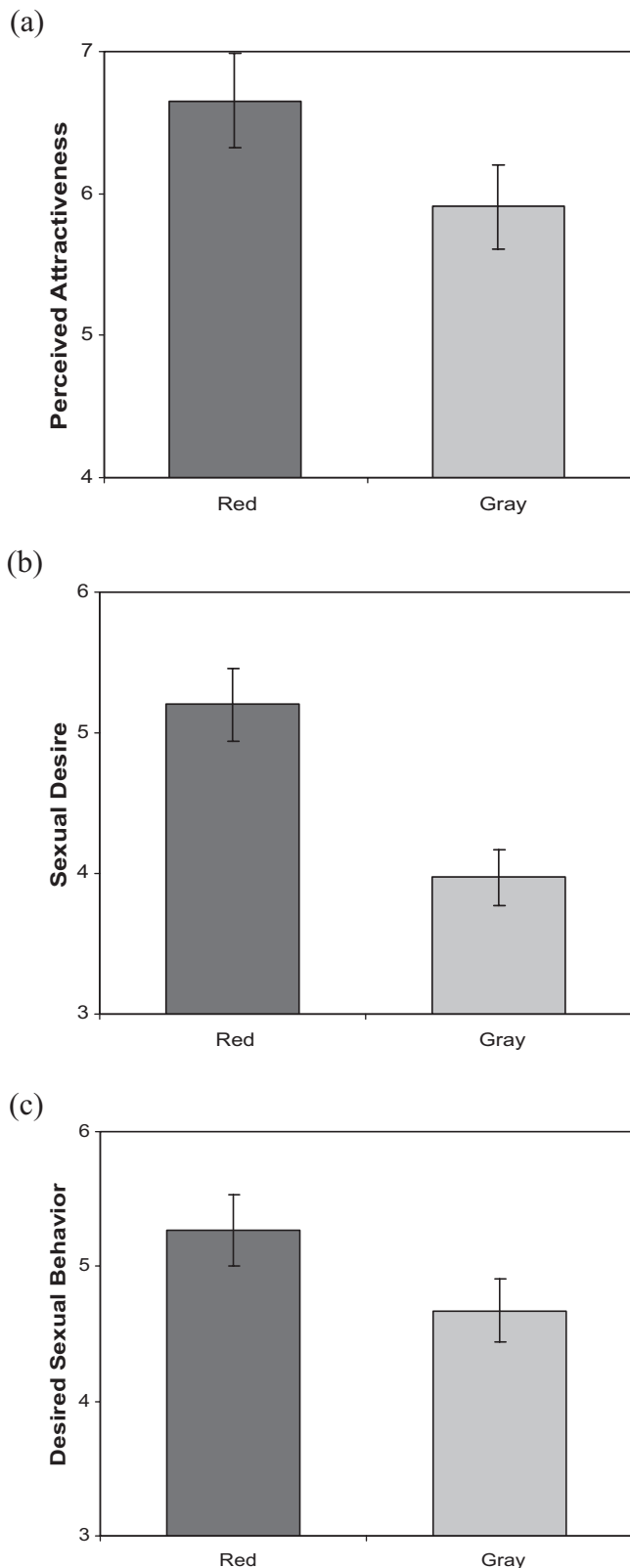


Figure 3. (a) Perceived attractiveness as a function of color in Experiment 3. (b) Sexual desire as a function of color in Experiment 3. (c) Desired sexual behavior as a function of color in Experiment 3. Confidence intervals (95%) are indicated by vertical lines.

The analysis on desired sexual behavior revealed a main effect for color, $F(1, 35) = 5.08$, $p < .05$, $\eta_p^2 = .13$. As displayed in Figure 3c, participants in the red condition wanted to engage in more sexual behavior with the target women than did those in the gray condition. None of the other effects were significant ($p > .39$).

The analysis on perceived likeability yielded a null effect for color ($p > .62$), and none of the other effects were significant ($p > .37$). Furthermore, all of the color effects reported above remained significant when the analyses were repeated with perceived likeability as a covariate.

One participant correctly guessed that the experiment focused on color and attractiveness/attraction. All of the above results remained the same when this participant was omitted from the analyses. In addition, in the awareness probe, color was viewed as having the least impact of the three factors: $M_{\text{facial expression}} = 6.89$ ($SD = 1.93$), $M_{\text{dressed}} = 5.14$ ($SD = 2.26$), and $M_{\text{color}} = 2.70$ ($SD = 1.96$); paired-samples t tests indicated that the rating for color was significantly lower than the ratings for the woman's facial expression, $t(36) = 8.72$, $p < .001$, and the way the woman was dressed, $t(36) = 5.41$, $p < .001$.

In sum, the results from this experiment supported our hypotheses. Men who viewed women on a red, relative to a gray, background perceived them to be more attractive and were more sexually attracted to them. Color did not affect overall likeability, and the focal results were shown to be independent of overall likeability. Thus, this experiment showed that the red effect extends to sexual attraction but not general positivity, is not due to differences in the lightness of color stimuli, and generalizes to a different stimulus viewing time and a different achromatic contrast color. In general, participants were unaware of the fact that the experiment focused on color and attractiveness/attraction, and they indicated that color had a minimal influence on their ratings of the women.

Experiment 4

In Experiment 4, we changed our comparison color from achromatic to chromatic, specifically from gray to green. Red and green are opposite colors in several well-established color models (Fehrman & Fehrman, 2004). Furthermore, 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. Also, it is important that red and green can be equated on chroma and lightness because this contrast allows a highly controlled test of the effect of hue holding constant the other two color properties. In this experiment, we also examined whether the effect of red extends to kindness and intelligence, the two positive characteristics that men (and women) across cultures report valuing most in a mate (Buss, 1989). Our theoretical analysis is relevant to attractiveness/attraction, not to general positive characteristics; thus, we predicted that red would influence perceptions of attractiveness and sexual attraction, but not perceptions of kindness and intelligence, and that the predicted effect of red would hold with these other highly valued characteristics controlled.

Method

Participants

Thirty-one male undergraduates in the United States participated for extra course credit. The mean age of participants was 19.97 years ($SD = 1.22$). Participant ethnicity was as follows: 24 Caucasian, 5 Asian, 1 Hispanic, and 1 other.

Design, Procedure, and Materials

Participants were randomly assigned to one of two between-subjects conditions: the red condition ($n = 16$) or the green condition ($n = 15$). The presentation of experimental materials to participants was the same as in Experiment 1. A different female photo from the Corneille et al. (2005) set was used in this experiment. The photo was a 4-in. \times 6-in. (10.2 cm \times 15.2) yearbook-like head and upper torso shot of a moderately attractive young adult woman with blonde hair. She wore a turtleneck sweater and had a neutral look on her face. In a pilot test with a separate sample of men, this woman received a mean attractiveness rating of 5.94 ($SD = 1.39$) on a scale ranging from 1 (*not at all attractive*) to 9 (*extremely attractive*).

The colors for the manipulation were selected using the CIELCh color model and a GretagMacBeth Eye-One Pro spectrophotometer. A trial-and-error process was used to find standard red and green colors that were equated on lightness and chroma when printed. The parameters for the printed red color were LCh(46.1, 51.2, 29.3) and for the printed green color were LCh(46.1, 51.0, 147.6).

Measures

Perceived attractiveness. Mehrabian and Blum's (1997) four-item general attractiveness measure was used to assess perceived attractiveness. The measure requires participants to rate the target person on various aspects of attractiveness (e.g., facial attractiveness or bodily attractiveness) using a scale ranging from 1 (*very unattractive*) to 9 (*very attractive*). Scores were averaged to form a composite index ($\alpha = .83$).

Sexual attraction. The sexual desire measure was the same as that used in Experiment 3 ($\alpha = .87$), as was the desired sexual behavior measure ($\alpha = .92$).

Perceived kindness and intelligence. We used Dijkstra and Buunk's (2002) four-item kindness measure to assess perceived kindness (e.g., "How nice do you think this person is?" and "How friendly do you think this person is?"). Participants rated the target person using a scale ranging from 1 (*not at all*) to 9 (*very*), and scores were averaged to form a composite index ($\alpha = .85$).

We used Dijkstra and Buunk's (2002) two-item intelligence measure to assess perceived intelligence ("How intelligent do you think this person is?" and "How highly educated do you think this person is?"). Participants rated the target person using a scale ranging from 1 (*not at all*) to 9 (*extremely*), and scores were averaged to form a composite index ($\alpha = .84$).

Awareness probe. The awareness probe was the same as that used in the prior experiments.

Results and Discussion

We used independent-samples t tests to examine the effect of color condition (red vs. green) on the dependent measures. The

analysis on perceived attractiveness revealed a significant effect of color, $t(29) = 2.05$, $p < .05$, $d = 0.73$. As displayed in Figure 4a, participants in the red condition rated the target woman as more attractive than did those in the green condition.

The analysis on sexual desire revealed a significant effect of color, $t(29) = 4.29$, $p < .001$, $d = 1.55$. As displayed in Figure 4b, participants in the red condition rated the target woman as more sexually desirable than did those in the green condition.

The analysis on desired sexual behavior revealed a significant effect of color, $t(29) = 4.59$, $p < .001$, $d = 1.11$. As displayed in Figure 4c, participants in the red condition wanted to engage in more sexual behavior with the target woman than did those in the green condition.

The analyses on both perceived kindness and intelligence yielded a null effect for color ($ps > .40$). Furthermore, all of the color effects reported above remained significant when the analyses were repeated with perceived kindness or intelligence as a covariate.

None of the participants was able to correctly guess the purpose of the experiment. In addition, in the awareness probe, color was viewed as having the least impact of the three factors: $M_{\text{facial expression}} = 6.83$ ($SD = 1.17$), $M_{\text{dressed}} = 5.07$ ($SD = 2.07$), and $M_{\text{color}} = 3.43$ ($SD = 2.11$); paired-samples t tests indicated that the rating for color was significantly lower than the ratings for the woman's facial expression, $t(30) = 7.43$, $p < .001$, and the way the woman was dressed, $t(30) = 3.07$, $p < .01$.

In sum, the results from this experiment supported our hypotheses. Men who viewed a woman on a red, relative to a green, background perceived her to be more attractive and were more sexually attracted to her. Color did not affect kindness or intelligence judgments, and the focal results were shown to be independent of perceived kindness and intelligence. Thus, this experiment showed that the red effect does not extend to general positive characteristics, is not due to differences in the chroma of color stimuli, and generalizes to a different target woman and a chromatic contrast color with appetitive associations. Participants were unaware of the fact that the experiment focused on color and attractiveness/attraction, and they indicated that color had a minimal influence on their ratings of the woman.

Experiment 5

In Experiment 5, we changed our comparison color from green to blue. Like green, blue should be a conservative contrast to red because blue is the most commonly selected color in studies of young adult and adult color preference (Fehrman & Fehrman, 2004; McManus, Jones, & Cottrell, 1981). Also, like green, blue is a chromatic color, meaning that red and blue can be equated on chroma and lightness, thereby affording another highly controlled test of the effect of hue with the other two color properties held constant. In this experiment, we also extended our dependent measures beyond attractiveness judgments and sexual attraction to include behavioral intentions regarding dating and willingness to spend money on a date. We anticipated that red would not only facilitate perceptions of attractiveness and sexual desire, but that it would also lead to stronger intentions to date and spend money on the target woman. Finally, in this experiment we also shifted the color presentation to the shirt of the target woman. Displaying the

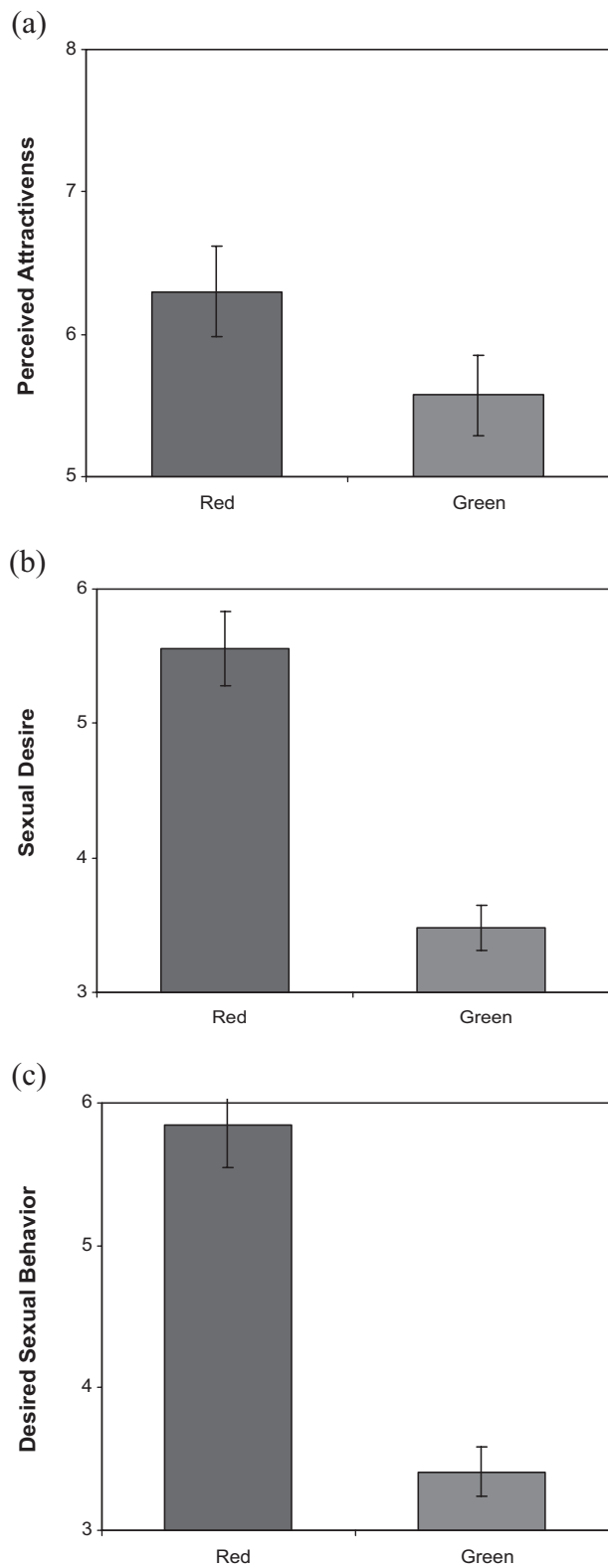


Figure 4. (a) Perceived attractiveness as a function of color in Experiment 4. (b) Sexual desire as a function of color in Experiment 4. (c) Desired sexual behavior as a function of color in Experiment 4. Confidence intervals (95%) are indicated by vertical lines.

colors on the woman's shirt extended our test of the red effect to a new type of color presentation, one that is more commonly encountered by men in daily life.

Method

Participants

Twenty-three male undergraduates in the United States participated for \$1.00 or a comparable donation to charity. Participation was restricted to individuals who did not have a blue–yellow (or red–green) color deficiency. The mean age of participants was 19.77 years ($SD = 1.34$). Participant ethnicity was as follows: 20 Caucasian, 1 Asian, and 2 other.

Design, Procedure, and Materials

Participants were randomly assigned to one of two between-subjects conditions: the red condition ($n = 12$) or the blue condition ($n = 11$). The presentation of experimental materials to participants was the same as in Experiments 1 and 4. The female photo was selected from www.Hotornot.com, a popular Web site expressly designed to generate attractiveness judgments; individuals post photos of themselves on this site, and others rate the attractiveness of the photos on a scale ranging from 1 (*not*) to 10 (*hot*). The photo was a 3-in. \times 6-in. (7.6 cm \times 15.2 cm) yearbook-like head and upper torso shot of a moderately attractive young adult woman with brown hair. She wore a plain form-fitting shirt and had a neutral look on her face. In a pilot test with a separate sample of men, this woman received a mean attractiveness rating of 6.80 ($SD = 1.32$) on a scale ranging from 1 (*not at all attractive*) to 9 (*extremely attractive*).

For the experiment, the photo was centered on an 8.5-in. \times 11-in. (21.6 cm \times 27.9 cm) page, and color was manipulated by varying the woman's shirt color. Unlike the prior photos, this photo was in color, which allowed the shirt color to be varied in a naturalistic manner. In both the red and blue conditions, Adobe Photoshop was used to color the shirt before the photo was printed on Epson enhanced matte white paper. An Epson Stylus Photo R800 color printer was used to produce the picture stimuli.

The colors for the manipulation were selected using the CIELCh color model and a GretagMacBeth Eye-One Pro spectrophotometer. A trial-and-error process was used to find standard red and blue colors that were equated on lightness and chroma when printed. The parameters for the printed red color were LCh(45.9, 54.8, 32.5) and for the printed blue color were LCh(46.0, 54.9, 283.0).

Measures

Perceived attractiveness. The perceived attractiveness measure was the same as that used in Experiment 4 ($\alpha = .91$).

Sexual attraction. The sexual desire measure was the same as that used in the prior experiments ($\alpha = .86$), as was the desired sexual behavior measure ($\alpha = .90$).

Dating scenarios. Participants were provided with two scenarios with an accompanying question for each. The first scenario focused on asking the target woman on a date: "Imagine that you are not dating anyone, and have decided to try computer dating. If you see this person on a computer dating website, would you ask

her out?" Participants responded using a scale ranging from 1 (*no, definitely not*) to 9 (*yes, definitely*). The second scenario focused on spending money on a date with the target woman: "Imagine that you are going on a date with this person and have \$100 in your wallet. How much money would you be likely to spend on your date?" Participants responded using a scale ranging from \$0 to \$100 in intervals of \$10.

Awareness probe. The awareness probe was the same as that used in the prior experiments.

Results and Discussion

We used independent-samples *t* tests to examine the effect of color condition (red vs. blue) on the dependent measures. The analysis on perceived attractiveness revealed a significant effect of color, $t(21) = 2.10, p < .05, d = 0.86$. As displayed in Figure 5a, participants in the red condition rated the target woman as more attractive than did those in the blue condition.

The analysis on sexual desire revealed a significant effect of color, $t(21) = 2.42, p < .05, d = 1.00$. As displayed in Figure 5b, participants in the red condition rated the target woman as more sexually desirable than did those in the blue condition.

The analysis on desired sexual behavior revealed a significant effect of color, $t(21) = 2.67, p < .05, d = 1.11$. As displayed in Figure 5c, participants in the red condition wanted to engage in more sexual behavior with the target woman than did those in the blue condition.

The analysis on ask on a date revealed a significant effect of color, $t(21) = 2.29, p < .05, d = 0.95$. As displayed in Figure 5d, participants in the red condition indicated a greater likelihood of asking the target woman on a date than did those in the blue condition.

The analysis on spend on a date revealed a significant effect of color, $t(21) = 3.19, p < .01, d = 1.35$. As displayed in Figure 5e, participants in the red condition indicated an intention to spend more money on the date with the target woman than did those in the blue condition.

None of the participants was able to correctly guess the purpose of the experiment. In addition, in the awareness probe, color was viewed as having the least impact of the three factors: $M_{\text{facial expression}} = 7.22 (SD = 1.51)$, $M_{\text{dressed}} = 7.26 (SD = 1.42)$, and $M_{\text{color}} = 5.96 (SD = 1.55)$; paired-samples *t* tests indicated that the rating for color was significantly lower than the ratings for the woman's facial expression, $t(22) = 3.24, p < .01$, and the way the woman was dressed, $t(22) = 4.83, p < .001$.

In sum, the results from this experiment supported our hypotheses. Men who viewed a woman in a red relative to a blue shirt perceived her to be more attractive, were more sexually attracted to her, and indicated a greater likelihood of asking her on a date and spending money on a date with her. Thus, this experiment showed that the red effect extends to dating and spending intentions and generalizes to a different type of color presentation, another target woman, and another chromatic contrast color with appetitive associations. Participants were unaware of the fact that the experiment focused on color and attractiveness–attraction, and they indicated that color had a minimal influence on their ratings of the woman.

General Discussion

The five experiments of the present research provide strong support for the hypothesized red effect. The effect was observed with two different durations of color presentation, with two different types of color presentation, with four different contrast colors (both achromatic and chromatic), and with four different female targets. It is important to note that the effect was present for male but not female perceivers and was observed on perceived attractiveness, sexual attraction, and dating and spending intentions, but not on other positive variables (overall likeability, kindness, and intelligence). Participants appeared to be unaware of the red effect, despite its being of considerable magnitude.

By demonstrating that a brief glimpse of red enhances men's attraction to women, the present research opens a new and provocative window on the study of human attraction. Research on women's attractiveness tends to focus on physical characteristics such as facial symmetry or waist-to-hip ratio, but in our work we have shown that red can serve as a nonphysical (i.e., nonfacial or bodily) factor influencing women's appeal to men. It is important to bear in mind, however, that our conceptual analysis suggests that red may also have a physically based influence on women's attractiveness, specifically when it is displayed on women's skin via vascularization. Future research is needed to test this possibility by examining, for example, whether the recent finding that women are viewed as more attractive during ovulation (Roberts et al., 2004) is mediated, at least in part, by a discernable increase in vascularization on the face or body. If this or a related finding could be documented, it would put red in the unique place of being both a physical and a nonphysical determinant of women's attractiveness.

Each of our experiments used a moderately attractive woman as the target stimulus, and an interesting question for future research is the generalizability of our findings across levels of women's attractiveness. We see no reason to anticipate different findings for women who fall within a few points of the middle of the attractiveness continuum, and this encompasses the vast majority of women. However, we are unsure whether the red effect demonstrated here would be found for highly attractive or highly unattractive women. Regarding highly attractive women, red may enhance men's attraction to them as well, but it is also possible that a ceiling effect exists, such that neither red nor anything else is needed to elicit maximum male attraction. Regarding unattractive women, it is possible that red straightforwardly boosts their attractiveness, much as the imminence of closing time at the bar makes women in general more appealing to men (Gladue & Delaney, 1990). However, it is also possible that red has a null effect in this instance, or even exacerbates an initial negative response. Evaluative mechanisms operate flexibly, not rigidly, making use of multiple informational inputs (Cosmides & Tooby, 2000; Tesser & Martin, 1996). As such, when several negative characteristics or indicators of fitness are present (e.g., facial asymmetry and a high waist-to-hip ratio), a sexual signal such as red may trigger repulsion rather than attraction.

An important aspect of our series of experiments was the demonstration that red does not influence women's perceptions of the attractiveness of other women, nor men's perceptions of women's overall likeability, kindness, or intelligence. This specificity of the red effect with regard to both sex of perceiver and type of positive

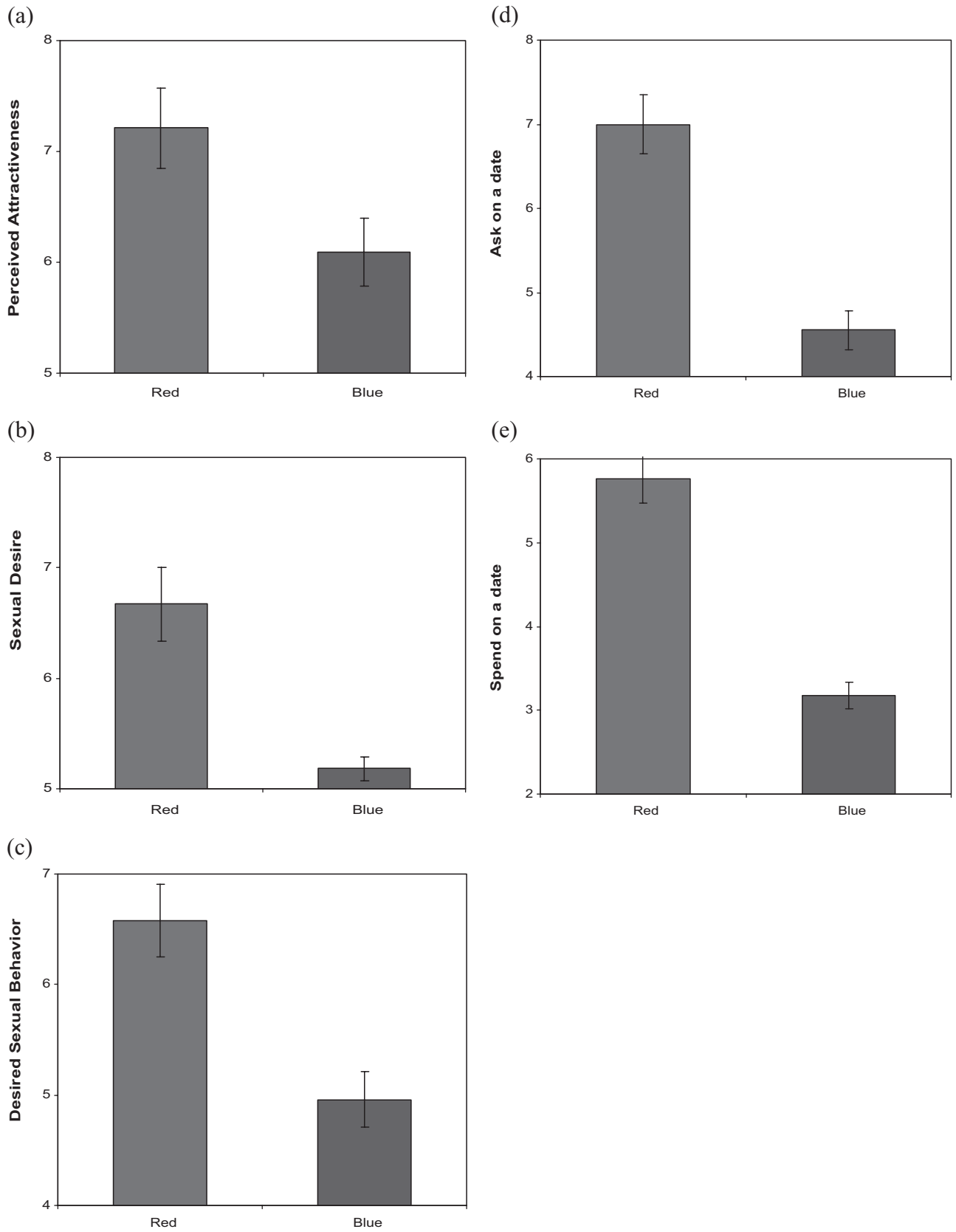


Figure 5. (a) Perceived attractiveness as a function of color in Experiment 5. (b) Sexual desire as a function of color in Experiment 5. (c) Desired sexual behavior as a function of color in Experiment 5. (d) Ask on a date as a function of color in Experiment 5. (e) Spend on a date as a function of color in Experiment 5. Confidence intervals (95%) are indicated by vertical lines.

attribute lends strong support to our position that red carries sexual meaning (for a conceptual parallel, see Maner, Gaillot, Rouby, & Miller, 2007). The attribute-based specificity is perhaps particularly noteworthy because it required working against the “beautiful is good” stereotype observed in the impression formation literature in which individuals who are perceived as physically attractive are also thought to possess a host of other positive characteristics (Dion, Berscheid, & Walster, 1972). In our research, the effect of red was confined to men’s perceptions of women’s attractiveness; it did not influence their perceptions of other positive characteristics that tend to covary with attractiveness in the beautiful-is-good stereotype (see Feingold, 1992).

Our research demonstrates a parallel in the way that human and nonhuman male primates respond to red. In so doing, our findings confirm what many women have long suspected and claimed—that men act like animals in the sexual realm. As much as men might like to think that they respond to women in a thoughtful, sophisticated manner, it appears that at least to some degree, their preferences and predilections are, in a word, primitive. Women, however, may have little room for phylogenetic pride, as it is possible that they respond to male red in a manner similar to that of nonhuman female primates. In several species of primate, red is displayed most prominently in dominant males (Setchell & Dixon, 2001), and females appear to be particularly attracted to male conspecifics showing red (Darwin, 1874; Waitt et al., 2003). Interestingly, women find dominant men highly attractive (Rainville & Gallagher, 1990; Sadalla, Kenrick, & Vershure, 1987), especially during ovulation (Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004), and it may be that women perceive red on men as a dominance cue with amorous implications. We have recently begun to examine the question of women’s response to a “gentleman in red” (which, it is important to reiterate, is independent of the question of men’s response to a “lady in red”) and have acquired preliminary evidence that a display of red on a man indeed increases his attractiveness to women. Thus, at least with regard to red and sex, it seems that neither men nor women will be able to rightfully claim the evolutionary high road.

In prior research (Elliot et al., 2007), we documented that the color red has aversive implications for psychological functioning in the achievement domain, in that it was shown to undermine intellectual performance. In the present research, we documented that red has appetitive implications for psychological functioning in the relational domain, in that it was shown to facilitate men’s attraction to women. Together, these findings demonstrate the context specificity of red: Red appears to carry different meanings and serve different functions in different contexts. This context specificity of red is not unique to humans, but is also observed in a number of other primates and simpler vertebrates. Male mandrills, for example, exhibit an aversive response to male conspecifics displaying red in competitive contexts, but show an appetitive response to female conspecifics displaying red during estrus (Setchell & Wickings, 2004, 2005). Likewise, domestic chicks avoid (poisonous) red insects, but are attracted to (ripe) red fruit (Gamberale-Stille & Tullberg, 2001). Laypersons and researchers alike tend to talk of color associations and color preferences in general, context-free terms (Dee & Taylor, 2002; Hemphill, 1996; Whitfield & Wiltshire, 1990), but the findings from our lab, in conjunction with those from research on nonhuman animals, sug-

gest that color must be discussed and studied in a more nuanced manner.

The practical implications of our findings are striking in the extent of their reach. That red is an aphrodisiac for men is not only valuable information for both men and women in the mating game, but should also prove of considerable interest to fashion and image consultants, product designers, and marketers and advertisers, among (many) others. Given the subtlety of the effect (men show little awareness of it) and the ease with which the effect may be evoked (via a 5-s glimpse of red), it is easy to imagine red having a widespread influence in daily life. However, it is important to bear in mind that red is but one of myriad visual stimuli perceived by men as they view women and that vision is but one of many modalities through which men acquire information as they form appetitive evaluations of women (Miller, 2000). Furthermore, although the procedures in our experiments mapped nicely onto real-world experiences, such as rating photos on www.HotOrNot.com or contemplating romantic candidates on a dating Web site, they did not involve a live interaction with another person. Now that we have documented the red effect under carefully controlled laboratory conditions, a logical next step is to test the strength and breadth of the effect in real-world settings. Another next step is to examine, in more extensive fashion, the degree to which the red effect truly takes place outside of conscious awareness. Although we showed that almost none of our participants correctly guessed the purpose of the experiment and that they thought that color had a minimal influence on their ratings, a definitive statement regarding awareness awaits research using nonconscious priming procedures.

Signal systems, including those involving color, are made up of a signaler and a receiver. Our primary focus in the present research has been on the response of the receiver, specifically the appetitive evaluative response of a man who views a red signal displayed by a woman. However, several issues pertaining to the signaling process itself are also of interest. The red of vascularization that women are presumed to naturally display on their bodies during ovulation is quite subtle, particularly in comparison to the florid sexual skin displayed by many other female primates (see Dixon, 1983). It is possible that women wear more rouge or lipstick during ovulation to make their natural bodily signals more conspicuous. It is also possible that women not only augment their natural sexual signals when ovulating, but also extend them through such practices as applying red nail polish, dressing in red clothing, or accessorizing with red purses or handbags.

Also of considerable interest is the extent to which women are aware of the influence that their red displays have on men and intentionally use red to convey a sexual message. To the degree that women are both aware of the red effect and intentional in their augmented and extended uses of red, a red display is likely to serve as an accurate, reliable sexual signal that facilitates communication and courtship. An example of such reliable signaling would be a woman who wears a red shirt or brings a red purse to a nightclub when in a sexy mood or when desirous of sexual attention, but who keeps such red ornamentation in her closet when just wanting a night out with her female friends. To the extent that women are unaware of the red effect, however, or use red on the basis of aesthetics alone (or for some other nonsexual purpose), they may inadvertently send sexual signals to men that result in unwanted romantic advances. Men have a strong tendency to attach sexual

meaning to women's ambiguous cues (Abbey, 1987; Haselton, 2003) and are likely see sex in red regardless of the signaler's intent. As such, even if adaptive overall, red may at times lead to miscommunication and misinterpretation in heterosexual interaction.

It is important to highlight that our purpose in the present research was to systematically document the novel and provocative red effect, not to put the precise origins of this effect to empirical test. These ultimate-cause questions have proven intricate and contentious in the nonhuman primate literature (see Emery & Whitten, 2003; Zinner, Nunn, van Schaik, & Keppeler, 2004), and we are reluctant to enter the fray in this initial exploration of romantic red in humans. We simply would like to state that the red effect documented herein does not stand or fall on any one biologically based interpretation or, in fact, on any biologically based interpretation at all. We presume that red serves a signal function for human females, but this need not be the case; it is possible that female red is simply a by-product of the underlying physiology of sexual excitation and that males have been selected to detect and respond to such cues (Gangestad, Thornhill, & Garver-Apgar, 2005; Miller, Tybur, & Jordan, 2007). It is also possible that red serves no adaptive function for humans whatsoever and that the red effect is due to associative learning alone. Our preferred explanation, and the one that we think best fits the available evidence, is that the red effect is the product of a biologically based signal system that is both reinforced and extended by societal conditioning (see Simpson & Gangstead, 2001, on the fallacy of either-or as opposed to both-and thinking in this regard). However, (considerable) additional research is needed before the specific origins of the effect can be known with certainty.

In closing, given the ubiquity of color stimuli in daily life, it is surprising how little research has been conducted on color in the psychological literature. Much is known about color physics and color physiology, but relatively little is known about color psychology (Fehrman & Fehrman, 2004; Whitfield & Wiltshire, 1990). This is particularly the case with regard to signal coloration in humans. Researchers have studied signal coloration in a variety of different nonhuman vertebrates for many years, and this area of study in humans seems a rich vein barely tapped (see Elliot & Maier, 2007; R. A. Hill & Barton, 2005). Color is a unique stimulus because it carries important meaning in a nonlexical format. As such, color messages may be conveyed and received by humans from infancy through old age, as well as by any other form of animate being with color vision. In essence, color represents something of a lingua franca within and across species, and this astounding breadth of relevance makes it of immense benefit in the study of basic approach and avoidance processes.

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