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Women more likely to wear red or pink at peak fertility

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Abstract

Although females in many closely related species signal their fertile window in an observable manner, often involving red or pink coloration, no such display has been found for humans. Building on evidence that human men are sexually attracted to women wearing or surrounded by red, we tested whether women show a behavioral tendency toward wearing reddish clothing when at peak fertility. Across two samples (total *N*=124), women at high-conception risk were over three times more likely to wear a red or pink shirt than women at low-conception risk, and 77% of women who wore red or pink were found to be at high, rather than low, risk. Conception risk had no effect on the prevalence of any other shirt color. Results thus suggest that red/pink adornment in women is reliably associated with fertility, and that female ovulation, long assumed to be hidden, is associated with a salient visual cue.

Sexual intercourse typically results in conception only within the few days of a woman's cycle prior to and during ovulation (Wilcox, Weinberg, & Baird, 1995), making it potentially adaptive for women to advertise their fertile window in an observable manner that attracts male attention, as do females of closely related primate species (Domb & Pagel, 2001; see Haselton, & Gildersleeve, 2011; but also see Burley, 1979). However, scientists have not found any clearly observable, objective behavioral display associated with ovulation in human women. Building on evidence that women are motivated to enhance their attractiveness during ovulation (Haselton, Mortezaie, Pillsworth, Bleske-Rechek, & Frederick, 2006), and that men perceive shades of red—when associated with women—as sexually attractive (Elliot & Niesta, 2008), we tested whether women preferentially display these colors during peak fertility.

Individuals across cultures associate red with love and passion (Aslam, 2006). Studies using a range of methods and populations have demonstrated that women's use of red is linked to sex and romance (e.g., Elliot & Pazda, 2012; Greenfield, 2005), and that men find women wearing or surrounded by red particularly attractive and sexually desirable (Elliot & Niesta, 2008). This last effect has been demonstrated among members of a highly isolated, traditional small-scale society where red carries divergent cultural associations than in the West, suggesting that the link between red and sexual attraction may be universal (Elliot, Tracy, Pazda, & Beall, in press).

Several possible explanations for men's attraction to redness on or surrounding women have been proffered (see Elliot & Niesta, 2008); for example, red's attention-grabbing perceptual properties; the fact that reddish skin tone often indicates sexual arousal in women; and the finding that males of other species show a similar attraction

(Bielert, Girolami, & Jowell, 1989), suggesting that these cognitions might have originally emerged in a shared ancestor and be retained in humans. Regardless of the mechanism underlying this attraction, the well-documented presence of this tendency among men leads to an interesting prediction regarding women. Given women's brief fertile window, it may be adaptive for them to dress in a way that increases their sexual attractiveness to men specifically during this period. Women thus may self-adorn in red or pink during this time, as part of a broader drive to appear more sexually attractive at peak fertility (Durante, Li, & Haselton, 2008; Haselton & Gangestad, 2006). Alternatively, if the hormones associated with ovulation make women feel sexier during peak fertility (Haselton & Gangestad, 2006), they may be inclined to wear clothing with attention-grabbing properties (e.g., red-colored) during this time, even in the absence of any desire to attract men.

Despite these suggestions, prior research suggests that the advertisement of human female fertility is largely hidden, involving vocal, olfactory, and subtle visual changes, but few overt behavioral displays (Bryant & Haselton, 2008; Miller, & Maner, 2011). For example, although two studies suggest that women's faces are judged as more attractive during peak fertility, the women in these studies posed neutral expressions and removed all cosmetics prior to being photographed, making it unlikely that their increased attractiveness was due to any objectively measureable behavioral display (Roberts et al., 2004; Puts et al., in press).

Other studies have documented changes in women's mate-seeking desires and behavioral tendencies during peak fertility: a self-reported increased desire to have sex with men (e.g., Haselton & Gangestad, 2006), an increased attraction to physical

markers of health and masculinity (Penton-Voak & Perrett, 2000), an increased desire to wear revealing clothing (Durante, Li, & Haselton, 2008), and a tendency to wear clothing that leads women to be judged as "trying to look more attractive" (Haselton et al., 2006). In addition, one study found that women at peak fertility wore more revealing clothing, but this effect emerged only among partnered women (whose partners were absent) attending Austrian discotheques where, presumably, dressing provocatively does not violate social norms (Grammar, Reninger, & Fischer, 2004). These caveats are important because, despite several attempts, prior studies have thus far failed to document a generalized, objectively observable change in women's everyday behavior or dress that is linked to ovulation. Furthermore, although Haselton and colleagues (2007) found that partnered women were rated as dressing "more fashionably" at peak fertility, there was no difference in ratings of sexiness (and, again, the effect on fashionableness was restricted to partnered women). Similarly, although Durante and colleagues (2008; 2011) found that women at peak fertility reported a desire to purchase and wear sexier clothing when imagining attending a social gathering where they might meet men, no difference emerged in the observed sexiness of the clothing the women actually wore. Consistent with the findings from the Austrian discotheque, Durante and colleagues (2008) argued that experimental studies may fail to document an ovulation-linked change in women's dress because dressing in provocative clothing is often not socially acceptable, particularly for women participating in research on a university campus. As a result, it remains unclear whether there is any salient, observable behavioral display reliably associated with female ovulation.

Building on the evidence reviewed above suggesting that women may seek to increase their attractiveness by self-adorning in reddish colors, and should be particularly motivated to do so during peak fertility, we tested whether women are more likely to wear red- or pink-colored clothing during this period, compared to other phases of their menstrual cycle. Support for this prediction would provide the first evidence for a distinct and visually obvious behavioral display linked to female ovulation.

Method

Participants

Sample A. 100 American women (aged 18-47, *median*=26) recruited through Amazon Mechanical Turk™ (see Buhrmester, Kwang, & Gosling, 2011) participated in exchange for monetary compensation.

Sample B. 24 undergraduates at a Canadian University (aged 17-31, *median*=19) participated in exchange for course credit.

Procedure

Two samples of regularly ovulating female participants[1] responded, online, to the question: "What color is the shirt you are currently wearing? (If your shirt is multicolored, please select the color which is most prevalent)." Response options were: Black, Blue, Gray, Green, Pink, Red, White, Yellow, and "Other." They also responded

[1] We requested that women not participate if they were: over forty-years-old, users of hormonal birth control, cigarette smokers, pregnant, or not experiencing regular menstrual cycles (see Haselton & Gildersleeve, 2011). We also requested that women not participate if they were within 5 days pre- or post-onset of menses, to minimize the inclusion of women for whom effects might be attributable to menstrual or premenstrual symptoms (see Haselton, & Gildersleeve, 2011). However, 22% of Sample A and 38% of Sample B reported being within this 10-day window, and were included in all analyses (all reported results across the two samples hold if these women are excluded). It is noteworthy that these recruitment efforts and exclusion criteria resulted in notably large proportion of women in the high-risk category (51% of Sample A, 42% of Sample B).

to the question, "How many days has it been since the onset of your last period of menses?" Responses were used to divide women into high (days 6–14; *n*=51, Sample A; *n*=10, Sample B) and low (days 0–5 and 15–28; *n*=49, Sample A; *n*=14, Sample B) conception-risk groups, based on a standard 28-day model of the menstrual cycle (Penton-Voak & Perrett, 2000). We excluded women whose first day of menses occurred more than 28 days previous, to avoid including women experiencing atypical cycles (Little, Jones, & Debruine, 2008).[2]

To address concerns regarding the assessment of menstrual history via self-report (Bean et al., 1979; but see Baker, Denning, Kostin, & Schwartz, 1998), participants were also asked, "Within how many days are you 100% confident in your above estimate?"; they responded using a scale where 1 indicated "0 days (I'm 100% confident)", 2 indicated "1 day", 3 indicated "2 days", 4 indicated "3 days", 5 indicated "4 days", 6 indicated "5 days", and 7 indicated "More than 5 days (I'm not very confident)". We excluded all participants who responded with 7 (*n*=9), and all for whom we could not determine conception-risk category membership with 100% certainty (*n*= 47). Specifically, we excluded, for example, any participant who indicated that her last menses began 12 days ago but was 100% confident of that estimate within 3 days. In this case, we would assume that her last period began 9-15 days ago, and thus could *not* be included in either the high-risk (days 6-14) or low-risk (days 0-5 and 15-28) group. In contrast, any participant who indicated that her last menses began 10 days ago and was

[2] Results held, collapsing across the two samples, if these women (*n*=9) were included.

100% confident within 3 days would be included, because we could assume that her period began 7-13 days ago, placing her firmly within the high-risk group (days 6-14).[3]

Results

Women were classified as wearing a red/pink shirt (Sample A, *n*=17; Sample B, *n*=5) or an other-colored shirt (Sample A, *n*=83; Sample B, *n*=19). Women at high-conception risk were substantially more likely to be wearing a red/pink-colored shirt compared to women at low-conception risk; 40% vs. 7%, χ^2 (1, *N*=100)=5.32, *p*=.02 (Odds ratio=3.85); and 26% vs. 8%, χ^2 (1, *N*=24)=3.82, *p*=.051 (Odds ratio=8.67), in Samples A and B respectively. Examining the likelihood that a woman's color choice predicted ovulation, we found that 76% of women in Sample A and 80% of women in Sample B who were wearing red/pink were at peak fertility, suggesting that red/pink-colored clothing is a strong indicator of ovulation; see Figure.

Conception risk had no effect on the prevalence of any other shirt color, in either sample (see Supplemental Materials available online for additional details).

[3] Results held, collapsing across the two samples, if these women were included.

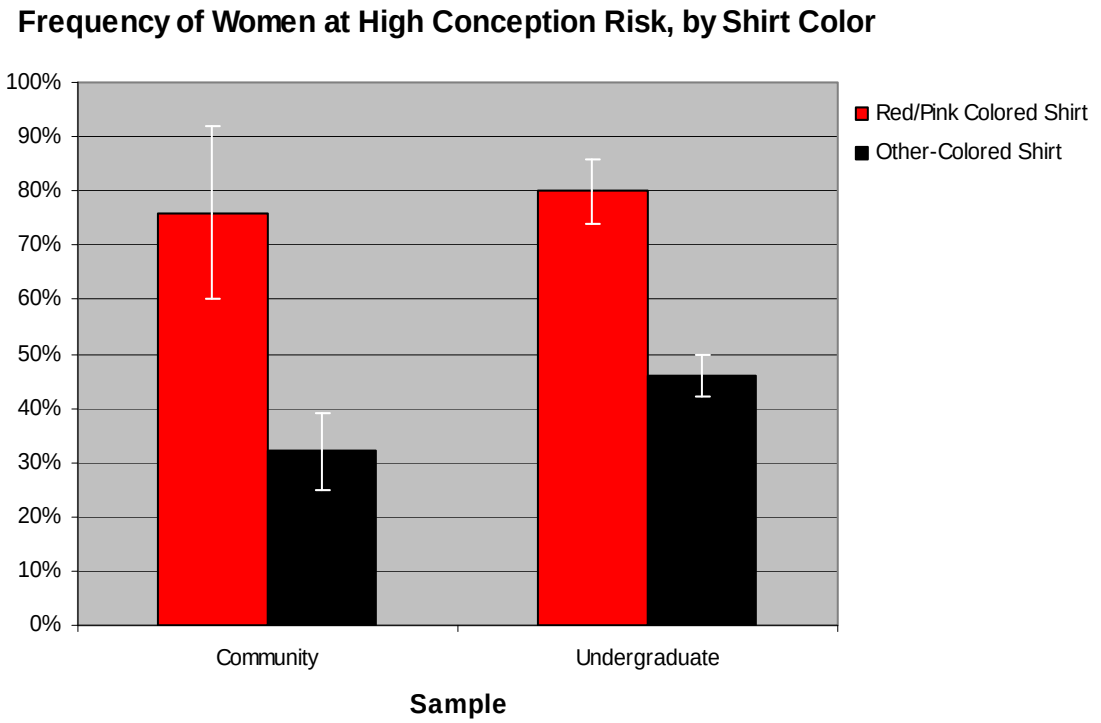

Figure Caption. Of women wearing red-or pink-colored shirts, 77% were at high-conception risk across the two samples (and 23% at low risk). In contrast, of women wearing any other-colored shirt, only 43% (across samples) were at high-conception risk (compared to 57% at low risk). Odds ratio = 3.85, p = .02 in the community sample (Sample A); Odds ratio = 8.67, p = .051 in the undergraduate sample (Sample B). Error bars indicate standard error of the mean.

Discussion

Across two samples of women, those at high-conception risk were three and a half times more likely to be wearing red or pink than those at low risk, and those who wore red or pink were over three times as likely to be at high- rather than low-conception risk. These findings support the expectation that displays of red and pink are a reliable fertility cue in women, and are the first to suggest a visually salient, publicly observable objective behavior that is associated with female ovulation.

The underlying mechanism accounting for the present findings is, as of yet, unknown, but may be best explained as a byproduct of other psychological and motivational changes that occur with ovulation. Past research has suggested that women desire to dress sexier during ovulation; however, studies have largely failed to demonstrate any consistent behavioral change in the sexiness of women's dress across periods of conception risk (Haselton et al., 2007; Durante, et al., 2008; Haselton & Gangestad, 2006; Grammer, et al., 2004). The current investigation offers a possible explanation for this discrepancy: Although women at peak fertility may largely refrain from dressing more provocatively out of social-normative concerns (Durante, et al., 2008), they may nonetheless seek to increase their apparent sexiness by adorning in the colors known to increase their attractiveness to men, which, at least in North American contexts, are not associated with any social stigma. Future studies are needed to test whether the present results are due to an increased desire among ovulating women to dress in a more sexually attractive manner. It is noteworthy, in this context, that prior studies examining male sexual interest have found that men's attraction to women wearing red holds when controlling for clothing sexiness (as well as other relevant

variables; Elliot & Niesta, 2008), raising the possibility that the present findings also may be due to something about redness that cannot be attributed entirely to ovulating women's desire to dress sexier.

Regardless of this issue, the present findings are likely to be linked, in some manner, to men's tendency to find red/pink attractive. An important question, then, is *why* men are, cross-culturally, so attracted to these colors. Several researchers have suggested that this proclivity is the result of an adaptation originating in our non-human primate ancestors, resulting from the fact that, in some primate species (e.g., chimpanzees), females' genitals acquire an extreme red/pink coloration during ovulation (i.e., estrous swellings), from increased vascularization (Elliot & Niesta, 2008; Gerald, 2003). The visibility of these swellings would make it adaptive for males of these species to find redness in females attractive, and it is possible that a cognitive mechanism associating red with attractiveness thus emerged in a shared non-human ancestor and was retained in humans. Importantly, this account presupposes that estrous swellings were present in at least some ancestor shared between humans and these other primates; it is thus challenged by evidence that exaggerated swellings emerged only after the chimpanzee genus diverged from the line that led to modern humans (Pagel & Meade, 2006). However, others have suggested that human ancestors may have displayed some form of considerably more subtle visual signs of estrus, including a slight reddening of the anogenital area (Sillen-Tullberg & Moller, 1993), and that humans' erect posture concealed this coloration such that, eventually, female fertility signaling through red coloration became maladaptive due to the energy expended creating such displays

(see Pawlowski, 1999). Given these competing accounts, this is an issue that would benefit from future investigations.

Another possibility is that red came to be associated with sexuality because of its impact on sensory systems unrelated to mating (Kirkpatrick & Ryan, 1991). Ancestral foraging practices made spotting ripened fruit (indicated through redness) paramount to survival (Osorio & Vorobyev, 1996), so the human perceptual system might have become finely attuned to this color, and men's tendency to find it attractive could be a byproduct of red's broader attention-grabbing properties. Future research is needed to examine whether the present effects are due to an increased desire, among women, to attract visual attention during the period when they feel sexier, even in the absence of any desire to attract men (and, conversely, to women at low fertility feeling less sexy and thus refraining from wearing such clothing).

One methodological limitation of the present research was our reliance on self-report rather than hormonal measures to assess conception risk. Although concerns have been raised regarding the reliability of the assessment method we used (Bean et al., 1979; but see Baker et al., 1998), our invocation of a new method to assess women's confidence in their self-reported menses onset is an important innovation that may be of use to future research. By assessing women's confidence in their self-reported menses onset date, this method takes into account women's uncertainty on this issue, and thus ameliorates some concerns regarding the use of self-reported estimates. Furthermore, if errors were made in our categorization of women into high- and low-risk groups, these would reduce our power to find effects, making the reported effects conservative

estimates of actual effect sizes. Nonetheless, future studies should seek to replicate and extend these findings using hormonal assessment techniques.

Regardless of these issues, which highlight important directions for future research, the present results are the first to indicate that female ovulation, long assumed to be hidden, is in fact associated with a distinct, objectively observable behavioral display.

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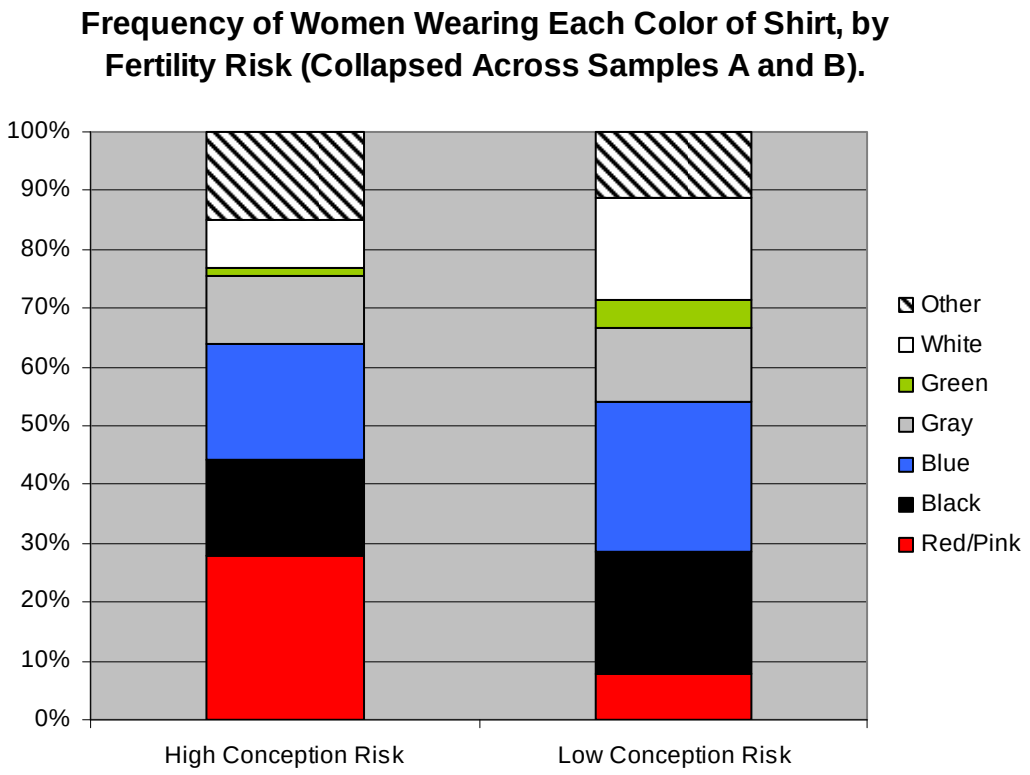
Supplemental Results

As reported in the main text, conception risk had no effect on the prevalence of any other shirt color (see Supplemental Figure). Across the two samples, χ^2 (1, *N*=124)=0.37, *p*=.54 (Odds ratio=0.75), for black; χ^2 (1, *N*=124)=0.58, *p*=.45 (Odds ratio=0.72), for blue; χ^2 (1, *N*=124)=0.44, *p*=.84 (Odds ratio=0.89), for gray; χ^2 (1, *N*=124)=0.97, *p*=.33 (Odds ratio=0.33), for green; χ^2 (1, *N*=124)=2.37, *p*=.124 (Odds ratio=0.42), in the opposite direction for white; and χ^2 (1, *N*=124)=0.37, *p*=.55 (Odds ratio=1.36), for "other". In Sample A, χ^2 (1, *N*=100)=0.12, *p*=.73 (Odds ratio=0.84), for black; χ^2 (1, *N*=100)=0.68, *p*=.41 (Odds ratio=0.68), for blue; χ^2 (1, *N*=100)=0.29, *p*=.59 (Odds ratio=1.40), for gray; χ^2 (1, *N*=100)=3.22, *p*=.073 (Odds ratio=N/A)[4],in the opposite direction for green; χ^2 (1, *N*=100)=1.06, *p*=.30 (Odds ratio=0.51), in the opposite direction for white; and χ^2 (1, *N*=100)=0.04, *p*=.85 (Odds ratio=1.12), for "other". In Sample B, χ^2 (1, *N*=24)=0.55, *p*=.46 (Odds ratio=0.41), for black; χ^2 (1, *N*=24)=0.007, *p*=.93 (Odds ratio=0.92), for blue; χ^2 (1, *N*=24)=2.45, *p*=.12 (Odds ratio=N/A) [1], in the opposite direction for gray; χ^2 (1, *N*=24)=1.46, *p*=.23 (Odds ratio=N/A)[1], for green; χ^2 (1, *N*=24)=1.22, *p*=.27 (Odds ratio=0.28), in the opposite direction for white; χ^2 (1, *N*=24)=1.46, *p*=.23 (Odds ratio=N/A)[1], for "other". It is not surprising that several colors (white, green, and gray) were marginally (or almost marginally) more likely to be worn by women at low-conception risk than by those at

[4] Odds ratio could not be calculated because one of the comparison groups had a frequency of zero.

high-conception risk, given that the tendency for high-risk women to wear red would necessarily make them less likely to wear other colors during this period.



Supplemental Figure. Women at high-fertility risk were more likely to wear red-or pink colored shirts compared to women at low risk; conception risk had no effect on the prevalence of any other shirt color. Across samples, of women at high-conception risk, 28% wore red-or pink colored shirts, 16% wore black colored shirts, 20% wore blue colored shirts, 12% wore gray colored shirts, 2% wore green colored shirts, 8% wore white colored shirts, and 15% wore "other" colored shirts. Of women at low-conception risk, 8% wore red-or pink colored shirts, 21% wore black colored shirts, 25% wore blue colored shirts, 13% wore gray colored shirts, 5% wore green colored shirts, 18% wore white colored shirts, 11% wore "other" colored shirts.