Impacts of sensory multimodality congruence and familiarity with short use on cosmetic product evaluation

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Abstract

Cross-modal association between sensory modalities is a natural phenomenon in the perception of our environment. For a cosmetic evaluation context, touch and smell appear as the two major sensory modes involved in product perception and cross-modal associations between these two modalities can be explored. In this study, we investigate if one specific olfactory notes of different cosmetic fragrance families is associated to a specific cosmetic textures. In addition, we investigate whether the mechanisms of congruence between touch and smell, and one week product use, influence product appreciation and well-being of the user. We conducted a 4 stage-experiment with 29 participants who evaluated cosmetic fragrances and cosmetic textures at the laboratory and at home. Results show that: 1) For a given texture type, specific olfactory notes are necessary to lead to congruent cross-modal pairing product. 2) Sensory modal congruent products produce the highest hedonic response. 3) The cross-modal congruence can be modified after product use and familiarization which can influence overall cosmetic product appreciation.

Keywords

Cosmetics; smell; touch; sensory multimodality; cross-modal association; congruence; familiarity; emotions.

I. Introduction

The world is a multi-sensory environment where each event has its multi-faces. The perception of an object is therefore always the result of the integration of information coming from our different senses. This simultaneous multimodal integration can create perceptual associations, called cross-modal associations [1], between specific sensory modalities. However, not all sensory modalities are involved equally to all stimuli and specific cross-modal integration may be particularly relevant for specific context. For a cosmetic product, touch and olfaction are intuitively the two most important senses and their integration play an important role in perceptual decision making to guide product utilization behavior [2]. In addition, state of the art about the actual cosmetic market shows that a given texture is more associated with particular family of fragrances. Indeed, we can notice with expert olfactory analysis that sensory parameters like fragrance, texture and color drive the cosmetic product mappings. Fresh, floral, citrus, green with aromatics or cold spices olfactory notes are more frequently associated with light textures to formulate usually moisturizing cosmetic products. Floral, aldehydic, powdery or oriental with hot spices olfactory notes are more frequently associated with solid textures to formulate usually anti-ageing and nutritive cosmetic products.

While several studies realized on smell/taste [3], smell/audition [4] and smell/vision [5] associations or on touch/taste [6], touch/audition [7] and touch/vision [8] associations show that cross modal interactions have an impact on subjective experience. Less attention has been attributed to the effects of association between smell and touch. One study realized by Demattè et al. [9] on the cross-modal association between touch and smell regarding fabrics evaluation have shown that olfactory cues can modulate tactile perception. Nonetheless, cross-modal interaction is not only limited to modify each modal perception but also modify the whole product hedonic evaluation (subjective preference and liking). Study of Croy et al. [10] have also shown on associative perception of smell and touch, that unpleasant odor decreases touch pleasantness of tactile stimulation compared to odorless control [11]. However, they use brush stroking as tactile stimulations which is far from cosmetic product evaluation with high emotional

stimuli [12]. To our knowledge, only the study of Courrèges et al. [2] have focused on the influences of cross-modal interaction between touch and smell on hedonic evaluation of cosmetic product. They have shown that the addition of a fragrance increased well-being ratings and liking of texture, but they have only studied the impact of different floral fragrance concentration and did not investigate the influence of different olfactory notes on product perception. Moreover, the mechanisms underpinning these effects, like the degree of congruence between the modalities, were not examined. The whole product appreciation depends not only on the degree of congruence between the sensory modalities but also on a dynamic process link to the degree of familiarity and affectivity after repeated use [13]. The home user experience is therefore very important in product evaluation, though it is still less studied.

In the present study, we try to answer the following global question: Could the general perception and subjective emotional evaluation of skin care cosmetics be influenced by the degree of congruence between product's texture and fragrance, and by the degree of familiarity with the product? Precisely, we have the following sub-questions; 1) How touch could create an expectation about other sensory modalities (especially about olfactory perception) and inversely, how an olfactory stimulus could evoke the experience of other sensory modalities (especially about texture perception)? 2) Can the different textures of skin care bases be more associated with specific olfactory notes? 3) How different texture-fragrance combinations impact emotions provided by cosmetic products? and 4) Whether the process of familiarization after home use modified product perception?

To answer these questions, we conducted a study in 4 stages:

- Test 1: Participants describe freely their perception about different selected textures and fragrances of cosmetic products.
- Test 2: To focus on cross modal interaction of touch and smell, we went through a more indexed evaluation where participants expressed their sensory evocations of smell during the presentation of different textures and their sensory evocation of touch during the presentation of different fragrances.
- Test 3: To examine the effect of cross-modal touch/smell congruence on emotion induced, participants expressed their emotional responses to real cosmetic products made of different combinations of texture/fragrance.
- Test 4: Participants did a Customer-Use-Test at home with 2 products, daily use for 1 week each, to evaluate the effect of familiarity on emotional responses and on global product evaluation.

II. Materials and Methods

II.1 Participants

A screening questionnaire about perfume and face skin care product's use frequency, was distributed to a list of voluntary participants. Participants were selected according to their cosmetic habits; only participants who reported using facial care products at least twice a week and perfume once a week, were selected. This step also allowed us to collect the usage habits of the subjects (type of perfume, type of skin, type of product used for the face, concern for the texture of a product, concern for the smell of a product). All participants reported having a normal sense of smell and touch, no history of olfactory dysfunction and no allergies to cosmetics and perfumes available on the market. To our knowledge studies done on cross-modal olfaction/touch perception of cosmetics available in the literature, focused on the evaluation of products by women. However, over the past decade, more and more men are interested in cosmetic products for the well-being of their body, so we wanted to include men and women in our study. Finally, 29 subjects (24 women and 5 men) participated to our study corresponding to the criteria mentioned above. Written informed consent was obtained from every participant.

II.2 Materials

Textures

Textures selection comes from different non-fragranced cosmetic formula, created by an external laboratory in regards to the actual cosmetic market. Indeed, there is a strong segmentation of the cosmetics market according to specific customer requirements. These segments are formed according to the age, skin type, skin benefits, customer needs, etc. There is therefore a wide variety of cosmetic product textures adapted to market zones/ cosmetic benefits. In contrast to previous studies done on cross-modal interaction between olfaction and touch, we wished to use textures representing the

usual variability of textures available on the market. We chose textures with various sensory and mechanical properties as they affect texture perception. We selected the following textures: cream, skin-gel, skin-balm and dry oil. These four formulas differ in texture attributes: 1) cream/skin-balm were more solid and 2) skin-gel/dry oil more liquid; 3) skin-gel/cream were more aqueous and 4) dry oil/skin-balm oilier. The samples were blinded presented to the participants with a three-digital random code. These formulations were developed with a cosmetic formulation laboratory, who provided all the non-toxicity regulatory files associated to the formulas.

Fragrances

All the fragrances have been created and submitted by 2 perfume houses: COSMO International Fragrance in Grasse (France) and TechnicoFlor in Paris (France). These fragrance suppliers were briefed to provide a large range of olfactory notes of different cosmetic fragrance families commonly used in international cosmetic markets. We chose six fragrances belonging to the major families present in the worldwide cosmetic market, as shown in figure 1. The samples were presented in a 60 ml large opening brown glass bottle with a three-digital random code. The perfume houses provided all the non-toxicity regulatory files associated to the fragrances. Fragrances were diluted at 0.25% in neutral mineral oil for test 1 and 2.

Figure 1: Selected fragrance samples positioned on olfactory families

Combined product: texture + fragrance

To study cross-modal congruence and to verify whether touch/smell associations present in the market could increase the comfort and well-being induced by cosmetic products, we created different combined products by mixing different textures with different fragrances. We were not able to test all the texture/fragrance combinations, so only certain of them have been evaluated. For each texture, we have chosen one or two fragrance(s) most associated in the market and supposed to be as congruent fragrance(s) and one fragrance least or not associated in the market and supposed to be as incongruent fragrance. As shown in the table 1, ten combined products were evaluated; three skin-gel textures, three cream textures, two dry oil textures and two skin-balm textures. Cross-modal combined cosmetic products were presented to participants with a three-digital random code. Our skin-balm texture had a base odor due to its strong odorant ingredients, so we adjusted its fragrance concentration to have a similar perceived intensity of fragrance between each of our products. The combined products were not only evaluated in the laboratory but also so-called one congruent and one incongruent of them (individually specific) were chosen to be used at home by the participants.

II.3 Procedure

Test 1: Free description

Participants sat on a chair in front of a table where there was a custom blind box with one small opening in front of the participant and one large opening in the other side, to allows the presentation of the stimuli by the experimenter. This custom box allows the blind presentation of the tactile stimuli not to visually bias the tactile perception of our samples. As we want to measure the spontaneous evocation of all sensory modalities in the perception of our samples, participants freely describe the four textures and the six fragrances. For each texture stimulus, participants were told to insert their hands in the box where the experimenter presented the texture and then applied the texture on their

Texture	So-called congruent associations		So-called incongruent associations
Cream	Freesia	Grape	Coffee
Skin-gel	Bamboo	Bergamot	Date
Skin-balm	Date		Bamboo
Dry oil	Bergamot		Grape

Table 1: Combined product (texture + fragrance) evaluated in the study. *The cream and skin-gel textures have 3 associated fragrances. The oil and skin-balm textures have 2 associated fragrances.*

dominant hand without seeing the product. Participants could touch the texture and use it on the way they wanted, while expressing themselves about their sensory experiences. They were asked to describe the stimulus and whatever it evoked to them by answering an online sheet edited in Lime Survey. The following instruction was displayed: "Please describe in your own words anything that the stimulus causes or evokes in you". After the evaluation of each texture stimulus, participants should use cotton pad soaked in unscented soap and then cotton pad soaked in distilled water to clean their skin. For each olfactory stimulus, participants responded to the same question. Participants had to dip a perfumer's blotter into the scented solutions to smell each sample. To avoid any sensory overlap, the experimenter ensured that a delay of one minute between the presentation of two olfactory stimuli was respected. The order of presentation of the stimuli was randomised and the order of presentation of tactile or olfactory stimuli was counterbalanced over participants.

Test 2: Indexed description

As we would study the relationships between olfaction and touch, participants were pushed in this test to express their olfactory expectations when touching tactile stimuli and conversely, to express their tactile expectations when smelling fragrances. Participants interacted with the four tactile stimuli and the six olfactory stimuli in the same way than in test 1 but they were asked to express their sensory experience using a derived quantitative descriptive analysis (QDA). Respectively, for tactile and olfactory stimuli, a list of 18 olfactory or tactile descriptors were proposed to participants as shown in table 2. The lists of sensory descriptors were generated to cover a wide range of texture attributes and olfactory families. For each stimulus (texture or fragrance), participants were asked to express the level of congruence between the descriptor and their sensory experience of the stimulus using a 5-point categorical scale with the labels: “Not at all”, “Not very”, “Moderately”, “Well”, “Perfectly”. The following instruction was displayed to participants: “Please click on one of the boxes to express the congruence felt between the descriptor and what the product evoked in you”.

The order of presentation of the stimuli was randomised and the order of presentation of texture or olfactory stimuli was counterbalanced over participants.

Test 3: Texture/fragrance combined products evaluation

After a short break, participants evaluate the 10 combined products according to five aspects: the pleasure provided by the use of the product, the comfort sensation provided by the application of the product, the congruence between the texture and the smell of the product, the level of their subjective excitability produced by the use of the product and the desire to use the product. Participants inserted their hand in the box to apply products and then smelled their hands. They responded on a Visual Analogue Scale by clicking at any point along a line between two extremes, which varied by question. Responses were recorded by the software as values between -500 (pixels) and +500 (pixels). The order of presentation of the stimuli was randomised over participants.

Tactile descriptors	Olfactory descriptors
Slight	Floral
Heavy	Fruity
Smooth	Nut
Rough	Lemon
Creamy	Herbal
Oily	Fresh
Hot	Spicy
Cold	Woody
Hard	Vanilla
Soft	Caramelized
Powdery	Grilled
Dry	Minty
Wet	Aromatic
Liquid	Citrus
Viscous	Tea
Greasy	Animal
Sticky	Smoked
Doughy	Medicinal

Table 2: Lists of sensory descriptors. *The list of olfactory descriptors was presented during the evaluation of textures and the list of tactile descriptors was presented during the evaluation of fragrances.*

Test 4: Home evaluation

We decided to focus only on cream and skin-gel textures for home evaluation as they were lighter and easier to use at any time of the day than skin-balm and dry oil. Each participant will use two products. The choice of the two texture/fragrance combined products depends on the participants' subjective experience measured in the test 3. Among six cream/fragrance or skin-gel/fragrance combined products, participants used at home the one which was evaluated as the most congruent between texture and fragrance and the one which was evaluated as the least congruent. They realized the home evaluation by using each product once a day on their face for seven days with a break of two days between the two products. They filled two online questionnaires presented with Lime Survey. They responded every day to a "Daily report" where they evaluated their mood and emotional state before and after applying the product using the Self-Assessment-Manikin (SAM) [14] (valence and arousal) and scores of 13 different moods. Participants also completed another questionnaire, called "Judgement report", on the first and last day of product use in which they were asked to indicate their overall product appreciation, texture appreciation, smell appreciation, feeling of comfort, congruence between texture and fragrance and desire to continue using the product. The order of use of congruent or incongruent products was randomized over participants.

Statistical Analysis

For test 1, only sensory terms were counted from descriptive terms. For the rest of the tests, normality of the data was checked before each statistical analysis with the Shapiro-Wilk test and homoscedasticity with the Levene test to realize parametric or non-parametric tests otherwise. For test 2, we used statistical tests to compare the congruence between different texture and olfactory descriptors. For test 3, we conducted statistical tests to compared participants' responses for both type of product ("Congruent" and "Incongruent") according to the five types of measures ("Congruence", "Pleasure", "Comfort", "Want to use" and "Arousal"). Correlations between congruence and pleasure, congruence and comfort, and congruence and want to use, were calculated to explore whether congruence has an impact on hedonic experiences. For test 4, we conducted a two-way ANOVA with factor 1: "Product type" at 2 level (congruent or incongruent) and factor 2: "Day use" at 2 levels (Day 1 and Day 7) to study the effect of product type and familiarization on congruence felt, overall appreciation and want to use the product. Correlations between congruence and global appreciation, congruence and comfort, and congruence and want to use, for both type of products (congruent or incongruent) were calculated to explore whether congruence has an impact on hedonic experiences during home use.

III. Results

III.1 Test 1: Free description

In this test, participants were free to describe the stimuli (texture or fragrance) in their own words and the occurrence of words related to sensory dimensions was counted. Figure 2 shows the number of participants who expressed words related to a sensory dimension for describing the samples. We notice that the first sensory dimension used to describe fragrance and texture was respectively the olfactory and tactile dimensions. For texture description, 86 % of participants responses contain words related to the tactile dimension, while for the description of fragrances, 73% of the participants' answers refer to the olfactory modality. The second most used dimension for fragrances and textures description is respectively touch and vision. The percentage of sensory representation of each modality is calculated with the ratio of the sum of the number of participants who expressed an expectation for that modality across all samples to the total number of sensory terms.

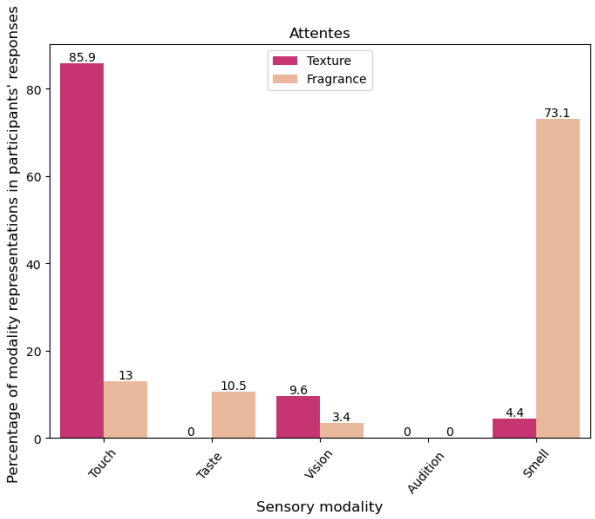

Figure 2 : Percentage of sensory modality used to describe samples.

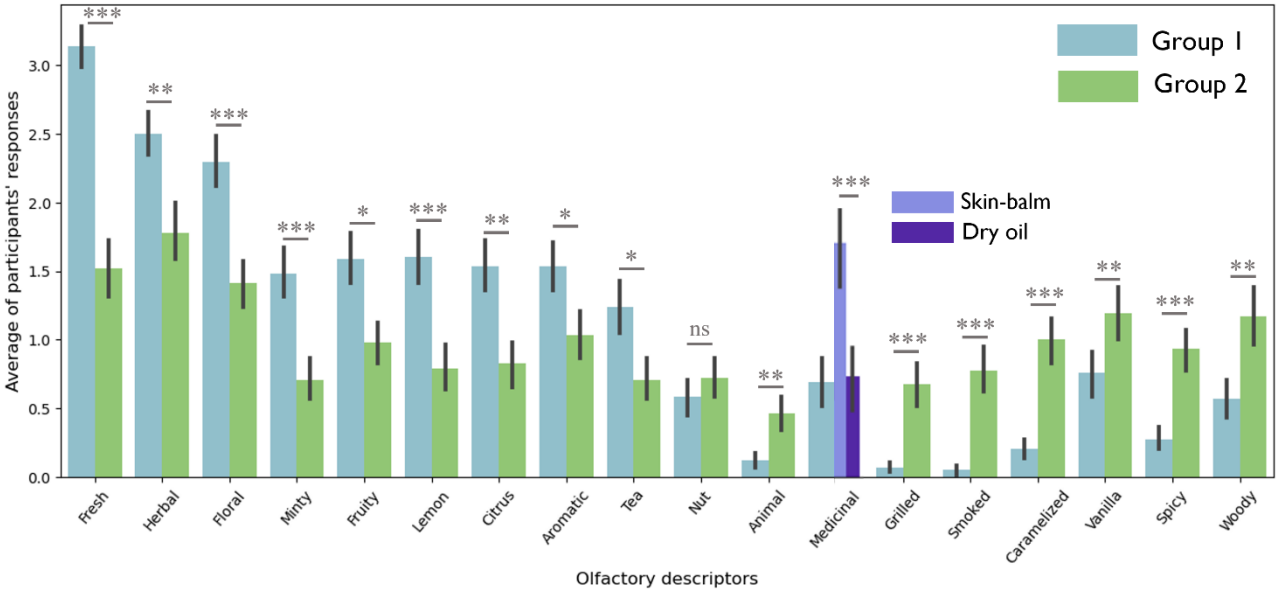

Figure 3 : Congruence of tactile experience and olfactory descriptors. *Group 1: tactile experience of cream or skin-gel; group 2: tactile experience of skin-balm or dry oil. Medicinal descriptor is not grouped by samples for skin-balm and dry-oil.*

III.2 Test 2: Indexed description

In this test, participants judged the degree of congruence between olfactory experience and tactile descriptors or tactile experience and olfactory descriptors using a 5-points categorical scale.

Texture stimuli

Results showed that the levels of congruence between tactile experience of cream and fragrance is very similar to that between skin-gel and fragrance, and that the congruence between tactile experience of skin-balm and fragrance is very similar to that between dry oil and fragrance. From these observations, the four textures tested were divided into two texture groups: group 1 included cream and skin-gel, group 2 included skin-balm and dry oil. Only one exception for group 2 was noticed: skin-balm was significantly more associated with olfactory medicinal descriptor than did dry oil ($mean_{skin\text{-}balm}$ = 1,690; $mean_{dry\ oil}$ = 0,724; $W(28)$ = 22.000; p=0.009). Figure 3 shows that each of the texture groups is associated with specific olfactory descriptors representing distinct olfactory families. Cream and skin-gel (group 1) tactile experience was more congruent with fresh, floral, herbal, citrus, fruity, minty, citrus, aromatic and tea olfactory notes, while dry oil and skin-balm (group 2) with grilled, smoked, caramelized, vanilla, spicy and woody olfactory notes, as demonstrate in table 3.

Descriptors	W	z	p
Fresh	102.000	-4.791	< .001
Herbal	273.500	-2.754	0.005
Floral	153.000	-3.596	< .001
Minty	150.500	-3.342	< .001
Fruity	201.000	-2.458	0.013
Lemon	131.000	-3.473	< .001
Citrus	125.500	-2.770	0.005
Aromatic	176.500	-2.269	0.022
Tea	139.500	-2.126	0.032
Nut	229.500	0.973	0.327
Animal	141.000	2.417	0.015
Medicinal	399.500	2.126	0.033
Grilled	214.500	3.441	< .001
Smoked	247.000	3.912	< .001
Caramelized	385.500	3.633	< .001
Vanilla	325.500	1.913	0.054
Spicy	482.500	3.609	< .001
Woody	318.500	2.630	0.008

Table 2 : Wilcoxon signed-rank test between group 1 (cream/skin-gel) and group 2 (skin-balm/dry oil) on level of congruence.

Olfactory stimuli

Unlike texture stimuli, where a given tactile experience is congruent with a specific olfactory descriptors, the congrence of an olfactory experience with different texture descriptors was less evident as shown in figure 3. Generally, the congruence of different olfactory experiences was similar for all texture descriptors, no specific congruence between an olfactory experience with a particular texture descriptor was observed. However, some fragrance specificities can be graphically highlighted with mean comparison. The "Coffee" seemed to show more congruence with several texture attributes such as to “Liquid”,

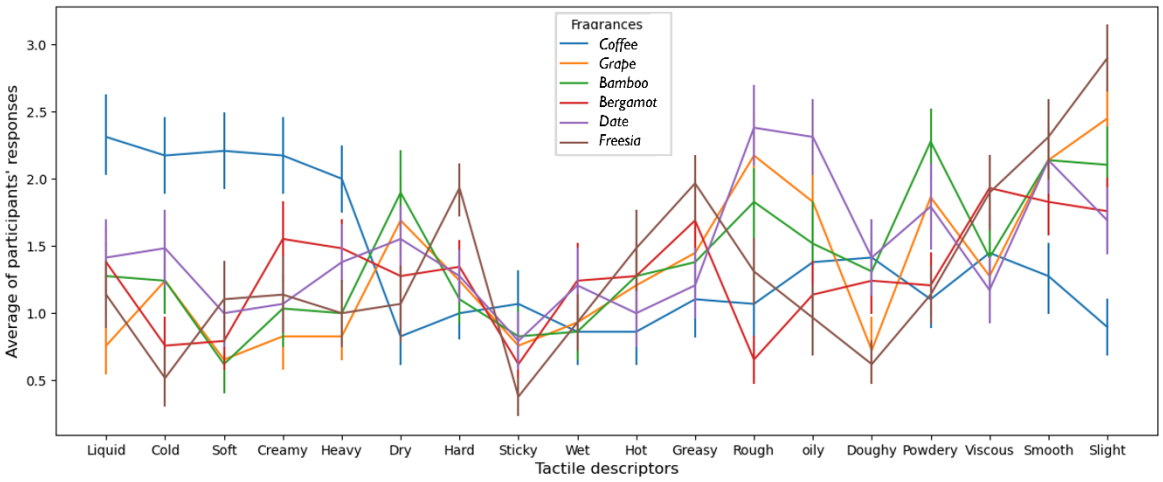

Figure 5 : Congruence of olfactory experience and tactile descriptors.

"Cold", "Soft", "Creamy", "Heavy", and less congruent with "Smooth" and "Slight" in comparison to other olfactory experiences. In addition, different olfactory experiences were the most congruent with different texture descriptors. For example, "Date" was the most congruent with "Oily", "Bamboo" with "Powdery" and "Freesia" with "Slight" and "Hard".

III.3 Test 3: Texture/fragrance combined products evaluation

In this test, participants interacted with ten combined cosmetic products and evaluated the perception of these products according with five types of measures: "Congruence", "Pleasure", "Comfort", "Want to use" and "Arousal". We focused our analysis on 8 product (2 fragrances per texture) and on 27 valid participant responses. In each graph in figure 5, the darker color represents the so-called fragrance-texture congruent product and the lighter color the so-called fragrance-texture incongruent product. As shown in figure 5, our hypothesis from the cosmetic market analysis on congruence was confirmed for cream texture, skin-gel texture, and dry-oil texture but not for skin-balm texture. For cream and skin-gel textures, congruence was positively correlated to pleasure, want to use and comfort of the product as shown in table 4, but not for skin-balm and dry oil textures. The figure 5 also shows that for a given texture, either the product was combined with a congruent or incongruent fragrance, the arousal state of the participant did not show difference. However, arousal varies according to the texture of the product which suggested that in our study, the arousal of the product is determined by the quality of the texture and not by the fragrance. For cream texture, the level of congruence was significantly different between congruent and incongruent product ($t(52)=5.698$, $p<.001$). The congruent cream based product has significantly higher scores for Want to use ($t(52)=2.823$, $p=0.007$), Pleasure ($t(52)=2.827$, $p=0.007$) and Comfort ($t(52)=2.464$, $p=0.017$) but not for Arousal ($t(52)=0.006$, $p= 0.995$).

Pearson's correlations

		Pearson's r		p
Cream	Pleasure	0.495	***	< .001
	Comfort	0.563	***	< .001
	Want to use	0.577	***	< .001
Gel	Pleasure	0.428	**	0.001
	Comfort	0.362	**	0.007
	Want to use	0.423	**	0.001

** p < .05, ** p < .01, *** p < .001*

Table 4: Correlation between congruence scores and pleasure, comfort and want to use the product for cream and skin-gel textures.

III.4 Test 4: Home evaluation

Analyses were conducted on 19 participants' valid responses given on the first and last day of use for both congruent and incongruent product (n=76, 19 responses x 2 products x 2 days). Statistically significant correlations were shown between congruence with global appreciation of the product ($r(75)= 0.420$, $p<.001$) and with want to use the product ($r(75)= 0.515$, $p<.001$) but not with comfort ($r(75)= 0.180$, $p=0.114$). Two-way ANOVA with factor 1: "Product type" at 2 level (congruent vs. incongruent) and factor 2: "Day use" at 2 levels (Day 1 vs. Day 7), showed that congruent products have higher scores for congruence ($F(1, 74) =37.618$, $p < .001$), for want to use ($F(1, 74) =6.271$,

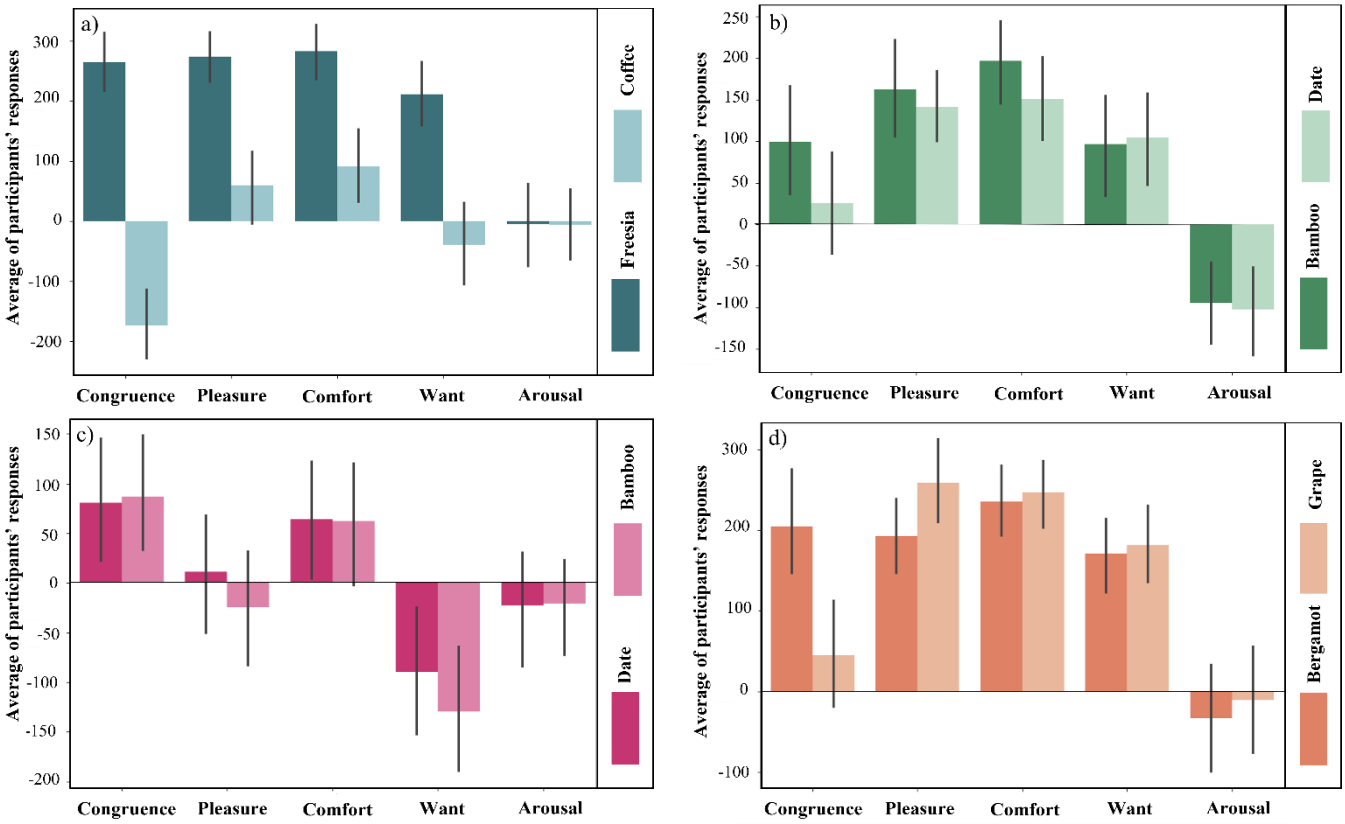

Figure 5: Average of participants' responses for each measure (arousal, comfort, congruence, pleasure, and want to use the product) for congruent and incongruous products of each texture. *a) Cream texture, b) Skin-gel texture, c) Skin-balm texture and d) Dry oil texture. For each graph, the darker color represents the texture/fragrance congruent product and the lighter the texture/fragrance incongruent product.*

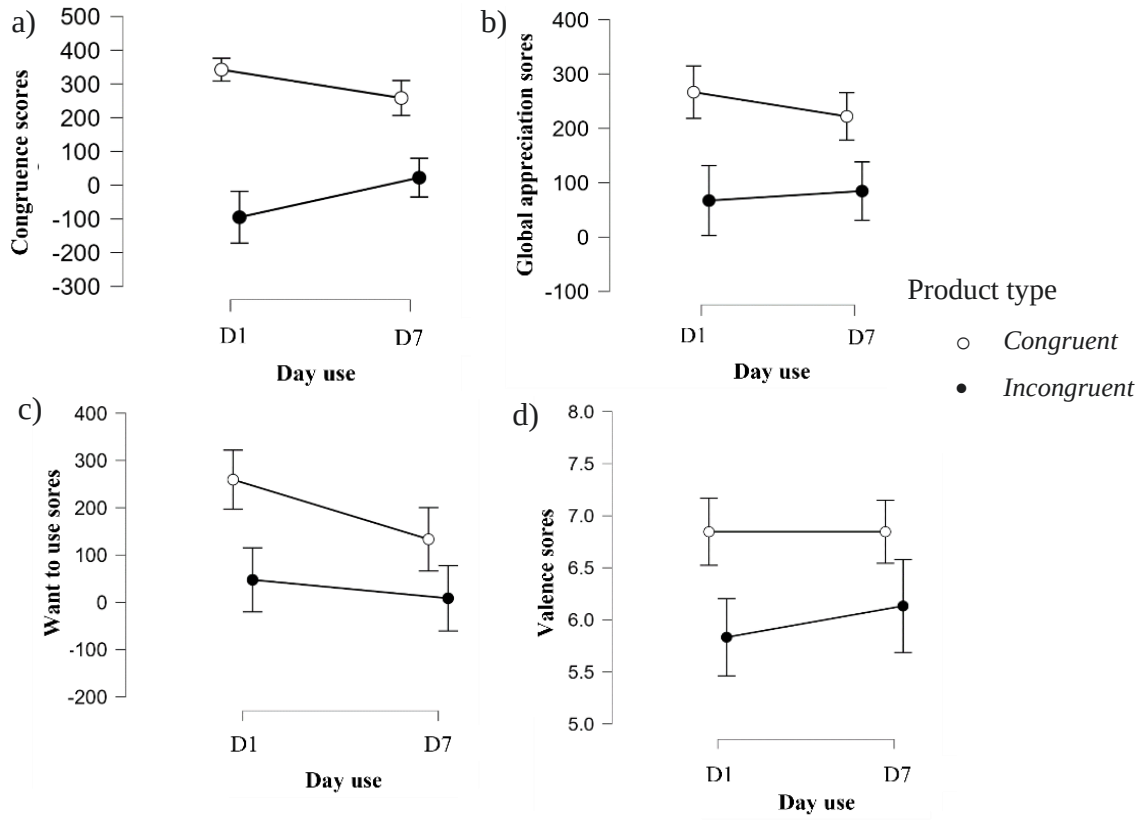

Figure 6: Evolution of congruence scores(a), global appreciation(b), want to continue using the product(c) and valence(d), over one week of use of the two types of products.

p=0.014), for global appreciation (F(1, 74)=10.417, p=0.002) and for valence (F(1, 74)=5.328, p=0.023). “Day use” (F(1, 74)=0.092, p=0.763) and interaction between “Product type” and “Day use” (F(1, 74) = 3.558,) tend towards significance only for congruence scores. As shown in figure 6.a), congruence scores seem to decrease after one week of use for congruent product and increase for incongruent product. In addition, figure 6.b) shows a similar pattern for the global appreciation scores which seem to decrease after one week of use for congruent product. Figure 6.c) suggests that the want to continue to use the product decreases after one week of use faster for congruent product than for incongruent product. Moreover, figure 6.d) shows that valence scores seem to be stable after one week of use for congruent product and increase for incongruent product.

IV. Discussion

With free descriptive analysis, we have shown that monosensory experience can evoke multimodality perception. We notice that the number of words relative to smell in free fragrance description is lower than number of words relative to touch in free texture description. This result highlights that olfactory stimuli are more likely to be described with words link to another sensory modality and support the difficulty observed to describe, identify, and name odors [15]. In addition, for tactile experience, apart from texture perception, the most evoked modality is the vision. This observation supports that vision and touch are strongly associated in the perception, since a same texture attribute (e.g., greasy, liquid, oily, viscous, etc.) can be perceived either by vision and/or by touch. These two sensory modalities give complementary information as shown in the study of Whitaker et al. [16], and our results suggest that texture perception is an integrated feature of tactile and visual information. However, the visual perception is not always the most evoked cross-modal perception. In our study, olfactory experience is the most associated with the tactile perception, after the olfactory dimension. This tight olfactory/tactile association was also observed in the study of Spector et al. [17]. In everyday life, vision very often guides motor actions in the manipulation of objects, whereas in cosmetics, products often have a fragrance that guides the user's usage behavior. Thus, cross-modal associations appear to be dependent on the simultaneous role of sensory modalities involved in information extraction.

To study the cross-modal congruence in cosmetic products, we have used derived DQA method to judge the congruence between tactile experience and olfactory descriptors, as well as between olfactory experience and texture descriptors. When examining how tactile experience was congruent with olfactory descriptors, the four textures tested can be divided into two distinct groups of textures. Group 1 is made of cream and skin-gel and group 2 of dry oil and skin-balm. Cream and skin-gel are thought to be more congruent with fresh, fruity or floral olfactory notes, while dry oil and skin-balm with caramelized, spicy and woody olfactory notes. However, olfactory experiences paired with tactile perception are quite similar between different fragrances, despite some exceptions: oriental notes are more congruent with oily textures while floral and green notes are respectively more congruent to light and powdery textures. These associations can be due to associative learning [18] owing to the presence of more frequent specific texture/fragrance association in cosmetic market. Since the tactile experience of a texture type, causes congruence with defined olfactory descriptors but less for olfactory experience with defined tactile descriptors, cross-modal associations between touch and smell appear to be asymmetrical. In addition, participants expressed that they found it easier to imagine a fragrance from a texture than a texture from a fragrance. In everyday life, few categories of textures exist compared to the large olfactory notes, we may encounter. Thus, a fragrance can often be associated with all types of textural structures while a texture may be more associated with a specific olfactory note.

One of our purposes is to explore whether sensory pleasure and comfort from a whole product (combined texture-fragrance product), is partially underpinned by the cross-modal congruence. In fact, the relationship between cross-modal congruence and perception of whole product is not simple. Our results in the laboratory have shown that high smell/texture cross-modal congruence is positively correlated with pleasure, comfort and global appreciation scores only for cream and skin-gel based products. In addition, at the beginning and at the end of the home use, it was shown that the congruence is correlated with the other parameters of overall appreciation and want to use the product.

Thus, evaluating the congruence of cream-based and skin-gel-based products can be a good measure for predicting the pleasure provided by the product. These two textures appear as the most commonly used in facial care which suggest that congruence is a good predictor of pleasure for products that are well known by consumers and/or used regularly.

For congruent products use during home evaluation, we notice little changes in the hedonic experience (valence) and overall appreciation (want to use and appreciation of the product). This sensory habituation can be argued by the study of Ferdenzi et al. where results show that repeated exposure to odors induce a decrease of emotional intensity over repetitions [19]. For incongruent products, results are not the same: congruence and valence scores enhance during home use. These observations show that the texture/fragrance cross-modal congruence is variable during use, suggesting that the process of familiarization impacts the touch/smell cross-modal perception. Even though high pleasure is evoked by the products with their cross-modalities judged as congruent, the dynamic increase of congruence during use for product considered as incongruent at first, could modified the perceived pleasure. The incongruent products are often new products with a fragrance-texture association not yet previously presented in cosmetics market. They can appear as more innovative [20] and can reduce the phenomenon of sensory habituation by maintaining the attention of consumers through the surprise effect. Our results show that after repeated use, the degree of congruence increases, leading to increased pleasure and comfort. Thus, the incongruence measured at the first use is not necessarily an indication of a negative product, on the contrary it could represent a product that has the potential to evolve. The sensory non-habituation created by an original combined product would allow a stronger consumer loyalty in the long term.

Our results can have some limitations as only self-report measurements of emotions have been analyzed. They can be vulnerable to people state of mind or social bias and may raise questions of objectivity [21]. However, alternative methods exist [22] and the study done by Moustafa et al. show that physiological measurements (heart rate and skin conductance) can be relevant to measure emotions in response to odors [23]. We recorded physiological measurements: heart rate, breathing rate and skin conductance during our study. The next step is to investigate whether the physiological measurements can provide additional information on the emotions induced by congruent and incongruent products. In addition, we can go further with longer home use to understand how participants' responses might evolved on a long-term cosmetic use.

V. Conclusion

In this study, we have demonstrated that for a particular cosmetic texture, there exists some specific cosmetic fragrances making cross-modalities to be congruent between them. In addition, this cross-modal congruence between cosmetic textures and fragrances can predict the pleasure and comfort provided by the products made of cream and skin-gel textures. However, touch/smell congruence is a dynamic process and can be affected by the process of familiarization. Touch/smell incongruent products can be perceived differently after home use. Incongruence could be a relevant characteristic causing attention on novelty to attract the consumer, this could be relevant to explore in the development of future cosmetic product. Our results highlight that cross-modal correspondence is a complex phenomenon depending on familiarity and on product use which could affect users' mood. It is therefore essential to integrate the full consumer product's journey as cross-modal associations depend on the context's use, the type of stimuli and also the consumer s' experience.

VI. Acknowledgement

We would like to thank COSMO International Fragrance and TechnicoFlor for their contribution in material supplies with a widely range of fragrances.

VII. Conflict of Interest Statement

NONE

VIII. References

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