Women Are More Likely to Wear Red or Pink at Peak Fertility

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Abstract
Although females of many species closely related to humans 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 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 ($N = 124$), women at high conception risk were more than 3 times more likely to wear a red or pink shirt than were 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. Our results thus suggest that red and 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 humans. Building on evidence that women are motivated to enhance their attractiveness during ovulation (Haselton, Mortezaie, Pillsworth, Bleske-Rechek, & Frederick, 2007), 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 cultural associations divergent from those found in the West, suggesting that the link between red and sexual attraction may be universal (Elliot, Tracy, Pazda, & Beall, 2013).

Several possible explanations for men's attraction to redness on or surrounding women have been proffered (see Elliot & Niesta, 2008)—including, 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 have been retained in humans. Regardless of the mechanism underlying this

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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 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 clothing) during this time, even in the absence of any desire to attract men.

Despite these possibilities, prior research has suggested 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 have suggested 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 (Puts et al., 2013; Roberts et al., 2004).

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 et al., 2008), and a tendency to wear clothing that leads women to be judged as trying to look more attractive (Haselton et al., 2007). 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 (Grammer, Renninger, & 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, Mortezaie, Pillsworth, Bleske-Rechek, and Frederick (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; Durante, Griskevicius, Hill, Perilloux, & Li, 2011) found that women at peak fertility reported a desire to purchase and wear sexier clothing when imagining attending a social gathering at which they might meet men, no difference emerged in the observed sexiness of the clothing the women actually wore. 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 with 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. A total of 100 American women (aged 18–47 years, *Mdn* = 26) recruited through Amazon's Mechanical Turk (see Buhrmester, Kwang, & Gosling, 2011) participated in return for monetary compensation.

Sample B. A total of 24 female undergraduates at the University of British Columbia (aged 17–31 years, *Mdn* = 19) participated in exchange for course credit.

Procedure

Two samples of regularly ovulating female participants[1] completed measures online. Participants responded 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." Participants also responded 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 a high-conception-risk group (Days 6–14; Sample A: *n* = 51; Sample B: *n* = 10) and a low-conception-risk group (Days 0–5 and 15–28; Sample A: *n* = 49; Sample B: *n* = 14) on the basis of a standard 28-day model of the menstrual cycle (Penton-Voak & Perrett, 2000). We excluded women whose first day of menses had occurred more than 28 days previously 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, Leeper, Wallace, Sherman, & Jagger, 1979; but see Baker, Denning, Kostin, & Schwartz, 1998), we also asked participants, "Within how many days are you 100% confident in your above estimate?" Participants responded using a scale from 1 to 7 with the following anchors: 1 = *0 days (I'm 100% confident)*, 2 = *1 day*, 3 = *2 days*, 4 = *3 days*, 5 = *4 days*, 6 = *5 days*, and 7 = *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 had begun 12 days previously but was 100% confident of that estimate within 3 days. In that case, we would assume that her last period had begun within the past 9 to 15 days and, thus, she could not be included in either the high-conception-risk group (Days 6–14) or the low-conception-risk group (Days 0–5 and 15–28).[3] In contrast, any participant who indicated that her last menses had begun 10 days previously and was 100% confident within 3 days would be included because we could assume that her period had begun within the past 7 to 13 days, which would place her firmly within the high-conception-risk group (Days 6–14).

Results

Women were classified as wearing a red or pink shirt (Sample A, *n* = 17; Sample B, *n* = 5) or a different-colored shirt (Sample A, *n* = 83; Sample B, *n* = 19). Women at high conception risk were substantially more likely to be wearing a red or pink shirt compared with women at low conception risk—Sample A: 26% vs. 8%, $\chi^2(1, N = 100) = 5.32$, $p = .02$, odds ratio = 3.85; Sample B: 40% vs. 7%, $\chi^2(1, N = 24) = 3.82$, $p = .051$, odds ratio = 8.67. Examining the likelihood that a woman's shirt-color choice predicted ovulation, we found that 76% of women in Sample A and 80% of women in Sample B who were wearing red or pink were at peak fertility, which suggests that reddish-colored clothing is a strong indicator of ovulation (see Fig. 1 for results). In contrast, only 46% of women in Sample A and 32% of women in Sample B who were wearing shirts of any other color were at high conception risk. Indeed, conception risk had no effect on the prevalence of any other shirt color in either sample (for additional details, see the Supplemental Material available online).

Discussion

Across two samples of women, those at high conception risk were 3.5 times more likely to be wearing red or pink
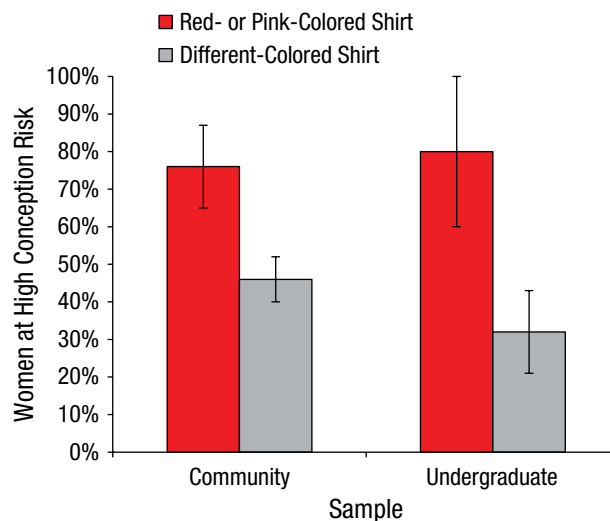

Fig. 1. Percentage of women at high conception risk in the two samples as a function of shirt color. Error bars indicate standard errors of the mean.

than were those at low risk, and those who wore red or pink were more than 3 times as likely to be at high conception risk than at low conception risk. These findings support the prediction 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 it may be best explained as a by-product 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 (Durante et al., 2008; Grammer et al., 2004; Haselton & Gangestad, 2006; Haselton et al., 2007). 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 self-adorning in the colors that are known to increase their attractiveness to men and that, at least in North American contexts, are not associated with any social stigma. Future studies are needed to test whether the present results were 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 the sexiness of the women's clothing (as well as other relevant variables; Elliot & Niesta, 2008), raising the

possibility that the present findings also may have been 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 and pink attractive. An important question, then, is why are men, 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, due to the fact that in some primate species (e.g., chimpanzees), females' genitals acquire an extreme red or 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 nonhuman ancestor and was retained in humans. 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, other researchers have suggested that human ancestors may have displayed some form of considerably subtler 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 because of 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 by-product of red's broader attention-grabbing properties. Future research is needed to examine whether the present effects were 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, whether the effects were due to women at low fertility feeling less sexy and therefore 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 may be of use in future research. By taking into account women's uncertainty on this issue, this method ameliorates some concerns regarding the use of self-reported estimates. Furthermore, if errors were made in our categorization of women into high- and low-conception-risk groups, these errors 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 our 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.

Author Contributions

Both authors contributed to the study design. Data collection, analyses, and interpretations were performed by A. T. Beall under the supervision of J. L. Tracy. Both authors contributed to the composition of the manuscript, with A. T. Beall composing initial drafts. Both authors approved the final version of the manuscript for submission.

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Supplemental Material

Additional supporting information may be found at http://pss .sagepub.com/content/by/supplemental-data

Notes

1. We requested that women not participate if they were more than 40 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 of the 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 participants in Sample A and 38% of participants in Sample B reported being within this 10-day window and were included in all analyses (all reported results across the two samples held when these women were excluded). It is noteworthy that these recruitment efforts and exclusion criteria resulted in a large proportion of women in the high-conception-risk category (Sample A: 51%; Sample B: 42%).
2. Results held, collapsing across the two samples, when these women ($n = 9$) were included in analyses.
3. Results held, collapsing across the two samples, when these women ($n = 47$) were included in analyses.

References

Aslam, M. M. (2006). Are you selling the right colour? A cross-cultural review of colour as a marketing cue. *Journal of Marketing Communications, 12*, 15–30.

Baker, A. H., Denning, A. C., Kostin, I., & Schwartz, L. (1998). How accurate are women's estimates of date of onset of next menses? *Psychology & Health, 13*, 897–908.

Bean, J. A., Leeper, J. D., Wallace, R. B., Sherman, B. M., & Jagger, H. (1979). Variations in the reporting of menstrual histories. *American Journal of Epidemiology, 109*, 181–185.

Bielert, C., Girolami, L., & Jowell, S. (1989). An experimental examination of the color component in visually mediated sexual arousal of the male chacma baboon (*Papio ursinus*). *Journal of Zoology, 219*, 569–579.

Bryant, G. A., & Haselton, M. G. (2008). Vocal cues of ovulation in human females. *Biology Letters, 5*, 12–15.

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science, 6*, 3–5.

Burley, N. (1979). The evolution of concealed ovulation. *American Naturalist, 114*, 835–858.

Domb, L. G., & Pagel, M. (2001). Sexual swellings advertise female quality in wild baboons. *Nature, 410*, 204–206.

Durante, K. M., Griskevicius, V., Hill, S. E., Perilloux, C., & Li, N. P. (2011). Ovulation, female competition, and product choice: Hormonal influences on consumer behavior. *Journal of Consumer Research, 37*, 921–934.

Durante, K. M., Li, N. P., & Haselton, M. G. (2008). Changes in women's choice of dress across the ovulatory cycle: Naturalistic and laboratory task-based evidence. *Personality and Social Psychology Bulletin, 34*, 1451–1460.

Elliot, A. J., & Niesta, D. (2008). Romantic red: Red enhances men's attraction to women. *Journal of Personality and Social Psychology, 95*, 1150–1164.

Elliot, A. J., & Pazda, A. D. (2012). Dressed for sex: Red as a female sexual signal in humans. *PLoS ONE, 7*(4), e34607. Retrieved from http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0034607

Elliot, A. J., Tracy, J. L., Pazda, A. D., & Beall, A. T. (2013). Red enhances women's attractiveness to men: First evidence of universality. *Journal of Experimental Social Psychology, 49*, 165–168.

Gerald, M. S. (2003). How color may guide the primate world: Possible relationships between sexual selection and sexual dichromatism. In C. Jones (Ed.), *Sexual selection and reproductive competition in primates: New perspectives and directions* (pp. 141–172). Norman, OK: American Society of Primatologists.

Grammer, K., Renninger, L. A., & Fischer, B. (2004). Disco clothing, female sexual motivation, and relationship status: Is she dressed to impress? *Journal of Sex Research, 41*, 66–74.

Greenfield, A. B. (2005). *A perfect red: Empire, espionage, and the quest for the color of desire.* New York, NY: HarperCollins.

Haselton, M. G., & Gangestad, S. W. (2006). Conditional expression of women's desires and men's mate guarding across the ovulatory cycle. *Hormones and Behavior, 49*, 509–518.

Haselton, M. G., & Gildersleeve, K. A. (2011). Can men detect ovulation? *Current Directions in Psychological Science, 20*, 87–92.

Haselton, M. G., Mortezaie, M., Pillsworth, E. G., Bleske-Rechek, A., & Frederick, D. A. (2007). Ovulatory shifts in human female ornamentation: Near ovulation, women dress to impress. *Hormones and Behavior, 51*, 40–45.

Kirkpatrick, M., & Ryan, M. J. (1991). The evolution of mating preferences and the paradox of the lek. *Nature, 350*, 33–38.

Little, A. C., Jones, B. C., & DeBruine, L. M. (2008). Preferences for variation in masculinity in real male faces change across the menstrual cycle. *Personality and Individual Differences, 45*, 478–482.

Miller, S. L., & Maner, J. K. (2011). Ovulation as a male mating prime: Subtle signs of women's fertility influence men's mating cognition and behavior. *Journal of Personality and Social Psychology, 100*, 295–308.

Osorio, D., & Vorobyev, M. (1996). Colour vision as an adaptation to frugivory in primates. *Proceedings of the Royal Society B: Biological Sciences, 263*, 593–599.

Pagel, M., & Meade, A. (2006). Bayesian analysis of correlated evolution of discrete characters by reversible-jump Markov chain Monte Carlo. *American Naturalist, 167*, 808–825.

Pawlowski, B. (1999). Loss of oestrus and concealed ovulation in human evolution. *Current Anthropology, 40*, 257–276.

Penton-Voak, I. S., & Perrett, D. I. (2000). Female preference for male faces changes cyclically: Further evidence. *Evolution & Human Behavior, 21*, 39–48.

Puts, D. A., Bailey, D. H., Cárdenas, R. A., Burriss, R. P., Welling, L. L. M., Wheatley, J. R., & Dawood, K. (2013). Women's attractiveness changes with estradiol and progesterone across the ovulatory cycle. *Hormones and Behavior, 63*, 13–19.

Roberts, S. C., Havlicek, J., Flegr, J., Hruskova, M., Little, A. C., Jones, B. C., . . . Petrie, M. (2004). Female facial attractiveness increases during the fertile phase of the menstrual cycle. *Proceedings of the Royal Society B: Biological Sciences, 271*, S270–S272.

Sillen-Tullberg, B., & Moller, A. P. (1993). The relationship between concealed ovulation and mating systems in anthropoid primates: A phylogenetic analysis. *American Naturalist, 141*, 1–25.

Wilcox, A. J., Weinberg, C. R., & Baird, D. D. (1995). Timing of sexual intercourse in relation to ovulation: Effects on the probability of conception, survival of the pregnancy and sex of the baby. *New England Journal of Medicine, 333*, 1517–1521.