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Masculinity/Femininity of Fine Fragrances Affects Color–Odor Correspondences: A Case for Cognitions Influencing Cross-Modal Correspondences

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Abstract

Four experiments found that the colors people choose as corresponding to the odors of fine fragrances are influenced by the perceived masculinity/femininity of those fragrances. Experiment 1 examined the colors chosen for 3 male and 3 female fragrances. The pattern of colors chosen for female fragrances differed from that for male fragrances. Experiments 2 and 3 found that colors assigned to 2 unisex fragrances depend on whether subjects thought that the fragrances were male or female fragrances. Experiment 4, by labeling unisex fragrances as male or female, showed that this difference in color selection was the result of subjects' thinking that a fragrance is a male or female fragrance. Thinking of the masculinity/femininity of a fragrance influences the selection of colors that corresponds to these odors.

Key words: color, cross-modal correspondences, femininity, masculinity, odor, synesthesia

Introduction

Although we speak of the senses as separate entities, we actually experience the world multimodally and perceive many correspondences between the senses. These cross-modal correspondences can range from simple linguistic metaphor (e.g., blues music) to actually experiencing one sense when another sense is stimulated (e.g., seeing colored music). Martino and Marks (2001) distinguish between weak and strong synesthesia, weak synesthesia being simple cross-sensory correspondence and strong synesthesia being the experience of one sense by stimulation of another.

Few people exhibit strong synesthesia, although exact estimates of incidence differ. Baron-Cohen, Burt, et al. (1996) estimate the rate to be approximately 1 in 2000 people, whereas Simner et al. (2006) find rates of 4.4%. In strong synesthesia, a person will experience a percept in a modality different from that which the stimulus usually excites. So, for example, a common form of strong synesthesia is the perception of colored sounds (Marks 1975). In this type of synesthesia, a person will see a color in response to a sound such as a musical note. This type of synesthesia is very consistent over time. Baron-Cohen, Wyke, and Binnie (1987) and Baron-Cohen, Harrison, et al. (1993) have shown that people are reliable in reporting the same cross-modal correspondences as long as 1 year after the first test.

On the other hand, most people exhibit the cross-sensory correspondences of weak synesthesia. In weak synesthesia, people report that stimuli from 2 modalities correspond or seem to "go together" but do not experience a percept in 1 modality when another modality is stimulated. These correspondences are consistent across individuals. For example, most people match increasing auditory pitch levels to increasing visual brightnesses (Marks 1974). The correspondences in weak synesthesia also seem to be consistent over time. For example, Gilbert et al. (1996) found that subjects reported very consistent color–odor correspondences that were stable over 2 years.

Although there are few reported cases of color–odor connections in strong synesthesia (Ginsberg 1923), such connections appear to be robust in weak synesthesia (Gilbert et al. 1996; Schifferstein and Tanudjaja 2004; Dematte et al. 2006). The underlying cause or causes of this robust color–odor correspondence has yet to be determined. These color–odor correspondences might be the result of innate, biological connections in the brain. However, there might be some other underlying cause or causes for the color–odor correspondences seen.

Recently, Schifferstein and Tanudjaja (2004) investigated whether emotion plays such a role in the color–odor

correspondences in weak synesthesia. They used fine fragrances that were not easily identifiable and were, therefore, not easily associated with an item having a particular color (such as lemon odor with the color yellow). This reduced the likelihood that the selection of a color for an odor was the result of the association of the odor with an object of a particular color. They tested to see if the colors selected as corresponding to odors were related to the emotions elicited by those odors using a semantic differential task (Osgood et al. 1957). Because certain colors correspond to certain emotions (D'Andrade and Egan 1974; Cimbalo et al. 1978; Boyatzis and Varghese 1994; Collier 1996; Hemphill 1996), people might "see" odors as having the colors that correspond with the emotions the odors elicited. They did find that there was a significant negative relationship between the degree to which a particular odor and color corresponded and the difference between the scores of the odor and color on the emotional dimension of pleasure (but not on the dimensions of arousal or dominance). So, the color–odor correspondences they saw were partly due to the underlying pleasantness of the stimuli.

However, it was clear that these color–odor correspondences were also influenced by factors other than emotion. This is not surprising given the idiosyncratic nature of odor–emotion correspondences (Herz 2001). Whether a scent is perceived as pleasant or unpleasant depends on what that scent was associated with in the past (Herz 2001; Herz et al. 2004; Yeomans et al. 2006). One subject might find the odor pleasant because it reminds him/her of a person he/she loves, whereas another might hate the odor because it reminds him/her of someone he/she dislikes. Given this fact, one would not expect a great deal of consistent correspondence of scent with emotion. Therefore, the colors people choose as corresponding to an odor, if based solely on emotion, would not be consistent across subjects. Because the colors people choose as corresponding to certain odors are consistent across people and stable (this is true when people choose either color words or color chips, see Gilbert et al. 1996), some factor or factors other than emotion must underlie such correspondences.

One possible influence on the choice of colors that correspond to odors is cognitions produced by smelling the odor. For odors of common objects, like food odors, those cognitions might take the form of thoughts about the source of the odor the subject is smelling and most likely trying to identify. So, for example, a person smelling a lemon scent might well think about a lemon and choose a yellow color to correspond to that odor. That such color–odor associations occur has been suggested by data showing that people respond faster and more accurately to color–odor pairs that have stronger associations (e.g., red–cherry) than weaker associations (e.g., red–lemon) (Zellner et al. 1991; Dematte et al. 2006).

The semantic label the odor has may also influence the choice of a corresponding color by affecting what thoughts come to mind. For example, methylsalicylate is a chemical, which is a key olfactory ingredient in wintergreen and also in root beer. If subjects are told that they are smelling wintergreen, they might think of mints and choose green or white as corresponding colors. If, instead, they are told that they are smelling root beer, they might think of the soda and choose brown as the corresponding color. Here, the color selections are based on what subjects are thinking about the odor they are smelling.

In the case of the fine fragrances used by Schifferstein and Tanudjaja (2004), there is no semantic label, and only if a subject can identify the odor would his/her thoughts about the color of the fragrance, bottle, or packaging influence his/her color–odor associations. Yet, particular odors resulted in particular color choices. If cognitions are underlying these color–odor associations, what cognitions could those be?

One thing that might come to mind when people smell fine fragrances is the masculinity or femininity of the fragrances. These cognitions might occur quite automatically for fine fragrances because they are often marketed to be worn by only 1 gender and, therefore, thought of as appropriate for only males or females. Fiore (1992) found that fragrances influenced subjects' impressions of the personality of people wearing the fragrance. In that study, people wearing floral fragrances were thought not to have masculine traits. Likewise, Sczesny and Stahlberg (2002) found that subjects were more certain that they would employ people wearing a typically masculine perfume than those wearing a typically feminine perfume or no perfume. The authors suggest that certain fragrances elicit gender stereotypes such that a floral female scent makes it seem less likely that the individual will make a good manager. This research suggests that some fragrances are categorized and thought of as male and others as female.

If this gender categorization of an odor occurs when one smells the odor, then a corresponding color associated with that gender might also come to mind. Indeed Taft (1997), using semantic differential scales (Osgood et al. 1957), found that the color pink (and to a lesser extent yellow, orange, purple, and red) viewed either on a chip or on a variety of familiar objects was rated as the most feminine color and blue, brown, and gray were rated as the most masculine. From an early age, girls are provided with many pink items (e.g., pacifiers, jewelry) and boys with blue (e.g., pacifiers, clothing) (Pomerleau et al. 1990). A number of studies have shown gender differences in color preference with more males than females preferring blue and more females than males preferring pink and purple (Silver and Ferrante 1995; Ellis and Ficek, 2001) possibly because of the connotations of the colors as masculine or feminine. These gender–color associations (e.g., pink is feminine and blue is masculine) occur both in adults and in children as young as 3–4 years of age (Picariello et al. 1990).

If what comes to mind when a complex fine fragrance is smelled is its masculinity or femininity and subjects are asked to choose a color that corresponds to that odor, they might

well choose a color that is associated with the gender called to mind—blue for masculine and pink for feminine.

Experiment 1

This study investigates whether the color–odor correspondences that occur to fine fragrances are different for fragrances marketed as masculine and those marketed as feminine. Because the fragrances marketed as masculine should call to mind masculinity and the feminine fragrances femininity, we would expect the choices of corresponding colors to be different for the feminine and for the masculine scents. In addition, if the color choices are based on the thoughts of masculinity and femininity, we expect that choices of colors should be similar across the feminine fragrances and also across the masculine fragrances. Three feminine and 3 masculine fragrances were used. One of each kind of fragrance came from a different fragrance family than did the other 2. We chose 1 fragrance of each kind from a different fragrance family to ensure that the subjects were not choosing colors based on the similarity of the odors but on the overall masculinity or femininity of the fragrance.

Materials and methods

Participants

Sixty-three Montclair State University undergraduate psychology students (33 female, 30 male) participated in this study. All received extra credit in their class for participating. Fifty-six participants (88.9%) were between the ages of 18 and 25. Three (4.7%) were between the ages of 26 and 30, 1 (1.6%) was between ages 31 and 35, and 3 (4.7%) were 41 years of age or older. Forty-one (65.1%) self-identified as Caucasian, 2 (3.2%) as African-American, 7 (11.1%) as Hispanic, and 11 (17.5%) as other. None of the participants had allergies to fragrances or scents. All participants were able to smell the fragrances. All participants in this and the subsequent experiments were treated within the ethical guidelines of the American Psychological Association, and informed consent was collected from all participants.

Materials

Six different fine fragrances (3 feminine and 3 masculine) were used as stimuli. They are listed here along with their fragrance family and subfamily in parentheses. The 3 feminine fragrances used were Estee Lauder Beautiful (floral–floral), Prescriptives Calyx (floral–fruity), and Lancome Tresor (floriental–woody). The 3 masculine fragrances used were Ralph Lauren Polo (chypre–herbaceous), Hugo Boss (chypre–woody), and Guy Larcoche Drakkar Noir (fougere–herbaceous). The 6 fragrances were presented by injecting 0.15 ml of each scent into an Interstate Specialty Products (MA) polyethylene pellet #475-4905-250 that was placed in an 8 oz Qorpak plastic sniff bottle.

The color questionnaire used in the present study was that used previously by Gilbert et al. (1996) and Radar and Tellegen (1987). This survey asked the participants to think of the color(s) that each fragrance elicited. They were then to distribute 5 points among 11 colors (i.e., red, orange, yellow, green, blue, purple, pink, brown, black, white, and gray) in any combination they felt appropriate for each fragrance.

In addition, subjects were given a questionnaire consisting of a series of demographic questions and another questionnaire asking subjects to rate the intensity, pleasantness, masculinity, and femininity of the fragrance (and 17 other questions, which were part of another study, the results of which will not be reported here). The subjects rated the pleasantness of the fragrances on a 201-point bipolar scale on which −100 was labeled as "most unpleasant," +100 as "most pleasant," and 0 as "neither pleasant nor unpleasant." The intensity, masculinity, and femininity of each fragrance was rated using 101-point scales on which 0 was labeled "not at all," 50 was labeled "moderately," and 100 was labeled "strongest imaginable." Subjects were also asked to take their best guess as to the identity of the fragrance.

Procedures

Testing occurred in 1-h sessions. Each subject was tested alone. A partition was used to conceal the odor delivery bottles from the subjects until the fragrance was administered. Before the subjects arrived, polyethylene pellets were injected with the fragrances and placed into the opaque odor delivery bottles. The fragrances were presented at room temperature.

Upon arrival, the subjects were immediately asked if they had allergies to any scents or fragrances. If they did, they were thanked for their participation and excused. If not, they were given the demographic questionnaire to complete. All subjects were then given all 6 fragrances, presented one at a time in random order, in odor delivery bottles. Subjects were instructed to squeeze a bottle and sniff the fragrance as many times as they wanted to in order to answer the questions. After they were given the first fragrance, subjects filled out the questionnaire that included the intensity, pleasantness, masculinity, and femininity ratings. They then filled out the color questionnaire and guessed the identity of the fragrance. They then returned the odor delivery bottle and the questionnaire to the experimenter and were handed the bottle containing the second fragrance. The same process was repeated until subjects were finished with the 6th and final fragrance.

Results

Testing revealed no significant differences between male and female subjects on masculinity, femininity, or color ratings. Therefore, all data were collapsed across gender.

All 6 fragrances were rated as more than moderately intense on average (mean ratings ranged from 55.92 to 68.27). They were all judged as pleasant (mean ratings ranged from 11.5

to 48.6). All 3 masculine fragrances were rated as more masculine than all 3 feminine fragrances (Wilcoxon signed-rank tests; all Z values > 5.29, $P < 0.001$). Mean masculinity scores for the masculine fragrances ranged from 60.1 to 68.9 and mean masculinity scores for the feminine fragrances ranged from 18.4 to 23.2. All 3 feminine fragrances were rated as more feminine than all 3 masculine fragrances (Wilcoxon signed-rank tests; all Z values > 3.72, $P < 0.001$). Mean femininity scores for the feminine fragrances ranged from 62.6 to 71.0 and the mean femininity scores for the masculine fragrances ranged from 24.4 to 36.2.

None of the subjects were able to identify any of the 3 female fragrances, Boss, or Drakkar Noir. Only 6 subjects correctly identified Polo.

Friedman tests were conducted on the color point distributions for each fragrance in order to determine if the colors were chosen equiprobably or if subjects tended to assign points to particular colors for particular fragrances. One subject did not give color information for Tresor. Friedman tests for all fragrances indicated that subjects did not uniformly assign points to colors but instead tended to choose some colors over others (the 6 Friedman χ^2 (10) values ranged from 28.6 to 93.6, $P < 0.003$ in all cases). Kendall's coefficient of concordance (W) was calculated to measure the degree to which the pattern of color selection was the same across fragrances. Kendall's $W = 0.28$ for agreement among all 6 fragrances. However, when the 3 masculine and feminine fragrances were analyzed separately, the Kendall W values were 0.53 and 0.77, respectively. This indicates that agreement about colors was greater for each group of 3 fragrances marketed to a particular gender than for the total set of 6.

Although the color selection varied from fragrance to fragrance, the predominant colors chosen for the 3 feminine fragrances were pink (19%), white (16%), and yellow (14%). For Beautiful, subjects assigned most of their points to pink (20%), yellow (15%), and blue and white (12%). For Calyx, subjects assigned the most points to orange (19%), yellow (16.5%), and pink (16%). For Tresor, they assigned most of their points to white (28%), pink (21%), and purple (14%) (Figure 1).

The color selection also varied among the 3 masculine fragrances; however, here too a few colors were predominantly chosen. For the masculine fragrances, subjects assigned the most points to green (21%), blue (17%), and brown (9.5%). For Polo, subjects assigned most of their points to green (31%), brown (17%), and blue (10%). For Drakkar Noir, subjects assigned most of their points to blue (22.5%), green (13%), black (10%), and orange (10%). For Boss, subjects assigned the most points to blue (19%), green (18%), and yellow (9.5%) (Figure 2).

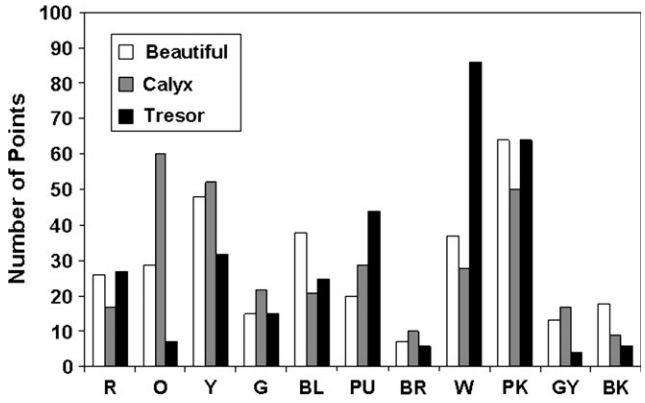

Figure 1 Total number of points assigned to each of the 11 colors (R = red, O = orange, Y = yellow, G = green, BL = blue, PU = purple, BR = brown, W = white, PK = pink, GY = gray, and BK = black) by subjects in Experiment 1 for the 3 feminine fragrances (Beautiful = white bars, Calyx = gray bars, and Tresor = black bars).

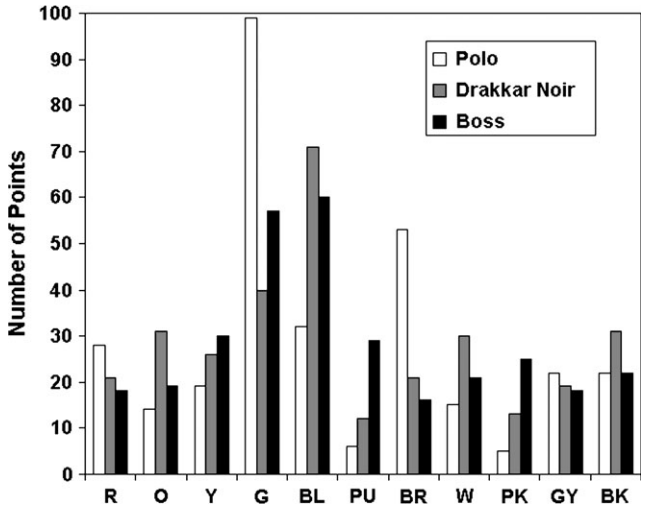

Figure 2 Total number of points assigned to each of the 11 colors (R = red, O = orange, Y = yellow, G = green, BL = blue, PU = purple, BR = brown, W = white, PK = pink, GY = gray, and BK = black) by subjects in Experiment 1 for the 3 masculine fragrances (Polo = white bars, Drakkar Noir = gray bars, and Boss = black bars).

Discussion

Clearly, the fragrances marketed as masculine were perceived as masculine and those marketed as feminine were perceived as feminine. These fragrances have components or combinations of components that make them identifiably masculine or feminine.

The results indicate that subjects' choices of color associations were not uniformly assigned across fragrances. Their decisions were based upon the fragrances' targeted gender. The colors chosen for the male fragrances were more similar to one another than they were to those chosen for the female fragrances and vice versa. The most frequently chosen colors associated with the female fragrances were pink and yellow (pink being stereotypically associated with females—Picariello et al. 1990) and the male fragrances were most associated with blue and green (blue being stereotypically

associated with males—Picariello et al. 1990). Overall, we found that the targeted gender for the fragrances had a significant effect on the colors chosen to correspond with the fragrances.

It is possible that the agreement on colors selected for the fragrances perceived as masculine or as feminine was the result of those fragrances containing different notes that happened to correspond to those colors, rather than the perception of the fragrance as being masculine or feminine. Although the female fragrances were classified as being in different families of fragrances, they all had floral notes. Likewise, the masculine fragrances all had woody notes. The following studies address this issue.

Experiment 2

This experiment investigates whether people who perceive 2 unisex fragrances (CKOne and CKBe) as being masculine pick corresponding colors that are different from those who perceive those same fragrances as feminine. Because the fragrances are the same for both groups, any difference in color selection is due to the perceived masculinity or femininity of the fragrance, not to the chemical composition of the fragrance. In addition, we examine whether the colors chosen for the fragrances perceived as feminine and masculine are the same ones that were chosen for feminine and masculine fragrances in Experiment 1.

Materials and methods

Participants

Fifty-two Montclair State University undergraduate psychology students (34 female, 18 male) participated in this study. All received extra credit in their class for participating. Forty-seven participants (90.4%) were between the ages of 18 and 25. Three (5.8%) were between the ages of 26 and 30, 4 (7.7%) were between ages 31 and 35, and 1 participant was 41 years of age or older. Twenty-six (50%) participants self-identified as Caucasian, 5 (9.6%) identified as African-American, 12 (23.1%) as Hispanic, and 9 (17.3%) as other. None of the participants had allergies to fragrances or scents. All participants were able to smell the fragrances.

Materials

Two different fine fragrances were used as stimuli. They were CKOne (citrus) and CKBe (musk), 2 unisex fragrances from different fragrance families produced by Calvin Klein. The 2 fragrances were presented in the same manner as those in Experiment 1.

Subjects were given the demographic questionnaire as in Experiment 1. As in Experiment 1, they then rated the intensity, masculinity, femininity, and pleasantness of each fragrance. The subjects were finally asked to assign color(s) to the odors using the color questionnaire used in Experiment 1 and asked to try to identify the fragrance.

Procedures

The procedure was the same as in Experiment 1. All subjects were given both fragrances to smell and judge. The order of presentation of the fragrances was alternated so that half of the subjects judged CKOne first and the others judged CKBe first.

Results

Testing revealed no significant differences between male and female subjects on masculinity, femininity, or color ratings. Therefore, all data were collapsed across gender.

Both CKOne and CKBe were judged as pleasant (mean = 40.7, standard deviation [SD] = 57.3, and mean = 40.7, SD = 42.7, respectively). Both CKOne and CKBe were judged as more than moderately intense (mean = 65.3, SD = 22.0, and mean = 51.8, SD = 24.0, respectively). CKOne was rated as slightly more feminine (mean = 53.7, SD = 35.2) than masculine (mean = 35.6, SD = 33.8), Wilcoxon signed-rank test $Z = 2.00$, $P = 0.046$. There was no significant difference between the femininity (mean = 48.2, SD = 28.4) and masculinity scores (mean = 38.7, SD = 31.9) for CKBe, Wilcoxon $Z = 1.24$, $P = 0.22$.

Subjects who rated the odors as equally feminine and masculine (1 person for CKOne and 3 for CKBe) or who failed to give masculinity, femininity, or color ratings were eliminated from the data analysis for that fragrance. Only 1 person correctly identified CKOne and no subjects correctly identified CKBe. Subjects were divided into 2 subgroups for each fragrance. Those who gave higher femininity than masculinity ratings for a given fragrance were categorized as subjects who judged the fragrance as feminine. Those who gave higher masculinity than femininity ratings were categorized as subjects who judged the fragrance as masculine. For the 2 fragrances, both for the subjects who rated them as masculine (CKOne $n = 19$ and CKBe $n = 20$) and for those subjects who rated them as feminine (CKOne $n = 28$ and CKBe $n = 25$) fragrances, the points were not uniformly distributed among the 11 colors. Points were assigned to some colors more frequently than to others (Friedman χ^2 (10) ranged from 24.93 to 32.62, $P < 0.006$ in all cases). In addition, the pattern of color selection depended on whether the subjects thought they were smelling a male or female fragrance (χ^2 (10) = 80.06, $P < 0.00001$, for CKOne and χ^2 (10) = 37.86, $P < 0.00001$, for CKBe). Subjects who reported that the CKOne was a female fragrance assigned most of their points to white (22.8%), pink (16.4%), orange (16.4%), and yellow (16.4%), whereas those who reported that it was a male fragrance most often chose blue (25.3%) and green (23.2%) (Figure 3). Subjects who reported that the CKBe was a female fragrance assigned the most points to pink (21.6%) and white (19.2%), whereas subjects who reported that it was a male fragrance chose blue (23.0%) and white (21.0%) (Figure 4).

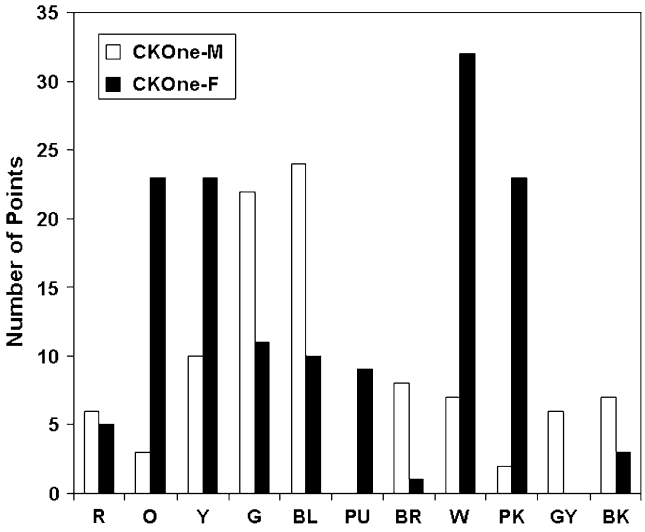

Figure 3 Total number of points assigned to each of the 11 colors (R = red, O = orange, Y = yellow, G = green, BL = blue, PU = purple, BR = brown, W = white, PK = pink, GY = gray, and BK = black) by subjects who rated the CKOne as masculine (white bars) and by subjects who rated the CKOne as feminine (black bars) in Experiment 2.

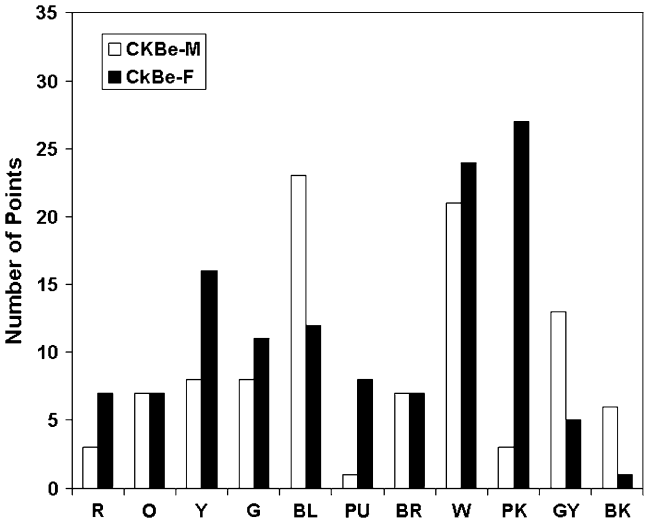

Figure 4 Total number of points assigned to each of the 11 colors (R = red, O = orange, Y = yellow, G = green, BL = blue, PU = purple, BR = brown, W = white, PK = pink, GY = gray, and BK = black) by subjects who rated the CKBe as masculine (white bars) and by subjects who rated the CKBe as feminine (black bars) in Experiment 2.

Discussion

The results suggest that perceiving a fragrance as being feminine or masculine influences the selection of colors that correspond to that fragrance. As in Experiment 1, subjects choose pink when they thought of the fragrance as being feminine and blue when they thought of it as masculine. In addition, for CKOne, the pattern of colors selected was similar to that found in Experiment 1. Points were assigned primarily to pink, white, and yellow when CKOne was judged as feminine and to blue and green when it was judged as masculine. It, therefore, seems that the perceived masculinity or femininity of a fragrance might significantly influence the color–odor correspondences for fine fragrances.

Experiment 3

In the previous studies, the subjects rated the masculinity and femininity of the fragrances prior to filling out the color questionnaire. It is possible that asking subjects to judge the masculinity and femininity of the fragrance made them think of that aspect of the fragrance so that it influenced the subjects' color selections. It is possible that subjects would not automatically think of the masculinity and femininity of a fine fragrance when smelling the fragrance and in such a case that aspect of the fragrance would not influence color choice.

This experiment tests whether the colors that subjects choose for the 2 unisex fragrances will be influenced by the perceived masculinity or femininity of the fragrance if they are asked to judge the color before rating the masculinity and femininity. That is, is the effect seen in Experiments 1 and 2 due to subjects' first thinking about the sex of the individuals who would wear the fragrances?

Materials and methods

Participants

Sixty Montclair State University undergraduate psychology students (49 female, 11 male) participated in this study. All received extra credit in their class for participating. Fifty-six participants (93.3%) were between the ages of 18 and 25. Three people were between the ages of 26 and 30 and 1 person was between 31 and 35 years of age. Forty-two (70%) participants self-identified as Caucasian, 6 (10%) as African-American, 4 (7%) as Hispanic, and 8 (13%) as other. None of the participants had allergies to fragrances or scents. All participants were able to smell the fragrances.

Materials

The same 2 fragrances (CKOne and CKBe) were used as were used in Experiment 2. They were prepared and delivered in the same way. All questionnaires were the same as in Experiments 1 and 2.

Procedures

The procedure was the same as for Experiment 2 except that the subjects answered the color part of the questionnaire before rating the fragrances on the intensity, masculinity, femininity, and pleasantness scales.

Results

Testing revealed no significant differences between male and female subjects on masculinity, femininity, or color ratings. Therefore, all data were collapsed across gender.

Again, both CKOne and CKBe were judged as pleasant (mean = 51.0, SD = 39.3, and mean = 53.5, SD = 36.3, respectively). Both CKOne and CKBe were judged as more than moderately intense (mean = 66.5, SD = 17.2, and mean = 63.6, SD = 19.1). There was no significant difference between the femininity (mean = 55.6, SD = 34.2) and masculinity (mean = 40.5, SD = 35.3) ratings for CKOne, Wilcoxon signed-rank test $Z = 1.71$, $P = 0.09$. There was also no significant difference between the femininity (mean = 56.0, SD = 29.2) and masculinity (mean = 46.1, SD = 34.0) ratings for CKBe, Wilcoxon $Z = 1.21$, $P = 0.23$.

Subjects who rated the fragrances as equally feminine and masculine (3 subjects for CKOne and 7 subjects for CKBe) or who failed to give masculinity, femininity, or color ratings were eliminated from the data analysis for that fragrance. None of the subjects correctly identified either the CKOne or CKBe fragrances. For the subjects who rated CKBe as masculine ($n = 22$) and for those subjects who rated both CKOne and CKBe as feminine (CKOne $n = 35$ and CKBe $n = 30$), the points were not uniformly distributed among the 11 colors. Some colors were assigned significantly more points than were others by subjects who rated the CKBe as masculine (Friedman χ^2 (10) = 27.35, $P = 0.002$) and feminine (Friedman χ^2 (10) = 46.70, $P < 0.001$). Subjects who rated CKOne as feminine also assigned significantly more points to some colors than to others (Friedman χ^2 (10) = 53.87, $P < 0.001$). Subjects who rated the CKOne as masculine ($n = 22$) assigned more points to some colors than to others, although not quite significantly so (Friedman χ^2 (10) = 16.70, $P > 0.08$).

The specific pattern of color selection differed depending upon whether subjects thought that the fragrance was masculine or feminine (χ^2 (10) = 60.01, $P < 0.00005$, for CKOne and χ^2 (10) = 47.44, $P < 0.00005$, for CKbe). Subjects who reported that the CKOne was a feminine fragrance assigned the most points to pink (24.6%) and yellow (14.8%), whereas those who reported that it was a masculine fragrance chose white (17.3%), blue (14.5%), and yellow (14.5%) (Figure 5). Subjects who reported that the CKBe was a feminine fragrance predominately chose white (25.3%), blue (19.3%), pink (17.3%), and yellow (15.3%), whereas subjects who reported that it was a masculine fragrance chose blue (26.4%) (Figure 6).

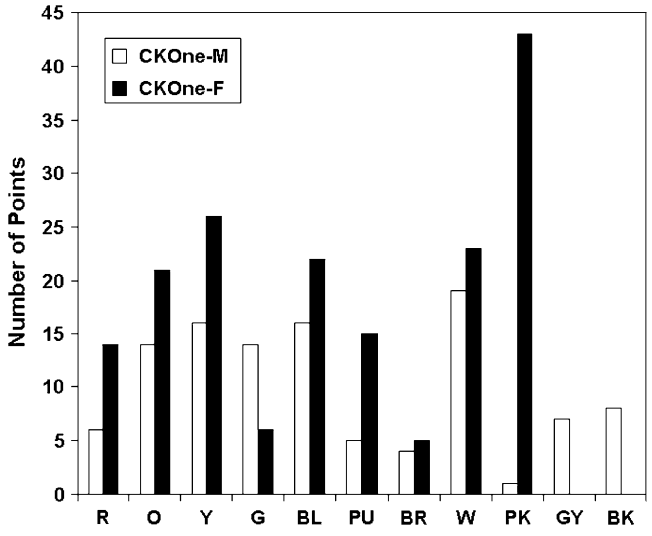

Figure 5 Total number of points assigned to each of the 11 colors (R = red, O = orange, Y = yellow, G = green, BL = blue, PU = purple, BR = brown, W = white, PK = pink, GY = gray, and BK = black) by subjects who rated the CKOne as masculine (white bars) and by subjects who rated the CKOne as feminine (black bars) in Experiment 3.

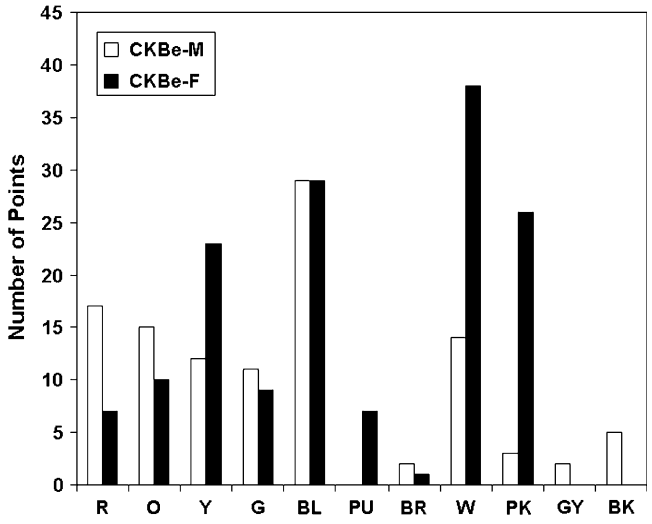

Figure 6 Total number of points assigned to each of the 11 colors (R = red, O = orange, Y = yellow, G = green, BL = blue, PU = purple, BR = brown, W = white, PK = pink, GY = gray, and BK = black) by subjects who rated the CKBe as masculine (white bars) and by subjects who rated the CKBe as feminine (black bars) in Experiment 3.

Discussion

Although the difference in the color selections between the fragrances judged as male or female was not as pronounced as in Experiment 2, it was still the case that pink was frequently chosen only when subjects perceived the fragrances as feminine and blue was more frequently chosen when they perceived the fragrances as masculine. This suggests that a fine fragrance is automatically categorized as masculine and feminine and that this categorization affects what colors are chosen as corresponding to that fragrance.

It is possible that the people who judge a fragrance as masculine actually perceive the fragrance differently than those who judge it as feminine. That is, through some difference in their olfactory systems the same odor might smell differently to the 2 groups of subjects, and this might cause them to categorize the fragrance differently. The following study will address that issue.

Experiment 4

By allowing subjects to categorize themselves into people who perceive a unisex fragrance as masculine or feminine, we run the risk that they do so because they perceive the odors differently. Some subjects might have an inability to smell certain components of the fragrance (i.e., they might have specific anosmias—see Amoore 1977) or they might smell the same odor differently. For example, androstenone has been described as sweaty and urinous by some and floral and musky by others (O'Connell et al. 1989; Bartoshuk and Beauchamp 1994). Still others report smelling no odor whatsoever (Bremner et al. 2003).

This experiment's design eliminates the possibility that the differences seen between those subjects rating the fragrances in Experiments 2 and 3 as masculine or feminine were the result of the 2 groups of subjects perceiving the same odor differently. It ensures that the difference in color selection is the result of cognitions, of "thinking" of a fragrance as masculine or feminine. To do this, people in the present experiment are told that the fragrance is either a masculine or feminine one. So instead of allowing subjects to decide whether the fragrance is masculine or feminine based on their perception of the odor, we caused them to "think" of the fragrance as masculine or feminine by suggesting to half of them (randomly selected) that the fragrance was for men and the other half that it was for women. Thus, we attempted to cognitively manipulate the subjects into viewing the fragrances as masculine or feminine in order to see if that changed the colors they selected as corresponding to the fragrances.

Materials and methods

Participants

Sixty-eight Montclair State University undergraduate psychology students (54 female, 14 male) participated in this study. All were volunteers from a psychology subject pool. Sixty-four participants (94.1%) were between the ages of 18 and 25. One participant (1.5%) was between the ages of 26 and 30, 2 participants (3.0%) were 36–40 years of age, and 1 subject (1.5%) was 41 years of age or older. Forty-eight (71%) self-identified as Caucasian, 6 (9%) as African-American, 9 (13%) as Hispanic, and 5 (7%) as other. None of the participants had allergies to fragrances or scents. All participants were able to smell the fragrances.

Materials

The 2 fragrances were the same as those used in Experiments 2 and 3 (CKOne and CKBe). Subjects were given the demographic and color questionnaires used in the preceding studies. As in the previous studies, they were asked to rate the intensity, masculinity, femininity, and pleasantness of each fragrance and guess its identity.

Procedures

The procedure was the same as that of Experiment 3 except that when subjects were handed an odor delivery bottle they were told that the fragrance was either a fragrance for women or for men.

Results

Testing revealed no significant differences between male and female subjects on masculinity, femininity, or color ratings. Therefore, all data were collapsed across gender.

Subjects who rated the odors as equally feminine and masculine (2 subjects for CKOne) or who failed to rate the femininity, masculinity, pleasantness, or color of either fragrance were dropped from the data analysis. Five subjects correctly identified CKOne and 1 subject correctly identified CKBe. People who were told that CKOne was feminine rated it as significantly more feminine (mean = 65.6, SD = 30.6) than did the subjects told that it was masculine (mean = 48.2, SD = 31.8), Mann–Whitney U (n = 34,34) = 782, 374, $P < 0.015$. People who were told that CKOne was masculine rated it as significantly more masculine (mean = 50.1, SD = 32.4) than did the subjects told that it was feminine (mean = 33.9, SD = 32.4), Mann–Whitney U (n = 34,34) = 749.5, 406.5, $P < 0.04$. People who were told that CKBe was feminine rated it as significantly more feminine (mean = 59.6, SD = 31.0) than did the subjects told that it was masculine (mean = 30.6, SD = 31.8), Mann–Whitney U (n = 34,34) = 861, 295, $P < 0.001$. People who were told that CKBe was masculine rated it as significantly more masculine (mean = 64.3, SD = 33.5) than did the subjects told that it was feminine (mean = 37.8, SD = 33.2), Mann–Whitney U (n = 34,34) = 819, 337, $P < 0.003$.

Subjects rated both CKOne and CKBe as more than moderately intense (mean = 65.0, SD = 19.8, and mean = 65.0, SD = 21.4, respectively). Both CKOne and CKBe were rated as pleasant (mean = 46.5, SD = 47.4, and mean = 53.1, SD = 45.6, respectively). There was no significant difference in the pleasantness ratings of either CKOne or CKBe between subjects told that the fragrances were feminine and those told that they were masculine although it approached significance for CKOne (Mann–Whitney U [n = 33,33] = 682, 407, $P > 0.07$, for CKOne and Mann–Whitney U [n = 33,31] = 613, 410, $P > 0.17$, for CKBe).

For the 2 fragrances, both for subjects told that they were male and subjects told that they were female fragrances, the points were not uniformly distributed among the 11 colors (Friedman χ^2 (10) = 21.25–31.07, $P < 0.02$ in all cases). In addition, the pattern of color selection differed depending upon whether subjects were told that it was a male or female fragrance (χ^2 (10) = 52.31, $P < 0.00005$, for CKOne and χ^2 (10) = 44.75, $P < 0.00005$, for CKBe). Subjects who were told that the CKOne was a feminine fragrance predominantly chose pink (20.0%), whereas those who were told that it was a masculine fragrance chose blue (23.4%) (Figure 7).

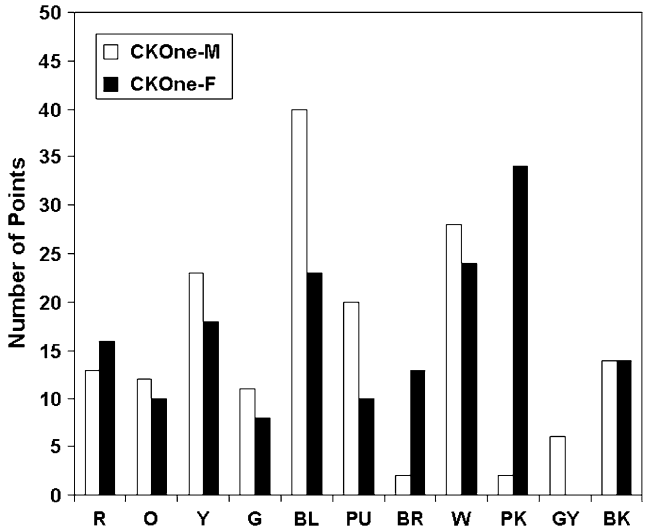

Figure 7 Total number of points assigned to each of the 11 colors (R = red, O = orange, Y = yellow, G = green, BL = blue, PU = purple, BR = brown, W = white, PK = pink, GY = gray, and BK = black) by subjects who were told that the CKOne was masculine (white bars) and by subjects who were told that the CKOne was feminine (black bars) in Experiment 4.

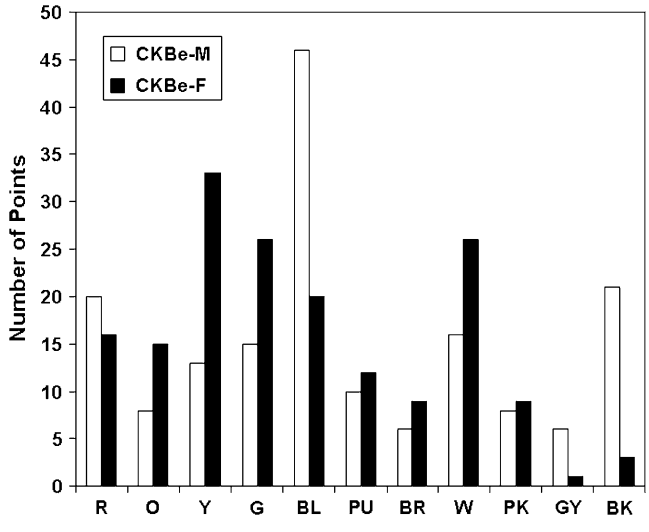

Figure 8 Total number of points assigned to each of the 11 colors (R = red, O = orange, Y = yellow, G = green, BL = blue, PU = purple, BR = brown, W = white, PK = pink, GY = gray, and BK = black) by subjects who were told that the CKBe was masculine (white bars) and by subjects who were told that the CKBe was feminine (black bars) in Experiment 4.

Subjects who were told that CKBe was a feminine fragrance predominantly chose yellow (19.4%), whereas subjects who were told that it was a male fragrance chose blue (27.2%). (Note: The same pattern of results was obtained when data analysis was restricted to only those subjects who gave higher masculinity than femininity ratings to odors when told they were male scents and higher femininity than masculinity ratings to odors when they were told they were female scents.) (Figure 8).

Discussion

The selection of colors for the fragrances by subjects told they were masculine once again differed from that for subjects told they were feminine fragrances. The color choice patterns were similar to those in the previous studies. Here, as in those cases, color points were frequently assigned to blue when subjects were told that a fragrance was masculine and less frequently when told it was feminine. In addition, color points were assigned to pink for the CKOne most frequently when subjects were told that the fragrance was feminine and not when told it was masculine. So, it appears that the colors chosen as corresponding to a fragrance are related to whether the fragrance is thought of as a masculine or feminine fragrance and not to any difference in perception of the fragrance due to differences in individuals' olfactory systems.

However, that does not eliminate the possibility that telling the subjects that the fragrance is a feminine or masculine one changes the perception of the odor. Such top–down influence on the perception of odors has been demonstrated (Dalton 1996; Herz and von Clef 2001). This same effect could be happening here. Being told that the fragrance is masculine and thinking of it as being a masculine scent could make it smell "masculine" and therefore the corresponding color is blue, whereas if subjects are told that it is feminine it smells "feminine" and therefore pink.

General discussion

The present studies demonstrate that how people think of a fine fragrance influences the color(s) they choose as corresponding to the fragrance. Specifically, thinking of the fragrances as being masculine or feminine changes color choices. Not only do people choose different colors for odors that are perceived and marketed as feminine fragrances than for those perceived and marketed as masculine fragrances but also the colors they choose are often those that people regard as feminine and masculine colors (Picariello et al. 1990; Taft 1997).

In 8 of 9 cases where fragrances were masculine or thought of as masculine (the 3 male fragrances of Experiment 1 and the 2 instances from Experiments 2–4), the color blue was assigned the greatest or second greatest number of points. Pink never was in first or second place in any of these 9 instances. Green also was ranked in first or second place frequently for masculine fragrances (4 of 9 times) but not for feminine fragrances (1 of 9 times).

The selection of colors was quite different for the feminine fragrances. In the 9 cases where the fragrances were feminine or thought of as feminine, pink was assigned the greatest or second greatest number of points 6 times. Blue was never assigned the most points and was assigned the second most points only once (in Experiment 3 where subjects were least

likely to be using the masculinity/femininity of the fragrance as the basis for their color selection because they were asked to rate that aspect of the fragrance only after rating the color). Yellow was ranked in first or second place 4 out of 9 times for the feminine fragrances and only once for the masculine fragrances (again, in Experiment 3).

White was often assigned the most or second most points (6 of 9 for feminine, 3 of 9 for masculine). This color was obviously assigned to the fragrance for some reason other than the masculinity or femininity of the scent; however, we do not know the reason.

The choice of masculine and feminine colors as corresponding to an odor is based on thinking about the odor as masculine or feminine. This was demonstrated in Experiment 4 by instructing some subjects to view a fragrance as masculine and others to view it as feminine. The color selection differed between subjects who were told that the fragrance was masculine and those told it was feminine. Subjects tended to choose the male-associated color blue when told that the fragrance was a male fragrance. When told that the fragrance was a female fragrance, they did not choose blue but instead chose the female-associated colors pink or yellow.

What we do not know is if thinking about an odor as masculine or feminine changes the colors selected as corresponding to those odors because of associations (whether learned or unlearned) between masculinity/femininity and color or because thinking about an odor as masculine rather than feminine makes it smell differently and those different odor perceptions are innately linked to different colors. Telling subjects that a fragrance is for females might cause them to focus on feminine components of the fragrance and telling them that it is for males might cause them to focus on masculine components. Clearly, from Experiment 1, we can see that some fine fragrances are readily identifiable as masculine or feminine either because of certain components present or the combinations of components. Other fragrances that are marketed as unisex are less strongly categorized as masculine or feminine. However, even with those fragrances, subjects have a tendency to perceive them as more strongly masculine or feminine (Experiments 2 and 3).

When smelling a fine fragrance, subjects are evaluating the fragrance. They are evaluating the fragrance on characteristics that will help them determine whether or not they will want to wear the fragrance. The evaluation will therefore involve the pleasantness of the fragrance that Schifferstein and Tanudjaja (2004) found contributing to color choice. In addition to evaluating the fragrance's pleasantness, an individual is also determining whether the fragrance is for men or women. They are thinking of it as being either masculine or feminine. That is, is it a fragrance that they would purchase to wear? From this set of experiments, we have found that subjects are quite good at determining if a fragrance is being marketed as a masculine, feminine, or unisex fragrance. Those fragrances used in Experiment 1 that were marketed for only one or the other gender were rated as more strongly masculine or feminine than were the 2 unisex fragrances used in the other Experiments. Because of the saliency of this characteristic of fine fragrances, we believe that it has a strong influence in determining the color that people perceive as corresponding to that fragrance.

For other kinds of odors, such as food odors, it is more likely that people are thinking about the object of origin of the odor. The color of that object might more strongly influence the color selected as corresponding to an odor (e.g., yellow for lemon) when the subject can identify the odor. However, because people are notoriously bad at identifying odors (Engen and Ross 1973; Desor and Beauchamp 1974), they probably use this information only for odors that are extremely familiar. Because the identification of a fine fragrance or its component odors is rare for most people, it is unlikely that the color of the object causing the odor would influence the selection of a color for that class of odors other than possibly choosing red, orange, or yellow for a "fruity" fragrance or green or brown for a "woodsy" one.

So, even if there are some innate connections between colors and odors, those connections are probably influenced by both emotions (Schifferstein and Tanudjaja 2004) and also by cognitions generated by smelling the odor. Those cognitions may include the object of origin of the odor or, in the case of fine fragrances, the masculinity/femininity of the odor. What thoughts come to mind has to do with the nature of the odor. As we demonstrate here, for fine fragrances where it is important to determine if it is meant for a man or a woman, the masculinity/femininity of the fragrance appears to be an important factor in determining color–odor correspondences.

Factors influencing color–odor correspondences

From the experimental evidence that exists thus far, we know of 3 factors that influence color–odor correspondences. The first is naturally occurring cross-modal connections between odor and color. For example, there appears to be an inverse relationship between odor intensity and lightness (i.e., stronger odors correspond to darker colors, Kemp and Gilbert 1997). This correspondence seems similar to that seen between pitch and brightness (Marks 1974; Marks et al. 1987) in that it is the result of a naturally occurring connection between the 2 dimensions. Marks (1982) found that color names (many of which we used in the present study) also appear to correspond to the dimensions of pitch and brightness. In his study, yellow was the brightest and had the highest pitch, whereas black was the dimmest and had the lowest pitch. There also appear to be some dimensions of odor that also correspond to pitch and hue because different odors of the same intensity do correspond to different hues (Gilbert et al. 1996) and different pitches (Belkin et al. 1997). However, we do not know what features of the odors are behind these correspondences. These findings suggest that there might be naturally occurring correspondences

between many sensory modalities and dimensions, including some dimension of odor quality, odor intensity, pitch, brightness, and hue.

A second source of influence on odor–hue correspondence is emotion. We know that some of the difference in color choice with odor quality is the result of the pleasantness of the odor (Schifferstein and Tanudjaja 2004). This is not surprising because pleasantness is a salient aspect of odors (Berglund et al. 1973; Jones et al. 1978). Light colors, especially yellow, tend to be chosen for pleasant odors and more neutral colors such as brown and white tend to be chosen for unpleasant colors. However, as Schifferstein and Tanudjaja (2004) point out, although the emotion elicited by the odor does influence the color choice, it is not the only mediator.

The present set of studies demonstrate that cognitions elicited by an odor can also act as mediators in odor–color correspondences. Gilbert et al. (1998) suggested in their paper on odor–color correspondences that such might be the case in the odor–color correspondences found in their study. Even without the ability to exactly identify an odor (see Engen and Ross 1973; Desor and Beauchamp 1974), individuals might still be able to categorize an odor, for example, as fruity. This would be a good enough identification to result in the high agreement in odor–color correspondences noted by Gilbert et al. (1998) and Dematte et al. (2006). In this case, individuals would be more likely to choose red, orange, or yellow as colors going with fruit than blue, green, or black.

It is still the case that the cognitions that are elicited by an odor will be dependent on the individual's history with that odor and the ability to recognize it. For example, if an individual smells a garlic odor and recognizes it as such, that identification (which could be either semantic or a visual image of garlic) would result in the selection of white or beige as the corresponding color. However, an individual whose only exposure to garlic was on pizza might also select red as a corresponding color (due to the tomato sauce). These differences in experience-guided identification should result in some variability in odor–color correspondences with hard-to-identify odors.

In our case, using fine fragrances that were rarely correctly identified, the identity of odorant probably played little role in the color selection. Instead, the cognition that was most salient was the fragrance's targeted gender. As we show, individuals are rather good at classifying fragrances as being appropriate for one or the other gender. So, for most fine fragrances, we think these cognitions are quite salient and guide the color selection. Any particular cognition can become a salient cognition through priming the subject to think about some aspect of the odor as we demonstrated in Experiment 4 by telling subjects that a unisex fragrance was either for men or women. So, we should be able to affect odor–color correspondences for other classes of odor by making some aspect of the odor salient to the subject. For example, we would expect that people would pick the color red as corresponding to the odor of benzaldehyde (cherry/almond odor) if they were primed to think of fruits. On the other hand, they might be more likely to choose brown if they were primed to think of nuts.

All 3 of these mechanisms (innate connections, emotion, and cognitions) probably interact to guide the selection of a color for an odor. Further research is needed in order to understand how these mechanisms combine and interact. In addition, further research is needed in order to understand the cognitions driving color selections for different categories of odors.

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