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Female body odour is a potential cue to ovulation

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Human body odours have been reported to influence female mate choice. Women prefer the odours of immunocompatible men and, during their fertile period, judge the body odours of men with symmetrical bodies—which is indicative of genetic quality—as sexy and pleasant. The reproductive success of men largely depends on mating with fertile women, but it is not known whether men can detect a woman's fertile period. We asked women who had regular menstrual cycles and who were not using hormonal contraceptives to wear a T-shirt for three consecutive nights during their late follicular (ovulatory) phase and another T-shirt during the luteal (non-ovulatory) phase of their menstrual cycle. Male raters judged the odours of T-shirts worn during the follicular phase as more pleasant and sexy than odours from T-shirts worn during the luteal phase. The odour differences between the follicular and luteal phases did not dissipate quickly over time as male raters were able to detect and judge follicular phase body odours as more pleasant and sexy than the odours from the luteal phase even after the T-shirts were kept at room temperature for one week. These findings suggest that ovulation may not be concealed and that men could use ovulation-linked odours in their mate selection.

Keywords: body odour; follicular phase; luteal phase; ovulation

1. INTRODUCTION

Visual and olfactory cues can transmit important information relevant to human mate selection. For instance, people prefer mates who have low fluctuating asymmetry (FA) (i.e. random deviation from perfect bilateral symmetry of morphological structures) and, thus, relatively symmetrical bodies (Gangestad & Thornhill 1997). Low FA is presumably associated with increased genetic, physical health and ability to cope with psychological and emotional stress (Manning 1995; Manning *et al*. 1997; Shackelford & Larsen 1997; reviewed in Thornhill & Møller 1997). The detection of FA or its correlates will allow an individual to assess mate quality. Aside from visual detection of FA, the pleasantness of male body odour is affected by their degree of FA (Gangestad & Thornhill 1998; Rikowski & Grammer 1999; Thornhill & Gangestad 1999). During the ovulatory phase of their menstrual cycle, women rate the body odours of men with lower FA as more pleasant and sexy than the body odours of men with high FA. However, during non-ovulatory phases or when taking oral contraceptives, women do not differentially rate the body odours of men with high and low FA.

A negative relationship between body odour and degree of FA was not observed when men rated female body odour (Thornhill & Gangestad 1999), although Rikowski & Grammer (1999) reported that men judge the body odours of facially attractive women as more pleasant and sexy than less facially attractive women. However, Thornhill & Gangestad (1999) found that men do not differentially rate the pleasantness of women's body odour at the most fertile phase of their menstrual cycle from women at the least fertile phase of their menstrual cycle. Thus, it appears that neither the degree of FA nor variations in menstrual cycle phase reliably make women's body odour attractive to men. The explanation may be associated with the fact that men invest significantly less than women in parental investment. Thus, the variance in a potential mate's genetic quality is less important to males than females (Trivers 1972; Symons 1979; Buss 1994). Nevertheless, it still may be important for males to detect when ovulation occurs as such a capability will enhance their reproductive success. A variety of cues may be used.

Van den Barghe & Frost (1986) reported that female skin colour becomes lightest near the ovulatory phase of the menstrual cycle. Manning *et al*. (1996) and Scutt & Manning (1996) showed that, during ovulation, females exhibit lower FA in paired soft tissue traits such as breast and digit length than at any other menstrual cycle phase. Grammer (1996) reported that ovulating women, as compared to non-ovulating women, engage in more sexual signalling at social gatherings (i.e. at pubs and discotheques), such as exposing a greater amount of skin and wearing skirts that are tighter and shorter.

Given these signals, it would be surprising if body odour is not linked to menstrual cycle phases and does not play any role in men's preferences. It is pertinent to point out that volatile fatty acid vaginal secretions ('copulins') fluctuate across the menstrual cycle; women produce the greatest amount of copulins around ovulation with production steadily declining during the luteal phase of the menstrual cycle (Preti & Huggins 1975). However, in women taking oral contraceptives these fluctuations are eliminated and the overall production of volatile fatty acid is reduced (for a review see Schaal & Porter 1991). The odours of copulins, which covary with menstrual cycle phase, could make body odour a reliable mating signal for males. This notion is supported by the finding that males who are pair bonded with a woman judge her body odours (collected from saliva and the vagina, underarms and loin) from her ovulatory phase more pleasant and longer lasting than body odours collected from other phases of her menstrual cycle (Poran 1994).

It is quite possible that the use of a between-subjects design in which the body odours of groups of ovulating women are compared with a group of non-ovulating

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women, as reported in Thornhill & Gangestad's (1999) study, does not allow weak yet reliable odour cues to be detected. We controlled for this potential confound of individual odour profiles by using a within-subjects design in which menstrual cycle phase (follicular and luteal phase) odours were collected from the same women.

2. METHOD

(a) *Participants*

Volunteers were recruited from advanced psychology classes taught by the first author. After listening to a brief description of the research objective, women in the class were asked to volunteer for the study if they were not currently using a hormonal birth control method, had had regular menstrual cycles (28 ± 3 days) during the previous six months and were willing to adhere to behavioural and dietary restrictions for the month-long study. A total of 29 women agreed to volunteer but ten women did not complete the month-long research protocol. The T-shirts of two volunteers had clear odours of pizza and tobacco smoke and were therefore discarded.

Thus, the reported data are based on 17 Caucasian women (mean age $= 22.4 \pm 4.5$ years).

(b) *Odour collection procedure*

As in previous studies (e.g. Wedekind *et al*. 1995; Gangestad & Thornhill 1998; Rikowski & Grammer 1999; Thornhill & Gangestad 1999) cotton T-shirts were used for collecting body odour. Each participant was given a bag containing two unworn, white, 100% cotton T-shirts, a box of unscented detergent for washing clothes and bed sheets, bars of unscented body soap (Ivory®) and a bottle of unscented hair shampoo. The T-shirts were washed with unscented detergent and, after drying, each was placed in a large plastic freezer bag (Ziplock®). Each participant was asked to make up a five-digit personal code and write her code on the freezer bags with a permanent ink pen. The T-shirt bags had this code and a prefix (F or L) in order to distinguish the T-shirt to be worn during the follicular and luteal phases of the woman's menstrual cycle. Each participant was given a set of written instructions for remaining 'odour neutral' (these were the same behavioural and dietary restrictions as used by Rikowski & Grammer (1999) and Thornhill & Gangestad (1999)). For example, they were instructed to refrain from using perfume, engaging in sexual activity, sharing their bed with anyone (male, female or pets) and eating onions, garlic or spicy foods during the days on which the T-shirts were to be worn. Each participant was asked to mark her calendar on the day of onset of menstrual blood flow or blood spotting (day 0) and then mark days 13, 14 and 15 (follicular phase) and days 20, 21 and 22 (luteal phase) on which the T-shirts were to be worn. All participants were given a set of written instructions for wearing the T-shirt. On the first day of each T-shirt session, the participants were required to wash their bed sheets and pillow covers with unscented detergent soap. They were also asked to bathe or take a shower and shampoo their hair prior to wearing the T-shirt. These procedures assured that the personal hygiene practices of the participants differed minimally from each other. Each participant wore the T-shirt from the bag marked F in direct contact with the skin at night while sleeping. Each morning, the participant placed it in the plastic box and then wore the same T-shirt for consecutive nights (days 13–15 of her menstrual cycle). At the end of this session, each participant folded the T-shirt, placed it in the plastic bag and placed the sealed bag in the freezer. Each participant wore the T-shirt marked L for three consecutive nights during her luteal phase (days 20–22 of her menstrual cycle) following the same procedure as for the follicular phase. Experimenters collected both frozen bags from the participants and stored them in a freezer until the odour ratings could be made.

(c) *Odour attractiveness rating procedure*

Fifty-two Caucasian males (mean age $= 23.3 \pm 4.9$ years) volunteered to act as raters. None of the volunteers were acquainted with the women participating in the study. The raters were not told that they would be rating T-shirts worn by ovulating and non-ovulating women; they were informed that the T-shirts were worn by women differing in attractiveness and that the purpose of the study was to determine whether differences in physical attractiveness could be associated with the intensity and pleasantness of body odours.

The rating procedure was identical to that for women's T-shirt odours reported by Thornhill & Gangestad (1999). Before the ratings took place, the freezer bags were thawed by leaving them at room temperature for *ca*. 3 h. Eighteen pairs of T-shirts (one pair of unworn T-shirts with a fabricated personal code and the prefixes F and L on the bags was included in the sample) were sorted into six pair groups and each group was placed in a box. Each rater was placed alone in a separate cubicle with a rating sheet that had the pair number for each T-shirt to be rated. Boxes of T-shirts were circulated between raters. When the rater finished rating each T-shirt in the box, it was replaced by another box until all 18 pairs of T-shirts were rated. In this way, presentation of the T-shirt stimuli was randomized. The raters were instructed to pick one plastic bag, open it and smell it without touching the T-shirt and rate the odour for intensity (1 = not intense at all to 10 = very intense), pleasantness (1 = very unpleasant to 10 = very pleasant) and sexiness (1 = very unsexy to 10 = very sexy). The raters recorded their ratings of the T-shirts using the T-shirt codes on the rating sheet. Then the rater sealed the plastic bag, placed it back in the box and rated the other T-shirt with an identical code to the previous T-shirt except for the prefix L or F. Obviously, the raters would have noticed that the two plastic bags had the same code on them except for the letter F or L. After the rating session was over, the raters were asked if the letters signified any meaning to them. None of the raters associated the letter F or L with the two phases of the menstrual cycle.

C. Wedekind (personal communication) reported that odours of T-shirts become weaker after one to two weeks but that they remain clearly recognizable. As a crude measure of determining whether odours from the follicular and luteal phases dissipate over time, all pairs of T-shirts were stored for one week at room temperature. At the end of the week, we asked the 17 raters who had previously rated the T-shirts to rate all T-shirt pairs again for intensity, pleasantness and sexiness.

3. RESULTS

As the raters were required to rate each T-shirt for intensity, pleasantness and sexiness of odour, the ratings of each T-shirt were analysed within raters. Inter-rater reliability was assessed as the average, intraclass consistency correlation across the 52 raters and 18 T-shirts in the initial study. Both raters and targets (T-shirts) were considered to represent a random sample of all possible raters and targets (Strout & Fleiss 1979; McGraw &

Wong 1996). These intraclass correlations for ratings of intensity, pleasantness and sexiness were 0.945, 0.942 and 0.948, respectively.

The critical issue was whether there would be menstrual cycle phase-dependent (follicular versus luteal phase) differences in the rated intensity, sexiness and pleasantness of the T-shirts. Linear regression analysis revealed that menstrual cycle phase (luteal phase = 0 and follicular phase = 1) significantly predicted the rated magnitude of sexiness ($\beta = 0.073$, $t = 3.10$ and $p = 0.002$) and pleasantness ($\beta = 0.091$, $t = 3.87$ and $p < 0.001$) but not intensity ($\beta = -0.012$, $t = -0.50$ and $p = 0.616$) of the T-shirts. The ratings of sexiness and pleasantness were strongly associated for the T-shirts worn during both the follicular and luteal phases (table 1).

A smaller replication with 19 raters and T-shirts from four women was also conducted. As found in the original study, the majority of T-shirts (three out of four) from the follicular phase were rated as more pleasant and sexy than those from the luteal phase. When considering the T-shirts used in the original study and replication together, the mean rating of the follicular phase was higher than that for the luteal phase in 15 out of 21 pairs ($\chi^2 = 3.85$, d.f. = 1 and $p = 0.0495$). The mean combined pleasantness and sexiness ratings for each pair of T-shirts worn during the follicular and luteal phases are presented in Appendix A.

Finally, we explored whether odour-based differences in the T-shirts worn during the follicular and luteal phases would be evident after the T-shirts were left for seven days at room temperature. A repeated-measures analysis of variance was conducted on the combined ratings of pleasantness and sexiness. Raters who smelt the T-shirts on the first occasion (original rating test) and also smelt the T-shirts on the second occasion (rating after seven days exposure of T-shirt) were used in the analyses. The results revealed a significant effect of menstrual cycle phase ($F_{1,16} = 5.86$ and $p = 0.020$) showing that the T-shirts worn during the follicular phase were more attractive (pleasant and sexy) and the odour was judged to be more intense than the T-shirts worn during the luteal phase. Passing of time did affect the magnitude of odour attractiveness; a T-shirt kept unfrozen for seven days had a lower magnitude of odour attractiveness compared to the original ratings ($F_{1,16} = 7.77$ and $p = 0.013$) but the interaction of menstrual cycle phase and rating occasions was not significant ($F_{1,16} = 0.05$ and $p = 0.823$). Interestingly, a significant interaction between women by menstrual phase was evident ($F_{15,240} = 5.11$ and $p = 0.001$) suggesting that the raters noticed a difference in attractiveness between the follicular and luteal phase odours of the T-shirts of some women more than others. Such variations in odour attractiveness were independent of the age and body weight of the participants.

Table 1. *Intercorrelation coefficients (Pearson's r) for intensity, pleasantness and sexiness ratings of body odour during the follicular and luteal phases of the menstrual cycle*

(All *r*-values are significant at $p < 0.001$.)

	follicular phase		luteal phase	
	intense	pleasant	intense	pleasant
pleasant	0.362	—	0.192	—
sexy	0.374	0.864	0.252	0.853

4. DISCUSSION

To summarize the main findings, body odour associated with the follicular phase, as compared to the luteal phase, was judged significantly more pleasant and sexy. The differences in pleasantness and sexiness of the follicular and luteal phases remained detectable, even after seven days.

These results are in contrast to the findings of Thornhill & Gangestad (1999) who reported that the odours of T-shirts worn during the follicular and luteal phases did not differ in perceived pleasantness or sexiness. However, these investigators used a between-subjects design whereas a within-subjects design was used in the present study. The within-subjects design allows for control of personal idiosyncratic bodily odour differences among women as odours of both the follicular and luteal phases can be collected from the same women. The only other study to have used a within-subjects design reported a greater pleasantness rating associated with bodily odours collected during mid-cycle (late follicular phase) than odours collected at other phases of the menstrual cycle (Poran 1994). In spite of similar results, there are some significant methodological differences between the present study and that of Poran (1994). First, Poran (1994) used only seven long-term (two to eight years), pair-bonded men for rating bodily odours. The participating women were asked to collect samples of saliva, vaginal odours and sweat from the armpits and loin. However, it was not stated whether the women used deodorants or perfumes on the days of sample collection. It is quite possible that pair-bonded men associated these uncontrolled odours with various phases of the menstrual cycle. In addition, Poran (1994) did not specify whether the women were sexually active during the collection period of the body odours. If the women were sexually active during their ovulatory phase, it could be that sexual intercourse changed the odours collected during that phase.

In the present study, the participating women were required to refrain from sleeping with anyone (male, female or pets) and from engaging in any sexual activity while wearing the T-shirts. None of our participants reported breaking any of these rules when questioned during T-shirt collection. In addition, none of the raters were acquainted with the participants and had no way of associating any menstrual cycle-linked behavioural changes with the smell of the T-shirts. Finally, it should be stressed that our raters did not know that the T-shirts pairs they were to judge were collected during different phases of the menstrual cycle. The raters were led to believe that one of the T-shirts in the pair was worn by an attractive woman whereas the other was worn by an unattractive woman. In spite of these methodological differences between the present study and the study of

Poran (1994), the findings are strikingly similar—men rate body odours associated with the ovulatory phase as more pleasant than odours associated with the non-fertile phase. Thornhill & Gangestad's (1999) failure to find this association could have been due to methodological differences between the studies.

These findings raise serious doubts about conventional scientific wisdom that human female ovulation is concealed and, hence, that men cannot detect when women are ovulating. In addition to the present findings, there are other data showing that ovulating women exhibit physical characteristics that are known to be sexually attractive to men (Symons 1995). For example, Manning *et al*. (1996) found that women's breasts become more symmetrical around mid-cycle when a woman is most fertile. During ovulation women's skin is suffused with blood and their skin lightens slightly compared to non-fertile periods (Symons 1995). Ovulating women who report not taking birth control pills also expose greater amounts of skin, wear tighter skirts and engage in more sexual signalling in social gatherings (Grammer 1996).

Even in the absence of such visual cues men can apparently detect ovulation from a woman's body odour. However, our data do not provide information on the nature and development of the ovulation detection mechanism. We have no information about whether activation of the ovulation detection mechanism is dependent on sexual or other experience. In addition, we did not investigate whether women with symmetrical faces and bodies and who are judged to be attractive emit more or less intense bodily odour during ovulation than women who are not attractive. Further research is needed in order to explore these issues.

The functional significance of menstrual cycle-dependent identification of bodily odour and its persistence (seven days in the present study) need to be explained. It would seem that males could use these menstrual cycle-dependent olfactory cues in order to fine-tune their behaviours towards their mates or potential mates. The changes in odour profile could have been used by males in ancestral populations as cues for guarding their mate from other males and/or copulating with her in order to increase the possibility of conception. A pair-bonded male would have an advantage over a strange male because a pair-bonded male would be familiar with the female's skin colour and breast symmetry and could use changes in these characteristics along with odour cues to detect when she is most fertile.

Our findings clearly suggest that ovulation-linked odours are not fleeting or short lived but our research design did not allow us to determine whether such odours would have been detectable and judged pleasant if there were other competing odours. We left the T-shirts at room temperature for one week but there were no competing odours. In an ancestral environment, women would have been exposed to various odours while foraging or attending to various chores. It could be that environmental odours from foraging, dirt and perspiration would overwhelm ovulation-linked odours.

However, if it is assumed that ovulation-linked odours remain detectable in spite of competing odours for two to three days after ovulation, the consequences of such persistence would be quite different between pair-bonded and strange males. The persistence of ovulation-linked body odour would allow a strange male to pursue a female if such an opportunity was available. All odours are subject to habituation and adaptation. Dalton (2000) summarized experimental evidence showing that continued or repeated exposure to odours results in an elevation in odour threshold and reduced responsiveness to supra-threshold stimulation in humans. One of the consequences of this phenomenon would be that a pair-bonded male would be maximally sensitive to the onset of ovulation-linked odours but, after being repeatedly exposed, would not be affected by the bodily odour of his mate after some time. However, a non-paired male would find these female body odours hedonistically positive. A non-paired male may prefer to pursue such a woman instead of one with no odour or odours associated with the non-fertile phase of the menstrual cycle. The human female egg is capable of being fertilized for approximately the first 12–24 h after ovulation (Hyde & DeLamater 2000). Thus, a non-paired male can potentially impregnate a woman. In addition, a female with the pleasant odours associated with ovulation can benefit by initiating behaviours which will ensure extra-pair copulation. Baker and Bellis (1995) reported that women engage in extra-pair copulation more often during mid-cycle when they are more likely to be impregnated. Further research is needed in order to check the reliability of these speculations.

The significance of the present finding lies in demonstrating that ovulation may not be totally concealed from pair-bonded males and that such males could use body odours along with other visual cues for detecting ovulation in pair-bonded females.

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REFERENCES

Baker, R. R. & Bellis, M. A. 1995 *Human sperm competition*. London: Chapman & Hall.

Buss, D. M. 1994 *The evolution of desire: strategies of human mating*. New York: Basic Books.

Dalton, P. 2000 Psychophysical and behavioral characteristics of olfactory adaptation. *Chem. Senses* **25**, 487–492.

Gangestad, S. W. & Thornhill, R. 1997 Human sexual selection and developmental stability. In *Evolutionary social psychology* (ed. J. A. Simpson & D. T. Kenrick), pp. 169–195. Mahwah, NJ: Erlbaum Associates.

Gangestad, S. W. & Thornhill, R. 1998 Menstrual cycle variation in women's preferences for the scent of symmetric men. *Proc. R. Soc. Lond.* B **265**, 927–933.

Grammer, K. 1996 *The human mating game: the battle of the sexes and the war of signals*. Paper presented to the Human Behavior and Evolution Society Annual Meeting, 29 June, Northwestern University, Evanston, IL, USA.

Hyde, J. S. & DeLamater, J. D. 2000 *Understanding human sexuality*. New York: McGraw-Hill.

McGraw, K. O. & Wong, S. P. 1996 Forming inferences about some intraclass correlation coefficients. *Psychol. Meth.* **1**, 30–46.

Manning, J. T. 1995 Fluctuating asymmetry and body weight in men and women: implications for sexual selection. *Ethol. Sociobiol*. **16**, 145–155.

Manning, J. T., Scutt, D., Whitehouse, G. H., Leinster, S. J. & Walton, J. M. 1996 Asymmetry and the menstrual cycle in women. *Ethol. Sociobiol.* **17**, 129–143.

Manning, J. T., Koukourakis, K. & Brochie, D. A. 1997 Fluctuating asymmetry: metabolic rate and sexual selection in human males. *Ethol. Sociobiol.* **18**, 15–21.

Poran, N. S. 1994 Cyclic attractivity of human female odours. *Adv. Biosci.* **93**, 555–560.

Preti, G. & Huggins, G. R. 1975 Cyclical changes in volatile acidic metabolites in human vaginal secretions and their relation to ovulation. *J. Chem. Ecol.* **1**, 361–368.

Rikowski, A. & Grammer, K. 1999 Human body odour, symmetry and attractiveness. *Proc. R. Soc. Lond.* B **266**, 869–874.

Schaal, B. & Porter, R. H. 1991 'Microsomatic humans' revisited: the generation and perception of chemical signals. *Adv. Study Behav.* **20**, 135–199.

Scutt, D. & Manning, J. T. 1996 Symmetry and ovulation in women. *Hum. Reproduct.* **11**, 2477–2480.

Shackelford, T. K. & Larsen, R. J. 1997 Facial asymmetry as indicator of psychological, emotional, and physiological distress. *J. Person. Soc. Psychol.* **72**, 456–466.

Strout, P. E. & Fleiss, J. L. 1979 Intraclass correlations: uses in assessing rater reliability. *Psychol. Bull.* **86**, 420–428.

Symons, D. 1979 *The evolution of human sexuality.* Oxford University Press.

Symons, D. 1995 Beauty is in the adaptations of the beholder. In *Sexual nature, sexual culture* (ed. P. R. Abramson & S. D. Pinkerton), pp. 80–118. University of Chicago Press.

Thornhill, R. & Gangestad, S. W. 1999 The scent of symmetry: a human sex pheromone that signals fitness? *Evol. Hum. Behav.* **20**, 175–201.

Thornhill, R. & Møller, A. P. 1997 Developmental stability, disease and medicine. *Biol. Rev.* **72**, 497–548.

Trivers, R. L. 1972 Parental investment and sexual selection. In *Sexual selection and the descent of man: 1871–1971* (ed. B. Campbell), pp. 136–179. Chicago, IL: Aldine.

Van den Berghe, P. L. & Frost, P. 1986 Skin color preference, sexual dimorphism, and sexual selection: a case of gene culture co-evolution? *Ethnic Racial Stud.* **9**, 87–113.

Wedekind, C., Seeback, T., Bettens, F. & Paepke, A. J. 1995 MHC-dependent mate preferences in humans. *Proc. R. Soc. Lond.* B **260**, 245–249.

APPENDIX A

Table A1. *Mean combined rating of pleasantness and sexiness for the follicular and luteal phases for pairs of T-shirts in the original study (first 17 pairs) and replication (last four pairs of numbers with suffix R)*

T-shirt pair	mean follicular phase	mean luteal phase	follicular phase minus luteal phase	s.d. of difference
1	7.77	2.47	10.24	5.36
2	7.50	−1.00	6.50	3.04
3	7.83	4.91	12.74	4.91
4	5.99	0.19	6.17	3.08
5	6.09	0.70	6.79	3.58
6	10.53	0.17	10.70	4.80
7	8.83	0.73	9.56	3.78
8	5.74	0.24	5.99	3.18
9	6.39	0.37	6.76	4.22
10	7.31	−0.33	6.99	4.23
11	5.97	−0.97	5.00	2.99
12	12.60	−0.27	12.33	3.15
13	6.90	0.43	7.33	3.08
14	7.27	1.87	9.14	4.88
15	6.31	0.20	6.51	2.75
16	9.34	3.44	12.79	4.20
17	7.61	−0.08	7.53	2.08
18R	8.11	1.31	9.42	5.41
19R	9.11	0.36	9.47	4.99
20R	6.68	−0.15	6.53	2.43
21R	9.05	1.27	0.32	6.07