Pilot Project to Measure the Subjects' Emotions after Use of a Cosmetic Care Product

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Background: Cosmetic products are intended for skin care, to clean and perfume the skin and to improve its outer appearance. The outer appearance is also influenced by expression of facial emotions. This means that the cosmetic goal can be reached or improved by induction of relaxation or of positive emotions. Cosmetics may therefore intend to improve the subjects' well-being, e.g. by increasing positive affect of self-touch and thereby improving the facial outer appearance. Standardized psychological questionnaires as well as physiological parameters are suitable to measure valence and arousal of emotions e.g. after standardized induction of psychological stress. In this pilot project, we have investigated the suitability to investigate the effect of cosmetic facial treatment followed by induction of moderate psychological stress by using the Socially Evaluated Cold Pressure Test (SECPT).

Methods: After giving their informed consent, one male and three female volunteers (37 to 65 years old) were included in the study. After standardized self-treatment with the cosmetic product, moderate stress was induced using the SECPT during which one hand is dipped into ice-cold water. Before and after this procedure, standardized questionnaires (PANAS = Positive and Negative Affect Scale) were assessed. Frontal alpha-asymmetry was measured with electroencephalography (EEG) to assess the valence of the subjects' emotions. The level of arousal was measured using the Galvanic Skin Response (GSR) and the heart rate.

Results: We observed increases in GSR results and PANAS ratings indicating that moderate stress was induced by SECPT in the subjects. After thoroughly filtering of EEG data for movement artefacts, alpha asymmetry could be measured in all volunteers to detect the valence of the subjects' emotions. However, the number of subjects investigated was much too low to detect unambiguous effects of the cosmetic treatment.

Conclusions: Measurement of emotions is difficult because they can change quickly and unpredictably. This pilot project paved the way to measure effects of cosmetic treatments on the intensity and valence of emotions in a setting with standardized moderate stress induction. Standardization of stress level and control of environmental influences such as noise and social interaction could be sufficiently controlled. The developed study design is now established to measure well-being effects of cosmetic care products of volunteers in test panels with larger case numbers. In this specific new design the cosmetic treatment is

intended to reduce the negative emotional response to a moderate physical stress and by that improve the well-being of the subjects.

Keywords: Well-being, Cold Pressure Test, EEG, Frontal alpha-asymmetry, PANAS

Introduction

For decades, the cosmetic industry tried to improve the efficacy of cosmetic products to improve the outer experience of their users to make them look younger and more beautiful. Science was used to improve cosmetic formulations as well as the methods to subjectively and objectively quantify the product effects. The focus was mainly directed on the skin and its appendages. Only recently, more focus was directed to psychological aspects of beauty and well-being.

It is generally and internationally accepted that cosmetic products are intended for skin care, to clean and perfume the skin as well as to improve its outer appearance. However, the outer appearance is also influenced by expression of facial emotions. Humans are social beings. Mainly facial muscles tension can be read by human observers and interpreted as more or less beautiful. Already Mueser et al. in 1984 [1] stated: “You’re only as pretty as you feel”. In his study photographs of people posing with a happy neutral or unhappy face were rated for attractiveness. While neutral and happy expressions led to a comparable rating of attractiveness, faces with an unhappy expression were clearly rated less attractive. In a much larger study, Ebner et al. [2] confirmed and refined these findings. Ratings on faces with negative emotions like sad, angry, fearful or disgusted led to clearly lower attractiveness scores compared to neutral or happy faces. Regarding such facts, we hypothesize that cosmetic goals can be reached or improved by induction of relaxation or stimulation of positive emotions. Cosmetics may therefore intend to improve the subjects’ well-being, e.g. by increasing positive effect of self-touch, massage [3 Ohkawa 2023] and thereby improving the facial outer appearance [4 Bouhout 2023,.5 Gabriel 2021, 6 Leong 2022]. Also, the scent of a cosmetic product can have an influence on the subject’s emotions [7 Springer 2022].

Standardized psychological questionnaires as well as physiological parameters are suitable to measure valence and arousal of emotions e.g. after standardized induction of psychological stress. The Positive and Negative Affect Schedule (PANAS) is a widely accepted validated psychological questionnaire to assess the actual emotional status of a subject [8 Watson 1988]. The quantification of emotions is based on the physiological measurement of mainly two aspects, the valence (the degree of how positive or negative the emotion is) and the arousal (the intensity of the emotion) [9 Maus 2009].

Human emotions are highly variable. Therefore, in our approach we work with a standardized artificially induced moderate physiological stress induction. Further, we are not investigating the direct effect of a cosmetic treatment on the subject’s emotions, but the priming effect of a cosmetic treatment on the subject’s quantitative stress response. We hypothesize that a cosmetic treatment can decrease the quantitative response to moderate stress that is applied after the cosmetic treatment in a standardized way. To our knowledge this is the first time that such a design has been explored.

In this pilot project, we have investigated the suitability to investigate the effect of a cosmetic facial treatment with a facial care cream followed by induction of moderate psychological stress by use of the Socially Evaluated Cold Pressure Test (SECPT) [10]. ECG was used to quantify the valence of the stimulated emotion. We measured the frontal alpha-asymmetry [11 Davidson 1990, 12 Gable_2008].

A more sensitive indicator of minimal emotional arousal than other physiological responses, the Galvanic Skin Response (GSR) has been used extensively in studies of emotion [13 Sharma_2016]. GSR and heart rate were measured on the foot to leave both hands free for cosmetic application. PANAS was used in the beginning and end of the assessments to record the actual emotional status of the subjects. Further, the subjects were asked at the end of the study if they observed a positive effect of the cosmetic treatment.

Materials and Methods

Human subjects

This non-medical study on healthy human subjects was completed in accordance with the principal requirements of the declaration of Helsinki and according to the main principles of Good Clinical Practice (GCP). Volunteers were informed both orally and in writing of the study details including potential risks and inconveniences. They provided their written consent before they were included in the study. Three female subjects and one male subject were included in this pilot exploration. They were 37to 65 years old.

Main inclusion criteria were healthy and psychologically unobtrusive. Main exclusion criteria were psychiatric diseases, allergies on cosmetic products, pregnancy, breast-feeding, drug abuse, active skin disease in the test area, systemic therapies, occasional pain relief medication in small amounts was accepted. The subjects were asked about the scent of the test product they had to use. None of them reported that the smell was unpleasant.

Test Schedule

After 15 minutes of acclimation in a quiet waiting area, the subjects were asked to sit down on a comfortable chair in the measurement laboratory. The interior of the laboratory had a neutral atmosphere and was only equipped with necessary technology, wireless sensors and even mobile electroencephalography [15] to reduce disturbance of devices as best as possible. Only one technician and one volunteer were allowed in the laboratory during all assessments.

All sensors were appropriately applied to the volunteer and their function tested. All equipment stayed in place in recording mode over the complete assessment time.

The PANAS was filled in by the subject followed by baseline measurements for 5 minutes of ECG, GSR and heart rate. The subject was asked to sit quietly and close the eyes for the whole period of 5 minutes of recording to reduce movement artefacts. Directly after baseline measurements the product application was performed by the volunteer. After that the SECPT was performed on one hand, followed by the assessment of all objective measurements (ECG, heart rate and GSR) for 5 minutes. Again, the subject was asked to sit quietly and close the eyes for the whole period of 5 minutes of recording to reduce movement artefacts. Time stamps were taken at the beginning of each period of 5 minutes (M1 and M2 in Figures 3A, 3B) to recover the exact times of each measurement period for each assessment. M3 and M4 mark the beginning of application (M3) or SECPT (M4). At the end of the assessments the PANAS was repeated.

Product application

After verbal instruction, two of the four subjects applied the cosmetic care product (test cream) with both hands on cheeks, nose and chin, by use of gentle massage for 1 minute. It was allowed to take test product from the container a second time and reapply it during the interval of 1 minute.

The other two subjects used a micellar water for facial cleansing (control) with a cotton pad to wipe cheeks, nose and chin according to the usual procedure of the subject for a maximum of 1 minute. It was allowed to take the test product from the container a second time and reapply it during the test interval. A stop of application was allowed earlier, when the subject decided that cleansing was finished. In this case the subjects had to sit still and wait until the minute was complete.

Frontal alpha-asymmetry assessment

ECG on 8 locations (Figure 1) on the scalp were recorded (Enobio 8® by Neuroelectrics, Barcelona Spain.). To assess frontal alpha asymmetry the locations F3 and F4 were used. One prefrontal electrode (Fp1) served to mainly record eye movements. Further control electrodes were applied to enable appropriate filtering of artefacts from the measurement data. Figure 1 shows the setting of the 8 gel-electrodes The software (BrainVision Analyzer® by Brain Products GmbH, Gilching Germany) was used for data fitration/cleaning and transformation and calculation of frontal alpha-asymmetry.

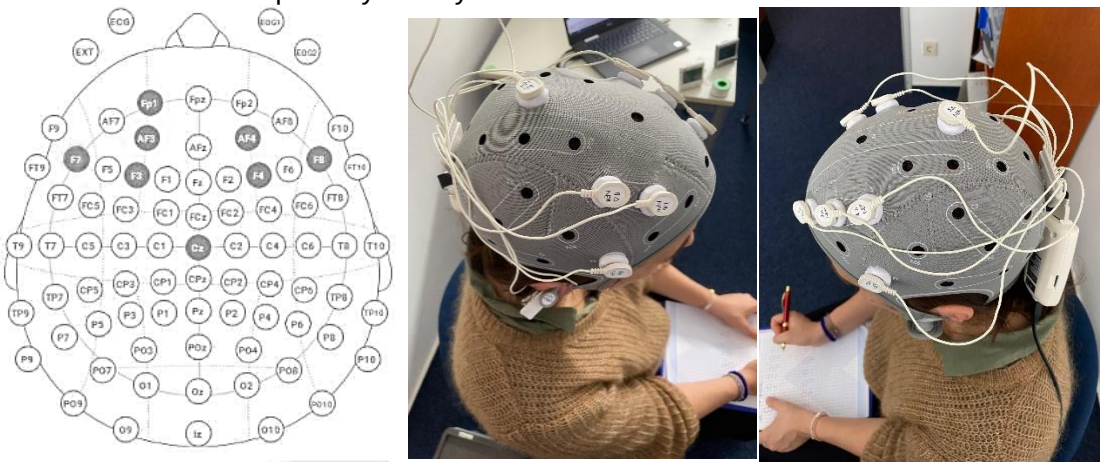

Figure 1: Subject after application of ECG helmet with 8 gel electrodes. The sensors are connected with thin cables to a small central device fixed behind the subjects head. Left: Electrodes connected (dark grey). For For alpha asymmetry calculation the alpha frequency signals of F3 and F4 was used

Galvanic Skin Response (GSR) and heart rate

In Figure 2 the location of GSR and heart rate sensors on the foot are shown. The integrated device (Shimmer3® GSR+ Unit, Shimmer Sensing, Dublin, Ireland). Heart rate was assessed on the back of the foot.

Figure 2: GSR and heart rate detection was performed wireless on the foot

Positive And Negative Affect Schedule

The validated German version of the PANAS [14] was used to assess the actual emotional state. Shortly explained, this is a fixed random list of 20 positive and negative descriptors like “active”, “interested”, “attentive”, angry, “irritable”, “afraid” etc. The subject rates each item on a 5-point Likert scale each item (from “not at all” to “extremely). A validated standardized evaluation is used to quantify positive and negative affect.

Results

PANAS ratings at the end of the study indicated that a moderate stress was induced by SECPT as the values for the dimension of positive ffect decreased in the subjects (data not shown).

Only the baseline and final recording were exactly scheduled to 5 minutes and were used to average all 3 physiological parameters. However, while EEG results in between phases were blurred due to movement artefacts, heart rate and GSR show interesting and highly individual results. Figures 3A and 3B illustrate the result of GSR and heart rate of two of the four subjects. While in subject 1 heart rate and GSR clearly increased during the phase before the cold pressure test (yellow), and returned to lower values already during the time, in subject 3 the heart rate decreased slightly during cold pressure test and GSR increased not before the hand was taken out of the water.

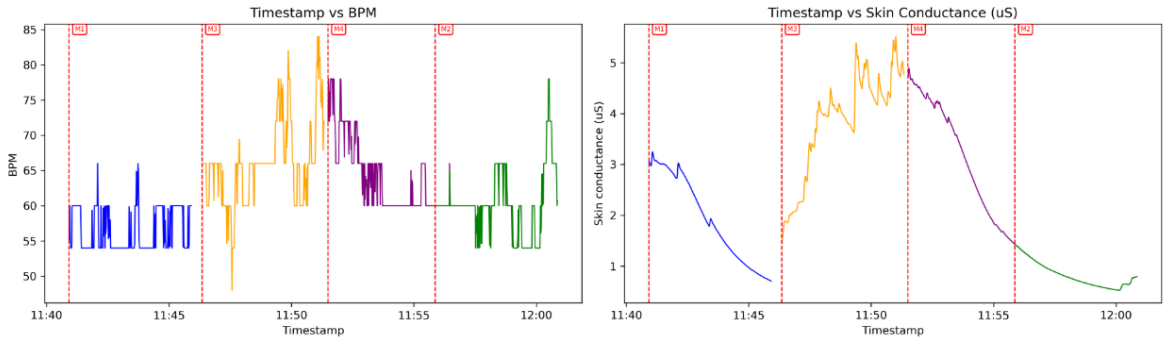

Figure 3A: Heart rate [BPM = Beats Per Minute] and GSR conductance [µS] of subject 1 (female). Blue: baseline (5 minutes), Yellow: Product application (1 minute) waiting for the cold pressure test (3 minutes), Purple: hand in cold water (3 minutes), Green: Recording at the end of the test (5 minutes)

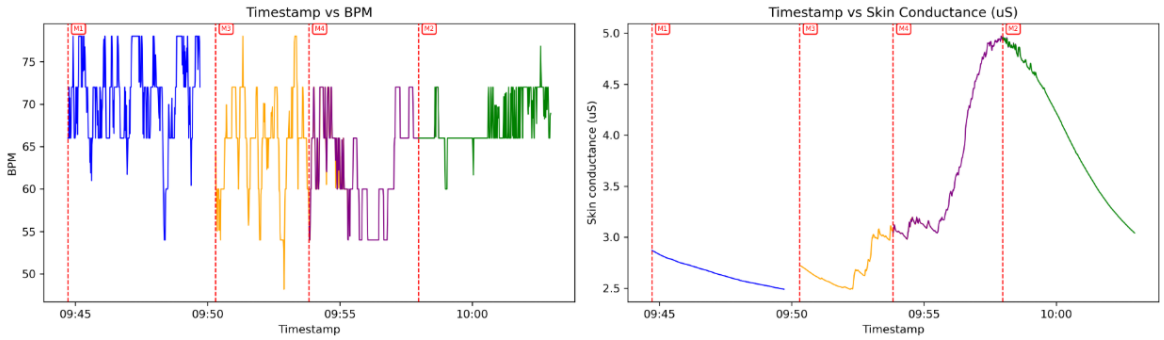

Figure 3B: Heart rate [BPM = Beats Per Minute] and GSR conductance [µS] of subject 3 (female). Blue: baseline (5 minutes), Yellow: Product application (1 minute) waiting for the cold pressure test (2 minutes), Purple: hand in cold water (3 minutes) waiting for start of the last recording phase (2 minutes), Green: Recording at the end of the test (5 minutes)

Table 1 displays the main results of this pilot study. The averages of recordings over 5 minutes of baseline (after time stamp M1) and after the SECPT (after time stamp M2) are displayed for each subject and the three physiological parameters. Table 2 shows the changes from baseline for the three averaged parameters.

Though the displayed values are the best controlled results of the study and averaged over a longer period of 5 minutes, still a high individual variability is seen in all parameters. GSR seems to show relaxation under the Test Cream treatment and increased arousal after use of the Control cleanser (see Table 2). The other two parameters give no clear tendencies. As the number of subjects is only two per treatment group also the GSR results may be due to chance.

Table 1: Mean of GSR, Heart Rate and Alpha Asymmetry over 5 minutes

Subject	Test Product	Assessment period	GSR [µS]	Heart Rate [BPM]	Alpha Asymmetry [Arb. units]
1	Test Cream	Baseline	2.969	62.7	-0.100
		After SECPT	1.599	60.3	0.021
2	Test Cream	Baseline	1.930	56.6	0.051
		After SECPT	0.825	60.2	0.054
3	Control	Baseline	2.651	71.0	-0.112
		After SECPT	3.995	67.6	-0.181
4	Control	Baseline	0.460	70.4	-0.064
		After SECPT	0.865	71.0	-0.038

Table 2: Mean changes from baseline to after SECPT of GSR, Heart Rate and Alpha Asymmetry

Subject	Test Product	Change GSR [µS]	Change Heart Rate [BPM]	Change Alpha Asymmetry [Arb. units]
1	Test Cream	-1.37	-2.4	0.121
2	Test Cream	-1.105	3.6	0.003
3	Control	1.344	-3.4	-0.069
4	Control	0.405	0.6	0.026

Discussion

Measurement of emotions is difficult because they can change quickly and unpredictably. Assessments on 4 subjects showed clear reactions to the cold pressure test (SECPT). In this pilot study no cross over design was yet realized and therefore no intraindividual data is available.

The data of only 4 subjects was not sufficient to discover differences between control (cleanser) and cosmetic care product (test cream). The case number of two per group is much too low to draw any reliable conclusions about product activity. Also, in the main study a cross over design

is planned to enable intra individual comparisons and reduce the high individual variability by that.
The effect of the cosmetic treatment had to be assessed versus a control treatment. The control product was not easy to choose, as it should provoke clearly less relaxation and should not trigger positive emotions. A first indication is seen as this might be true.

Conclusion
Though much work is still ahead, this pilot project paved the way to measure effects of cosmetic treatments on the intensity and valence of emotions in a setting with standardized moderate stress induction. Standardization of the stress level and avoidance of environmental influences such as noise and social interaction led to well controlled study conditions. The developed study design is now at a stage to measure well-being effects of cosmetic care products of volunteers in test panels with larger case numbers and cross over design. It is the scope of this ongoing project to show in a larger controlled study that a cosmetic treatment can reduce the negative emotional response to a moderate physical stress and by that improve the well-being of the subjects.

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Conflict of Interest Statement.
No conflict of interest declared. Stephan Bielfeldt, Natascha Hennighausen, Jayesh Bhat, Dörte Segger and Matthias Seise are employees of the SGS proderm GmbH / SGS Institute Fresenius GmbH.

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