

PERFUMES BETWEEN VENUS AND MARS
How gender categorization of perfumes is (not)
related to odor perception and odor preference

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Doctoral thesis in Psychology, Stockholm University, 2013



Perfumes between Venus and Mars

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To Roland, my partner in crime

Abstract

How we smell is important to a lot of people, as indicated by the high spending on perfumes. Most perfumes are categorized as feminine or masculine, and this gender categorization is an important factor when people purchase perfumes. This thesis explores odor perception and perfume preference when the person sniffing the perfume does not know the commercial gender categorization. Three psychophysical experiments were conducted, in which the participants scaled the femininity and masculinity of the perfumes, indicated preferences, and gender categorized the perfumes. The perfumes were presented both in glass bottles and when applied on human skin. Results of three experiments indicate that female and male participants (20–30 years old) preferred the same perfumes, both for themselves and for their potential partners. The preferred perfumes tended to be “unisex,” that is, perceived as neither strongly feminine nor strongly masculine. The participants did not perform well in gender categorizing the perfumes the same way as the commercial classifications, and they did not succeed in guessing the gender of the human when the perfumes were applied on human skin. The commercial gender associations of the perfumes only corresponded to how they were perceived in the case of extremely feminine or extremely masculine perfumes. I conclude that the gender categorizations of most perfumes are not related to how they are actually perceived.

Keywords: odor perception, perfumes, femininity, masculinity, gender-sensitive research, gender differences

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List of studies

The present doctoral thesis is based on the following studies:

Study I: Lindqvist, A. (2012). Perfume preferences and how they are related to commercial gender classifications of fragrances. *Chemosensory Perception*, 5(2), 197-204.

Study II: Lindqvist, A. (2013). Gender categorization of perfumes: The difference between odor perception and commercial classification. *(resubmitted)*

Study III: Lindqvist, A. (2012). Preference and gender associations of perfumes applied on human skin. *The Journal of Sensory Studies*, 27(5), 490-497.

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Introduction

One day many years ago my friend Maria was wearing a new perfume – I could tell by her odor. She smelled great and I asked her about her perfume. She showed me the bottle – it was her boyfriend’s perfume. “I always thought he smelled so nice,” she told me, “so I simply decided to try his perfume myself.” Obviously, this masculine perfume suited her just fine.

I thought a lot about that. Since I was already interested in gender studies, I wanted to analyze the gender associations of perfumes. This was years before I took my first course in experimental psychology, but when I did, it became obvious to me that I had the tools I needed for investigating people’s odor perception of and preference in perfumes.

The particular “masculine” perfume my friend Maria was wearing was DKNY Be Delicious. In one of the articles included in this thesis (see Lindqvist, 2012a), this particular perfume had a femininity value of 4.2 out of 10 and a masculinity value of 6.1 out of 10, indicating an odor that was neither extremely feminine nor extremely masculine, but rather unisex. The perfume was commercially categorized as a masculine odor, however, and its target group was men, not women such as Maria. One can wonder how such gender categorizing affects people’s choices when they buy perfumes. At least I know *I* wonder. This thesis explores the relationship between the commercial gender classification of perfumes and how these perfumes are perceived when the classification is unknown.

Body odors and perfumes in everyday life

In the novel *Perfume: The story of a murderer* by Patrick Süskind (1986), the main character, Jean-Baptiste Grenouille, tries to create a perfume mimicking the human smell. He comes to the conclusion that the ingredients of the natural human body odor include cheese, vinegar, and urine. In real life, however, the perfume industry tries to create scents that mask undesired body odors, such as that of sweat. Manufacturers also want consumers to associate particular perfumes with their own personalities.

The perfume market is large and successful. For example, it has been demonstrated that the scent of soap, rather than its actual cleaning effect, is a primary driver of consumer choice (Milotic, 2003). Furthermore, individuals spend large amounts of money on perfumes to improve their personal odor.

Over one billion dollars were spent every year on products to control body odor in the United States alone in the early 1990s (Labows & Preti, 1993). The same pattern is found all over the Western world, and today the perfume industry's annual sales are approximately USD 25–30 billion (Burr, 2009).

When sniffing a perfume, it is suggested that the masculinity or femininity of the scent comes to mind (Zellner et al., 2008), and most perfumes on the commercial market are classified as either feminine or masculine. There are unisex perfumes as well, but they are a minority (Sczesny & Stahlberg, 2002). The gender associations of perfumes are the main theme of this thesis.

Odors of the human body

Researchers have studied people's olfactory sensitivity to human body odors, and how this sensitivity is related to reproductivity. For example, it has been demonstrated that scents signaling the reproductive fertility of women can influence the level of testosterone in men, a hormone mediating men's mating behavior (Miller & Maner, 2010). It has also been demonstrated that fertile women are more sensitive to androstadienone, a metabolite of the hormone testosterone, than are women using oral contraceptives (Lundström et al., 2006), and that women's odor sensitivity varies over the menstrual cycle (Doty, 1992).

Other researchers have demonstrated that the ability to identify the body odors of others is related to whether heterosexual subjects are in a romantic relationship. If they are, the ability to identify the body odor of friends of the opposite sex decreases, indicating that romantic love draws away attention from potential new partners (Lundström & Jones-Gotman, 2009). In addition, a friend's body odor seems to activate regions in the brain previously associated with familiar stimuli, while the body odor of a stranger activates regions previously associated with unknown and fearful stimuli (Lundström et al., 2008), indicating that we do recognize one another's odors, not only the body odor of those we are in love with. In addition to the body odors of friends, humans can also discriminate age based on body odor (Mitro et al., 2012).

The odors of the human body are sometimes claimed to be gender-specific:¹ Some studies claim that people can discriminate between the axilla sweat of women and men (Hold & Schleidt, 1977; Schleidt, 1993), though these studies are rare and their results are relatively close to what would have been expected by chance.

Research has indicated that chemical communication might occur not only between non-human animals, but also between humans (Bensafi et al.,

¹ Or sex-specific; see discussion about sex and gender on page 19.

2004). In non-human species, odor often plays a fundamental role in coupling and mating behavior (see, e.g., Scordato & Drea, 2007). It is suggested that human mating may be similar to that of other animals in this respect (Buss, 1989), and that odor has the same kind of impact in human mating as well (Singh & Bronstad, 2001; Thornhill & Gangestad, 1999).

It has been suggested that the major histocompatibility complex (MHC) of immunity genes may influence mate choice in a number of vertebrates (Potts, 2002), including in humans (Garver-Apgar et al., 2006; Jacob et al., 2002; Wedekind et al., 1995). Researchers have demonstrated that women indicate a preference for the odor of men with a MHC locus differing from their own (Wedekind et al., 1995), although single women seemed to prefer odors of MHC-similar men (Roberts et al., 2008). It has also been demonstrated that romantic couples in some – but not all – populations are significantly more MHC-dissimilar than are random pairs (Chaix et al., 2008).

The term “pheromones” refers to a broad group of signal odors in, for example, mammals (including humans). It has been suggested that human pheromones influence human mating (McCoy & Pitino, 2002). For example, Cutler (1999) concluded that four behavioral effects of pheromones have been experimentally demonstrated in animals including humans: opposite-sex attractants, same-sex repellants, mother/infant bonding attractants, and pheromones adjusting the fertile cycle. It has also been suggested that a person’s odor preference in a partner differs between women and men (Herz & Inzlicht, 2002; Milinski & Wedekind, 2001; Sergeant et al., 2005) as well as between heterosexuals and homosexuals (Lübke et al., 2012; Martins et al., 2005).

However, other researchers claim that no strong evidence for the importance of pheromones or the MHC locus has been reported (see Hays, 2003 for an overview). Derti et al. (2010) demonstrated that results concerning the MHC locus are not as robust as they should be for drawing conclusions concerning the influence of MHC in human mating, and Jacob and McClintock (2000) argued that results from insects may not generalize to humans. McCoy and Pitino (2002) suggested that pheromones from young, fertile, sexually active women had powerful effects on the behavior of the other sex, but Winman (2004) claimed that McCoy and Pitino’s data did not support that conclusion.

Previous research into perfumes

Previous researchers do not agree on how central odor is to human. Although I will not focus on that discussion, I mention it since the idea that perfumes are and should be related to gender probably derives from the notion that odor is an essential factor in human mating. Some perfume ads use a dual

marketing approach in which, for example, both heterosexual and homosexual men are addressed by the same ads (as described by, e.g., Rohlinger, 2002), but many perfume ads still wrongly assume an exclusively heterosexual market (as pointed out by Tuna and Freitas, 2012), and often explicitly refer to heterosexual mating. It is within this understanding of the perfumery market this thesis is written.

In the early 1980s, researchers had already demonstrated that people evaluated a person with a pleasant odor as having more positive traits than a person not wearing a pleasant perfume (see Baron, 1981). Similar results have been obtained by several studies over the years. For example, the willingness to help a stranger seemed to be significantly greater if the stranger smelled pleasantly of perfume (Baron, 1997; Gueguen, 2001). In addition, earlier research found that individuals wearing perfume tend to be deemed more confident than individuals not wearing perfume (Higuchi et al., 2005), and it has been demonstrated that the perfumes in men's skincare products had positive effects on the test subjects' mood behavior (Abriat et al., 2005).

Perfumes are consequently described as one factor in social communication between human beings, in which women and men want to increase their gender-specific associations (see, e.g., Herz & Inzlicht, 2002; Milinski & Wedekind, 2001; Sergeant et al., 2005). In addition, it has been suggested that heterosexual women and men have different odor preferences in their partners (cf. Bigelow, 1993; Lübke et al., 2012; Milinski & Wedekind, 2001) and that heterosexuals and homosexuals have different odor preferences in their partners (Lübke et al., 2012; Martins et al., 2005).

Research into perfumes has focused mainly on how perfumes affect social behavior and on stereotyped associations regarding those wearing perfumes (see, e.g., Sczesny & Stahlberg, 2002). It is claimed that gender is manifested in how perfume odor is perceived (cf. Zarzo, 2008; Zellner et al., 2008), and earlier research trying to establish a "fragrance map" of perfumes has demonstrated how "femininity" and "masculinity" constitute two opposite, though overlapping, attributes along the same odor dimension (Jellink, 1993; Zarzo, 2008; Zarzo & Stanton, 2009; Zellner et al., 2008). Feminine odors have been described as "flowery" or "fruity" while masculine odors are described as "spicy" or "tangy" (see, e.g., Sczesny & Stahlberg, 2002). When rating the femininity and masculinity of perfumes, no significant difference between women and men has been identified (Zellner et al., 2008).

Earlier research has demonstrated that different kinds of gender-related perfumes have a significant impact on social interaction. As early as the 1980s, Baron (1983, 1986) demonstrated that women wearing a typical feminine perfume were seen as less confident than were non-perfumed women, while men wearing a typical masculine perfume were seen as more confident than non-perfumed men.

In addition, individuals wearing a typical feminine perfume have been described as having less typically masculine traits (Fiore, 1992), implying that the gender association evoked when sniffing perfumes applies not only to the gender of the individual wearing the perfume, but also to the personality (i.e., feminine/masculine traits) that person is assumed to have.

Sex and gender: What is the difference?

Humanity is often seen as comprising two groups, i.e., women and men, determined by their physical attributes. These two groups are seen as separate and different from each other, as in the now classical metaphor that Martians (men) and Venusians (women) meet, fall in love, and try to develop loving relationships, although they are from different planets (Gray, 1992).

However, the interpretation of “gender” as a dichotomous variable completely determined by biological “sex” is nothing but a hypothesis until verified. Moerman and van Mens-Verhulst (2004) define the concept “sex” as the bodily domain (i.e., the biological sex) and the concept “gender” as comprising four other domains, namely, the cultural, social, interpersonal, and psychological. Following this schema, a gender-sensitive approach to experimental psychology can be used by the researcher in questioning and analyzing the variables “sex” and “gender” and their connection (cf. Lindqvist, 2013). Of course, one can discuss whether, for example, the psychological domain is biologically or socially constructed, but in this definition of sex and gender, the biological sex is the only domain that can be fully determined and defined.²

Many researchers do not take the gender variable into consideration when analyzing data (see Marrocco & Stewart, 2001; Ramasubbu et al., 2001 for examples). For example, the dichotomous variable “sex” (with the possible answers “female” or “male”) has historically *not* been seen as a socio-demographic variable (cf. Klinge et al., 2001). The first step to address this oversight has been to apply a “gender perspective” to the research. In the social sciences (experimental psychology included), this “gender perspective” often consists of dividing the results into two groups – applying to women and men – and comparing the (potential) differences between them. The same reasoning can be applied to experiments in which variables are encoded as “feminine” or “masculine” without good arguments for such gendered categorization (e.g., perfume categories).

² This is valid for at least 95–97% of humanity. However, there are babies born with a biological sex not clearly feminine or masculine, so the gender dichotomy is not absolutely clear even for the bodily domain.

According to a gender-sensitive approach (cf. Moerman & van Mens-Verhulst, 2004), researchers first need to define what is meant by “gender” – what it is and is not. They then need to incorporate this knowledge into their research. Simply reporting differences between women and men is not enough (as discussed by Magnusson, 2011; Nowatzki & Grant, 2011), and Grant (2002) points out the need to deconstruct the concept of gender. So, the variable “gender” should be questioned in experimental psychology when applying a gender-sensitive approach in research. In this process, the other variables comprising the construct known as “gender” (cf. Lindqvist, 2013; Moerman & van Mens-Verhulst, 2004) must be identified. What these specific variables are, and how a gender-sensitive approach should be implemented, vary depending on the design and aim of the specific experiment.

Often, the bodily domain – “sex” – is the only information conveyed regarding the participants in psychological experiments, meaning that the influences of other domains are not investigated and analyzed. It is therefore impossible to identify what the differences between “women” and “men” found in such studies really signify. However, researchers sometimes try to investigate sex differences further. For example, Öberg et al. (2002) suggested that women’s superiority in episodic odor memory is mediated by their greater ability in odor identification. It has also been suggested that identified sex differences might be due to the participants’ differences in cognitive/emotional impact on the perception (Lundström et al., 2005). Such differences might disappear when controlling for other relevant variables (Larsson et al., 2003), supporting the notion that it is useful to analyze reported sex differences in depth to better understand them.

Most people in the Western world are so-called cissexuals, meaning that they are individuals whose sex and gender correspond.³ Because of this, when I use the term “gender” referring to the participants in my studies, I am referring both to how they define themselves (i.e., their gender) and to their biological sex, since this happens to be the same thing in the case of my research subjects.

Gender relevant variables

From a gender-sensitive perspective and based on an analysis of previous research, I have identified several relevant and measurable variables. This

³ Comparing the term “cissexuals” to the term “transsexuals,” referring to individuals whose sex and gender do not correspond, I think it is quite remarkable that most of us are familiar with the term “transsexual” but not the term “cissexual,” although cissexuals are far more common.

means that I have tried to integrate psychophysical methods of experimental psychology with a gender-sensitive approach to social sciences.

Gender in relation to odor perception of perfumes

Although earlier research has identified a gender dimension in people's odor perception of perfumes (see Jellink, 1993; Zarzo, 2008; Zarzo & Stanton, 2009; Zellner et al., 2008), gender has not been analyzed in this specific way, i.e., in which subjects judge perfumes without knowing the perfumes' gender categorizations. This implies an assumption that has not been empirically tested, and yet most research into people's odor perception of perfumes assumes that the commercial gender categorizations of perfumes correspond to their perceived gender associations. If that assumption underlies previous research, it can, and should, be tested.

In experiments in which the participants are unaware of the gender categorizations of the perfumes, typical feminine and masculine perfumes have primarily been used as stimuli (cf. Baron, 1983; Baron, 1986; Fiore, 1992). In this thesis, a broad range of perfumes was used as stimuli (see *Stimuli: Perfumes*, p. 26) in analyzing both typical feminine and masculine perfumes as well as more unisex odors. Gender was manifested in several ways concerning people's odor perception of these perfumes, ways that could be represented as variables.

The perceived (a) *femininity* and (b) *masculinity* of the perfumes, in other words, the participants' gender associations of the perfumes, could be measured for each perfume. The physical domain, i.e., "sex," was here represented by the commercial gender categorization of perfumes as either feminine or masculine (or a few classified as unisex). The participants could decide how feminine and masculine they thought each stimulus perfume was, and the concept of "gender" as "feminine odors" and/or "masculine odors" could be analyzed.

(c) Another variable was *participant gender*:⁴ Since it is suggested that human beings have different odor preferences in perfumes (cf. Sczesny & Stahlberg, 2002) depending on whether they are women or men, this was something I needed to take into consideration.

One fundamental step in gender-sensitive research is to investigate whether gender differences (i.e., differences in results between women and

⁴ Some criticism of the division of humanity into "females" and "males" is warranted, especially since these two groups often overlap in behavior (see e.g. MacInnes, 1988). In addition, by dividing the humanity into "females" and "males", all transgendered, transsexual, and intersexed individuals are excluded from the analysis (Nowatzki & Grant, 2011). However, this thesis has another focus, so I do not pursue this discussion. This footnote acknowledges queer theory as an important field of study, and expresses humility in relation to my own treatment of human gender.

men) occur (cf. Lindqvist, 2013; Moerman & van Mens-Verhulst, 2004); the next step is to explore why these differences occur – if they do. If not, there might be no point in comparing the results for female and male participants. Including participant gender as a variable was a necessary first step in further understanding human odor perceptions and preferences in perfumes.

(d) In addition, *the gender of the individuals on whom the perfumes are applied* was relevant to this thesis. In contrast to the gender of the participants, this variable could indeed be manipulated, as was done in Study III (Lindqvist, 2012b).

Cortez-Pereira et al. (2009) demonstrated the great sensitivity of the sensory analysis of odors applied on the human skin, and that unique odors are created by such application (Lenochová et al., 2012). In addition, one idea concerning perfumes is that the perfume changes depending on whether it is applied on a woman or man.

If the odor qualities of the perfumes are enhanced when applied on humans, then lab situations in which the perfumes are presented in bottles are inadequate for researching humans; actual, everyday odor perception of perfumes. Therefore, people's odor perception of and preference in perfumes could also be analyzed when the perfumes were applied on human skin. If women and men have different body odor qualities, then this could differently affect a perfume, depending on whether it was applied on a woman or a man.

(e) Research has already demonstrated that odor preference with respect to potential partners might differ between people depending on their *sexuality* (see, e.g., Lübke et al., 2012; Martins et al., 2005). Of course, *sexuality per se* cannot be manipulated, but this variable could be taken into consideration by, for example, having one group of participants who define themselves as heterosexuals and another who define themselves as homosexuals, and then comparing the results. However, sexuality was not a variable focused on in this thesis, which was written in a heterosexual discourse and context.⁵

(f) I believe that one of the most central gender-related variables in this thesis was *how the perfumes are commercially gender categorized*, since most perfumes are categorized as either feminine or masculine (Sczesny & Stahlberg, 2002). Some odor qualities are described as typically feminine or masculine, but one may wonder how the perfume industry categorizes the

⁵ Again, as was mentioned in footnote number 4, a gender discussion could be included here. Most research into human odor preference in perfumes or in partners focuses on heterosexual humans, although this is not always explicitly expressed (as in e.g. Chaix, et al., 2008; Derti, et al., 2010; Milinski & Wedekind, 2001; Winman, 2004). The discourse is thereby often heteronormative. I will not discuss heteronormativity further in this thesis, even though I believe the issue merits discussion. In my articles, I recognize this factor by clearly stating that the results exist in a heterosexual context, with heterosexual participants.

others. Gender is featured in both advertizing and on the perfume bottles (Bigelow, 1993), but how present is it in people's odor perception of the perfumes? Other research has demonstrated that the perception of rose odor was significantly affected by how the odor was named (Djordjevic et al., 2008). The same might be valid for perfumes and how they are gender categorized. Therefore, measures could be related to this commercial gender categorization.

(g) In addition, the participants made *their own gender categorizations of the perfumes*. Even when the participants scaled both the femininity and masculinity of each perfume, they did not explicitly decide whether they thought a perfume should be classified as feminine, masculine, or unisex. Adding this kind of judgment to the variables made it possible to compare the participants' gender categorizations with the commercial gender categorizations, and with the participants' gender associations of the perfumes (i.e., the femininity and masculinity scales).

(h) The last variable related to gender was how well the participants *guessed the perfumes' commercial gender category*. If the commercial gender categorizations have any legitimacy and validity, it should be possible for naïve participants (i.e., typical perfume consumers not trained in sniffing and judging perfumes) to guess how the perfumes are classified.

Odor preference

Heterosexual women and men⁵ are claimed to have different odor preferences with respect to their partners (Herz & Inzlicht, 2002; Sergeant et al., 2005), and it is sometimes suggested that odor plays an essential role in human mating (see *Odors of the human body*, p. 16). I will not add anything to that discussion, or make a digression, but even though perfumes are described as affecting the social interaction between humans, I do not believe that synthetic fragrances such as pleasant perfumes can be compared to the odors of the human body. However, perfumes are used to increase one's individual odor, so, taking all this together, it is natural to include preference in the list of variables. However, in the context of perfumes, preference may refer to three things:

(1) *pleasantness* in general, that is, how pleasant the participants thought the odor quality of each perfume was;

(2) the participants' personal preference regarding a specific perfume (i.e., did they want to use the perfumes themselves), which I call *self-preference*; and

(3) the participants' preference regarding the use of the perfumes by their (potential) partners, which I call *partner-preference*.

Memories connected to odors may influence the pleasantness judgments of those specific odors (see, e.g., Willander & Larsson, 2007; Rouby &

Bensafi, 2002). Because of this, the participants were also asked to indicate whether they could recognize the odor of the perfumes used as stimuli.

If several odor qualities are compared, or if participants judge several odor qualities at the same time, the odors need to have the same perceived intensity, since odor intensity affects the perceived pleasantness of odors (see Rouby & Bensafi, 2002 for an overview; see also Rouby, et al., 2009). For example, the perceived pleasantness of the same odor has been demonstrated to change when the odor intensity increases (see e.g. Henion, 1971; Moskowitz, 1982), which means that if the odor intensity differs too much between two stimuli, one odor stimulus might be perceived as more pleasant than the other because of differences in intensity, not in odor quality. That is, the variable *odor intensity* needs to be controlled for when measuring *pleasantness*, to validate that it is odor quality and not odor intensity causing the pleasantness values (cf. Berglund, 1991).

General Aims

My purpose of this thesis was to relate gender categorizations of perfumes to the participants' odor perceptions and judgments of the perfumes, to investigate whether gender smelled. Specifically, I addressed the following research questions:

- 1) Are perfumes commercially categorized as “feminine” and “masculine” perceived as belonging to two separate groups of perfumes when the test subjects are unaware of the commercial categorizations? This was analyzed in Study I.
- 2) Will participants produce gender categorizations of perfumes corresponding to the commercial categorizations when unaware of them? This was analyzed in Study II.
- 3) Will commercial gender categorizations of perfumes affect participants' perfume preferences? This was analyzed in Studies I and III.
- 4) When perfumes are applied on human skin, are the gender associations of and preference in the perfumes dependent on the gender of the human? This was analyzed in Study III.

Method

Stimuli: Perfumes

The studies included in this thesis used a selection of perfumes available on the commercial market. The first two studies used the same 12 perfumes, while the third study used two of the 12. Six of the perfumes used in Studies I and II were commercially gender categorized as feminine, five were categorized as masculine, and one was categorized as unisex. In Study III, one perfume was categorized as feminine and one as masculine.

The perfumes were chosen to represent a broad selection of perfumes. According to perfumers, the top notes vanish quite quickly when sniffing a perfume, after which the middle notes appear, followed, after more time, by the base notes. The following are the odor characteristics of each perfume (top notes / middle notes / base notes):

- 1) [F] Clementine, citrus / orchid, floral / creamy, tiramisu
- 2) [F] Clementine / orchid, honeysuckle / chocolate, coffee
- 3) [F] Fruity / strawberry, sweet / amber, vanilla, musk
- 4) [F] Jasmine, iris, berry / melon, musk / sandalwood, vanilla, musk
- 5) [F] Coconut, bergamot / jasmine / sandalwood, vanilla, musk
- 6) [F] Citrus, musk / vanilla, floral / sandalwood
- 7) [U] Citrus, vanilla / musk / sandalwood
- 8) [M] Lemon / rosemary, basil / musk, amber
- 9) [M] Citrus, pear, melon / basil, rosemary / sandalwood, musk
- 10) [M] Lavender, cardamom / iris, smoky / leather, mint
- 11) [M] Hawthorn, honeysuckle / sandalwood, violet / leather
- 12) [M] Cardamom, mandarin / bergamot, orchid / coffee, dark wood

The particular features of the different notes of these perfumes makes these 12 perfumes actually more dissimilar than they might at first seem, given that almost all the perfumes seem to have a hint of musk and some kind of citrus. However, when comparing the characteristics of the different notes (and of course when comparing the odors), it became quite obvious that the odor quality of the perfumes differed from one another.

According to the odor characteristics of the 12 perfumes used as stimuli, sweet odor qualities appeared more typical of perfumes classified as feminine, and smoky and/or woody odor qualities seemed more typical of

perfumes classified as masculine. This is in accordance with how the odor qualities traditionally have been associated with femininity and masculinity (cf. Fiore, 1992; Zarzo, 2008).

Perceptual scales and measurements

In the empirical studies of this thesis I used psychophysical methods⁶ for measuring the participants' perceptions of pleasant perfumes, and I wanted to apply a gender perspective to the analyses. The gender perspective has already been briefly described, and was integrated both in the research questions (p. 25) and variables of this thesis (see p. 21).

In psychophysics, the researcher's aim, as well as the participant's task, is to translate sensations into numbers. Asking the participants to directly assign numbers to their sensations is one way to do this, called direct scaling. This procedure was used in this thesis in two different ways; see *Free number magnitude estimation* (p. 27) and *Category scaling* (p. 28) below.

Free number magnitude estimation

In the late 1950s, Stanley Smith Stevens introduced the method of free number magnitude estimation (see Gescheider, 1997 for a background summary). In magnitude estimation, no fixed scale is used. Instead, the participants build their own scales during the experiment. The following was Stevens' instruction to participants in a free-number magnitude-estimation experiment:

You will be presented with a series of stimuli in irregular order. Your task is to tell how intense they seem by assigning numbers to them. Call the first stimulus any number that seems appropriate to you. Then assign successive numbers in such a way that they reflect your subjective impression. There is no limit to the range of numbers that you may use. You may use whole numbers, decimals, or fractions. Try to make each number match the intensity as you perceive it (Stevens, 1975, p. 30).

When using a fixed scale, for example, 0–10, to measure the intensity of a stimulus, the participant actually needs to be familiar with all the test stimuli to use the scale. If not, how could one know when to give the response “10,”

⁶ Psychophysics belongs to an old tradition, where Gustav Fechner's *Elements of Psychophysics* (1860) is a milestone. Psychophysics researches the relationship between psychological sensations, or human perception, (Ψ) and stimuli in the physical world (Φ ; see Gescheider, 1997).

that is, how could one know that one was perceiving the most intense stimulus, and that one would not perceive a more intense stimulus later in the experiment?

This is not a problem when using free number magnitude estimation. When the participant perceives the most intense stimulus so far during the test, it is always possible to give that stimulus the highest value so far – say 20. If the participant perceives a following stimulus as more intense, it is always possible to give the stimulus a higher value – say 23.

The next step is to transform individual scales into a common scale so they can be compared. There are several ways of doing this (see, e.g., Berglund, 1991). The simplest is based on the assumption that individual magnitude estimation scales are linearly related. That is, every participant's magnitude estimations and individual scale can be seen as a rubber band stretched along a scale. Simply stated, the rubber band could be anchored at 0, and also, for example, at 100; therefore, every participant's individual scale could be multiplied by a constant, giving the highest number on the scale a value of 100.

In this thesis, free number magnitude estimation was used when judging the odor intensity and odor pleasantness of the perfumes (cf. Berglund & Olsson, 1993; Brodin et al., 2009; Lindqvist et al., 2012). Free magnitude estimation was considered suitable here since the participants could not know beforehand what perfume they would believe to be the most pleasant or have the highest odor intensity. In this thesis, when applicable, the blank (i.e., a stimulus with a value of 0) was represented by an empty glass bottle containing no particular odor.

Category scaling

A category scale is a scale with a limited number of response alternatives (categories), assumed to be separated by equal distances on the underlying perceptual dimension (cf. Fink & Kosecoff, 1985). For example, the distance between the values 4 and 5 on the scale is supposed to be the same as the distance between the values 5 and 6 on the scale.⁷

In earlier research in which participants rated the masculinity and femininity of odors, the analyses were conducted either using indirect measurements of odor descriptors in existing databases of fragrances (Zarzo, 2008; Zarzo & Stanton, 2009) or using category scales (see, e.g., Sczesny & Stahlberg, 2002; Zellner et al., 2008). In this thesis, category scaling was used when the participants judged the femininity and masculinity of the

⁷ Whether this is really true in the social sciences, in which measures gauge things other than physical phenomena (e.g., weight) could of course be questioned, leading to an interesting philosophical discussion of what it is that we are measuring.

perfumes. The task was thereby to give every perfume a masculinity value of 0–10, where 0 meant “no masculine odor at all” and 10 meant “totally masculine,” and then to give the same kind of femininity value to every perfume.

In studies using category scaling (see, e.g., Sczesny & Stahlberg, 2002; Zellner et al., 2008), it is not always obvious whether the participants performed the femininity and masculinity scaling after the same sniff. In Studies I and II in this thesis, the participants did not scale the femininity and masculinity at the same time, to avoid the assumption that femininity and masculinity were two dimensions on a bipolar scale. I wanted to explore whether this bipolar scale was valid when femininity and masculinity judgments were treated as two separate measures.

Yes/no task

To illustrate the participants’ sensitivity in detecting commercial gender categorizations, I used yes/no tasks in which the participants simply answered “yes” or “no” to questions about the perfumes (see Macmillan & Creelman, 2005, p. 3 for a detailed description). The yes/no task is an appropriate choice when the experimenter wants to measure the participants’ ability to distinguish between stimuli. In this thesis, the participants were asked to:

- state whether they wanted to use the perfumes themselves (*self-preference*; Studies I and III)
- state whether they wanted their (potential) partner to use the perfumes (*partner-preference*; Studies I and III)
- indicate how they thought the perfumes *should be* gender categorized (Studies I and II)
- guess the *gender of the human* on whom the present perfume was applied (Study III)

All these tasks can be interpreted as yes/no tasks. For example, the question about how the participants thought the presented perfume should be gender categorized could be seen as a yes/no answer to the following questions:

- Do you think this perfume should be gender categorized as a feminine perfume?
- Do you think this perfume should be gender categorized as a masculine perfume?
- Do you think this perfume should be gender categorized as a unisex perfume?

If a participant thought a perfume should be gender categorized as “unisex,” that response could be analyzed as a “no, no, yes” profile of answers to the above three questions.

Participants

In the experiments included in this thesis, heterosexual undergraduates 20–30 years old participated. They were not psychology students and were thus not used to doing these kinds of tasks. Earlier research into the perception of wine odor has demonstrated that wine experts judged white wine colored red as having a typical red wine odor (Parr et al., 2003), that is, the experts were more biased since they had learned how the odor of wine “should” be. Since the purpose of my studies was to explore how typical perfume consumers/users perceived and judged the odors of perfumes, I did not want the participants to have similar biases. It was therefore essential that the participants in this research be naïve and new to these kinds of experiments.

Stimuli presentation

In all three studies, 1 ml of each perfume was placed in a 500-ml glass bottle, one perfume per bottle, which was then covered with aluminum foil so the odor would not dissipate. In Study III, the perfumes were also applied on human skin. The latter treatment was motivated by research examining the sensitivity of odors applied on the human skin (Cortez-Pereira et al., 2009), where a unique quality is created by the interaction between perfume and skin (Lenochová et al., 2012).

Summary of studies

Study I: Perfume preferences and how they are related to commercial gender classifications of fragrances

Study I relates to the first and third aim of this thesis: Are perfumes commercially categorized as “feminine” and “masculine” perceived as belonging to two separate groups of perfumes when the test subjects are unaware of the commercial categorizations? Will commercial gender categorizations of perfumes affect participants’ perfume preferences?

Method

Eighteen undergraduates (50% women) participated. They assessed the 12 perfumes with respect to gender scaling, pleasantness, and preference using the methods described above (p. 26). The participants were also asked to indicate whether any of the odors were perceived as familiar.

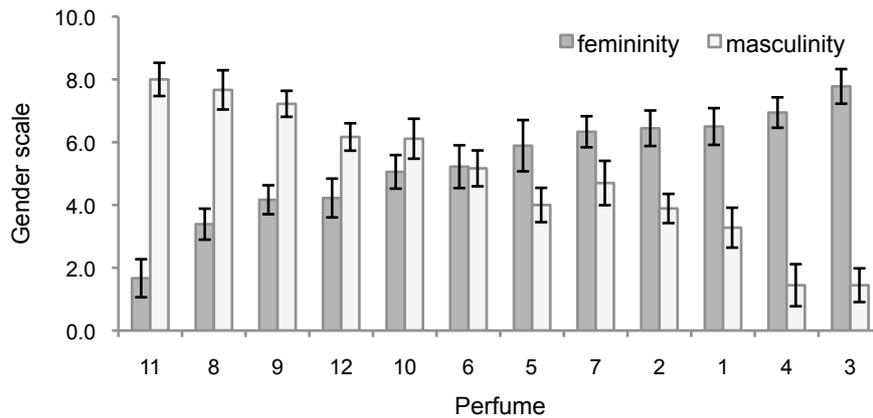
Results and discussion

Gender scaling

The results of the femininity scaling and masculinity scaling indicated that both gender scales (i.e., femininity and masculinity) were negatively correlated ($r = -0.93$, $p < 0.0001$), but that the groups of perfumes categorized as feminine and categorized as masculine were not separable: When graphically analyzing the gender scales of the perfumes, it became obvious that the perfumes constituted a gender continuum on which some perfumes were perceived as extremely feminine or extremely masculine, but on which most perfumes were positioned in the middle, perceived as not particularly feminine or particularly masculine (Figure 1). This gender continuum, on which the femininity and masculinity scales overlap, confirms the assumption that the femininity and masculinity associations of perfumes can indeed be interpreted as end points of a single bipolar dimension.

The perfumes perceived as most feminine in this study (see Figure 1) elicited a large proportion of typical “feminine” descriptors, according to

Figure 1. The femininity values and masculinity values (y -axis) for each perfume examined in Study I; error bars indicate standard error, specific perfume ID no. marked on x -axis.



earlier research (Zarzo, 2008; Zarzo & Stanton, 2009), including variations of floral odors, whereas the perfumes scaled as most masculine elicited odor descriptors corresponding well to these defined as “masculine,” such as spicy and woody scents. When comparing the odor descriptors for each perfume (see p. 26) with the gender continuum illustrated in Figure 1, the gender associations in Study I seem to be defined by an odor quality spectrum ranging from typical masculine to typical feminine descriptors.

Pleasantness

Each individual pleasantness scale was multiplied by the specific constant that made the highest value 100, and the average pleasantness value was calculated for each perfume. Since no blanks were presented for pleasantness, I also calculated rank orders for each participant’s pleasantness scaling to validate the first calculation of pleasantness. The pleasantness scale and the rank orders for pleasantness were found to be highly positively correlated ($r_s = 0.81, p = 0.000$), validating the pleasantness scale.

The odors were not judged as familiar by the participants, and there was no significant correlation between intensity and pleasantness ($r = -0.085, p = 0.225$), indicating that the pleasantness ratings were not influenced by familiarity or by differences in odor intensity.

Table 1 shows the average pleasantness values for each perfume, together with self-preference and partner-preference. Weak and statistically non-significant coefficients of correlation were found between pleasantness and

Table 1. The percentage of participants in Study I ($n = 18$) wanting to use each perfume themselves (“self”; in %) and wanting their potential partner to use the perfume (“partner”; in %), as well as average pleasantness value (“pleasant”; magnitude-estimation scale, arbitrary unit with a maximum value of 100, standard deviation within parentheses) for each perfume.

Perfume no.	Self	Partner	Pleasant
1	33.3	33.3	56.4 (33.1)
2	27.8	38.9	60.0 (29.8)
3	38.9	38.9	72.1 (31.0)
4	27.8	16.7	50.4 (30.7)
5	33.3	38.9	70.6 (35.1)
6	38.9	44.4	67.0 (33.3)
7	38.9	44.4	58.5 (33.3)
8	44.4	44.4	61.8 (36.6)
9	50.0	61.1	70.1 (33.9)
10	33.3	44.4	59.7 (29.3)
11	0.0	5.6	33.7 (29.6)
12	33.3	55.6	60.0 (33.3)

femininity scaling ($r = 0.483$, $p = 0.112$) and between pleasantness and masculinity scaling ($r = -0.247$, $p = 0.439$).

Preference

There was a significant and strong correlation between self-preference and partner-preference ($r = 0.841$, $p < 0.01$; values in Table 1), indicating that the participants tended to want to use the same perfumes as they wanted their potential partners to use. There was also a strong significant correlation between pleasantness and self-preference ($r = 0.856$, $p < 0.01$) as well as between pleasantness and partner-preference ($r = 0.785$, $p < 0.01$).

There was no significant correlation between self-preference and any gender scale (femininity: $r = 0.367$, $p = 0.241$; masculinity: $r = -0.092$, $p = 0.776$), or between partner-preference and any gender scale (femininity: $r = 0.100$, $p = 0.758$; masculinity: $r = 0.209$, $p = 0.515$).

Conclusions

Although gender is something individuals associate with when sniffing perfumes, the relationship between commercial gender categorization and odor preference seemed less central in this study, when the participants decided what perfumes they preferred both for themselves and for their partners. However, gender association seemed important: The participants tended to dislike perfumes perceived as extremely feminine or extremely

masculine, and tended to prefer perfumes positioned more in the middle of the gender continuum, that is, they preferred “unisex” odors.

Study II: Gender categorization of perfumes : The difference between odor perception and commercial classification

Study II relates to the second aim of this thesis: Will participants produce gender categorizations of perfumes corresponding to the commercial categorizations when unaware of them?

Methods

The same participants as in Study I participated in the experiment in Study II. They assessed the 12 perfumes with respect to gender scaling and gender categorization using the methods described above (p. 26).

Results and discussion

Gender categorization

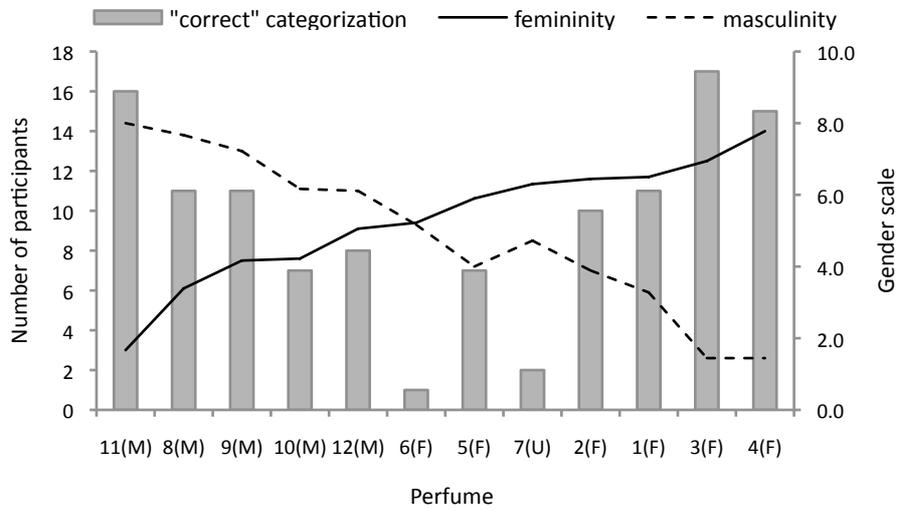
On average, the participants wanted to categorize 3.8 perfumes (32%) as unisex, compared with only one perfume (8%) actually commercially categorized as unisex. This result alone validates the indications from Study I, namely, that many perfumes on the market seem to be perceived as “unisex” even though they are categorized as “feminine” or “masculine.”

Figure 2 shows how the number of “correct” gender categorizations (i.e., the number of participants who categorized each perfume in line with its commercial categorization; gray bars) was related to the femininity scaling (dashed line) and masculinity scaling (solid line) for each perfume. In Figure 2, it is obvious that most participants tended to categorize the perfumes another way than did the perfume industry. A large number of participants categorized the perfumes the same way as did the perfume industry, but only in the case of the few perfumes perceived as either extremely feminine or extremely masculine (nos. 3, 4, and 11).

Ability to discriminate between feminine and masculine perfumes

Data from the gender-categorizing task could be interpreted as hit/false responses, where the participants’ sensitivity or ability in discriminating between feminine and masculine odors could be analyzed. This analysis was not included in the published article, but can be seen as verifying the results discussed there.

Figure 2. Left y-axis: total number of participants who categorized the perfumes “correctly,” i.e., the same as the commercial gender categorization (gray bars). Right y-axis: the femininity value (dashed line) and masculinity value (solid line) for each perfume. Commercial gender categorization for each perfume, together with their specific ID nos., is marked on x-axis.



The sensitivity measure used was d' -prime, d' , calculated using Equation 1 (Macmillan and Creelman, 2005, p. 8):

$$d' = z(H) - z(F) \quad \text{Eq. 1}$$

A “hit” was defined as when a participant categorized a perfume in line with its commercial categorization, whereas “false” was defined as when a participant categorized the perfume differently from the commercial gender categorization.

Table 2 shows the d' values for each perfume. A value of zero (0) indicates that the participants displayed no ability to identify the commercial gender categorization of the perfume. A d' value of 1.0 corresponds to 69% of hits (for an unbiased observer), implying a situation in which the difference between the perfume’s masculinity and femininity was just noticeable. Negative d' values are typically interpreted as indicating no sensitivity. However, in this thesis, relatively large negative d' values were found for some perfumes, which indicates that the participants systematically categorized that perfume differently from the commercial gender categorization.

According to the results presented in Table 2, the participants were not particularly sensitive in categorizing the perfumes the same as did the

Table 2. The d' results for the perfumes indicating the ability of Study II participants ($n = 18$) to discriminate between feminine and masculine perfumes, with the ID no. and commercial gender categorization of each perfume specified.

ID	gender	d'
1	f	0.44
2	f	0.00
3	f	3.05
4	f	2.18
5	f	-1.31
6	f	-3.92
7	u	-1.74
8	m	0.44
9	m	0.44
10	m	-1.31
11	m	2.61
12	m	-0.87

perfume industry, and only three perfumes (i.e., nos. 3, 4, and 11) had a d' value over 1.0. There was no difference in sensitivity between female and male participants ($t = 2.30, p = 0.75$), as indicated by an independent t -test.

Conclusions

The participants in this study displayed a relatively poor ability to categorize the perfumes in line with the commercial gender categorizations. This inability/low sensibility was demonstrated to be particularly notable in the case of the perfumes positioned in the middle of the gender continuum identified by gender scaling. Study II thereby strengthens the assumption of Study I, namely, that commercial gender categorizations of perfumes did not correspond well to the participants' judgments and perceptions of the perfumes.

Study III: Preference and gender associations of perfumes applied on human skin

Study III relates to the third and fourth aim of this thesis: Will commercial gender categorizations of perfumes affect participants' perfume preferences? When perfumes are applied on human skin, are the gender associations of and preference in the perfumes dependent on the gender of the human?

Method

Study III consisted of two experiments conducted on the same day. In Experiment 1, the participants sniffed perfumes applied on human skin, and in Experiment 2 they sniffed the same perfumes presented in glass bottles.

Two perfumes were selected as stimuli in this study, one commercially categorized as “feminine” and one commercially categorized as “masculine”: perfume no. 6 [F] and perfume no. 9 [M], already described above (see p. 26). These were selected as stimuli since they were both given high pleasantness values in Study I (cf. Lindqvist, 2012a) and since, according to the *Fragrantica* website (www.fragrantica.com), they also had different commercial gender categorizations.

Seventeen undergraduates (9 women, 8 men) participated. They assessed the two perfumes chosen as stimuli with respect to pleasantness, gender scaling, and preference using the methods described above (p. 26). In the first experiment, the participants also stated whether they thought each of the two perfumes had been applied on a woman or on a man.

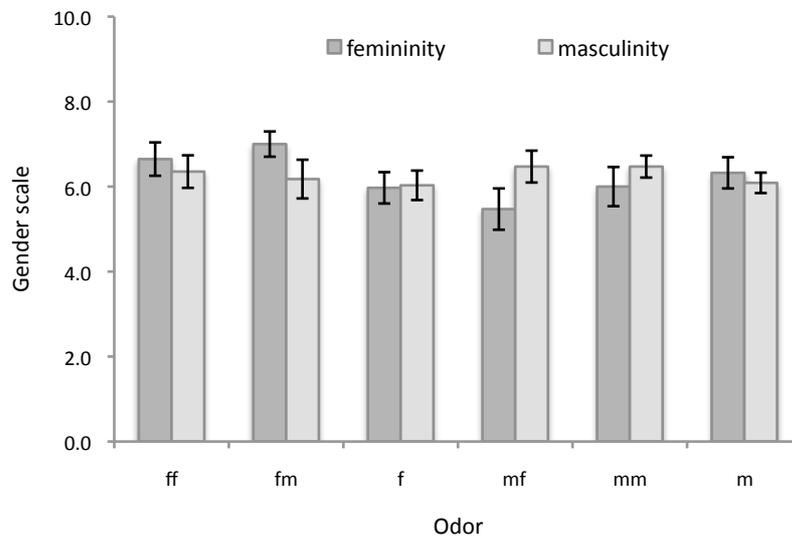
Results and discussion

Gender scaling

According to the gender scaling from Experiments 1 and 2, it was validated that both perfumes were positioned in the middle of the gender continuum (as already demonstrated in Study I; see Figure 1, p. 32). Figure 3 shows the femininity scaling and masculinity scaling from both experiments. Figure 3 indicates that the feminine⁸ perfume was scaled as slightly more feminine than was the masculine when applied on human skin (independent of gender). These differences were not significant (according to dependent t-tests), but are still worth mentioning since they indicated that the perfumes

⁸ When using the terms “feminine perfume” and “masculine perfume” in this section, I am referring to how the perfumes were commercially categorized.

Figure 3. The femininity scaling (black bars) and masculinity scaling (gray bars) in Study III for the feminine perfume applied on a woman (ff), the feminine perfume applied on a man (fm), the feminine perfume in a glass bottle (f), the masculine perfume applied on a woman (mf), the masculine perfume applied on a man (mm), and the masculine perfume in a glass bottle (m); error bars indicate standard error.



were perceived differently when applied on humans (cf. Cortez-Pereira et al., 2009). However, that difference in perception did not seem to be influenced by human gender, since the same trend could be demonstrated for both human genders.

Preference

The preference values of the female and male participants were largely overlapping, as indicated by the effect sizes (Cohen's d), and no significant differences in the preference measures were evident between the female and male participants according to independent t -tests (see Table 3 for values). In both experiments, there was a significant correlation between self-preference and partner-preference (Experiment 1: $r_s = 0.622$, $p = 0.000$; Experiment 2: $r_s = 0.420$, $p = 0.000$).

Since there was no significant correlation between intensity and preference in Study I for the two perfumes chosen as stimuli in this study ($r = 0.072$, $p = 0.678$), and since the dosage of the perfumes was the same as in Study I, it is reasonable to believe that the preference judgments in this study were not influenced by odor intensity.

Table 3. Values of independent *t*-tests (*t*-value, *p*-value, Cohen's *d*) concerning differences between female (*n* = 9) and male (*n* = 8) participants in terms of self-preference and partner-preference in Study III.

Measure	<i>t</i>	<i>p</i>	<i>d</i> *
Exp 1, self	0.23	0.76	0.16
Exp 1, partner	0.89	0.14	0.44
Exp 2, self	1.16	0.28	0.26
Exp 2, partner	0.15	0.80	0.00

* *t* = *t*-value; *p* = *p*-value; *d* = Cohen's *d*-value

Taken together, these results imply that the women and men in this experiment tended to prefer the same perfumes for themselves and for their potential partners. When comparing the results within Experiment 1, as well as between Experiments 1 and 2, using *t*-tests, there were no significant differences in either of the two preference measures between the two experiments, or depending on whether the perfumes were applied on a woman or on a man.

Identifying the human gender

In Experiment 1, the total percentage of the participants who succeeded in guessing whether the perfumes were applied on a woman or on a man was 40–71%, which is not very different from what would have been expected by chance (50%). The probability that one of the participants would have been 75% correct (i.e., made a correct gender identification in 3 of 4 cases) is 0.25.

Since the answers from this task could be seen as hit/false responses, the participants' sensitivity or ability in discriminating between perfumes applied on a woman and on a man can be further analyzed. As in Study II, the sensitivity measure *d'* was used (see p. 35). The same equation for calculating *d'* was consequently used here as well (see p. 36). A "hit" was defined as when a participant succeeded in guessing the gender of the human, and "false" as when a participant failed in this task. This analysis was not included in the article reporting Study III, but nevertheless verifies the results discussed there.

A value of zero (0) indicated no ability to discriminate between the genders of the persons on whom the perfumes were applied. There was no difference in sensitivity between female and male participants (*t* = 0.66, *p* = 0.70), as indicated by an independent *t*-test. The *d'* values of the sensitivity in guessing the correct gender of the human were zero (0) for both the woman and the man, indicating that the participants displayed no ability to discriminate between the gender of the persons on whom the perfumes were applied.

Conclusions

The participants did not succeed in identifying the human gender when the perfumes were applied on human skin, and the human gender did not seem to have any central impact on people's odor perception of the perfumes studied.

Again, as found in Study I, self-preference and partner-preference were positively and significantly correlated.

General discussion

The general aims of this thesis were to analyze how the characteristics of the earlier identified gender dimension of perfumes were related to participant preference in perfumes, when the participants did not know how the perfumes were commercially gender categorized.

The strategy for doing this was to apply a gender-sensitive approach to the experiments reported in this thesis. I tried to identify different domains related to gender that might affect people's odor perception of perfumes by asking myself: "What is gender in these particular experiments?" This question was answered by defining the variable "gender" in different ways. Eight different gender variables were identified (see p. 21), seven of which were measured in the empirical studies.

Question 1

Are perfumes commercially categorized as "feminine" and "masculine" perceived as belonging to two separate groups of perfumes when the test subjects are unaware of the commercial categorizations?

My results suggest a negative answer to this question, in agreement with the results of earlier research (Zarzo, 2008; Zarzo & Stanton, 2009; Zellner et al., 2008). The results of Study I indicated that the perfumes selected as stimuli constituted a gender continuum on which the femininity and masculinity dimensions were overlapping. This supports the assumption that femininity and masculinity can be seen as constituting a bipolar gender scale.

Comparing the odor qualities of the perfumes (see *Stimuli: Perfumes*, p. 26) with the gender scale results in Figure 1 reveals that the gender associations also reflected differences in odor quality, since the continuum in Figure 1 extends from typical "masculine" descriptors, such as leather and smoky, and more spicy descriptors, to sweet, citric, and more general fruity and flowery odors. The descriptors defining subgroups in Figure 1 corresponded well to the main groups of odor descriptors identified by Zarzo and Stanton (2006; 2009).

This identified gender continuum did not invalidate the results indicating that gender is a factor when people sniff and judge perfumes. However, it verified that the manufacturers' categorization of perfumes as "feminine,"

“masculine,” or “unisex” may not be supported by people’s actual perceptions and gender associations (see Question 2 below for further discussion of this).

It is worth mentioning that most of these 12 perfumes chosen as stimuli were perceived as “unisex.” When calculating the group mean femininity and masculinity values for each perfume, only 3 of 12 perfumes had notably high values (>7.5 of 10) on the femininity or masculinity scale, indicating that 9 of 12 perfumes were not perceived as particularly feminine or masculine – in other words, were not perceived as particularly “gendered.”

As shown in Figure 1, the officially unisex perfume (no. 7) was certainly positioned somewhere in the middle of the continuum, but a more valid gender categorization of the perfumes would also define nos. 5, 6, 10, and 12 as unisex perfumes (see Figure 1). Common to perfumes 5, 6, 7, 10, and 12, positioned in the middle of the gender continuum, was that, according to their odor descriptors, they were sweet with hints of, for example, vanilla, cardamom, and citrus.

Question 2

Will participants produce gender categorizations of perfumes corresponding to the commercial categorizations when unaware of them?

My results suggest a negative answer to this question. The results of Study II indicated that participants, independent of gender, had a relatively low sensitivity in categorizing the perfumes the same as they were commercially categorized. This low sensitivity seemed to be related to the gender associations (i.e., the femininity and masculinity scaling) of the perfumes, with the perfumes positioned in the middle of the gender seeming to be especially difficult to categorize “correctly.”

The participants only matched the perfume industry’s gender categorization (i.e., “correctly” labeled the perfumes) in the case of perfumes positioned at the extremes of the gender continuum. The more “unisex” the gender associations of a perfume became, the greater the difference identified between the participants’ gender categorizations and the industry categorization. This was expected, and validates the assumption that the gender continuum is nothing but a *continuum*, on which the perfumes positioned in the middle are to a lesser extent perceived and identified as “feminine” or “masculine.”

Comparing the d' values in Table 2 with Figure 2 reveals that the perfumes with a relatively high d' value (>2) were the three perfumes at the extremes of the gender continuum (i.e., no. 11 being extremely masculine, and nos. 3 and 4 being extremely feminine). Concerning the rest of the

perfumes, the participants displayed a low sensitivity in gender categorizing the perfumes the same as they were commercially categorized.

However, perfume no. 6 had a negative d' value, indicating that the participants systematically categorized it differently from the commercial categorization: 16 of 18 participants, or 89%, categorized the perfume as unisex, although it was commercially categorized as feminine.

Question 3

Will commercial gender categorizations of perfumes affect participants' perfume preferences?

My results suggest a negative answer to this question. The results in Study I indicated that the participants wanted to use the same perfumes themselves as they wanted their (potential) partner to use, since self-preference and partner-preference were positively correlated.

The positive correlation between self-preference and partner-preference was unexpected. Perfumes are advertised as primarily feminine or masculine, and heterosexual humans, at least in the Western world,⁹ are accordingly claimed to have different odor preferences from those of their partners (Herz & Inzlicht, 2002; Lübke et al., 2012; cf. Milinski & Wedekind, 2001; Sergeant et al., 2005). Perhaps, however, this positive correlation was not that remarkable: instead, the remarkable thing is that the perfume market has been so focused on categorizing perfumes as feminine or masculine, even though many of them could as well be described as unisex odors, as seen in Figure 1.

Comparing the self-preference and the partner-preference values in Table 1 with the gender scale in Figure 1 revealed that only one perfume had a self-preference and a partner-preference value over 50%, meaning that there was only one perfume that most participants wanted to use themselves and also wanted their (potential) partner to use (this was perfume no. 9, perceived as slightly more masculine than feminine). This is probably an expression of the fact that choosing perfume is something quite personal (cf. Freyberg & Ahren, 2011).

However, one interesting result is that the perfumes found at the extremes of the gender continuum (i.e., no. 4 being the most feminine and no. 11 the most masculine) were also the two perfumes with the lowest preference values (less than 30%). This indicated that the participants in this study

⁹ Even though I made this kind of disclaimer in footnote 5, I once again want to stress that this thesis is written from within a quite narrow context in which the heterosexuals of the Western world implicitly constitute the norm. However, it has been demonstrated that odor preference varies between cultures (Ayabe-Kanamura et al., 1998) – a matter that I believe merits further research.

disliked perfumes with strong gender associations, and preferred more unisex odors (even though these unisex odors were not categorized as such).

When comparing the pleasantness values in Table 1 (p. 30) with the odor descriptors of the perfumes (p. 26), it seemed as though the participants most liked odors with a scent of citrus.

Nor in Study III did the perfume preferences differ between the female and male participants in terms of self-preference versus partner-preference. The results of Study III indicated that the women and men participants preferred the same perfumes for both themselves and their partners, in line with the results of Study I. In Study III, perfumes that earlier participants liked the most were chosen as stimuli (see the pleasantness results in Study I, p. 32); these perfumes were found in the middle of the gender continuum. From a perceptual point of view, the results imply that, for a large number of perfumes, there is no reason to categorize them as “feminine” or “masculine” odors, since there might be no difference in women’s and men’s preference for them.

Question 4

When perfumes are applied on human skin, are the gender associations of and preference in the perfumes dependent on the gender of the human?

My results suggest a negative answer to this question. The results of Study III indicated that the participants, independent of gender, did not succeed well in identifying the gender of the persons on whom the perfumes were applied. Moreover, the gender of these people did not seem to affect how the participants perceived the odor of the studied perfumes.

When comparing the results of Experiment 1 (perfumes applied on human skin) and Experiment 2 (perfumes presented in glass bottles), a trend could be identified in which the perfumes seemed to be slightly differently perceived (see Figure 3). These differences were not significant according to dependent *t*-tests, but may indicate that the odor of perfumes is perceived differently when these perfumes are applied on human skin versus being presented in a bottle. This statement is rarely controversial. The interesting finding, however, is that the perfumes applied on humans followed the same trend whether applied on a woman or a man.

Synthesis of results

In this thesis, I have demonstrated that the participants’ perceptions of perfumes did not relate to the commercial gender categorizations of the perfumes. In contrast to how the perfumes are promoted by the perfume industry, the odor preference in perfumes did not seem to differ between the

heterosexual women and men participating in these experiments. In addition, the unique odor that develops when perfumes are applied on human skin seemed to be independent of human gender. In summary, when the commercial gender categorizations of the perfumes were unknown to the participants, they seemed to prefer intermediate odors between the feminine extreme (“Venus”) and the masculine extreme (“Mars”).

Strengths and limitations

In this section, I will discuss the strengths and limitations of my studies separately for issues relating to stimuli selection, sample of participants, and experimental design.

Stimulus sample

In total, 12 perfumes were selected as stimuli in this thesis. All of them were used in Studies I and II, and two of them were selected as stimuli in Study III. The perfumes were selected in order to cover a broad range of odors available on the commercial market. However, only 12 perfumes of the thousands available were used in this thesis. Of course this is a limitation: Even though the perfumes used as stimuli in this thesis *did* represent a broad range of odor characteristics (see the detailed presentation of the perfumes on p. 26), the results could have differed if 12 other perfumes had been used instead of these.

I believe that the results would have been largely the same even if the stimulus sample had differed, as long as the different stimulus sample was chosen according to the same criteria as used here (i.e., to cover a broad range of odors characteristics in the field of perfumes). This assumption was validated when comparing the present results with the gender associations and implicit gender-continuum of odor qualities found in earlier research using completely different perfumes (cf. Jellink, 1993; Zarzo, 2008; Zarzo & Stanton, 2009; Zellner et al., 2008).

The central matter examined here was not the characteristics of the gender associations of the perfumes *per se*, but rather how the gender associations of the perfumes were related to the other measures used in these three studies. I believe that the gender continuum identified in Studies I and II, in which the femininity and masculinity scaling overlapped, validates that the perfumes selected as stimuli *did* cover a broad range of odors. This is a strength of this thesis.

Other stimuli considered here are the people on whom the perfumes were applied in Study III. Only two such people were used here, one woman and one man. This limited number is of course a limitation of the study, since it is unclear to what extent the results generalize to humans in general. As

already mentioned, Study III represents a first attempt to explore this matter, and the tendency was that the gender of the human on whom the perfume was applied did not affect the participants' perception of the perfumes. However, the use of at least 10 people on whose skin perfumes would be applied would probably be needed to properly address (and answer) this question.

Participants

Only 18 people participated in Studies I and II, and only 17 participated in Study III, making it relatively difficult to generalize the results to a larger population. However, since this thesis was a first attempt to apply a gender-sensitive experimental psychology approach in exploring people's odor perception of perfumes, generalizing the results to a large population was not an aim. Instead, this thesis has identified some tendencies that could be further explored in the future. Even so, having a larger number of participants would of course have been useful.

The participants used in this study were all 20–30 years old. This also makes it difficult to generalize the results to a larger population with a broader age distribution, since the perception of odors changes with aging (see, e.g., Konstantinidis et al., 2006; Rouby et al., 2009). Therefore, when taking this research further, older participants should also be included in the experimental work. However, since age could well affect people's odor perception of perfumes, it was also a strength of this research that I kept the age of the participants within a narrow, relatively young range.

As already discussed, the sexuality of the participants might also affect the results (see p. 21). An obvious strength of this research was that I clearly took this into consideration by explicitly choosing heterosexual participants. An associated limitation, however, is that the results therefore cannot be generalized to a larger population, since it would include considerably more people than just those defining themselves as heterosexuals.

Finally, as noted by Ayabe-Kanamura et al. (1998), odor preference varies between cultures. The participants in these experiments were all young adults from Sweden, possibly one of the most progressive countries concerning gender issues. This research might therefore be applying a gender-sensitive approach at an already gender-sensitive society, and that might have affected participant willingness to express a preference for “unisex” odors.

Experimental Design

A strength of this thesis research was the application of a gender-sensitive approach to the field of experimental psychology, when researching people's odor perception of perfumes. I did this in accordance with the idea of

gender-sensitive research (cf. Lindqvist, 2013), namely, by systematically identifying the actual meaning of the variable “gender” in the present context.

Another strength of this thesis is that the three constituent studies were planned with the same aims and hypotheses in mind, and were thus coherent and well connected. This is particularly obvious when comparing Studies I and II, since Study II is an extension of Study I. However, Study III is also well linked to the other two studies, and since it uses the same measures, it validates that the results were consistent outside the lab environment as well.

However, since this – as already mentioned – was my first attempt to apply a gender-sensitive approach to this kind of research, I could unfortunately not include every aspect of such research in this thesis. An apparent limitation was that I did not even include every identified variable (see p. 21 for a list): the 8th variable, h, where the participants should guess how the perfumes are commercially gender categorized, was not included and thus not analyzed in this thesis. The ability to discriminate between feminine and masculine odors, discussed when presenting the results of Study II (p. 35), however, might be seen as an indirect measure of this excluded 8th variable. Nevertheless, the participants could explicitly have been asked to guess how the perfumes were commercially categorized.

In Study III, the results *might* have been different if the perfumes had been applied on different persons. I do not think so, but what I think is really not the point here: This could, of course, have been tested, and therefore constitutes a limitation.

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