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Seeing, smelling, feeling! Is there an influence of color on subjective affective responses to perfumed fabric softeners?

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ABSTRACT

Visual cues are likely to convey early sensory impressions and to generate strong expectations about product characteristics, which in turn could influence the final assessment of a product. The aim of this study was to investigate the influence of color on the verbal measurement of emotions in response to different perfumes in fabric softeners, the hypothesis being that color-perfume congruent pairs will induce enhanced positive emotional responses. In a first experiment, 102 participants were asked to report their feelings for nine perfumed fabric softeners, which were perfumed with one of three perfume variants and presented as one of three color variants. Verbal measurements of emotions were performed by using the ScentMove™ questionnaire. Results indicated that the subjective affective responses varied as a function of perfumes and were influenced by colors. A second experiment was conducted to verify whether the color-perfume congruency could be optimized. A group of 70 respondents participated in a color-matching exercise with the same three perfume variants and 10 possible colors, including the three original color variants. Results confirmed that other color-perfume associations could be more than or equally congruent to those presented in the first experiment. A third experiment was carried out to investigate whether increasing the color-perfume congruency would result in a significant increase of the subjective affective response. A group of 95 respondents were asked to report their feelings for nine perfumed fabric softeners, which were perfumed with the same three perfume variants and presented as one of three optimal color variants. The optimization of color-perfume pairing did not result in a significant increase of the subjective affective response. More generally, this study underlines the predominant role of perfume in the emotional response and a more limited influence of color.

1. Introduction

Visual cues convey early sensory impressions and may generate strong expectations, especially for olfactory perception, as we generally see products and foods before smelling and eating them (Cardello, 1994; Dalton, 2002; Demattè, Sanabria, & Spence, 2006). According to the assimilation-contrast theory (Anderson, 1973), visual information is either confirmed or disconfirmed through the smelling or eating experience of the actual stimulus (Deliza & MacFie, 1996). Expected and actual experiences are combined to produce the final evaluation of the stimulus. We decided to specifically investigate the influence of color information, one of numerous visual cues that can generate expectation, on olfactory perception.

Cross-modal color–odor interactions have been demonstrated by several authors (for a review, see Cardello, 2007; Spence, Levitan, Shankar, & Zampini, 2010). Engen (1972) showed that the presence of color increases false alarm rates for odor detection. Through a lexical analysis of tasting comments by wine experts, Morrot, Brochet, and Dubourdieu (2001) observed that white wines that were colored red were described as if they were red wines. Zellner and collaborators observed that flavor intensity is stronger in the presence of color than it is in equally concentrated colorless solutions (Zellner & Kautz, 1990; Zellner & Whitten, 1999). These authors and others also highlighted the existence of a color–odor appropriateness, or congruency, that could enhance the description and discrimination of odors (Davis, 1981; Shankar et al., 2010a; Shankar, Simons, Shiv, Levitan, & Spence, 2010b; Zampini, Sanabria, Phillips, & Spence, 2007; Zampini, Wantling, Phillips, & Spence, 2008; Zellner, Bartoli, & Eckard, 1991). The importance of color–odor appropriateness was also demonstrated in relation to identification tasks. For example, Stevenson and Oaten (2008) observed that participants made significantly more errors, were less accurate, and had a longer response latency when odors were presented with an inappropriate color (e.g., strawberry and cherry in green water) compared with an appropriate color

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(e.g., strawberry and cherry in red water). Blackwell (1995) reported that participants misidentified an orange-flavored solution as lime when it was colored green. In the same vein, Sakai, Imada, Saito, Kobayakawa, and Deguchi (2005) found that a cola-flavored solution was misidentified as orange or tea when it was colored orange.

Color–odor matching tasks demonstrated that some odors are associated with specific colors nonrandomly (Gilbert, Martin, & Kemp, 1996). This result was confirmed by Demattè et al. (2006) in both explicit and implicit tasks. This systematic correspondence probably results from repeated exposure to specific color-flavor parings through daily experience (Elliot & Maier, 2007). For example, a lemon odor is most commonly associated with the color yellow because lemons are yellow in most cultures; moreover, when we see a yellow-colored beverage, we expect a lemon flavor. Interestingly, Schifferstein and Tanudjaja (2004) found consistency in color–odor pairing for more complex fine fragrances, which could not be easily described nor easily associated with an object. Thus, color–odor pairings are probably not driven by identification per se, but are more likely linked to implicit semantic knowledge triggered by the odor or the color.

Another line of research has underlined the importance of color–odor appropriateness for more subjective evaluations. Zellner and collaborators (1991) showed that appropriate color–odor combinations are more pleasant, the appropriateness improving the successful identification and consequently increasing the positive hedonic value. Zellner and Durlach (2003) studied the influence of color on the expected and experienced refreshment, intensity, and liking of lemon, mint, and vanilla beverages. Lemon and mint solutions colored brown were less refreshing than when they were colored with another color. Liking ratings were affected in the same way and depended on the color, as observed for refreshment. Fenko, Schifferstein, Huang, and Hekkert (2009) studied the influence of color on the freshness for different types of products. Color was more important than odor for determining the freshness of soft drinks and dishwashing liquids and as important as odor for determining the freshness of scented candles.

More than its influence on liking and refreshment evaluation, color may influence reported feelings. Schifferstein and Tanudjaja (2004) investigated whether color–odor associations may be partly due to emotional associations using emotion scales adapted from the semantic differential measure of emotional state (Mehrabian & Russel, 1974), which is based on three emotional dimensions: pleasure, arousal and dominance. They found that only the pleasantness of the stimuli was linked with color–odor associations, but not the dominance or the arousal of the emotional dimensions. In our study, we wanted to further investigate whether color–odor associations influence the reported feelings by using another model for verbally measuring emotions. We used the ScentMove™ questionnaire (Porcherot et al., 2010), a simplified version of the Geneva Emotion and Odor Scale (GEOS; Chrea et al., 2009), originally developed to measure the subjective affective experience (i.e., feeling) elicited by everyday odors. Starting from a list of 480 terms (extracted from the literature on emotions and on olfaction, including the terms derived from the dimensional and the basic emotion models), Chrea et al. conducted three studies to select the most relevant terms for describing an emotional state that consumers experienced when smelling an odor in the past, or when smelling a presented odorant. The resulting model, GEOS, contains 36 representative emotional terms grouped into six categories with factorial analyses.

On the basis of the complete version of the GEOS questionnaire, we adapted the questionnaire to our commercial and development needs, and we reduced the number of terms to conduct quicker screening tests in sensory booths without losing the psychometric properties of the full set of scales. More precisely, we selected the three most representative terms for each of the six emotional categories by considering those terms with the highest loadings derived from the factorial analyses and those terms with the highest consensus as measured with Cronbach's alpha. The resulting ScentMove™ questionnaire consists of six scales, each illustrated by three terms related to "Sensuality/Desire" (Romantic, Desire, In love), "Relaxation" (Relaxed, Serene, Reassured), "Pleasant feeling/Well-being" (Happiness, Well-being, Pleasantly surprised), "Refreshment/Energy" (Energetic, Invigorated, Clean), "Sensory pleasure/Nostalgia" (Nostalgic, Mouthwatering, Amusement), and "Unpleasant feeling/Disgust" (Disgusted, Irritated, Unpleasantly surprised). We demonstrated that the ScentMove™ questionnaire yielded comparable results to the original GEOS questionnaire and provided reproducible, discriminating, and consensual data for different fragranced and flavored product categories. Results also indicated that this questionnaire was relevant to consumers for expressing their feelings, even if the three words do not have exactly the same meaning (Porcherot et al., 2010). One of the particularities of the ScentMove™ questionnaire is its capability of disentangling quantitative changes in affect (the same type of feelings but with different strengths) from qualitative changes (different feelings). Based on six emotional categories, it constitutes a powerful alternative to the more classical questionnaires (i.e., pleasure-arousal-dominance and basic emotions scales; Delplanque et al., 2012).

The aim of this study was to investigate the influence of color on the subjective affective experience, or feelings, for different perfumes of fabric softeners. The hypothesis was that color-perfume congruent pairs will induce higher liking and higher positive emotional responses. Three experiments were conducted. In the first experiment, nine fabric softeners were perfumed with three perfume variants and presented in combination with three color variants (blue, pink, and white). Respondents assessed their feelings by using the ScentMove™ questionnaire. The second experiment aimed at optimizing the color-perfume congruency by providing another color range; respondents participated in a color-matching exercise with the same three perfume variants and 10 possible colors, including the three original color variants. A third experiment was then conducted to further investigate the relation between color-perfume congruency and the subjective affective response. Nine perfumed fabric softeners, which were perfumed with one of the same three perfume variants and presented as one of three optimal color variants, were presented to respondents for the verbal assessment of emotions with the ScentMove™ questionnaire.

2. Experiment 1: Subjective affective response to colored and perfumed fabric softeners

This experiment investigated whether color influences liking and affective responses to perfumes of fabric softeners, as well as the role of the color-perfume congruency.

2.1. Method

2.1.1. Participants

One hundred two participants (25–50 years old, 81% female, French and Swiss nationalities) participated in one sensory booth session. They were recruited in different departments of the Firmenich, S.A., company at different locations around Geneva, Switzerland. All participants were able to smell the perfumes of the fabric softeners. They were not paid for their participation and completed a consent form.

2.1.2. Procedure

Each participant was invited to a 30-min booth session between 9 a.m. and 11 a.m. Three morning sessions were necessary to conduct the experiment with all the participants. Nine colored and perfumed fabric softeners were presented one at a time and following a balanced presentation order (Latin square design; MacFie, Bratchell, Greenhoff, & Vallis, 1989). Fifty-gram samples of fabric softener were presented in transparent and cylindrical plastic containers (8 cm height × 4 cm diameter) identified by a three-digit code. For each sample, participants were requested to remove the cap of the plastic container, smell the perfume of the fabric softener, and provide answers by using the computer. The scales and their respective terms were displayed on the computer screen with FIZZ software (Biosystèmes, Couternon, France). Participants were instructed to smell the perfume as many times as needed to complete the questionnaire. Importantly, the color-perfume association was never mentioned and the perfumed fabric softeners were presented one at a time so that participants could not guess the total number of samples or the details of the design, i.e., three possible perfumes in three different colors.

2.1.3. Questionnaire

The ScentMove™ questionnaire (Porcherot et al., 2010) was used to measure participants' feelings. In particular, participants were invited to rate the pertinence of each of the following series of three feeling terms to describe their feelings while smelling the perfume of the fabric softener:

1. Happiness – Well-being – Pleasantly surprised
2. Romantic – Desire – In love
3. Disgusted – Irritated – Unpleasantly surprised
4. Relaxed – Serene – Reassured
5. Nostalgic – Amusement – Mouthwatering
6. Energetic – Invigorated – Clean

For readability, all terms are here presented in English; however, they were presented in French to the participants. For simplification, these scales are identified by the following feeling categories in the Results and the Discussion sections: (1) well-being, (2) desire, (3) disgust, (4) relaxed, (5) nostalgic, and (6) energetic.

To give their answers, participants were invited to make a mark on the 10-cm linear scale that ranged from "no feelings" to "very intense feelings" (answers being scored from 0 to 10) for the six series of three feeling terms by considering the term or terms that were most relevant to them. These six scales were presented first on one computer screen. Participants were also asked to rate on linear scales their liking of the perfume (0 = "I do not like at all"; 10 = "I like very much"); the familiarity of the perfume (0 = "not familiar at all"; 10 = "very familiar"); the intensity of the perfume (0 = "null"; 10 = "very intense"); and the color-perfume congruency, which corresponds to "how much the perfume fits with the color of the fabric softener" (0 = "does not fit at all"; 10 = "fits a lot"). These additional questions were presented on a second computer screen with the liking question at the first position. The full questionnaire was therefore presented on two computer screens.

2.1.4. Perfumed fabric softeners

The colored and perfumed fabric softeners were experimental products made by Firmenich, S.A., application laboratories. They consisted of a white commercial and nonperfumed fabric softener containing 12% of active softener ingredients. The fabric softeners were then perfumed by our internal application teams with one of three perfume variants (Cotton, Lagoon, and Princess perfumes from the Firmenich perfume collection added at 1.2%) and presented with one of three color variants, creating a 3 (colors) × 3 (perfumes) experimental design. The three color variants, white, blue azure, and pink, are illustrated in Fig. 1. The pink and blue azure colors were obtained by adding colorants from Miliken Chemical (Spartanburg, SC, USA) to the white commercial fabric softener (40 mg of Royal MC colorant for the blue azure color; 80 mg of pink AL colorant for the pink color). Considering that Cotton perfume (almondy and powdery olfactory character) was specially designed by the perfumers for a white fabric softener, Lagoon perfume (fresh and marine olfactory character) for a blue–colored fabric softener, and Princess perfume (floral and fruity olfactory character) for a pink-colored fabric softener, these three samples represented the higher color-perfume congruent combination from the point of view of Firmenich experts.

Fig. 1. Picture of the three colored fabric softeners presented in transparent containers (white, pink and blue azure).

2.1.5. Statistical analysis

To analyze the influence of color on feeling responses, we conducted a multivariate analysis of variance (MANOVA) on the individual feeling scores, with perfume (three levels), color (three levels), and feeling (six levels) as within-subject factors. ANOVAs were then performed separately on liking, familiarity, naturalness, intensity, and congruency ratings, with perfume (three levels) and color (three levels) as within-subject factors. Following that, paired *t*-tests were used to specify perfume and color differences. To address the problem of multiple comparisons, we applied the conservative Bonferroni correction to all analyses (*n* being the number of comparisons, the new significance level set to .05/*n*).

2.2. Results

The MANOVA performed on the feeling scores revealed a significant main effect of perfume [$F(2,808) = 5.86$; $p < 0.003$], a main effect of color [$F(2,808) = 18.59$; $p < 0.001$], and significant perfume × feeling [$F(10,1608) = 27.36$; $p < 0.001$] and color × feeling [$F(10,1608) = 4.75$; $p < 0.001$] interactions, indicating that different perfumes and different colors elicited different reports of feelings. However, this analysis did not reveal any significant perfume × color × feeling interaction [$F(20,2667) = 0.49$; $p = 0.98$], suggesting that changing the color of the selected perfumes did not introduce significant differences in the feeling profiles.

We further characterized the significant interactions by performing Bonferroni-corrected ANOVAs (significance level set to .05/6, which corresponds to 0.008) on ratings obtained for each feeling category for perfumes and colors separately.

Fig. 2 represents the mean feeling scores (± SE bars) among the three perfumes (A) and among the three colors (B), as well as the results of the Bonferroni-corrected ANOVAs. The reported feelings differed (Student's *t*-tests) among the three perfumes, the Lagoon

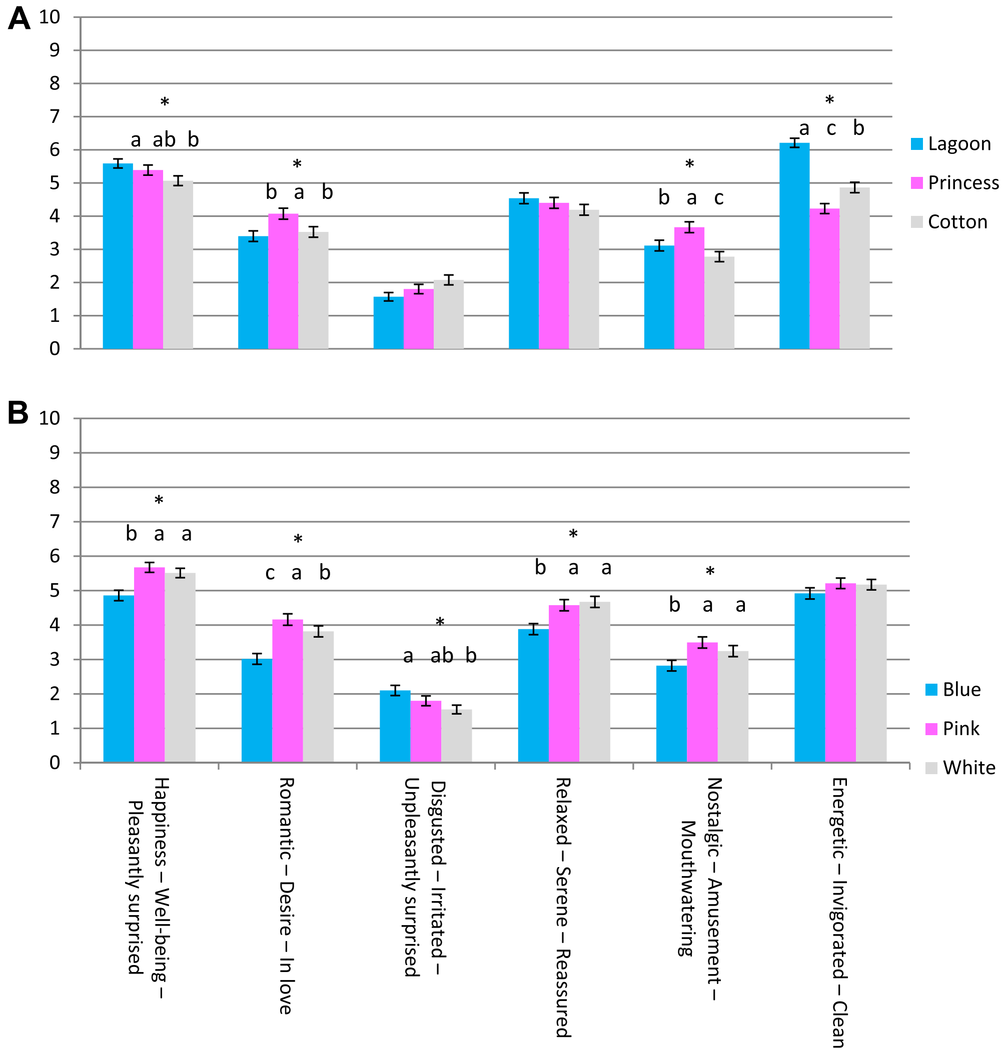

Fig. 2. Mean feeling scores (± SE bars) for the three perfumes (A) and the three colors (B). An asterisk indicates a significant difference ($ps < 0.008$; Bonferroni-corrected paired *t*-tests). Means with all different letters are significantly different at the 95% of confidence level from Student's *t*-tests.

perfume producing stronger reported feelings for the well-being category than the Cotton perfume, and higher scores for the energetic category than for the other two perfumes (Fig. 2). Princess perfume elicited higher ratings for the nostalgic and desire categories than did the Lagoon and Cotton perfumes. The reported feelings also differed among the three colors, the pink and white colors eliciting significantly more feelings than the blue color related to well-being, desire, relaxed, and nostalgic categories and less feelings related to the disgust category. No significant difference was observed between the white and pink fabric softeners, except for the desire category, with the pink color producing significantly more desire feelings than the white color.

The ANOVA performed on the other questions (Table 1) revealed significant color effects for liking, naturalness, and congruency ratings; perfume effects for familiarity, intensity, and congruency ratings; and a perfume × color interaction for congruency ratings.

The blue-colored fabric softeners were liked significantly less (5.54) and were perceived as less natural (3.08) than the pink and the white fabric softeners (5.87 and 5.83, respectively, for liking; 3.47 and 3.69, respectively, for naturalness). In addition, the Lagoon perfume was perceived as significantly more familiar (6.6) and more intense (7.6) than the other two perfumes (5.4 and 7.03, respectively, for Cotton and 5.14 and 7.12, respectively, for Princess). Congruency scores were the highest for the perfumes initially created for the specific colors revealing that participant responses to color-odor congruency matched expert choices. However, other associations were similarly congruent. We did not find evidence for significant congruency differences for the Lagoon

Table 1
F ratios associated with the tested effects from the ANOVA, perfume (three levels), color (three levels), and within-subject factors.

Effect (ddl)	Familiarity	Liking	Intensity	Naturalness	Congruency
Color (2,2)	4.43	8.06*	4.99	8.90*	18.98*
Perfume (2,2)	47.22*	5.39	19.80*	0.77	14.36*
Color × perfume (4,4)	2.51	1.01	1.06	0.46	10.87*

* Corresponds to a significant effect, considering the Bonferroni-corrected significance level, which is set to .05/5 = 0.001.

perfume between the blue, the pink, and the white-colored fabric softeners. Congruency ratings also did not differ for the Princess perfume associated with the pink and the white-colored fabric softeners. We therefore wanted to investigate whether the reported congruency, although consistent with the expert choices, could be improved or optimized to reveal more modulation of feelings in response to the perfumes when other colors were compared.

3. Experiment 2: Color-perfume matching task for congruency optimization

This experiment was conducted to investigate whether color-perfume congruency could be increased or optimized. More precisely, we questioned whether participants would have chosen other colors if they had more choices.

3.1. Methods

3.1.1. Participants

A panel of 70 participants (25–45 years old, 76% female, French and Swiss nationalities) participated in one sensory booth session. Fifty-one percent of the participants were the same as in the first experiment. They were recruited in different departments of the Firmenich, S.A., company at different locations around Geneva, Switzerland. All participants were able to smell the perfumes of the fabric softeners. They were not paid for their participation and completed a consent form.

3.1.2. Procedure

Each participant was invited to a 20-min booth session between 9 a.m. and 11 a.m. Three morning sessions were necessary to conduct the experiment with all the participants. Three fabric softeners, perfumed with the same perfumes as those in Experiment 1 (i.e., Lagoon, Princess, and Cotton), were presented one at a time and following a balanced presentation order (Latin square design; MacFie et al., 1989). Fifty-gram samples of fabric softener were presented in opaque and cylindrical plastic containers (8 cm height $\times$ 4 cm diameter) identified by a three-digit code. For each sample, participants were requested to remove the cap of the plastic container, smell the perfume of the fabric softener, and perform a color-perfume matching task by selecting one of the 10 colors that best fit the perfume.

The 10 colors were presented to the subject in 20-g samples of colored fabric softener contained in transparent, cylindrical glass containers (8 cm height $\times$ 2 cm diameter). These containers were identified by a three-digit code. The 10 colors, illustrated in Fig. 3, were white, pink, blue azure (as provided in Experiment 1), peach (2 g Crimson + 80 mg yellow BL colorants), yellow (80 mg yellow BL colorant), red (25 g Crimson colorant), purple (80 mg violet colorant), light green (1 g Royal MC + 80 mg yellow BL colorants), dark green (1 g Royal MC + 5 g yellow BL colorants), and another nuance of blue, marine-like (80 mg Blue MC colorant). All colorants were from Miliken Chemical. The 10 glass containers of differently colored fabric softeners were presented in a white plastic box to optimize contrast differences among the colors. The colored and perfumed fabric softeners were experimental products made by Firmenich, S.A., application laboratories. Participants performed a color-perfume matching task during which they were requested to smell the perfume and select the code of the color that best fit the perfume.

Participants provided their answers by selecting the code of the color displayed on the computer screen with FIZZ software (Biosystèmes). Participants were not allowed to smell each perfume for more than 10 s in order to foster spontaneous answers in conditions similar to those for the feeling measurements.

3.1.3. Statistical analyses

Each participant was allowed to select only one color for each of the three perfumes. We counted the number of choices and calculated the corresponding percentages by color and by perfume. Finally, a chi-square analysis was performed for each perfume to estimate whether the color-perfume match was different from random matching. The number of choices was compared between subjects who participated in the first experiment and subjects who did not participate in the first experiment in order to verify that the results did not differ between the two groups. As no significant difference was observed, the following analyses do not take this factor into account.

3.2. Results

The Cotton perfume was matched with the white color by the highest percentage of respondents, followed by the blue marine color and the purple color (Table 2). Chi-square analysis indicated that the color-perfume match for this perfume was not random (p-value = 0.021). As the Cotton perfume was initially created for a white fabric softener, most of the participants were in agreement with the expert color-perfume association. The Princess perfume was matched with the peach color by the highest percentage of respondents, followed by the yellow and pink colors; a total of 51% of the respondents chose these three colors. Chi-square analysis indicated that the color-perfume match for this perfume was not random (p-value < 0.0001). The Lagoon perfume was matched with the blue marine color by the highest percentage of respondents, followed by the purple and blue azure colors; a total of 43% of the respondents chose these three blue nuances. Chi-square analysis indicated that the color-perfume match for this perfume was not random (p-value = 0.034). The red and green colors were associated with these three perfumes only by a very low percent-

Fig. 3. Picture of the 10 colored fabric softeners presented in transparent containers (from left to right; white and pink, as provided in Experiment 1; peach; yellow; red; blue azure, as provided in Experiment 1; blue marine; purple; dark green, light green).

Table 2
Percentage of respondents who matched each color with each perfume.

Perfume	White (%)	Blue marine (%)	Blue azure (%)	Peach (%)	Red (%)	Yellow (%)	Pink (%)	Purple (%)	Green dark (%)	Green light (%)
Cotton	**17**	**14**	3	8	2	3	8	**11**	1	3
Princess	5	2	2	**21**	4	**18**	**12**	4	2	0
Lagoon	6	**19**	**11**	1	2	4	6	**13**	4	4

Percentages in bold correspond to the three colors with the highest percentages by perfume.

age of participants. The results of Experiment 2 revealed that other perfume color associations could be more than or equally congruent to those proposed by the experts, i.e., by associating a peach or yellow color with the Princess perfume and by associating another blue nuance with the Lagoon perfume.

In the third experiment, we therefore investigated whether using optimized color-perfume congruency stimuli would result in a significant enhancement of subjective affective responses.

4. Experiment 3: Subjective affective response to perfumed fabric softeners with optimized colors

In this third experiment, we presented the three perfumes in the three colored fabric softeners that were selected by the highest percentage of respondents in Experiment 2. Interestingly, the original colors (white for the Cotton perfume, pink for the Princess perfume, and blue azure for the Lagoon perfume) were part of this selection and allowed the comparison between the new colors and the original colors for each perfume, corresponding to expert choices.

4.1. Method

4.1.1. Participants

Ninety-five participants (29–46 years old, 78% female, French and Swiss nationalities) participated in one sensory booth session. Thirty-seven percent of the participants were the same as those in the first experiment, and 36% were the same as those in the second experiment. They were recruited in different departments of the Firmenich, S.A., company at different locations around Geneva, Switzerland. All participants were able to smell the perfumes of the fabric softeners. They were not paid for their participation and completed a consent form.

4.1.2. Procedure

Each participant was invited to a 30-min booth session between 9 a.m. and 11 a.m. Three morning sessions were necessary to conduct the experiment with all the participants. Nine colored and perfumed fabric softeners were presented one at a time and following a balanced presentation order (Latin square design; MacFie et al., 1989). Fifty-gram samples of fabric softener were presented in transparent and cylindrical plastic containers (8 cm height × 4 cm diameter) identified by a three-digit code. For each sample, participants were requested to remove the cap of the plastic container, smell the perfume of the fabric softener, and provide answers by using the computer. The scales and their respective terms were displayed on the computer screen with FIZZ software (Biosystèmes). Participants were instructed to smell the perfume as many times as needed to complete the questionnaire.

4.1.3. Questionnaire

The same questionnaire and the same procedure were used as described in Section 2.1.3 for Experiment 1 (i.e., ScentMove™ questionnaire).

4.1.4. Perfumed fabric softeners

The colored and perfumed fabric softeners were experimental products made by application laboratories of the Firmenich, S.A., company. They consisted of a white commercial and nonperfumed softener containing 12% of active softener ingredients. Nine perfumed fabric softeners were presented to each participant. They were perfumed with one of three perfume variants (Cotton, Lagoon, and Princess perfumes from the Firmenich perfume collection added at 1.2%) and presented in one of three optimal color variants, as defined by the three colors selected by the highest percentage of participants from the color-perfume matching task described in the second experiment. Cotton perfume was thus presented in the white fabric softener, the new blue-marine-colored fabric softener, and the purple-colored fabric softener; Lagoon perfume was presented in the two blue-colored fabric softeners (marine and azure) and in the purple-colored fabric softeners; and Princess perfume was presented in the pink-, peach-, and yellow-colored fabric softeners (please refer to Fig. 3. to see the corresponding colors). We used the same colorants from Miliken Chemical and the same concentrations as described in Experiment 2. These nine colored and perfumed fabric softeners were presented one at a time and following a balanced presentation order.

4.1.5. Statistical analysis

To analyze the influence of color on feeling responses, we conducted a MANOVA on the individual feeling scores, with perfume (three levels), color (two levels; original color, or color corresponding to the expert choice vs. new colors), and feelings (six levels) as within-subject factors. Other MANOVAs were performed by perfume to allow the comparison of the three colors independently of whether or not they corresponded with expert choices, with color (three levels) and feelings (six levels) as within-subject factors.

ANOVAs were then performed separately on liking, familiarity, naturalness, intensity, and congruency ratings, with perfume (three levels) and color (two levels, new vs. original) as within-subject factors. ANOVAs were also performed by perfume with color (three levels) and within-subject factors. Further paired *t*-tests were conducted to specify perfume and color differences. To address the problem of multiple comparisons, we applied the conservative Bonferroni correction to all analyses (n being the number of comparisons, the new significance level set to $.05/n$).

Results of the subjects who did not participate in the first and second experiments were compared with the results of the other subjects in order to check that the results did not differ between the two groups.

4.2. Results

The MANOVA performed on the feeling scores revealed a significant main effect of perfume [$F(2, 756) = 4.88$; $p < 0.0078$] and a significant perfume × feeling interaction [$F(5,1504) = 26.26$; $p < 0.0001$], but no significant effect of color [$F(2,756) = 0.0001$; $p = 0.99$] or color × feeling interaction [$F(5,752) = 1.28$; $p = 0.27$]. These results indicated that the feeling reports were influenced

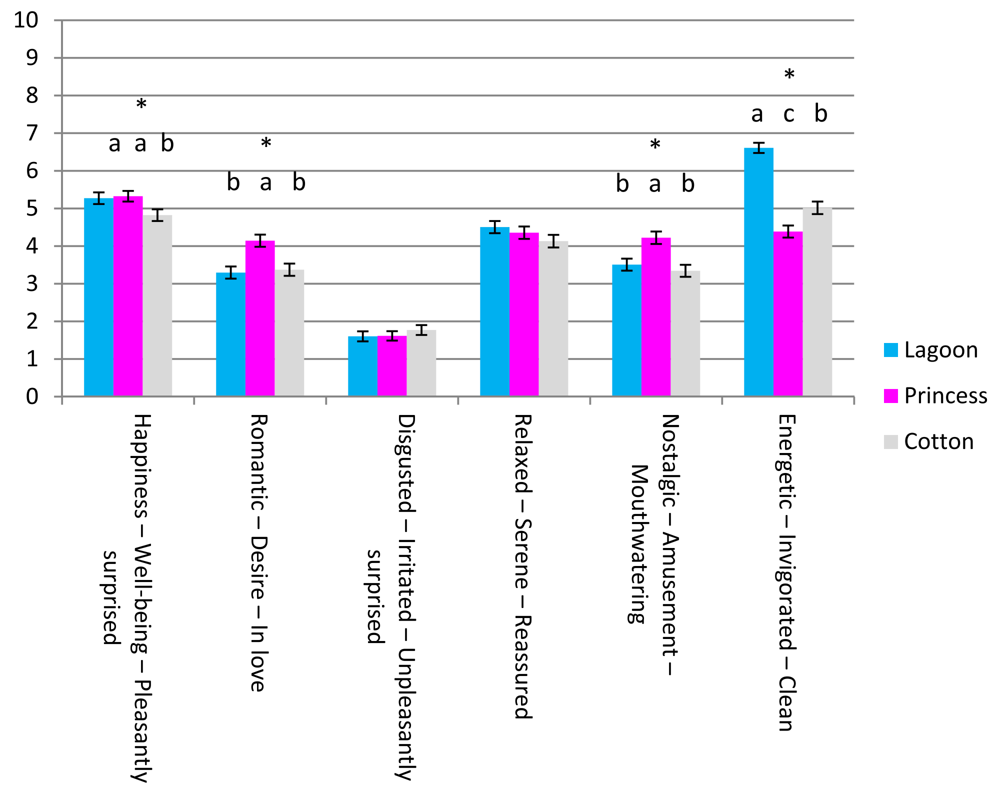

Fig. 4. Mean feeling scores (± SE bars) for the three perfumes. An asterisk indicates a significant difference (*ps* < 0.008; Bonferroni-corrected paired *t*-tests). Means with all different letters are significantly different at the 95% of confidence level from Student's *t*-tests.

by the perfume, but not by the color. In addition, this analysis did not reveal any significant perfume × color × feeling interaction [$F(10,1504) = 1.08$; $p = 0.36$], suggesting that changing the color of the selected perfumes did not introduce significant differences in the feeling profiles. Fig. 4 represents the mean feeling scores (± SE bars) among the three perfumes, as well as the results of the Bonferroni-corrected ANOVAs. The reported feelings differed (Student's *t*-tests) among the three perfumes, the Cotton perfume producing weaker reported feelings for the well-being category, the Princess perfume producing stronger reported feelings for the desire and nostalgic categories, and the Lagoon perfume producing stronger reported feelings for the energetic category (Fig. 4).

MANOVAs performed for each perfume did not reveal any effect of color for the three perfumes [Lagoon: $F(2,282) = 0.34$; $p = 0.71$; Cotton: $F(2,282) = 0.51$; $p = 0.60$; Princess: $F(2,282) = 0.19$; $p = 0.83$] nor any color × feeling interaction for the three perfumes [Lagoon: $F(10,556) = 0.96$; $p = 0.56$; Cotton: $F(10,556) = 0.98$; $p = 0.79$; Princess: $F(10,556) = 0.96$; $p = 0.42$]. Again, these results indicated that the color did not produce a significant influence on the subjective feelings reported for the perfumes.

The ANOVAs performed on the other questions (Table 3) revealed no effect of color, but significant effects of perfume for familiarity, liking, intensity, and congruency ratings. Those analyses also revealed a perfume × color interaction for congruency ratings. The Lagoon perfume was perceived as significantly more familiar (6.49), more liked (6.37), and more intense (7.33) than the other two perfumes (5.33, 5.63, and 6.98, respectively, for Cotton and 4.98, 5.84, and 6.81, respectively, for Princess). ANOVAs performed for each perfume revealed an effect of color for congruency ratings only for Cotton and Lagoon perfumes. The white color was reported as significantly more congruent (6.12) than the blue marine (4.91) and purple (4.86) colors for Cotton perfume, and the blue marine color was reported as significantly more congruent (7.03) than the blue azure (6.08) and purple (5.92) colors for Lagoon perfume.

Table 3
F ratios associated with the tested effects from the ANOVA, perfume (three levels), color (two levels), and within-subject factors.

Effect (ddl)	Familiarity	Liking	Intensity	Congruency
Color (1,1)	1.60	0.10	2.84	1.42
Perfume (2,2)	39.04*	7.53*	9.46*	6.54*
Color × perfume (2,2)	2.31	1.75	0.81	8.52*

* Corresponds to a significant effect, considering the Bonferroni-corrected significance level, which is set to .05/5 = 0.001.

These results showed that the white color, corresponding to the expert choice, was already highly congruent with the Cotton perfume. Thus, the color-perfume congruency could not be significantly increased for the Princess perfume. Interestingly, the color-perfume congruency could be significantly increased for the Lagoon perfume with another blue nuance (marine-like, instead of azure-like), but this significant increase of color-perfume congruency did not significantly impact the liking and the feeling responses to the perfumes.

5. Correlational analyses

The results of these three experiments showed that, on average, changing the color of the selected perfumes of the fabric softeners did not introduce significant differences in reported feeling profiles, despite significant reported variations in color-perfume congruencies. In this section, we report the statistical relationship that we investigated between color-perfume congruency scores and between reported feeling responses for each individual.

Bonferroni-corrected Pearson correlations calculated from Experiment 1 showed a positive correlation between the congruency and liking scores ($R = 0.37$, $p < 0.0001$), positive correlations between the congruency and positive emotional categories (well-being, $R = 0.32$, $p < 0.0001$; desire, $R = 0.28$, $p < 0.0001$; relaxed, $R = 0.34$, $p < 0.0001$; nostalgic, $R = 0.21$, $p < 0.0001$; energetic,

$R = 0.33$, $p < 0.0001$), and a negative correlation between the congruency and disgust feelings ($R = -0.21$, $p < 0.0001$).

In the same way, correlations calculated from Experiment 3 showed a positive relation between the congruency and liking scores ($R = 0.48$, $p < 0.0001$) and between the congruency and positive emotional categories (well-being, $R = 0.36$, $p < 0.0001$; desire, $R = 0.27$, $p < 0.0001$; relaxed, $R = 0.36$, $p < 0.0001$; nostalgic, $R = 0.29$, $p < 0.0001$; energetic, $R = 0.42$, $p < 0.0001$), but a negative correlation between the congruency and disgust feelings ($R = -0.26$, $p < 0.0001$). Thus, for both experiments, the higher that the congruency was evaluated by the participant, the higher their liking scores and emotional responses, which confirmed our hypothesis.

6. Discussion

The aim of this study was to investigate the influence of color on the subjective affective experience evoked by perfumes of fabric softeners, the hypothesis being that higher reported congruence in color-perfume pairs will induce higher liking and higher positive emotional responses.

The first result is that reported feeling responses differed as a function of the perfumed fabric softeners. This result demonstrates the sensitivity of ScentMove™ to measure feeling differences in response to different variations of the same product, as was demonstrated for fine fragrances or perfume oils (Porcherot et al., 2010). This study constitutes an empirical demonstration that this questionnaire could be suitable for the study of verbally reported emotional reactions specific to categories of perfumed products.

Results from the first experiment also highlighted that perfume liking scores of fabric softeners were influenced by color differences, which corroborates results described in the literature (Fenko et al., 2009; Zellner et al., 1991; Zellner & Durlach, 2003). Like other authors (Dalton, 2002), we have shown that olfaction could be affected by the visual system, even when the question focused on perfume perception. This cross–modal interaction was also demonstrated in odor discrimination, even though participants were instructed to ignore visual stimuli (Demattè, Sanabria, & Spence, 2009).

More interestingly, the results of the first experiment demonstrated an implicit color influence on the verbally reported emotional responses to the perfumes of the fabric softeners. Indeed, compared with the blue color, white and pink colors significantly increased scores of happiness, romantic, nostalgic, and relaxed emotional categories. In addition, compared with the white and blue colors, the pink color significantly increased the desire response to the perfumes of the fabric softeners. In line with our previous results (Porcherot et al., 2010), these results also showed the capability of the ScentMove™ questionnaire in providing additional insight into respondents' liking.

However, the influence of the color on the emotional response seemed limited, since the feeling responses differed as a function of color and as a function of perfume, but changing the color of the selected perfumes did not introduce significant differences in the feeling profiles. One plausible explanation could be that the level of familiarity of the three perfumes was too high, since greater color influences have been reported for unfamiliar odors, which are harder to discriminate and describe (Stevenson & Oaten, 2008). In our study, the high level of perfume familiarity might have incidentally induced identification of the main olfactory character despite the fact that the task required neither recognition nor identification. It has already been shown that people are better at identifying more familiar odors than less familiar ones (Herz & von Clef, 2001; Zellner et al., 1991). In recent work, we also demonstrated that reinforcing participants' semantic knowledge of an odor by providing its name had less influence on the reported subjective feelings in response to that odor when it was highly familiar (Porcherot et al., 2012).

Another explanation is that the chosen colors were highly congruent with the perfumes and that the color-perfume congruency had already reached an optimum level, especially in the third experiment. Colors with more contrast, such as green or red, which were selected less often in Experiment 2, might have shown more differences in the emotional response compared with the optimized colors. This result emphasizes that slight changes of color could not result in significant changes in the liking scores and in the verbal report of emotions. However, these results do not refute the importance of color-perfume pairing for a consistent marketing message. Indeed, Pearson correlation coefficients calculated at the individual level showed that the more congruent the color-perfume associations, the higher the feeling responses.

The color-perfume match result of the second experiment was confirmed with the congruency scores from the third experiment, which were higher for the colors chosen by the highest numbers of respondents in Experiment 2. However, we did not observe a high consensus in the second experiment; three colors were selected by an equivalent number of participants at a maximum of 21%. These three colors were close in hue for the Lagoon perfume, as two blue and purple colors were chosen, but could also be very different, such as the white, purple, and blue for the Cotton perfume. Thus, despite a certain consistency between the three experiments, these results did not corroborate a robust correspondence between colors and odors, as shown by Gilbert and collaborators (1996) and Schifferstein and Tanudjaja (2004).

Our conclusions are only valid within the limits of the experimental conditions, which were close to market reality in terms of perfume and color selection, but which were different from the conditions of a natural environment. For instance, one could argue that the influence of color is limited because employees are more familiar with the perfumes. Thus, potential influences might have been masked, along with the fact that we did not investigate whether the participant was a consumer of the product or not (King & Meiselman, 2009). Some of the consumers might be exclusive buyers of fabric softener of a certain color. The impact of the color might depend on whether the respondents buy fabric softener of the color presented, buy fabric softener of a different color, or do not buy fabric softener of a particular color. One can assume that consumers who exclusively buy blue-colored softeners might be more disturbed by another color than are consumers who do not pay much attention to colors and buy fabric softener of any color.

Since product experience is multisensory, it would also be interesting to know which sensory modality plays a leading role in a particular experience and context (Fenko et al., 2009). Previous studies have already shown that the dominant modality depends on the period of usage. When buying a product, vision is probably the most important modality, but smell can become more important at a later stage (Fenko, Schifferstein, & Hekkert, 2010). The color and perfume description might be the first determinants of fabric softener choice. This might be followed later by the perfume of the fabric softener after it is taken home and smelled. The buying intention was not measured in our study, and we focused only on emotional responses while the participants smelled the perfume of fabric softeners. Further studies could therefore be envisaged to measure the influence of the softener color in a more explicit way.

7. Conclusion

The aim of this study was to investigate the influence of color on the verbal measurement of emotions in response to different perfumes of fabric softeners. Our results indicated that participants' subjective affective response was different for the different perfumes and was influenced by color, but that changing the color of the selected perfumes did not introduce significant differences in the feeling profiles. Our results however suggest that improving color-perfume congruency could induce a modest increase in both liking and positive feeling reports. More generally, this study underlines a predominant role of the perfume and a more limited influence of color.

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