IFSCC 2025 full paper (IFSCC2025-1552)

"Unveiling the Emotional Impact of Lipstick: A Neurophysiological and Behavioral Study."

Audrey Diwoux [1,2,*], Damien Gabriel [2,3,4] , Pierre-Édouard Billot[2,4], Aline Denoncin[5], Youcef Ben Khalifa[1]and Marie-Héloïse Bardel[1]

[1] Innovation Research & Development CHANEL Fragrances & Beauty, Pantin, France; [2] Université de Franche-Comté, INSERM, UMR 1322 LINC, Besançon, France, [3] Centre d'Investigation Clinique, Inserm, CIC 1431, CHU, Besançon, France, [4] Plateforme de Neuroimagerie Fonctionnelle et Neuromodulation Neuraxess, Besançon, France, [5] IT&M STATS, Boulogne-Billancourt, France.

* Audrey DIWOUX, 8 rue du Cheval Blanc, CS 40045, 93694 Pantin Cedex, France
00 33 (1) 43 93 50 88, audrey.diwoux@chanel.com

1. Introduction

Cosmetics play a central role in our daily routines, extending far beyond their aesthetic function. Whether it involves makeup, skincare, or perfume, these products influence not only our appearance but also our self-image, self-confidence [1] and self-esteem [2]. This reinforcement contributes to more assertive and positive social behaviors [3], and supports the development of positive emotional states such as relaxation and overall well-being [4–6]. For this reason, the emotional impact of cosmetics is therefore receiving growing attention in neuroscience. However, most existing studies rely on subjective data collection methods such as questionnaires, surveys, or focus groups [7]. Although practical, these approaches primarily assess the conscious component of emotions and are sensitive to various biases, including mood, time of day, or environmental factors [8]. Emotions are a complex phenomenon, integrating cognitive, behavioral, and physiological dimensions, and require more objective tools for accurate assessment.

For example, by combining subjective questionnaires with physiological measures such as brain activity, electrodermal activity, or heart rate, as well as behavioral indicatorslike facial expressions, it becomes possible to obtain a more reliable evaluation of emotional responses [9–11].

Although these methods reflect unconscious mental processes that cannot be voluntarily controlled [12], and are commonly used in other research fields [11, 13, 14], their use in cosmetic science remains limited. A recent review identified only 33 studies using neurophysiological tools in this context, and no standardized guidelines have been established so far, especially concerning makeup [15]. To our knowledge, only four studies have specifically examined the emotional and physiological effects of lipstick, showing variations in heart rate, electrodermal activity, and even cortical responses depending on the product's color, scent, or perceived pleasantness. This highlights the need for further investigation into the emotional impact of lipsticks using objective physiological measures

Therefore, the present study aims to explore the emotional effects of lipstick application, chosen for its strong visual impact. The objective is to assess and differentiate the emotions triggered by the application of various lipsticks. To this end, a multimodal approach combining physiological measurements (electrodermal activity and heart rate), behavioral analysis (facial expressions), and self-reported data (questionnaires) was adopted. The main hypothesis is to confirm the possibility of objectively measuring the emotions induced by lipstick application. The next step is to evaluate whether the combined use of these measures could help differentiate products based on their appreciation and the emotions they elicit.

2. Materials and Methods

The study included 60 healthy Caucasian women (mean age: 36 years, range: 21-49 years, SD: 7,84), regular users of red satin-finish lipsticks from luxury brands. Each participant was informed about the study procedure and signed an informed consent form before beginning the protocol.

Three red satin-finish lipsticks were tested:

- **FPL:** each participant's Favorite Personal Lipstick, used as a positive control;
- **GLP:** a luxury lipstick presented in glass packaging (Glass Luxury Packaging);
- **BLP:** a lipstick from the same brand as GLP, but in black plastic packaging (Black Luxury Packaging).

Participants attended a one-hour individual session, seated in front of a mirror in a laboratory simulating a bathroom. They were equipped with physiological sensors (electrodermal activity: EDA and cardiac activity: PPG via Shimmer3 at a sampling rate of 128 Hz) and filmed for facial expression analysis (iMotions/Affectiva). The procedure included three randomized trials (one per lipstick). Each trial followed the sequence below (Figure 1): pre-application questionnaires, baseline measurement (2 minutes), lipstick application by the participant, post-application measurement (2 minutes), and post-application questionnaires. A 2-minute break with makeup removal separated the trials. To ensure ecological validity, the application was unconstrained (quantity, duration, and gestures), and the participant was alone.

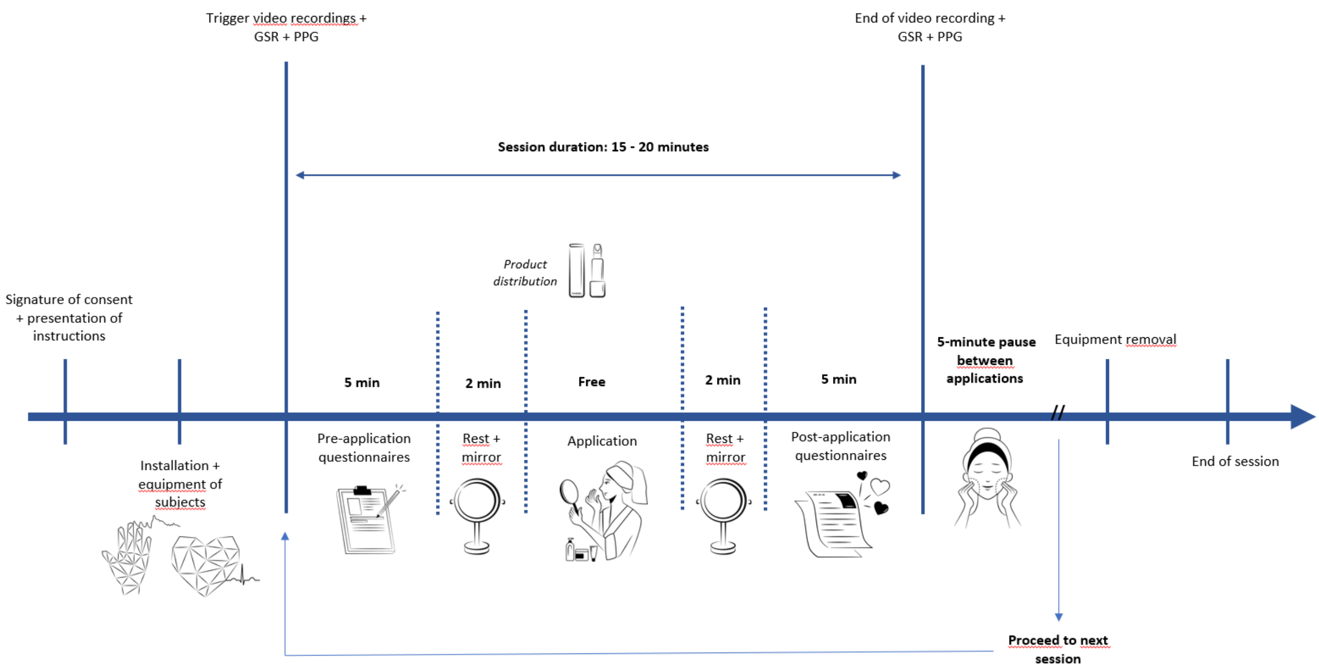

Figure 1: Experience Timeline.

The questionnaires collected before and after application were based on visual analog scales (ranging from 0 “not at all” to 10 “extremely”) and included: a well-being questionnaire to assess the participants’ current levels of well-being and stress, as well as their levels of emotional valence (positive or negative emotion) and arousal (high or low emotional intensity); and a questionnaire containing 35 adjectives representing emotional states (e.g., Seductive, Confident, Disappointed). Additionally, after each application, a product appreciation questionnaire was administered (overall appreciation, color, texture, and visual appearance).

Regarding physiological measures, data were collected continuously before (Pre), during (App), and after (Post) application (Shimmer3, sampling rate of 128 Hz). Electrodermal activity (EDA) reflects emotional sweating and provides insight into emotional arousal (emotion intensity). Cardiac activity (PPG) indicates the participant’s state: low activity reflects a calm state, while high activity reflects a state of stress. Finally, facial expressions (FACS system) were expected to provide information about emotional valence (positive or negative emotions).

The physiological data were pre-processed (EDA: Ledalab [16] ; PPG: Kubios HRV Scientist 3.5.0 [17]) to ensure good signal quality and to extract relevant variables (e.g., number and amplitude of EDA responses, and heart rate for PPG). Facial expressions were determined using a specific algorithm (Affectiva by iMotions). Participant exclusions were applied in cases of poor signal quality or procedural errors.

Data analysis was performed using R Studio 4.2.0. Linear mixed-effects models for repeated measures were used to evaluate the fixed effects of Product (FPL, GLP, BLP) and Period (Pre, App, Post for physiological measures; Pre, Post for facial expressions and questionnaires), as well as their interaction effects (Product * Period), with Participant as a random factor.

Specific analyses were conducted for the well-being questionnaires (Delta t is the difference : Pre-Application - Post-Application), as well as for the appreciation questionnaire (single period factor: Post). Post-hoc comparisons used Tukey correction, and effect sizes (ηp^2) were calculated.

3. Results

3.1 Effects of lipstick application (period effect)

The questionnaires showed that applying lipstick led to an increase in positive emotions related to Seduction (All $F > 129$, $p < .001$), such as Feminine, Seductive and Irresistible ; to Proactivity (All $F > 19.81$, $p < .001$), such as Boosted, Energetic, or Stimulated; to visual appearance ($F = 26.54$, $p < .001$), such as Fulfilled; and to positive feelings (All $F > 4.5$, $p < .05$), such as Self-confident and Refreshed. There was also a decrease in negative emotions (All $F > 5.72$, $p < .05$) such as Nervous, Worried, and Disgusted.

These effects were accompanied by an increase in facial expressions of Surprise, Engagement, Attention, Neutrality, and the "Lip Pucker" movement (All $F > 9.01$, $p < .01$) after application compared to before.

In addition, there was an increase in electrodermal activity (peak amplitude and number of peaks: All $F > 8.03$, $p < .001$) during application compared to before.

A decrease in parasympathetic activity was also observed after application, as indicated by an increase in RMSSD (Root Mean Square of Successive Differences), SDNN (Standard Deviation of NN intervals), and HF (High-Frequency power), compared to baseline (All $F > 3.11$, $p < .05$).

3.2 Product differenciation

Beyond the effects due to the application of lipstick, differences between the products were also highlighted. However, only the questionnaires and cardiac activity allowed for differentiation between the products, whereas electrodermal activity and facial expressions did not.

3.2.1 Questionnaires

The questionnaires revealed several interaction effects (product*period).

3.2.1.1 Emotional profile

First, the GLP (glass) and FPL (personal favorite) lipsticks significantly increased the "Boosted" ($M_{Pre-GLP} = 5.53$, $SD_{Pre-GLP} = 2.46$, $M_{Post-GLP} = 7.07$, $SD_{Post-GLP} = 2.25$; $M_{Pre-FPL} = 5.72$, $SD_{Pre-FPL} = 2.37$, $M_{Post-FPL} = 7.03$, $SD_{Post-FPL} = 1.9$) and "Stimulated" scores ($M_{Pre-GLP} = 5.6$, $SD_{Pre-GLP} = 2.41$, $M_{Post-GLP} = 7.08$, $SD_{Post-GLP} = 1.92$; $M_{Pre-FPL} = 5.54$, $SD_{Pre-FPL} = 2.28$, $M_{Post-FPL} = 6.92$, $SD_{Post-FPL} = 2.22$) after application (All $F > 3.36$, $p < .05$), which was not the case for BLP (black plastic). GLP also increased "Self-confidence" ($M_{Pre-GLP} = 6.61$, $SD_{Pre-GLP} = 2.24$, $M_{Post-GLP} = 7.88$, $SD_{Post-GLP} = 1.47$) after application ($F(2) = 3.57$, $p < .05$) (Figure 2).

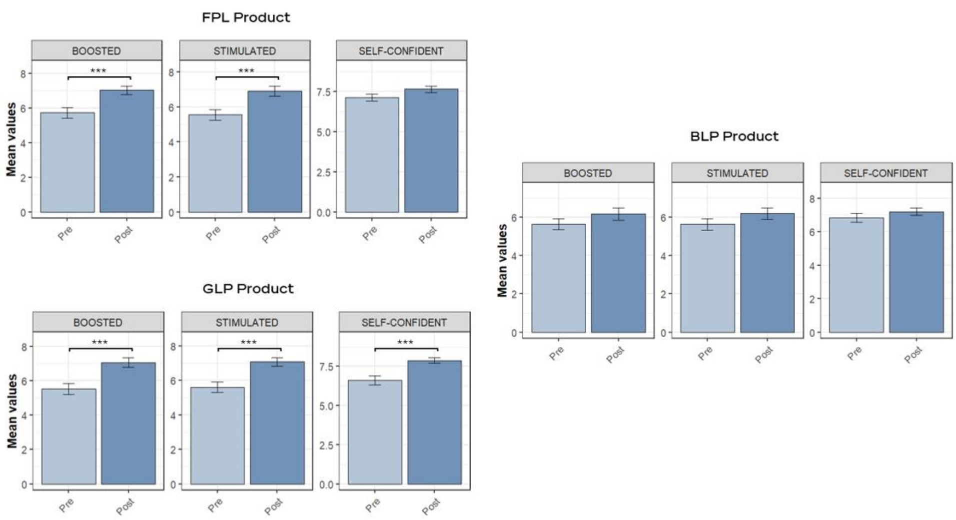

Figure 2: *Representation of the emotional profile adjective scores before and after the application of each lipstick (Product × Period interaction). Significant differences between the pre- and post-application phases are indicated by significance stars for each product. The significance values of the post-hoc tests are as follows: *** $p \leq 0.001$, ** $p \leq 0.01$, and * $p \leq 0.05$.*

3.2.1.2 Well-being

In terms of well-being, GLP and FPL led to a greater increase in overall well-being ($M_{GLP} = 0.85$, $SD_{GLP} = 1.61$; $M_{FPL} = 0.87$, $SD_{FPL} = 1.63$; $M_{BLP} = 0.37$, $SD_{BLP} = 1.85$) and emotional valence ($M_{GLP} = 0.38$, $SD_{GLP} = 1.83$, $M_{FPL} = 0.43$, $SD_{FPL} = 1.94$; $M_{BLP} = -0.2$, $SD_{BLP} = 2.19$) compared to BLP (All $F > 5.48$, $p < .001$).

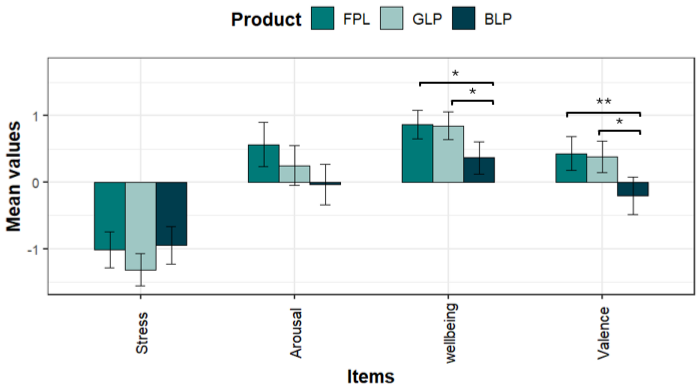

Figure 3: *Representation of the scores for well-being based on the type of lipstick (Product Effect). Significant differences between products are indicated by significance stars. The significance values of post-hoc tests are as follows: *** $p \leq 0.001$, ** $p \leq 0.01$, and * $p \leq 0.05$. The results are presented according to Delta t (Difference Post-Application vs. Pre-Application); a negative value indicates a decrease between before and after, while a positive value indicates an increase. The results are ranked from the least significant (on the left) to the most significant (on the right).*

3.2.1.3 Likings

Finally, overall liking revealed that BLP was overall less liked (texture : $M_{GLP} = 8.97$, $SD_{GLP} = 1.87$; $M_{FPL} = 8.6$, $SD_{FPL} = 1.37$; $M_{BLP} = 7.97$, $SD_{BLP} = 1.83$; Visual : $M_{GLP} = 8.25$, $SD_{GLP} = 1.54$; $M_{FPL} = 8.48$, $SD_{FPL} = 1.16$; $M_{BLP} = 7.4$, $SD_{BLP} = 1.89$; and overall : $M_{GLP} = 8.35$, $SD_{GLP} = 1.6$; $M_{FPL} = 8.35$, $SD_{FPL} = 1.19$; $M_{BLP} = 7.48$, $SD_{BLP} = 1.92$) compared to GLP and FPL (All $F > 6.66$, $p < .01$).

Moreover, FPL was preferred for its color ($M_{FPL} = 8.68$, $SD_{FPL} = 1.07$; $M_{BLP} = 7.83$, $SD_{BLP} = 1.78$) compared to BLP ($F(2) = 4.71$, $p < .05$), and GLP generated more "Pleasantly surprised" ($M_{GLP} = 7.35$, $SD_{GLP} = 2.37$; $M_{FPL} = 5.59$, $SD_{FPL} = 2.76$) than FPL ($F(2) = 4.71$, $p < .05$).

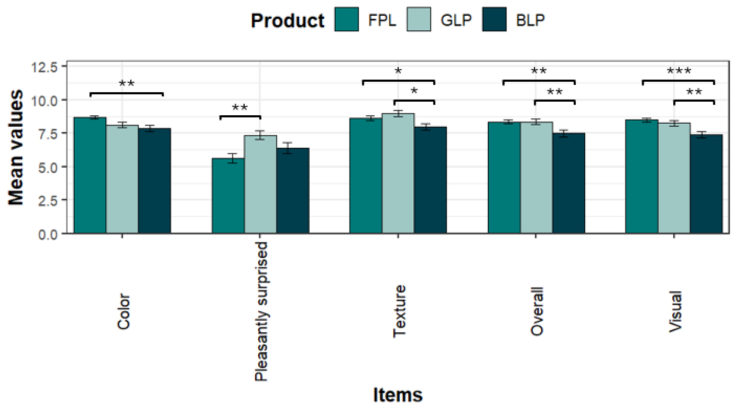

Figure 4: *Representation of the appreciation scores based on the type of lipstick (Product Effect). Significant differences between products are indicated by significance stars. The significance values of post-hoc tests are as follows: *** $p \leq 0.001$, ** $p \leq 0.01$, and * $p \leq 0.05$. The results are presented for the post-application period, as this questionnaire was only administered after each product application. The results are ranked from the least significant (on the left) to the most significant (on the right).*

3.2.2 Cardiac activity

These results are supported by product*period interactions observed in cardiac activity. The FPL and GLP products led to an increase in Mean RR ($M_{Pre-GLP}$ = 785.25, $SD_{Pre-GLP}$ =107.58, $M_{App-GLP}$ = 775.36, $SD_{App-GLP}$ = 106.26 , $M_{Post-GLP}$ = 796.18, $SD_{Post-GLP}$ = 111.85 ; $M_{Pre-FPL}$ = 781.23, $SD_{Pre-FPL}$ = 107.92, $M_{App-FPL}$ = 758.45, $SD_{App-FPL}$ = 101.07, $M_{Post-FPL}$ = 801, $SD_{Post-FPL}$ = 111.02) and a decrease in Mean HR ($M_{Pre-GLP}$ = 77.94, $SD_{Pre-GLP}$ = 11.64, $M_{App-GLP}$ = 78.96, $SD_{App-GLP}$ = 11.98 , $M_{Post-GLP}$ = 76.96, $SD_{Post-GLP}$ = 11.85 ; $M_{Pre-FPL}$ = 78.35, $SD_{Pre-FPL}$ = 11.66, $M_{App-FPL}$ = 80.59, $SD_{App-FPL}$ = 11.48, $M_{Post-FPL}$ = 76.43, $SD_{Post-FPL}$ = 11.44) and Min HR ($M_{Pre-GLP}$ = 71.54, $SD_{Pre-GLP}$ = 11.66, $M_{App-GLP}$ = 71.88, $SD_{App-GLP}$ = 11.56 , $M_{Post-GLP}$ = 69.4, $SD_{Post-GLP}$ = 11.35 ; $M_{Pre-FPL}$ = 71.43, $SD_{Pre-FPL}$ = 11.53, $M_{App-FPL}$ = 73.48, $SD_{App-FPL}$ = 11.59, $M_{Post-FPL}$ = 69.27, $SD_{Post-FPL}$ = 11.35) after application compared to during application (All $F > 2.52$, $p < .05$).

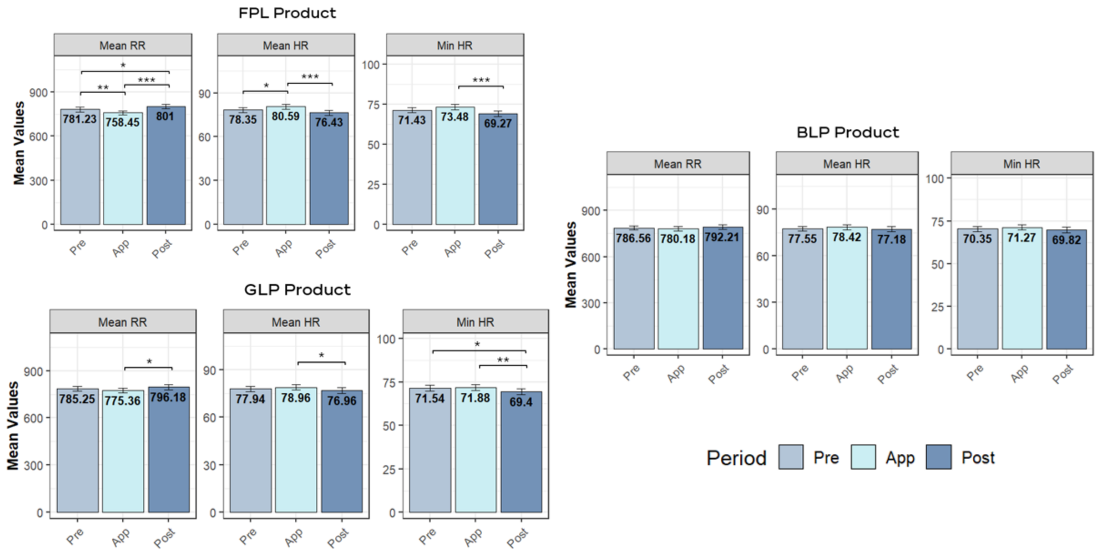

Figure 5: *Representation of the scores for the cardiac variables (Mean RR, Mean HR, and Min HR) before, during, and after lipstick application (Product × Period interaction). Significant differences between the before (Pre), during (App), and after (Post) application phases are indicated by significance stars for each product. The significance values for the post-hoc tests are as follows: *** $p \leq 0.001$, ** $p \leq 0.01$, and * $p \leq 0.05$.*

4. Discussion

Our multimodal approach confirmed that it is possible to measure the emotional impact of lipstick application, although fine differentiation between products remains a challenge.

Overall, lipstick application increased positive emotions (seduction, proactivity, well-being), decreased negative emotions, and induced sympathetic reactivity (increased EDA) during application, followed by a trend toward relaxation (increased parasympathetic PPG indices) post-application.

However, in this study, neither electrodermal activity nor facial expressions — which mainly indicated increased engagement and attention — allowed for significant differentiation between the three tested products. Differentiation was made possible through questionnaires and cardiac activity (PPG).

Thus, the questionnaires clearly showed the superiority of the GLP and FPL products over the BLP product in terms of generated positive emotions ("Boosted" and "Stimulated"), well-being (overall well-being and positive valence), and appreciation (overall, visual, and texture).These effects were corroborated by PPG, which revealed stronger signs of relaxation after the application of GLP and FPL compared to BLP.

Using the participants' personal favorite lipstick was therefore a good positive control to position the other two products. However, not all measures allowed for differentiation between the products. A literature review on studies using neurophysiological measures to assess the emotional impact of cosmetics showed that differentiating cosmetic products is difficult, but not impossible [15]. However, makeup products appeared to be more complex to study. Furthermore, no clear guidelines yet exist in this field. This work is therefore of great relevance for the field of the neuroscience of emotions related to cosmetics, where identifying the variables of interest for each measure is essential.

As previously mentioned, only questionnaires and cardiac activity allowed for product differentiation. Facial expressions and electrodermal activity, on the other hand, showed that lipstick application constitutes a significant emotional stimulation. However, it seems not possible to differentiate the products using these measures.

Yet, an increase in electrodermal activity has been highlighted when viewing one's favorite cosmetic products [18], or during the olfaction of pleasant scents and perfumes [19]. Moreover, one study showed the possibility of using electrodermal activity to distinguish lip balm, which triggered the highest emotional arousal [20]. However, we are not surprised to find no differences, as in our study, the data associated with the questionnaires also showed no difference in emotional arousal between the products. This means that even though the products are different, the overall arousal they induce seems similar.

Regarding facial expressions, they showed that lipsticks do not seem to induce particularly intense emotions, which could explain the absence of marked or exaggerated facial expressions. To date, and to our knowledge, no published study has yet explored the use of facial expressions (with algorithme) to analyze the emotions evoked by lipsticks. In the cosmetics field, only one study has used them to differentiate joy and sadness during perfume olfaction [21].

Finally, regarding product differentiation, decreases in heart rate of the same magnitude as in our study (2 to 4 bpm) have been reported during the viewing of images of women wearing makeup compared to photos without makeup [22], after the olfaction of cosmetic products [23–25], when viewing cosmetic products with pleasant colors [26], during the olfaction of pleasant scents [19] or after the application of a cream enriched with essential oils [27]. In the literature on emotions, a decrease in heart activity is often associated with stress reduction and positive emotions such as relaxation [28, 29], or emotional states such as happiness [30].Thus, the decrease in heart rate observed for the FPL and GLP products could reflect a greater moment of relaxation, with an individual preference for these products, as shown by the questionnaires. Furthermore, although this decrease may seem modest, it indicates a measurable physiological impact after the application of lipstick.

Thus, this study highlights the difficulty of objectively capturing subtle differences between similar products. Moreover, it emphasizes the importance of a multimodal approach to capture information specific to each measure, to better understand the emotions experienced during the application of cosmetic products.

The main limitations of this study include the high interindividual variability of responses, the challenges in interpreting subtle facial expressions through algorithms, and the ecological validity of a laboratory-based measurement.

5. Conclusion

In conclusion, a strong emotional reactivity during application (evidenced by increased electrodermal activity), followed by a relaxation phase after application (reflected by increases in certain cardiac indices related to parasympathetic activity), was observed. These variations reflect the complexity of emotional responses and underscore the importance of combined strategies to study them.

The questionnaires and PPG proved to be the most sensitive tools in this context for differentiating the lipsticks. Our results suggest that a product with more luxurious packaging (GLP) or a personally preferred product (FPL) induces more pronounced positive emotional (questionnaires) and physiological (relaxation) effects than the standard packaging (BLP).

In summary, while methodological challenges remain, this study underscores both the difficulty and the possibility of recording and differentiating the emotions associated with cosmetic application.

6. References

[1] Mohammed AH, Hassan BAR, Wayyes AM, Al-Tukmagi HF, Blebil A, Dujaili J et al. Exploring the quality of life of cosmetic users: A cross-sectional analysis from eight Arab countries in the Middle East. Journal of Cosmetic Dermatology 2023; 22(1):296–305.

[2] Kathleen M. Brinegar. Running Head : The Correlation Between Makeup Usage and Self-Esteem The Correlation Between Makeup Usage and Self-Esteem 2014. Available from: URL: https://www.semanticscholar.org/paper/Running-Head-%3A-The-Correlation-Between-Makeup-Usage-Brinegar/ebf7c6e8d31d601b2dc9ad4db60a5af71f0dd408.

[3] Korichi R, Pelle-de-Queral D, Gazano G, Aubert A. Why women use makeup: implication of psychological traits in makeup functions. Journal of cosmetic science 2008; 59(2):127–37.

[4] Kosmala A, Wilk I, Kassolik K. Influence of makeup on the well-being and self-esteem of women. Piel. Zdr. Publ. 2019; 9(3):215–20.

[5] Matsuoka Y, Yoneda K, Sadahira C, Katsuura J, Moriue T, Kubota Y. Effects of skin care and makeup under instructions from dermatologists on the quality of life of female patients with acne vulgaris. The Journal of Dermatology 2006; 33(11):745–52.

[6] Marahatta S, Singh A, Pyakurel P. Self-cosmetic care during the COVID-19 pandemic and its psychological impacts: Facts behind the closed doors. Journal of Cosmetic Dermatology 2021; 20(10):3093–7.

[7] Trautmann M, Wendel V, Prinz D, Primmel B, Willging G, Nagorsen E et al. Not only age but also tactile perception influences the preference for cosmetic creams applied to the forearm. International Journal of Cosmetic Science 2017; 39(3):344–50.

[8] Romano Bergstrom J, Duda S, Hawkins D, McGill M. Physiological Response Measurements. In: Eye Tracking in User Experience Design. Elsevier; 2014. p. 81–108.

[9] Dzedzickis A, Kaklauskas A, Bucinskas V. Human Emotion Recognition: Review of Sensors and Methods. Sensors (Basel) 2020; 20(3).

[10] Chunawale A, Bedekar M. Human Emotion Recognition using Physiological Signals: A Survey. SSRN 2020.

[11] Cai Y, Li X, Li J. Emotion Recognition Using Different Sensors, Emotion Models, Methods and Datasets: A Comprehensive Review. Sensors (Basel) 2023; 23(5).

[12] Ivonin L, Chang H-M, Diaz M, Catala A, Chen W, Rauterberg M. Traces of Unconscious Mental Processes in Introspective Reports and Physiological Responses. PLoS One 2015; 10(4):e0124519.

[13] Aguiar Neto FS de, Rosa JLG. Depression biomarkers using non-invasive EEG: A review. Neurosci Biobehav Rev 2019; 105:83–93.

[14] Alvino L, Pavone L, Abhishta A, Robben H. Picking Your Brains: Where and How Neuroscience Tools Can Enhance Marketing Research. Frontiers in Neuroscience 2020; 14:577666.

[15] Diwoux A, Gabriel D, Bardel M-H, Ben Khalifa Y, Billot P-É. Neurophysiological approaches to exploring emotional responses to cosmetics: a systematic review of the literature. Frontiers in Human Neuroscience 2024; 18:1443001.

[16] Benedek M, Kaernbach C. A continuous measure of phasic electrodermal activity. J Neurosci Methods 2010; 190(1):80–91. Available from: URL: https://www.sciencedirect.com/science/article/pii/S0165027010002335.

[17] Tarvainen MP, Niskanen J-P, Lipponen JA, Ranta-Aho PO, Karjalainen PA. Kubios HRV--heart rate variability analysis software. Computer Methods and Programs in Biomedicine 2014; 113(1):210–20.

[18] Ohira H, Hirao N. Analysis of skin conductance response during evaluation of preferences for cosmetic products. Frontiers in Psychology 2015; 6:103.

[19] Pichon AM, Coppin G, Cayeux I, Porcherot C, Sander D, Delplanque S. Sensitivity of Physiological Emotional Measures to Odors Depends on the Product and the Pleasantness Ranges Used. Frontiers in Psychology 2015; 6:1821.

[20] Lombardi SA. Emotional effects induced by lip balms containing different emollients: Neuroscientific approach to studying the tactual experience. Household and Personal Care Today 2017; 12(3):42–7.

[21] Mahieu B, Visalli M, Schlich P, Thomas A. Eating chocolate, smelling perfume or watching video advertisement: Does it make any difference on emotional states measured at home using facial expressions? Food Quality and Preference 2019; 77:102–8.

[22] Pössel P, Ahrens S, Hautzinger M. Influence of cosmetics on emotional, autonomous, endocrinological, and immune reactions. International Journal of Cosmetic Science 2005; 27(6):343–9.

[23] Abriat A, Barkat S, Bensafi M, Rouby C, Fanchon C. Psychological and physiological evaluation of emotional effects of a perfume in menopausal women. Int J Cosmet Sci 2007; 29(5):399–408.

[24] Painchault T, Perrin L, Loijens LWS, Linden X, Theuws HMM, Zimmerman PH. Application of scientific measures to demonstrate the relaxing properties of Peony fragrance in hair care products. J Sens Stud 2020; 35(2).

[25] Field T, Diego M, Hernandez-Reif M, Cisneros W, Feijo L, Vera Y et al. Lavender fragrance cleansing gel effects on relaxation. Int J Neurosci 2005; 115(2):207–22.

[26] Barkat S, Thomas-Danguin T, Bensafi M, Rouby C, Sicard G. Odor and color of cosmetic products: correlations between subjective judgement and autonomous nervous system response. Int J Cosmet Sci 2003; 25(6):273–83.

[27] Sgoifo A, Carnevali L, Pattini E, Carandina A, Tanzi G, Del Canale C et al. Psychobiological evidence of the stress resilience fostering properties of a cosmetic routine. Stress 2021; 24(1):53–63.

[28] Agrafioti F, Hatzinakos D, Anderson AK. ECG Pattern Analysis for Emotion Detection. IEEE Trans. Affective Comput. 2012; 3(1):102–15.

[29] Jaramillo-Quintanar D, Cruz-Albarran IA, Guzman-Sandoval VM, Morales-Hernandez LA. Smart Sensor Based on Biofeedback to Measure Child Relaxation in Out-of-Home Care. Sensors (Basel) 2020; 20(15).

[30] Shi H, Yang L, Zhao L, Su Z, Mao X, Zhang L et al. Differences of Heart Rate Variability Between Happiness and Sadness Emotion States: A Pilot Study. J Med Biol Eng 2017; 37(4):527–39.