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Original Article

The impact of artificial fragrances on the assessment of mate quality cues in body odor

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ABSTRACT

Cultural practices may either enhance or interfere with evolved preferences as predicted by culture–gene coevolution theory. Here, we investigated the impact of artificial fragrances on the assessment of biologically relevant information in human body odor. To do this, we examined cross-sensory consistency (across faces and odors) in the perception of masculinity and femininity in men and women, and how consistency is influenced by the use of artificial fragrance. Independent sets of same and opposite-sex participants rated odor samples (with and without a fragrance, $n = 239$ raters), and photographs ($n = 130$) of 20 men and 20 women. In female, but not male raters, judgments of masculinity/femininity of non-fragranced odor and faces were correlated. However, the correlation between female ratings of male facial and odor masculinity was not evident when assessing a fragranced body odor. Further analysis also indicated that differences in ratings of male odor masculinity between men with high and low levels of facial masculinity were not present in fragranced body odor samples. This effect was absent in ratings of female odors by both female and male raters, suggesting sex-specificity in the effects of fragrance on odor perception. Our findings suggest that women may be more attentive to these odor cues, and therefore also to disruption of this information through fragrance use. Our results show that cultural practices might both enhance and interfere with evolved preferences.

1. Introduction

It is well-established that many non-human species use olfactory information to assess potential mates on attributes such as reproductive status (Clarke, Barrett, & Henzi, 2009; Miranda, Almeida, Hubbard, Barata, & Canário, 2005), competitive ability (Huck, Banks, & Wang, 1981; Rich & Hurst, 1998) and genetic compatibility (Ilmonen, Stundner, Thoss, & Penn, 2009; Ruther, Matschke, Garbe, & Steiner, 2009). Additionally, olfactory cues not only reveal characteristics of the individual, but have also been found to induce physiological and behavioral changes in the perceiver, such as accelerating or delaying the onset of puberty, inducing ovulation/abortion, increasing and decreasing sperm allocation as well as affecting the performance of copulatory behaviors in many non-human animals (for a review see Petrulis, 2013). Humans, however, have a reduced number of olfactory receptor cells and functional olfactory receptor genes compared to other mammals, such as dogs and mice (Schaal & Porter, 1991; Young, 2002). This has previously led to the conclusion that humans are chiefly visual creatures. However, while we may be inferior to other species in regards to our ability to detect odors, we are in fact quite well endowed with sebaceous and apocrine glands (Kippenberger et al., 2012); this led Stoddart (1990) to label humans as 'the scented ape'. The apocrine glands become active during puberty (Montagna & Parakkal, 1974), suggesting a potential role in sexual selection. Based on such information, it has been hypothesized that humans retain the ability to assess olfactory cues in mate choice scenarios, with body odor posited as serving an analogous signaling function in humans to urinary and glandular odor cues in other animals (Comfort, 1971; Penn et al., 2007; Schleidt, Hold, & Attili, 1981; Stoddart, 1990).

In support of this, research suggests that humans indeed use olfactory cues present in odor to assess a range of qualities. For example, humans can assess an individual's sex (Schleidt et al., 1981), personality (Sorokowska, 2013), diet (Fialová, Roberts, & Havlíček, 2013), genetic compatibility (Havlicek & Roberts, 2009; Havlíček & Roberts, 2013) and health status (Moshkin et al., 2012) via odor. Humans also have the capacity to recognize kin via body odor (Ferdenzi, Schaal, & Roberts, 2010; Roberts et al., 2005; Weisfeld, Czilli, Phillips, Gall, & Lichtman, 2003), which is important in sexual selection in order to avoid inbreeding. Individuals can assess olfactory cues of a woman's menstrual cycle stage, with studies finding that men perceive female odors collected

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during the follicular phase of the menstrual cycle to be more attractive than those from the luteal phase, the latter being associated with a low conception risk (Singh & Bronstad, 2001; Gildersleeve, Haselton, Larson, & Pillsworth, 2012; Kuukasjärvi et al., 2004). Furthermore, findings to date demonstrate that information which is available in body odor is often correlated with mate-choice relevant information present in cues from other modalities. For example, individuals prefer the smell of others who exhibit attractive nonverbal behavior (Roberts et al., 2011) or low fluctuating asymmetry, believed to reflect genetic and developmental stability, who are also often rated as being more attractive facially (Rikowski & Grammer, 1999; Thornhill & Gangestad, 1999). Additionally, previous studies suggest that these olfactory cues may not only provide information, but, as found with non-human animals, potentially alter the physiological state of the perceiver. For example, Bensafi et al. (2003) found that presentation of a human sex steroid derived compound lead to increased physiological arousal in women and decreased arousal in men.

In spite of the apparent value of olfactory cues in evaluating others, there are a number of cultures where conscious detection of body odor is perceived negatively (e.g., Schleidt et al., 1981). This is echoed in the early development and use of fragrances and perfumes worldwide, which dates back to at least the ancient Egyptian and Greek civilizations (Stoddart, 1990). Indeed, the fragrance industry in western societies is worth billions of dollars, and personal fragrance use is widespread, with one study finding that 79% of women and 60% of men sampled in the UK reported using a deodorant every day (Roberts, Miner, & Shackelford, 2010). The use of such products raises the question of what effect they might have on the cues present in body odor, and in turn how this influences social and sexual interactions with others. Indeed, it was reported that videos of men who used fragranced antiperspirants were judged as more attractive compared to videos of men who used the placebo; perhaps due to changes in self-confidence of the target men (Roberts et al., 2009).

One model that has been employed to help explain the apparent contradiction between the communicatory significance of body odor and our apparent desire to repress it is the culture–gene coevolution paradigm. According to this paradigm, the cultural attitudes, beliefs, practices and perceptions of others can be selected in a similar fashion to that of genetic material and as such these cultural norms and behaviors are subject to a process analogous to natural selection (Feldman & Laland, 1996; Richerson & Boyd, 2006). Consequently, it has been posited that this contradiction regarding olfaction and fragrance may represent an interaction between culturally evolved practices and biologically evolved olfactory signals. Indeed it has been proposed that biologically evolved preferences might even shape cultural practices. Havlíček and Roberts (2013) discuss the use of cosmetics in this regard, an example of this being that individuals may wear foundation in order to improve the appearance of skin health—a biologically evolved preference being enhanced via a cultural practice. In support of this, one study found there to be greater contrast in the luminance of females' faces than males', and that gender assumptions of androgynous faces could be manipulated by increasing or decreasing the luminosity contrast of images (Russell, 2009). Furthermore, the author found that the same face had higher levels of contrast when makeup was applied compared to having no makeup applied, lending support to the concept that facial cosmetics are used to enhance sexually dimorphic attributes, in this case femininity, which may play a role in human mate choice.

Based on this framework, recent research suggests that rather than completely masking cues present in body odor, fragrances may instead be chosen (perhaps unintentionally) to enhance the unique qualities of an individual's body odor. For instance, it has been shown that preferences for common perfume ingredients relate to the major histocompatibility complex (MHC), a set of genes involved in immune function (Hämmerli, Schweisgut, & Kaegi, 2012; Milinski & Wedekind, 2001). MHC is potentially an important cue of genetic compatibility in humans, as in other species, and MHC-disassortative odor preferences have been recorded (Havlíček & Roberts, 2013). MHC-correlated perfume choice may thus enhance idiosyncratic immunogenetic cues available in body odor and used in mate choice, as predicted by the culture–gene coevolution paradigm. In further support of this, Lenochová et al. (2012) found that mixtures of participants' body odor with their perfume of choice were perceived to be more pleasant than mixtures of body odor and an experimenter-assigned perfume, suggesting choice for fragrances that complement underlying body odor. However, how fragrance use may interfere with odor-based discrimination of other mate qualities has not yet been explored.

In order to clarify this issue, we investigated the effects of fragrance use on perceptions of masculinity and femininity in men and women. These traits have been previously linked to mate choice and sexual selection in humans, with masculinity potentially reflecting underlying genetic quality in males (Thornhill & Gangestad, 1999) and femininity being identified as a trait representing reproductive potential in human females (e.g. Fraccaro et al., 2010). Both traits are detectable across multiple modalities (Fraccaro et al., 2010; Little, Connely, Feinberg, Jones, & Roberts, 2011), with perceptions of facial masculinity having recently been found to correlate with sexually dimorphic traits such as height and weight (Holzleitner et al., 2014). Additionally, both traits are central constructs used in the commercial development of fragrances, with most perfumes and deodorants being classified as either masculine or feminine (so-called unisex fragrances are in the minority; Lindqvist, 2012). This further cements the cultural relevance of these sexually dimorphic traits for males and females, making them prime candidates for cultural practices which may have emerged as a result of biologically evolved preferences. Fragrances, as with other cosmetics, may be designed and used to enhance the perception of these traits, thus making an individual more appealing to the opposite sex.

The current study aimed to investigate whether commercially available fragranced products lead to changes in ratings of masculinity/femininity. This would be predicted by a culture–gene coevolution framework where cultural norms might be shaped by evolved, sexually dimorphic, preferences. Alternatively, the cultural practices might interfere with the evolved preferences. If this would be the case, fragranced products would decrease discrimination of masculinity/femininity. In order to assess these hypotheses, we first aimed to replicate previous findings that these mate-choice relevant, sexually dimorphic traits assessed using one modality are correlated with the assessments of the same trait in another modality. This was accomplished by examining the relationship between odor rated and facially rated masculinity/femininity. By comparison of these cross-modal relationships between faces and axillary odor, with and without the presence of a fragrance, we were able to investigate the impact that fragrance had on the assessment of individuals' odor, here taken as representing one aspect of their attractiveness to a potential mate. We hypothesized that fragranced odor samples would be rated as more masculine or feminine than unfragranced samples (in keeping with a culture–gene coevolution paradigm). Furthermore, we predicted that the ratings of masculinity and femininity given to male and female *unfragranced* axillary odors would be correlated with the ratings given to the same individuals' faces. Finally, we hypothesized that the presence of an artificial fragrance would lead to biased assessment of an individual's masculinity/femininity through body odor, thus resulting in no correlation between fragranced odor ratings and face ratings of masculinity/femininity, as fragrances are specifically designed to enhance these traits reducing the individual variation in these underlying body odor cues (Lindqvist, 2012).

2. Method

The study received ethical approval from the University of Stirling's Psychology Ethics Committee.