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Influence of conception risk and sociosexuality on female attraction to male red

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ABSTRACT

An experiment was conducted to test the moderating roles of ovulatory status and sociosexuality on female attraction to male red. Female participants were shown a picture of a man surrounded by a red or gray border, and then reported their sexual desire toward the man and their perceptions of his general likeability. The results indicated that women at times of high conception probability reported stronger sexual desire for the man surrounded by a red, relative to gray, border; this pattern was not found for women at times of low conception probability. The effect was significant only when the categorical "fertile window" (days 9–14) was calculated using the forward counting method from last menstrual onset. Color did not influence ratings of general likeability, and sociosexuality did not moderate the influence of color on participants' reports of sexual desire or their perceptions of general likeability. The results suggest that women tend to have a stronger sensitivity to red stimuli when their likelihood of conception is greatest. The increased sexual desire for men in red may be due to preferences for healthy and dominant men with high status.

1. Introduction

A striking difference between human and non-human primates is the absence of conspicuous morphological changes during ovulation, such as the estrogen-dependent sexual skin swellings found in chimpanzees and some Old World monkeys (Dixson, 2009). Women at times of high conception probability, relative to those at times of low conception probability, report stronger sexual desire (Pillsworth, Haselton, & Buss, 2004), are more prone to interact with men other than their primary partner (Dawson, Suschinsky, & Lalumière, 2012; Gangestad, Thornhill, & Garver, 2002), dress more provocatively (Durante, Li, & Haselton, 2008; Haselton, Mortezaie, Pillsworth, Bleske-Rechek, & Frederick, 2007), engage in more flirtatious behavior (Cantú, Simpson, & Griskevicius, 2014; Haselton & Gangestad, 2006a,b), and are more receptive to men's courtship invitations (Guéguen, 2009).

Women's preference for men with good genes is also heightened during peak fertility, which may confer reproductive benefits (Gangestad & Thornhill, 2008; Thornhill & Gangestad, 2008). For example, ovulating women pay more attention to attractive men (Anderson et al., 2010; Cantú et al., 2014), particularly those who have more masculine and/or symmetrical faces (Koehler, Rhodes, & Simmons, 2002; Little, Jones, Burt, & Perrett, 2007b; Penton-Voak et al., 1999) and are tall in height (Pawlowski & Jasienska, 2005; Pawlowski & Koziel, 2002). These features – attractiveness, masculinity/symmetry, height – are indicators of good genes, which may convey information regarding disease resistance (Lie, Rhodes, & Simmons, 2008; Little, DeBruine, & Jones, 2011; Thornhill & Gangestad, 2006) and/or fertility (Pawlowski, Dunbar, & Lipowicz, 2000; Prokop & Fedor, 2011). Woman, especially ovulating women, are also more attracted to dominant men (Cantú et al., 2014; Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004; Havlicek, Roberts, & Flegr, 2005). Dominant and high status men (Borgerhoff-Mulder, 1990; Waynforth & Dunbar, 1995) are favored by women due to their ability to provide physical security and material resources (Borgerhoff-Mulder, 1990; Kaplan & Hill, 1985).

Recent research suggests that women are more attracted to men displaying red relative to other chromatic and achromatic colors (Elliot et al., 2010; Roberts, Owen, & Havlíček, 2010; Stephen & McKeegan, 2010). This preference for men in or near red may be due, at least in part, to women's perception that men associated with red are healthier, more dominant, and higher in status (Elliot et al., 2010; Little, Jones, & Burriss, 2007a; Stephen, Coetzee, Law Smith, & Perrett, 2009a, Stephen, Oldham, Perrett, & Barton, 2012). Even extraneous red (i.e., red not on skin or clothing) can have an effect, as women rate black and white photographs of men framed in red as more attractive and sexually desirable (Elliot et al., 2010). Similar effects were found in non-human primates; female rhesus macaques looked longer at a male scrotum on a red background (compared with blue background) suggesting that extraneous color affects female mating preferences (Hughes, Higham, Allen, Elliot, & Hayden, 2015). As noted above,

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ovulating women appear to be particularly sensitive to cues of male quality, thus, women's ovulation status may influence their sexual response to male red. Specifically, at times of high relative to low conception probability, women may be more likely to be sexually attracted to a man wearing or near the color red (Hypothesis 1). Ovulation status would not be expected to moderate the relation between male red and women's perceptions of the male's general likeability.

Much as ovulating women are particularly sensitive to cues of male quality, women's sociosexuality, defined by Simpson and Gangestad (1991) as individual differences in willingness to engage in uncommitted sexual relations, appears to be especially responsive to such cues. Waynforth, Delwadia, and Camm (2005) and Quist et al. (2012), for example, found that sexually unrestricted women preferred masculine and symmetrical men to a greater degree than their sexually restricted counterparts. Similar results have been found regarding preference for vocal masculinity (Feinberg et al., 2006), particularly among sexually unrestricted women (O'Connor et al., 2014), and such women have also exhibited a stronger preference for males with greater material resources (Prokop & Fedor, 2013). Given the aforementioned association between the color red and male quality, sexually unrestricted women may be more attracted to a man displaying red than sexually restricted women (Hypothesis 2).

2. Method

2.1. Participants

401 Caucasian women attending a midsized Jesuit university in Slovakia participated in the study. After excluding women who reported having a homosexual or bisexual orientation, being pregnant, using hormonal contraceptives, having a color vision deficiency, or providing incomplete data, the sample was 249 women with the mean age of 22 years (SD = 6.14). All data were collected before any analyses were conducted; all data exclusions, manipulations, and variables analyzed are reported. Data exclusions were determined prior to any analysis.

Participants arrived at the laboratory for a study about first impressions; they participated in groups of up to 5 persons. Demographic and sociosexuality data were acquired first. Then, participants were given a folder containing a black and white picture of a young man (Fig. 1), framed by either a red or gray border. The picture was obtained from a standardized photo set (Corneille, Monin, & Pleyers, 2005). Other than the border color, the pictures were identical. Participants were instructed to open the folder, look at the picture (no time limit was given), and then complete a questionnaire; the questionnaire contained items assessing participants' sexual desire toward the man in the picture and their perceptions of his general likeability. The picture was 4″ wide by 6″ long, printed on archival quality paper with an Epson Stylus Photo printer. A GretagMacBeth spectrophotometer was used to select the color parameters from the spectral data (red LCh[42.7/49.0/21.4]; gray LCh[42.9/−/21.1]); this represents extremely rigorous color matching on the lightness dimension (Stokes, Fairchild, & Berns, 1992).

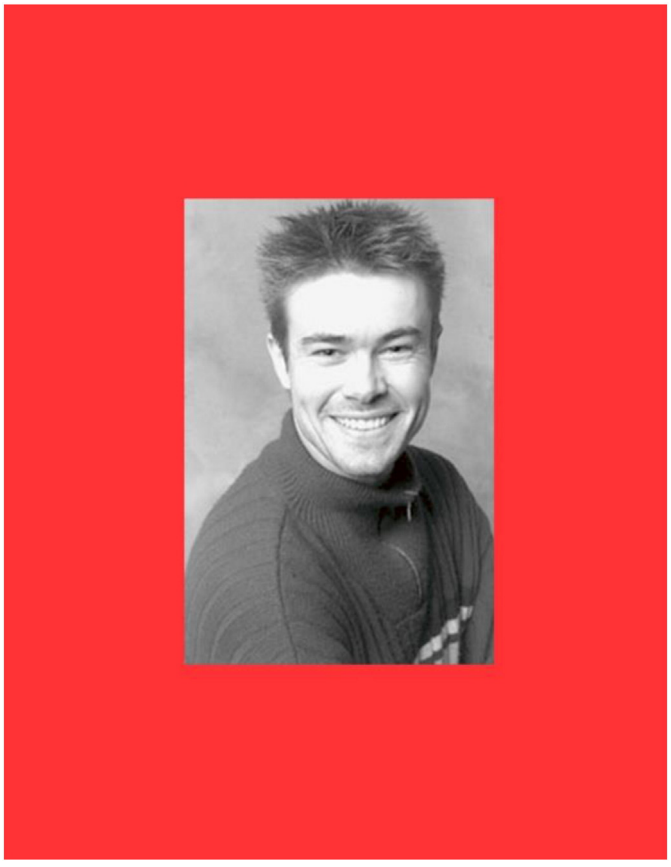

Fig. 1. The male target used in the study. The picture border was either red or gray. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

2.2. Measures

2.2.1. Conception risk

Two methods were used for calculation of conception risk. The forward method for calculation of the "fertile window" is one of most common methods used for calculations of conception risk (Gildersleeve, Haselton, & Fales, 2014). Participants who reported having a 28 day menstrual cycle were divided into high days (9–14) or low days (0–8 and 15–28) of conception risk based on their self-report of the previous onset of menstruation. These groups correspond to the follicular phase, menstruation, and luteal phase, respectively (e.g., Regan, 1996), and have been categorized accordingly in previous research (e.g., Prokop, Rantala, Usak, & Senay, 2013). Our sample contained 50 women categorized as having a high risk of conception and 199 women categorized as low risk. Color condition was the between subjects manipulation with n = 120 in the red condition and n = 129 in the gray condition. The second method was based on probabilities of conception risk using the backward method (Gangestad et al., in press). Woman's current day of the cycle was firstly placed on a standard 29-day cycle based on cycle length, then assigned probability values from Wilcox, Duncan, Weinberg, Trussell, and Baird (2001) for regular cycles (see Gangestad, Garver-Apgar, Simpson, & Cousins, 2007; Garver-Apgar, Gangestad, & Thornhill, 2008, for a similar procedure).

2.2.2. Sociosexuality

Sociosexuality was assessed with the Revised Sociosexual Orientation Inventory (SOI-R; Penke & Asendorpf, 2008). The 9-item SOI-R provides an overall assessment of sociosexual orientation. A high SOI-R score indicates unrestricted sociosexual orientation — a propensity to engage in more short-term sexual relationships. We summed the scores from the SOI-R to create an overall sociosexuality index (mean = 21.03, SD = 9.58) with acceptable reliability ($\alpha = 0.74$).

2.2.3. Sexual desire and general likeability

Sexual desire was assessed with 5 face-valid items (e.g., "To what degree would you like to have sex with this man?") on a scale ranging from 1 (*not at all*) to 7 (*very much*). *General likeability* was assessed with 4 face-valid items (e.g., "To what degree do you think this man is friendly?") on a scale from 1 (*not at all*) to 7 (*very much*). A principal components factor analysis with varimax rotation conducted on the set of nine items revealed a clear two factor solution (eigenvalues > 1.0) that accounted for 67% of the total variance; each item loaded on its

respective factor (all loadings > 0.65; no crossloading exceeded 0.41). Scores were averaged to form the sexual desire (mean = 3.94, SD = 1.67) and general likability (mean = 5.61, SD = 1.30) indexes. Both subscales had acceptable reliability (α = .90 and 0.76, respectively).

3. Results

We conducted a hierarchical multiple regression analysis with sexual desire as the dependent variable. Conception risk calculated with the forward method (dummy coded; high risk = 1, low risk = 0), sociosexuality (continuous), and color condition (dummy coded; red = 1, gray = 0) were entered in step one. Product terms representing each 2-way interaction were entered in step two. A product term representing the 3-way interaction was entered in step three. The same procedure was applied with the backward method, but in this case, actuarial data for conception risk probabilities were treated as a continuous predictor. All statistical tests were performed in SPSS 17.0.

3.1. Forward counting method

The overall regression model was significant, $F_{7, 241} = 2.63$, $p = .012$, $R^2 = .071$. A main effect emerged for sociosexuality, $F_{1, 248} = 10.76$, $p = 0.001$, $\beta = 0.21$, such that higher scores on sociosexuality were associated with increased sexual desire toward the male target. Neither the main effect of conception risk nor color condition reached significance ($Fs < 0.68$, $ps > 0.41$).

The two-way interaction between conception risk and color condition was significant, $F_{1, 248} = 3.93$, $p = 0.049$, $\beta = 0.21$, indicating that the effect of color on sexual desire differed across levels of conception risk (Table 1). We then ran analyses regressing sexual desire on color condition within each level of conception risk (at the mean level of sociosexuality). The simple effect of color condition on sexual desire was significant for women with high conception risk, $F_{1, 48} = 5.52$, $p = 0.023$, $\beta = 0.34$, indicating that red increased sexual desire, relative to gray, for women who were fertile. The effect size suggests that the size of this difference is moderate in magnitude (see Table 1). The simple effect of color condition on sexual desire was not significant for women with low conception risk, $F_{1, 198} = 0.05$, $p = .83$, $\beta = -0.02$. No other interactive effects reached significance.

We repeated the analyses with general likeability as the dependent measure. The overall regression model did not reach significance ($F = 1.04$, $p = .41$). None of the main or interactive effects reached significance ($Fs < 2.49$, $ps > 0.12$).

3.2. Backward counting method

The overall regression model was significant, $F_{7, 241} = 2.10$, $p = .044$, $R^2 = .057$. A main effect emerged for sociosexuality, $F_{1, 248} = 10.65$, $p = 0.001$, $\beta = 0.20$, such that higher scores on sociosexuality were associated with increased sexual desire toward the male target. Neither the main effect of conception risk nor color condition reached significance ($Fs < 0.68$, $ps > 0.41$). Furthermore, no interactive effects reached significance ($Fs < 0.76$, $ps > 0.34$).

We repeated the analyses with general likeability as the dependent measure. The overall regression model did not reach significance ($F = .55$, $p = .80$). None of the main or interactive effects reached significance ($Fs < 1.33$, $ps > 0.25$).

Table 1
The effect of red on sexual desire within each level of conception risk. Numbers are means; SD are in parentheses.

	High risk	Low risk
Red	4.22 (1.56)	3.95 (1.76)
Gray	3.35 (1.44)	3.99 (1.64)
Cohen's *d*	0.58	0.02

4. Discussion

This is the first study showing women's cycle shifts in preference for men associated with red. The results provide only partial support for our first hypothesis. Using the forward counting method, we showed that women at times of high conception probability reported stronger sexual desire toward the male target surrounded by red, relative to the same male surrounded by gray; no effect of red was observed for women at times of low conception probability. The backward counting method, where probabilities of conception were calculated, failed to show this effect, pointing to the need for additional investigation in this area.

The main finding herein represents a novel contribution to and expanded support for the ovulatory shift hypothesis (Gangestad & Thornhill, 2008; Thornhill & Gangestad, 2008), in that it identifies another way in which women's mating-relevant perceptions vary across the menstrual cycle. This finding also draws integrative links between the literatures on human and non-human female sexuality, as females from a variety of different vertebrate species exhibit preferences for males displaying red (including artificial or extraneous red, as examined herein; Waitt et al., 2003; Yasukawa, Butler, & Enstrom, 2009; Hughes et al., 2015), and there is some evidence that females' sensitivity to red stimuli is highest when their likelihood of conception is greatest (Boulcott & Braithwaite, 2007; Cronly-Dillon & Sharma, 1968).

In other research, women have been found to prefer red clothing for themselves at times when they are most fertile (Beall & Tracy, 2013; Eisenbruch, Simmons, & Roney, in press). This raises the possibility that the results of the present experiment might simply reflect a by-product of women's more general preference for red when conception risk is high. The general likeability data from our research provide evidence against this interpretation, as we observed no influence of red on females' perceptions of the general likeability of the male target.

Research on women's attraction to men displaying red has revealed that main effects for red are sometimes present (e.g., Elliot et al., 2010; Meier, D'Agostino, Elliot, Maier, & Wilkowski, 2012; Roberts et al., 2010), and are sometimes weak or not present (Buechner, Maier, Lichtenfeld, & Elliot, 2015), pointing to likely method- and context-based variation (i.e., moderation). The present experiment did not reveal a main effect of red on women's sexual desire toward men, which may provide insights for future research endeavors. For example, a Jesuit sample (used herein) may react differently to red than a more liberal college sample, or females may respond differently to male stimuli after completing sociosexuality questions. Furthermore, our stimulus presentation time was longer and our red stimulus was darker than in other studies in this domain (e.g., Elliot et al., 2010). Any of these variables may have led to a weaker main effect of red on sexual desire.

In light of ongoing discussion and debate about the evidentiary base for the ovulatory shift hypothesis (Gildersleeve et al., 2014; Wood, Kressel, Joshi, & Louie, 2014), we thought it important to note that the present experiment is the only research that we conducted on cycle status and color (for a comparable note, see Bruno, Martani, Corsini, & Oleari, 2013). The fact that the primary finding emerged only when using the forward counting method highlights the need for standardization in this literature, as called for in recent discussions. Gangestad et al. (in press) recently compared actuarial data with traditional calculations of fertility windows and found that the former method seems to be more sensitive in estimating conception risk. In addition, estimations of fertility windows based on self-reports, instead of hormonal assays, may lack accuracy, which may lead researchers to incorrectly categorize a fertile woman as infertile (and vice versa). Our sole reliance on self-reported cycle status should be seen as a limitation of our work. Subsequent work would do well to acquire objective indicators of cycle status (e.g., Feinberg et al., 2006) and perhaps use within-subject designs (e.g., Eisenbruch et al., in press) as well as behavioral indictors of

attraction (e.g., Guéguen & Jacob, 2013). Furthermore, attending to variables such as specific relationship status and sexual activity would be optimal in future research, as would testing females individually instead of in groups to avoid any potential effects due to intra-sexual competition or social-moral inhibition.

Our second hypothesis, that sexually unrestricted women would show stronger sexual desire toward men displaying red, was not supported. One possible reason is that a preference for high quality men may be moderated by the qualities of the perceiver's partner (Haselton & Gangestad, 2006a,b; Pillsworth & Haselton, 2006); if male red signals quality, perhaps it would enhance an unrestricted woman's sexual desire only if she is unsatisfied with her current partner. Future research examining partner satisfaction would shed light on this possibility. Additionally, Quist et al. (2012) hypothesize that a preference for some attractive male traits (e.g., masculinity) by sexually unrestricted women may represent a trade-off between the costs (e.g., antisocial personality, see Perrett et al., 1998) and benefits (e.g., long-term health, see Rhodes et al., 2003) associated with choosing a mate. Thus, a preference for masculine men for a short-term sexual relationship by sexually unrestricted women is less costly than involvement in a long-term relationship with masculine men by sexually restricted women (Quist et al., 2012). Benefits for long-term preference of men displaying red, a cue of physical health, dominance, and high status (Elliot et al., 2010; Little et al., 2007a,b; Stephen, Law Smith, Stirrat, & Perrett, 2009b, Stephen et al., 2012), may exceed potential costs and, thus, no associations with women's sociosexuality was found.

In conclusion, the present research contributes to both the ovulatory shift literature and the literature on color psychology. Most broadly, this work adds to our understanding of and highlights the complex nature of female sexuality.

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