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Partner's body odor vs. relatives' body odor: a comparison of female associations

Abstract*: People positively appraise odors of individuals who are genetically different from themselves. Here we analyzed the relationship between perceived similarity of body odor to the judges' relatives and their partners, and characteristics attributed to the odor donor. Seventy-six women were asked to smell one of the scents of twenty-nine men, and rate variables related to potential sexual interest in odor donor. We hypothesized that characteristics related to potential sexual interest would be associated with odor donors smelling similar to a partner, rather than with odor donors smelling similar to a relative. We found that perceived similarity to a partner's scent was positively correlated with ratings of variables related to potential sexual interest in odor donor, whereas the resemblance to a close relative's scent did not correlate with these assessments.*

Key words: *body odor, mate selection, sexual interest, kin recognition*

Introduction

Chemical signals transmitted by body fluids can convey social information (Ackerl, Atzmueller, & Grammer, 2002; Sorokowska, Sorokowski, & Szmajke, 2012; Yamazaki, Beauchamp, Curran, Bard, & Boyse, 2000). Studies have shown evidence for odor-mediated self-recognition (Hold & Schleidt, 1977; Lord & Kasprzak, 1989; Schleidt, 1980; Schleidt, Hold, & Attili, 1981; Russell, 1976) and kin recognition (Porter, 1998; Porter, Cernoch, & Balogh, 1985; Porter & Moore, 1981). Mothers learn to identify the smell of their infants within a few hours after birth (Kaitz, Good, Rokem, & Eidelman, 1987; Porter, Cernoch, McLaughlin 1983;), breast-fed infants can recognize the axillary odor of their mothers (Cernoch & Porter 1985), and infants in general recognize and prefer the body odor of their mother over that of another woman (e.g., Macfarlane, 1975). Furthermore, family members –siblings and other relatives–can identify each other by smell (Porter & Moore, 1981; Porter, Balogh, Cernoch, & Franchi, 1986), and relatives' smell is similar even when assessed by unrelated judges (Porter & Schaal, 2003).

Body odor seems to be determined genetically rather than environmentally (Roberts et al., 2005). For instance an individual allelic profile of the Major Histocompatibility Complex (MHC), called Human Leukocyte Antigen (HLA) in humans (Ehlers et al., 2000; Yamazaki et al., 2000) is an important factor contributing to body odor. Genes in this large chromosomal region influence body odor through a variety of compounds and reactions (see: Penn & Potts, 1998 for discussion). In addition, HLA influences body odor preferences (e.g., Wedekind & Füri, 1997; Wedekind, Seebeck, Bettens, & Paepke, 1995). So far, most studies investigating odor preferences in potential partners showed that participants tended to prefer odors of people with HLA alleles different to their own (but the strength of this effect differed, see: Havlicek & Roberts, 2009 for a review). Such preferences could be adaptive, because they increase the average genomic heterozygosity. HLA molecules critically influence the susceptibility to infection, and higher HLA-heterozygosity translates to a higher immunocompetence and increased resistance to multiple pathogens in the face of constantly changing pathogen spectra (e.g., Penn & Potts, 1999). Additionally, HLA-disassortative mating preferences may help avoid general inbreeding (Penn & Potts, 1999).

Several studies have suggested that HLA-related chemosignals play crucial role in self/non-self recognition based on odor cues. In Marxer-Tobler and Pineda (2012) study, participants exhibited practically identical rhythmic EEG patterns in reaction to one's own odor and to the odors of their ancestral in-group members. Relatedly, PET study of Lundström, Boyle, Zatorre, and Jones-Gotman (2009)

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showed that kin recognition activated regions of brain suggested to be related to self-referent stimulus processing. Also chemosensory event-related potentials (CSERP) analyses suggest that the brain preferentially processes information about HLA similarity over information about HLA dissimilarity (Pause et al., 2006). Recent studies of Milinski, Croy, Hummel, and Boehm (2013) provided a functional explanation of the role of HLA peptides in activation of sensory neurons of the olfactory system. "Self-peptides" activate a region in the right middle frontal cortex and thus, HLA-similarity detected in body odor probably influences the way the brain processes social signals (Milinski et al., 2013). Generally, all these studies suggest that HLA-related genetic similarity can be recognized through an automatic self-referential process (Pause, 2012).

Body odor is a valuable cue in mate choice (e.g., Rikowski & Grammer, 1999), and as people seem to be able to recognize kinship by body odor (Porter, 1998; Porter, Cernoch, & Balogh, 1985; Porter & Moore, 1981), it is likely that adults prefer (and positively associate) odors of individuals who are genetically different, not only from themselves, but also from their parents (see Jacob et al., 2002) and other relatives. Generally, all the studies described in previous sections show that (a) people are able to identify relatives based on body odor samples, and (b) people tend to assess body odors of individuals who are genetically dissimilar to themselves as sexually more attractive. Therefore, we hypothesized that characteristics related to potential sexual interest would be associated with odor donors smelling similar to a partner, rather than with odor donors smelling similar to a relative. In this context, we analyzed the assessments of pleasantness and intensity of body odor, and some variables related to mate value and potential sexual interest in odor donor (i.e., assessed sexiness, tenderness, aggressiveness, physical attractiveness, reliability, and dominance of odor donor, and whether he would be a good father of her children). We correlated these variables with perceived similarity of body odor to a relative's and partner's body odor.

We decided to use only male odors as they are more intense than female odors (Chen & Haviland-Jones, 1999), and we chose only female judges because women's olfactory sensitivity is higher than men's (for a review, see Doty & Cameron, 2009). Additionally, body odor seems to be an especially important source of information for women (Havlicek et al., 2008; Herz & Inzlicht; 2002). Compared to men, women declare higher importance of olfactory rather than visual cues in partner choice, sexual arousal, as well as in non-sexual context (Havlicek et al., 2008). This may be due to the fact that body odor may serve as an honest marker of good health, and consequently as a proxy for "good genes" of men (Butovskaya, Veselovskaya, Rostovtseva, Selverova, & Ermakova, 2012). Also, females recognize the odor of familiar individuals more readily than do males (Schleidt et al., 1981).

Methods

Participants

Seventy-six heterosexual women (judges) aged 18-33 (M=21.08; SD=3.22) were asked to smell an odor of one of the twenty-nine heterosexual men (odor donors) aged 18-33 (M=20.90; SD=4.29). Out of all the women, fifty-seven had partners, and none reported taking oral contraceptives. All participants lived in Moscow (Russia), and were Russian by origin. The study was conducted as part of the annual training of students, that constitutes a part of Human Ethology course; the subjects were not paid for their participation. None of the women's relatives or partners took part in the study. We obtained informed consent to participate in the study from all individuals and the research was approved by the ethics committee of the Center of Cultural Anthropology of Russian State University for Humanities, Moscow.

Procedure

As body odor samples, we used axillary cotton pads. Such samples should effectively convey social information because axillary apocrine glands are considered to significantly influence the composition of socially relevant chemosignals (see Heckmann, Teichmann, Pause, & Plewig, 2003). The odor donors were asked to refrain from eating odorous foods and drinking alcohol (they were all non-smokers) and not to use perfumes and or personal hygiene products for three days prior to the experiment. The subjects were allowed to use non-scented liquid soap and odorless antiperspirants as part of their personal care. They were also asked to sleep alone and not to let animals stay in the same bed the night of the experiment. On the morning of the scheduled day, the odor donors washed themselves with a provided odorless soap, then attached cotton pads under their arms (standard size Ebelin cosmetic pads, DM-Drogerie Markt, Czech Republic), and put on the provided t-shirt previously washed in odorless washing powder. Odor donors wore the pads for 24 hours straight. After that, the samples were collected and then frozen at -20°C. For more details on the collection of odor samples see Butovskaya et al. (2012).

Before the odor-carrying pads were presented to female experts (the tests were performed 7–14 days after freezing the pads), they were thawed to room temperature and placed in non-transparent glass containers. Each participating woman assessed one randomly selected odor (each body odor was assessed at least once). First, the women assessed whether the scent was similar to any of their close relative's body odors, and women with partners also rated whether it resembled their partner's odor. The ratings were performed on numerical rating scales ranging from 1 to 7, with verbal anchors for 1 ("extremely dissimilar") and 7 ("extremely similar"). Then, they were asked to assess the following characteristics on the 1 to 7 scale (again with verbal anchors for the extreme values): (a) characteristics of scent: intensity and pleasantness, (b) characteristics of

body odor donor: sexiness, tenderness, aggressiveness, physical attractiveness, reliability, dominance, and whether he would be a good father of her children. Each woman was tested individually. There were no restrictions to sniffing time, and the participants were allowed to sniff the odor as many times as they wished, but the instruction and whole procedure on average took about 10 minutes.

Results

Odors rated as similar to partner's scent were also assessed as similar to relatives' scent (r = .59, p < .01). Therefore, the results were analyzed using partial correlations – controlling first for "resemblance to your relative" and then for "resemblance to your partner". The correlations were computed separately for women who had a partner and for women who did not have a partner. All results are presented in Table 1.

For women who had partners, similarity to partner's scent correlated with perceived pleasantness of odor (r = .60, p < .01), and the following characteristics of an odor donor: sexiness (r = .37, p = .01), tenderness (r = .31, p = .02), physical attractiveness (r = .43, p < .01), reliability (r = .36, p = .01) and being a potentially good father to the woman's children (r = .30, p = .03). All the other correlations were not significant (see Table 1.)

The resemblance to a close relative's scent did not correlate with any of the characteristics of odor or odor donor neither for women who had partners, nor for all women pooled together.

We also tested the equality of correlations we found in the subsample of partnered women using Fisher's Z-transformation (with one-tailed test of significance; Preacher, 2002; Steiger, 1980). Tests revealed that the correlations were lower for "resemblance to your relative" than for "resemblance to your partner" for the following characteristics: (Z = -2.644, p < .01), physical attractiveness (Z = -2.719, p < .01), and reliability (Z = -1.691, p < .05). All other correlations differed non-significantly (all ps > .05).

Discussion

Results of our study suggest that women attribute different characteristics to odor donors whose scents are similar to their relatives and to those who smell similar to their partners. Odors perceived as similar to a partner's odor were assessed as more pleasant, and odor donors smelling similar to a partner were associated with sexiness, tenderness, physical attractiveness, reliability and being a potentially good father to a woman's children. At the same time, the resemblance to a close relative's scent did not correlate with any of the perceived characteristics of odor or odor donor. Such results suggest that women would probably not consider as mates men whose body odor indicates high genetic similarity.

Interestingly, in our study men smelling similar to women's relatives were not assessed negatively and generally the variables "similar to a relative" and "similar to a partner" were significantly correlated. Such results are in line with previous findings indicating that people do not necessarily prefer body odors of mates whose HLA is too dissimilar to their own HLA (Jacob et al., 2002; Santos, Schinemann, Gabardo, & Bicalho, 2005). Theoretically, the maximum HLA-heterozygosity should be the most beneficial, since HLA diversity in natural populations might be a key survival parameter since it increases resistance to pathogens (e.g., Penn & Potts, 1999). However, recent works have shown that in some cases the intermediate degree of heterozygosity could bring even more fitness (review: Milinski, 2003). Thus, instead of maximizing the heterozygosity, people might search for a partner who would be different from themselves only to an intermediate degree.

Table 1. Correlations between perceived characteristics of odor and odor donor, and perceived resemblance a partner and a relative.

	Resemblance to a partner Women with partners n=57		Resemblance to a relative Women with partners n=57		All women N=76	
	r	p	r	p	r	p
Intensity	-.09	.49	.14	.31	.06	.64
Pleasantness	**.60**	<.01	.17	.11	-.01	.94
Sexiness	**.37**	.01	.23	.08	.18	.18
Tenderness	**.31**	.02	.07	.58	.05	.73
Aggressiveness	-.18	.18	.06	.67	.04	.79
Physical attractiveness	**.43**	<.01	-.06	.64	-.09	.51
Reliability	**.36**	.01	.05	.72	-.02	.88
Dominance	.10	.46	-.18	.19	-.04	.77
Good father	**.30**	.03	.09	.53	-.06	.65

Note. Significant values are presented in bold.

Jacob et al. (2002) and Santos et al. (2005) have previously observed such pattern in body odor preferences. In Jacob et al. (2002) study, women did not prefer the body odors of men whose HLA profiles were too similar or too different, but the smells of those having intermediate HLA similarity to their own. Similarly, Santos et al. (2005) observed that raters had more problems with deciding whether the smell was pleasant or unpleasant when the similarities in their own and donors' HLA were increasing. Additionally, sexual-imprinting-like effect, produced by individuals in close relationships with their parents may also be of certain importance. Both these factors may be relevant explanations of the results we observed in our study.

Women assessed odor donors smelling similar to their partners as sexy, tender, physically attractive, reliable and being a potentially good father to their children. The differences between characteristics attributed to odor donors smelling similar to a partner and donors smelling similar to a relative were particularly salient for pleasantness, physical attractiveness, and reliability. These variables seem to be especially important in terms of selection of a long-term sexual partner. It suggests that there might exist some general odor cues, probably also related to HLA, which make some men preferred as mates for a particular woman. Possibly, the women had used these cues also when they were choosing their partners. Additionally, partnered women satisfied with their present boyfriend/husband associated smells which they found similar to their partner's smell in a highly positive way. Sexually connoted odors might gain hedonic value via associative learning (Knaapila et al., 2012), and probably the same process might be observed in the case of body odor of a partner.

We are aware that our research may have a few limitations. First, we did not use body odors of actual partners/relatives of our participants. However, this is a first study to test subjective emotional responses to body odors of strangers assessed as smelling similar to current partners and/or relatives. Our findings might provide basis for future research (involving the use of actual partners'/relatives' odors). We also did not test whether the assessments of odors as similar to partner's odor or relative's odor were reliable – this could have been and artifact, resulting from simultaneous assessments of other variables. Future researchers should take this issue into account and – most preferably – organize the rating sessions in such a way that each variable would be rated separately and independently. Further, studies show that menstrual cycle phase might modify female responses to certain odors, especially those which are biologically important. For example, Havlicek, Roberts and Flegr (2005) showed that women in the fertile phase of their cycle assessed odors of dominant males as being more pleasant than in different phases of their cycle. Future studies investigating preferences towards body odors and relating them to partner choice or kin perception should also include this variable.

In summary, our results suggest that associations evoked by certain body odors are related to perceived mate quality of unknown odor donors. Therefore, researchers in future studies examining odor-mediated mate choice should also analyze the psychological, not only biological aspects of perception of body odors.

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