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Psychological effects and brain correlates of a rose-based scented cosmetic cream

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Abstract

In the present study, we investigated the effects of a cosmetic cream with a rose based formula scent on mood, in a sample of 26 female participants, with a mean age of 27.42 years of age. We looked at psychological measures (e.g., mood-based self-reports scales) and brain-related correlates (e.g., brain activation patterns) of stress/relaxation in the scented versus an odorless skin care cream with the same physical characteristics. We employed a mood induction procedure using a face-processing task based on positive, neutral, and negative faces. Results showed that the scented cream led to more happiness no matter the sequence of presentation and was associated to more relaxation, satisfaction, happiness, and less stress if presented after the odorless cream. The use of scented cream also increased the discharge in the brain area related to the task of face perception, and also modulated the discharge of the area involved in pleasure perception and reward.

Practical applications

Results of the present study provide important data on the scent formulas that can be effectively used in cosmetics in order to boost their effects on mood.

1 | INTRODUCTION

Most of the cosmetics we are currently using contain fragrances based on volatile or semi-volatile compounds. This is due to the fact that fragrances have been found to be important for product choice and satisfaction (Bridges 2002). The use of fragrances can elicit affective psychobiological reactions in people using them (e.g., Herz, Beland, & Hellerstein, 2004; Tanida, Sakatani, Takano, & Tagai, 2004; Weber & Heuberger, 2008). Indeed, as an example, essential oils and fragrances are used in aromatherapy as therapeutic agents for the management of affective states (e.g., relaxation, stress control, subjective pain reduction etc.) or for inducing affective states (Haber, Kim, Mailly, & Calzavara, 2006; Schneider et al., 2006, 2007). Temporary beneficial psychological effects of aromas on human behavior, mood states, and quality of life have been found (see Angelucci et al., 2014; Fowler, 2006). Scents like lavender, jasmine, chamomile, citrus, orange, sweet marjoram, roses, Patchouli, jojoba, hiba oil, and/or or ylang-ylang have been shown to influence affective states, inducing either low arousal pleasant/positive states (e.g., relaxed mood) or high arousal pleasant/positive states (e.g., invigorated/energizing mood). For example, lavender was shown to induce relaxation in some studies, while in other studies it had an energizing effect (see Angelucci et al., 2014). On the other hand, Kiecolt-Glaser et al. (2008) found that while lavender had no better effect on affective states than water, the lemon oil did have a positive mood effect. Maybe some of these conflicting results are related to participants' various response expectations. Beneficial effects of exposure to lavender, jasmine, and mint (Rovesti & Colombo, 1973) on depressive and anxious symptoms

have been documented. Also, peppermint and rosemary have been found to be associated with increased sedation, improved memory, and improved cognitive functions (Moss, Cook, Wesnes, & Duckett, 2003). The same authors also found an anxiety reduction and sedative effects for lavender.

Studies investigating the effects of fragrances have used various established mood induction methods. Mood induction generally refers to the methodologies used to change a subject's mood, so that ulterior mood changes can be examined in different conditions (e.g., after the administration of a pleasant odor). For example, Tanida, Katsuyama, and Sakatani (2008) used mental arithmetic task, while Bradley, Brown, Chu, and Lea (2009) used anxiety-provoking film clips, and Kiecolt-Glaser et al. (2008) used the cold pressor task. All these procedures led to an increase in the level of the negative mood in the subjects examined. In other studies (Itai et al., 2000; Lehrner, Marwinski, Lehr, Johren, & Deecke, 2005; Muzzarelli, Force, & Sebold, 2006), the design permitted the use of more ecological means of mood induction, such as the initial screening for mood states [e.g., in psychiatric patients or in patients waiting for painful medical procedures (e.g., dental)]. Lastly, other procedures used in the more general literature refer to (a) using pictures to induce mood (e.g., International Affective Picture System; Lang, Bradley, & Cuthbert, 2008), and/or (b) giving an impromptu speech in front of an expert audience (trier social stressor; Slavich, Way, Eisenberger, & Taylor, 2010).

Various neurobiological structures (e.g., limbic structures) are involved in the processing of both fragrances/odors and emotions/mood states (e.g., Rolls, 2004; Royet, Plailly, Delon-Martin, Kareken, & Segebarth, 2003). This line of research generally examines the underlying neurobiology of the relationships between emotions/mood states and pleasant/unpleasant odors. Studies using brain-imaging procedures have mostly focused on the hedonic responses of olfaction (e.g., Zatorre, Jones-Gotman, & Rouby, 2000). The most investigated brain areas—most of which are related to dopaminergic reward system—were the ventral tegmental area, nucleus accumbens, striatum, amygdala, hippocampus, and the prefrontal cortex (Arias-Carrión, Stamelou, Murillo-Rodríguez, Menéndez-González, & Pöppel, 2010). While Fulbright et al. (1998) found the pleasant odor of Clementine to produce a significantly higher activation in the insula compared to an unpleasant odor, Anderson et al. (2003) found support for the activation of the orbitofrontal cortex for positive valence fragrances, suggesting the involvement of the integrated prefrontal cortex functions. Other studies, however, suggested that fragrance could induce activation of the orbitofrontal cortex independently of their valence (see Grabenhorst, Rolls, Margot, da Silva, & Velazco, 2007).

In brief, while some studies have shown different (even opposing) affective effects of the same fragrance (see also clove smell: Seubert, Rea, Loughead, & Habel, 2009), research generally documents a robust relationship between fragrances and various affective states. More studies examining the effects of specific fragrances on affective states, using rigorous and replicable methodology, are needed in order to be able to draw reliable conclusions. Moreover, although there is some variability in terms of the documented neural correlates (e.g., few fMRI studies) of the affective dimensions of fragrances (see also Soudry, Lemogne, Malinvaud, Consoli, & Bonfils, 2011), the brain basis of various specific fragrances needs to be investigated using state of the art paradigms and brain imagining methods.

2 | AIMS AND HYPOTHESES

In the present study we aimed to investigate the effects of a rose-based formula fragrance in the form of a scented cream product on psychological (e.g., mood-based self-reports scales) and brain-related measures (e.g., brain activation patterns) of stress, relaxation and positive emotions.

Drawing from the existing studies (some of which presented earlier) we predicted that the scented cream condition would be associated with decreased stress and increased relaxation/positive affective states, and thus dampen the reactivity in key brain areas associated with the processing of threat and negative stimuli (e.g., amygdala, anterior cingulated, orbitofrontal cortex) for negative faces. We also predicted the association of using the rose-based scented cream for the happy and neutral faces with activation of brain areas associated with reward (e.g., nucleus accumbens).

3 | METHOD

3.1 | Participants

The participants were 26 females graduate students, aged between 22 and 31 years old, with a mean age of 27.42 years (*SD* = 2.43), recruited through student mailing lists at Babes-Bolyai-University. Eighteen participants were given the rose-based scented cream in the first day of examination (and the odorless cream in the second day), while the other eight received the odorless cream in the first day (and the scented cream in the second day). One of the participants (who received the scented cream in the first day) did not show up for the study in the second day, leaving 17 participants who received the odorless cream in the second day of study.

3.2 | Measures

3.2.1 | Psychological outcomes

Visual analogues scales (VAS) were used for measuring affective states

Visual analog scale formats were used to assess relaxation, satisfaction, happiness, and stress. Specifically, we administered 10-cm visual analog scales assessing relaxation, satisfaction, happiness, and respectively stress (for details about the measurement process, see Montgomery, David, Dilorenzo, & Schnur, 2007). Participants were instructed to assess to what degree they feel each of the emotions from 0 = none to 100 = very much. The VAS for each emotion was scored by measuring in mm from the start of the line to participant's mark.

3.2.2 | Biological/brain-related measures

Subjects underwent an MRI brain scan by using a Skyra 3 T machine while undergoing an emotional processing task (described below), both with and without exposure to rose-based scented cream. Brain patterns during the experiment were recorded and analyzed.

3.3 | Procedure

The study procedure was implemented in two consecutive days. Both days followed the same procedure, except for the fact that a different variant of the cream (i.e., with or without fragrance) was given to the participants, according to a randomization sequence.

Before undergoing the brain scan in the first day, the participants signed informed consents and completed several visual analogue scales (VAS, described in the prior section) measuring their current mood states (i.e., relaxation, satisfaction, happiness, stress), as well as other psychological outcomes which are part of another study (e.g., their expectancies for mood states, cognitive and personality characteristics). Then they were asked to apply the Elizabeth Arden/EA cream on their faces—about 2 ml. Five minutes after the application of the cream, they were required to complete the same VAS measures.

The participants then underwent the functional brain scan sequences during an emotional face processing task (described below). At the end, they completed the VAS mood ratings again, as well as three other questionnaires measuring positive and negative mood states during the last 2 weeks (Profile of Emotional Distress; PED, Opris & Macavei, 2007). The face-processing task involved viewing six types of faces, in three categories: neutral, positive (i.e., happy), and negative (i.e., fearful, disgusted, sad and angry). This widely-used task (e.g., Lang et al., 2008) is an implicit measure of human emotional processing; we used it both for inducing transient positive and negative emotions, and for understanding how the scented cream impacts the generation of these transient emotions.

To ensure that the participants were paying attention to the faces, without revealing that our focus was on the emotions expressed by the faces, they were asked to decide, for each face, whether it was the same as the previous one, by pressing a button.

The duration of each MRI functional run was around 6 min and 30 s. All the participants underwent the same procedure.

3.4 | Data analysis

MRI data were analyzed using the Amplitude of Low Frequency Fluctuations (ALFF) [and fractional ALFF (f/ALFF)] as the main indicator of brain activity (Zang et al., 2007; Zou et al., 2008). The ALFF and fALFF are considered reliable markers of the amplitude of low frequency oscillations that characterize resting state networks in various brain regions. ALFF is calculated as the sum of amplitudes within a specific low frequency range, while f/ALFF is calculated as a fraction of the sum of amplitudes detectable in a given signal across the entire frequency range. After the standard pre-processing steps, we analyzed functional data using standard deconvolution analyses with a focus on the contrast between *fragranced* versus *no fragrance* condition for both participants.

4 | RESULTS

4.1 | Randomization check

No significant differences were found regarding mood at baseline when participants were grouped by the examination sequence (all *p*s > .05); These results suggest that pre-existing characteristics of the participants did not influence how they responded to the EA cream fragrance and show that randomization was successful.

4.2 | Scented cream effect on mood states

The descriptive statistics for the various mood states measured at different points during the study (i.e., at baseline, after using the cream product) are presented (by day of examination and type of cream received in each day) in Table 1.

The baseline data looked very similar for participants who received the scented cream in the first day (and the odorless cream in the second day), respectively for those who received the odorless cream in the first day (and the scented one in the second day) (see Figure 1 below).

No statistical differences were found for the emotional responses reported at different phases (i.e., baseline vs. cream), regardless of the type of cream received. For the participants who were given the scented cream in the first day (and odorless cream in the second), similar levels of relaxation, $t(16) = -.84$, $p = .43$, satisfaction, $t(16) = -1.05$, $p = .20$, happiness, $t(16) = -52$, $p = .60$, and stress, $t(16) = 1.26$, $p = .22$ were found. The same was true for the participants who received the odorless cream in the first day (and scented cream in the second): for relaxation, $t(7) = -.28$, $p = .78$; for satisfaction, $t(7) = 1.51$, $p = .17$; for happiness, $t(7) = -.10$, $p = .92$; and for stress, $t(7) = 1.54$, $p = .16$.

Repeated measures ANOVA were then conducted, looking for three types of possible effects (see Figure 2 and Table 2):

1. Main effect of Cream Type (odorless vs. scented cream): effect of the cream by itself, regardless of the order sequence;
2. Main Effect of Order Sequence (odorless-scented/O-S and scented-odorless/S-O): the effects of the order sequence by itself, regardless of the cream type;
3. Interaction Effect: the effects of the cream type as a function of the order sequence (i.e., are the effects of the cream different, if they are presented in a different order sequence).

For state happiness (see Table 2), there is a borderline significant effect (which would most likely reach statistical significance with more subjects) in favor of the scented cream over the odorless cream, regardless of the presentation order.

TABLE 1 Descriptive statistics for the various mood states measured at different points during the study (i.e., at baseline / after using the cream product)

			Mood states baseline				Mood states after cream			
			Relaxation M (*SD*)	Satisfaction M (*SD*)	Happiness M (*SD*)	Stress M (*SD*)	Relaxation M (*SD*)	Satisfaction M (*SD*)	Happiness M (*SD*)	Stress M (*SD*)
Day 1	*N*	26								
	Scented cream	18	6.78 (2.11)	7.19 (2.04)	7.26 (1.91)	3.23 (2.51)	7.28 (1.97)	7.42 (1.96)	7.74 (1.67)	3.22 (2.32)
	Odorless cream	8	7.23 (2.09)	6.69 (2.85)	6.78 (2.52)	2.22 (1.88)	8.15 (1.85)	6.82 (2.57)	6.43 (2.60)	1.64 (1.47)
Day 2	*N*	25								
	Scented cream	8	7.94 (1.65)	8.03 (1.35)	8.08 (1.27)	1.98 (1.95)	8.26 (1.43)	7.49 (2.56)	7.55 (2.65)	1.12 (.87)
	Odorless cream	17	8.22 (1.71)	7.54 (20.8)	7.47 (2.51)	1.64 (1.65)	8.24 (1.56)	8.03 (1.55)	8.05 (1.66)	2.02 (2.28)

Abbreviations: N, total number of participants; M, mean; SD, standard deviation.

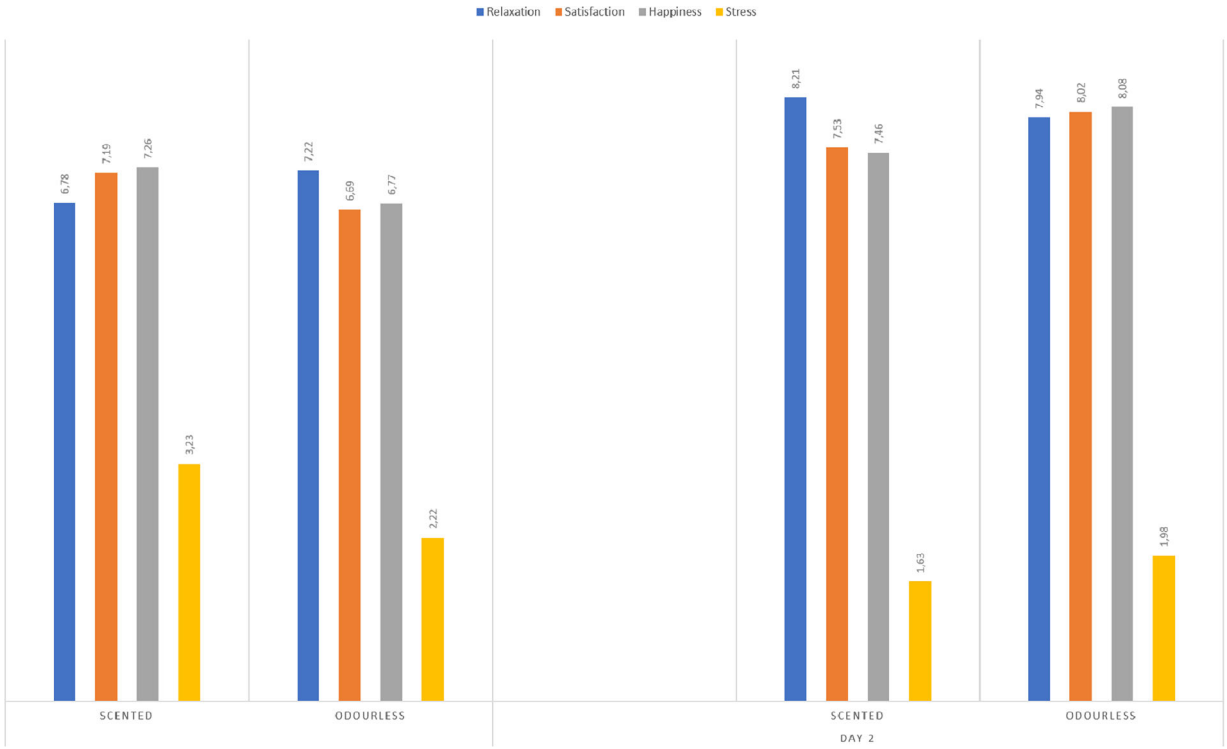

FIGURE 1 Emotional responses reported at each phase based on the type of cream received on a 0 to 10 interval

4.3 | Brain analyses

The analysis reported in Figure 3 is the fALFF, which measures the relative amount of low frequency oscillation in the spectrum of the BOLD signal. The low frequencies are related to neural activity, and they are the most important component of the neuronal component of the fMRI signal. fALFF is the ratio between these low frequency part of the spectrum (0.01–0.1) over the total frequencies of the signal. We performed a paired *t*-test comparing fALFF during vision of faces with the fragrance with the fALFF of the condition without fragrance. The results showed that fALFF is higher (which means a more intense neuronal discharge) in the areas involved in smell perception (insula, boxes 3 and 2) and in face perception (fusiform gyrus, box 1). Moreover, we also found activity in the area involved in reward (basal ganglia and, specifically the caudate, box 4) and area of the midbrain related to general arousal (box 1).

5 | CONCLUSIONS AND DISCUSSION

In this study, we aimed at investigating the affective and brain effects of using a rose-scented cosmetic cream. Our results are in line with our expectations that the scented cream condition was associated with increased positive affective states and reduced reactivity in key brain areas associated with the processing of threat and negative stimuli (e.g., amygdala, anterior cingulated, and orbitofrontal cortex).

More specifically, we found an effect of the scented cream over the odorless cream in the expected direction for all the emotions, more

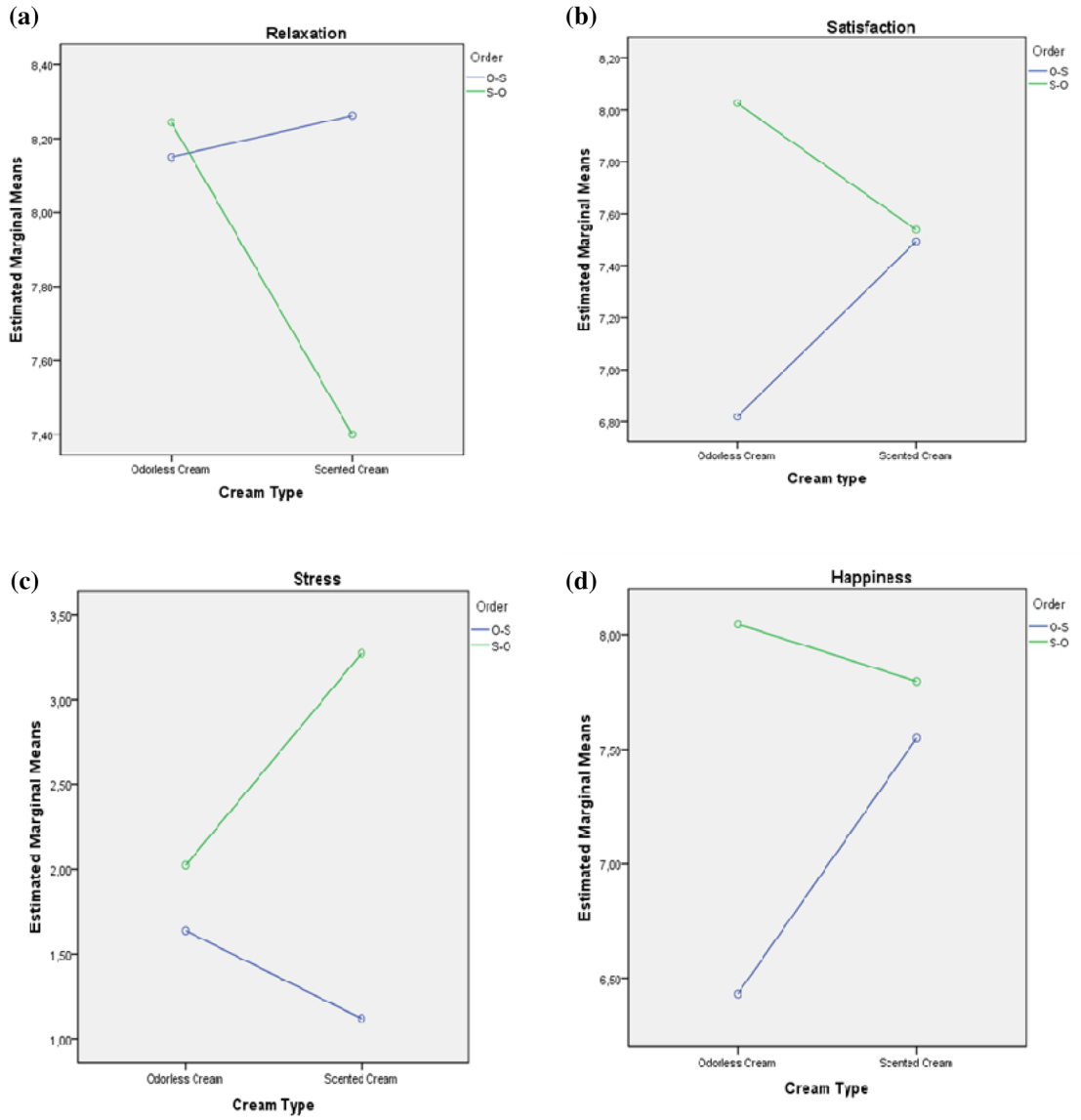

FIGURE 2 Effect of the scented cream versus the odorless cream on mood

TABLE 2 Repeated measures ANOVA based on 95% significance level

Mood states	Cream type	Order sequence	Interaction effect
Relaxation	$F(1,23) = 2.47$, $p = .129$	$F(1,23) = .294$, $p = .593$	$F(1,23) = 4.23$, $p = .051$
Satisfaction	$F(1,23) = .16$, $p = .691$	$F(1,23) = .55$, $p = .465$	$F(1,23) = 6.29$, $p = .020$
Happiness	$F(1,23) = 3.40$, $p = .078$	$F(1,23) = 1.25$, $p = .274$	$F(1,23) = 8.44$, $p = .008$
Stress	$F(1,23) = .73$, $p = .401$	$F(1,23) = 2.72$, $p = .113$	$F(1,23) = 4.28$, $p = .050$

relaxation, satisfaction, happiness, and less stress when the scented cream was presented after the odorless cream. This is in line with previous findings on the hedonic effects of fine fragrances (Rétiveau, Chambers, & Milliken, 2004), in terms of reducing negative mood and increasing vigor. Importantly, the effect of the scented cream on the other emotions, relaxation, satisfaction, happiness, and stress is qualified by an interaction with the sequence of presentation; that is, the scented cream can lead to more relaxation, satisfaction, happiness, and less stress if presented after the odorless cream. Moreover, for state happiness, there is a borderline significant effect (which would most likely reach statistical significance with more subjects) in favor of the scented cream over the odorless one, regardless of the presentation order (i.e., the scented cream does seem to lead to more happiness overall). Interestingly, the odorless cream seems to present a similar trend, if presented after the scented cream, most likely because the subjects already formed a set of expectancies regarding what they would be receiving.

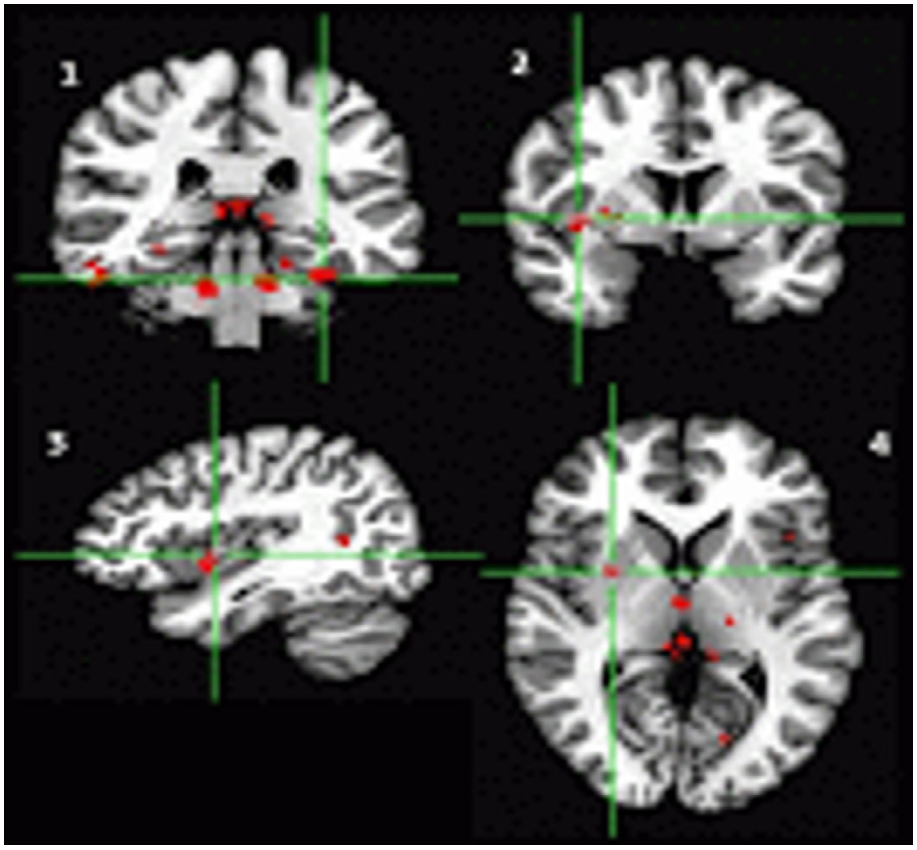

FIGURE 3 Fractional amplitude of low frequency fluctuation (fALFF) comparisons during vision of faces of the condition with the fragrance versus the condition without fragrance; box 1 = fusiform gyrus, boxes 2 and 3 = insula, box 4 = basal ganglia

Regarding the brain correlates of the cream fragrance (fMRI analyses), our results highlight a more intense neural discharge in the area involved in smell perception (i.e., insula, box 3 and 2), and in face perception (i.e., fusiform gyrus, box 1). Moreover, as expected (Arias-Carrión et al., 2010), we found also activity in area involved in reward (i.e., basal ganglia and, specifically the caudate, box 4) and area of the midbrain related to general arousal. Thus, based on the brain activation registered, the scented cream seems to increase the discharge in an area related to the task of face perception, which is explained by the mood induction task, and also modulates the discharge in areas involved in pleasure perception and reward. More specifically, by making the neural activity more intense in the basal ganglia and caudate, the scented cream seems to stimulate areas supporting positive affect and approach motivation, which refers to positive affective states triggered by positive stimuli.

In sum, taking into account that (a) all psychological results are based on self-report scales and (b) that we obtained an effect of the scented cream at the brain level (e.g., activating brain areas involved in pleasure and reward), it is possible that the effect of the scented cream is more at a general mood level (i.e., tacit dispositional affect; Jurchis, 2018), rather than at the level of fully conscious emotions, which are indeed, more strongly related to various specific activating events.

These results/conclusions should be understood in the following context. First of all, our findings should be interpreted with a lot of caution given the small sample size. It is also impossible to clearly untangle, in this design, which changes contributed more/lead to a significant interaction effect: the transition from the odorless cream to the scented cream or the other way around. Studies on larger samples, using different design and possibly two or more independent groups might help clarify these effects. It is however worth noting that these are inherent issues in research methodologies, which cannot be fully avoided. Future studies should also take into account potential moderators of the results (e.g., cognitive and personality structures).

Despite these limitations, this is, to our knowledge, the first study to use multiple outcomes, including state-of-the-art brain imaging procedures, to investigate the psychological effects of a rose-based scented cream. The results obtained bring important insights on the complex benefits that scented cosmetics can have on mood.

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REFERENCES

Anderson, A. K., Christoff, K., Stappen, I., Panitz, D., Ghahremani, D. G., Glover, G., … Sobel, N. (2003). Dissociated neural representations of intensity and valence in human olfaction. *Nature Neuroscience*, *6*(2), 196–202.

Angelucci, F. L., Silva, V. V., Dal Pizzol, C., Spir, L. G., Praes, C. E. O., & Maibach, H. (2014). Physiological effect of olfactory stimuli inhalation in humans: An overview. *International Journal of Cosmetic Science*, *36*(2), 117–123.

Arias-Carrión, O., Stamelou, M., Murillo-Rodríguez, E., Menéndez-González, M., & Pöppel, E. (2010). Dopaminergic reward system: a short integrative review. *International archives of medicine*, *3*, 24. https://doi.org/10.1186/1755-7682-3-24

Bradley, B. F., Brown, S. L., Chu, S., & Lea, R. W. (2009). Effects of orally administered lavender essential oil on responses to anxiety-provoking film clips. *Human Psychopharmacology Clinical and Experimental*, *24*(4), 319–330.

Bridges, B. (2002). Fragrance emerging health and environmental concerns. *Flavour Fragrances Journal*, *17*, 361–371. https://doi.org/10.1002/ffj.1106

Fowler, N. (2006). Aromatherapy, used as an integrative tool for crisis management by adolescents in a residential treatment center. *Journal of Child and Adolescent Psychiatric Nursing*, *19*(2), 69–76.

Fulbright, R. K., Skudlarski, P., Lacadie, C. M., Warrenburg, S., Bowers, A. A., Gore, J. C., & Wexler, B. E. (1998). Functional MR imaging of regional brain responses to pleasant and unpleasant odors. *American Journal of Neuroradiology*, *19*, 1721–1726.

Grabenhorst, F., Rolls, E. T., Margot, C., da Silva, M. A., & Velazco, M. I. (2007). How pleasant and unpleasant stimuli combine in different brain regions: Odor mixtures. *Journal of Neuroscence*, *27*(49), 13532–13540.

Haber, S. N., Kim, K. S., Mailly, P., & Calzavara, R. (2006). Reward-related cortical inputs define a large striatal region in primates that interface with associative cortical inputs, providing a substrate for incentive-based learning. *Journal of Neuroscience*, *26*(32), 8368–8376.

Herz, R. S., Beland, S. L., & Hellerstein, M. (2004). Changing odor hedonic perception through emotional associations in humans. *International Journal of Comparative Psychology*, *17*(4), 315–339.

Itai, T., Amayasu, H., Kuribayashi, M., Kawamura, N., Okada, M., Momose, A., … Kaneko, S. (2000). Psychological effects of aromatherapy on chronic hemodialysis patients. *Psychiatry and Clinical Neurosciences*, *54*(4), 393–397.

Jurchis, R. (2018). Fundamental properties of implicit knowledge structures: Implications for cognitive behavior therapies. *Journal of Cognitive and Behavioral Psychotherapies*, *18*(2), 117–129. https://doi.org/10.24193/jebp.2018.2.17

Kiecolt-Glaser, J. K., Graham, J. E., Malarkey, W. B., Porter, K., Lemeshow, S., & Glaser, R. (2008). Olfactory influences on mood and autonomic, endocrine, and immune function. *Psychoneuroendocrinology*, *33*(3), 328–339.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2008). International affective picture System (IAPS): Affective ratings of pictures and instruction manual. *Technical Report A-8*. Gainesville, FL: University of Florida.

Lehrner, J., Marwinski, G., Lehr, S., Johren, P., & Deecke, L. (2005). Ambient odors of orange and lavender reduce anxiety and improve mood in a dental office. *Physiology & Behavior*, *86*(1–2), 92–95.

Montgomery, G. H., David, D., Dilorenzo, T. A., & Schnur, J. B. (2007). Response Expectancies and Irrational Beliefs Predict Exam-Related Distress. *Journal of rational-emotive and cognitive-behavior therapy*, *25*(1), 17–34. https://doi.org/10.1007/s10942-006-0029

Moss, M., Cook, J., Wesnes, K., & Duckett, P. (2003). Aromas of rosemary and lavender essential oils differentially affect cognition and mood in healthy adults. *International Journal of Neuroscience*, *113*(1), 15–38.

Muzzarelli, L., Force, M., & Sebold, M. (2006). Aromatherapy and reducing preprocedural anxiety: A controlled prospective study. *Gastroenterology Nursing*, *29*(6), 466–471.

Opris, D., & Macavei, B. (2007). The profile of emotional distress; norms for the Romanian population. *Journal of Cognitive and Behavioral Psychotherapies*, *7*(2), 139–152. Retrieved from. http://jcbp.psychotherapy.ro/

Rétiveau, A. N., Chambers, E., & Milliken, G. A. (2004). Common and specific effects of fine fragrances on the mood of women. *Journal of Sensory Studies*, *19*, 373–394.

Rolls, E. T. (2004). Convergence of sensory systems in the orbitofrontal cortex in primates and brain design for emotion. *The Anatomical Record. Rec. A, Discoveries in Molecular, Cellular, and Evolutionary Biology*, *281*(1), 1212–1225.

Rovesti, P., & Colombo, E. (1973). Aromatherapy and aerosols. *Soap, Perfumery, and Cosmetics*, *46*(1), 475–477.

Royet, J. P., Plailly, J., Delon-Martin, C., Kareken, D. A., & Segebarth, C. (2003). fMRI of emotional responses to odors: Influence of hedonic valence and judgment, handedness, and gender. *NeuroImage*, *20*(2), 713–728.

Schneider, F., Gur, R. C., Koch, K., Backes, V., Amunts, K., Shah, N. J., … Habel, U. (2006). Impairment in the specificity of emotion processing in schizophrenia. *American Journal of Psychiatry*, *163*(3), 442–447.

Schneider, F., Habel, U., Reske, M., Toni, I., Falkai, P., & Shah, N. J. (2007). Neural substrates of olfactory processing in schizophrenia patients and their healthy relatives. *Psychiatry Research*, *155*(2), 103–112.

Seubert, J., Rea, A. F., Loughead, J., & Habel, U. (2009). Mood induction with olfactory stimuli reveals differential affective responses in males and females. *Chemical Senses*, *34*(1), 77–84.

Slavich, G. M., Way, B. M., Eisenberger, N. I., & Taylor, S. E. (2010). Neural sensitivity to social rejection is associated with inflammatory responses to social stress. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(33), 14817–14822.

Soudry, Y., Lemogne, C., Malinvaud, D., Consoli, S.-M., & Bonfils, P. (2011). Olfactory system and emotion: Common substrates. *European Annals of Otorhinolaryngology, Head and Neck Diseases*, *128*(1), 18–23.

Tanida, M., Katsuyama, M., & Sakatani, K. (2008). Effects of fragrance administration on stress-induced prefrontal cortex activity and sebum secretion in the facial skin. *Neuroscience Letters*, *432*(2), 157–161.

Tanida, M., Sakatani, K., Takano, R. B., & Tagai, K. (2004). Relation between asymmetry of prefrontal cortex activities and the autonomic nervous system during a mental arithmetic task: Near infrared spectroscopy study. *Neuroscience Letters*, *369*(1), 69–74.

Weber, S. T., & Heuberger, E. (2008). The impact of natural odors on affective states in humans. *Chemical Senses*, *33*(5), 441–447.

Zang, Y.-F., He, Y., Zhu, C.-Z., Cao, Q.-J., Sui, M.-Q., Liang, M., et al. (2007). Altered baseline brain activity in children with ADHD revealed by resting-state functional MRI. *Brain & Development*, *29*(2), 83–91.

Zatorre, R. J., Jones-Gotman, M., & Rouby, C. (2000). Neural mechanisms involved in odor pleasantness and intensity judgments. *Neuroreport*, *11*(12), 2711–2716.

Zou, Q.-H., Zhu, C.-Z., Yang, Y., Zuo, X.-N., Long, X.-Y., Cao, Q.-J., … Zang, Y. F. (2008). An improved approach to detection of amplitude of low-frequency fluctuation (ALFF) for resting-state fMRI: Fractional ALFF. *Journal of Neuroscience Methods*, *172*(1), 137–141.

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