The skin as a recipient of environmental influences for the emotional state: The new concept of Emossome

Pedro Contreiras Pinto[1]**,** Pedro Amores da Silva[2]

[1]Scientific director, PhD Trials, Lisboa Portugal, [2]R&D Department, ADAT, Lisboa, Portugal

PhD Trials, Av. Maria Helena Vieira da Silva, Lisboa, Portugal, +351216034267, geral@phdtrials.com

Abstract

Background: The skin is the first organ that interacts with the environment that surround us. This environment can have the capability to induce our emotional state by interacting with the skin receptors. The aim of this study was to evaluate the capacity of several stimulus to induce changes related with our skin to evaluate how the environment can actively become a sensorial modifier.

Methods: After Informed Written Consent and Ethical Commission submission, 65 male and female subjects were submitted to a sensorial study. Skin biometric parameters were obtained, namely skin microcirculation (Periflux PF5000), Trans Epidermal Water Loss (Tewameter TM300), Galvanic Skin Response (GSR) and Heart Rate frequency and variability (Shimmer), Eye tracking (tobbi TX2 and HTC VIVE pro Eye headset), thermography (FLIR Ebx30), and EEG (Actichamp 64 channels). Statistical and correlation analysis was performed using SPSS23 (IBM). Confidence level was established at 95%.

Results: Results show that tactile vibration decreased the Heart Rate Variability. The GSR peak detection significantly increases when the subjects smell the aversive and excited fragrances and increased when an aversive 3D video is visualized. In both situations TEWL also increased. Skin microcirculation increased during the more extreme stimulus. A Wavelet detection algorithm show an increase contribution of the sympathetic and local activity on the same stimulus presentation.

Conclusion: The Emossome was observed in all the stimulus that can interact with our skin to modify the emotional state of the subject, leaving our skin to act as an extension of our brain.

Keywords: Emossome, neurocosmetic, sensorial evaluation, data analysis, Virtual Reality

Introduction

The skin is the first organ that interacts with the environment that surround us. In the skin or directly connected with it there is a group of receptors and sensorial organs that could modify or be modified by the environment and create stimulus that generate skin interactions[1-3]. This ability may create an improved stimulus perception establishing an association with the surrounding environment that change our emotional state by interacting with the skin receptors. These connections would behave as an extension of our brain in a way that modifies our senses and finally induce changes in the moods and perception leading us to become more happy, excited, bored, surprised or even angry[3]. Several theories were developed to explain the emotional response to different stimulus, and metrics can be used to express in a quantitative way the relation with stimulus presentation and emotional state for example in the Russel's Circumplex of Affects[4-5]. This is the base of the new neurocosmetic products that claim to change these parameters in a significant way, and that is one of the reasons why consumers would use cosmetic products. In general, they use products that make them feel well.

The skin ability to perceive external stimulus has been studied. The perception of cooling, warming, itching, burning, stinging, tightness, and pain is possible through skin receptors such as thermoreceptors, mechanoreceptors and nociceptors. Other areas had developed models to study the skin ability to sensorial stimulation and how this induces pleasure, calm, and analgesia. These unrevealed targets may become a focus for treatment of anxiety and depression, as well as social disorders and traumas in which social touch becomes aversive[6].

However, minor stimulus were also able to stimulate receptors that activate specific pathways. Examples of these are the sensations that are created in the skin after application of cosmetic products that increase skin hydration in subjects suffering from atopic or dry skin. In general ingredients that generate these stimuli can leave perceptions and simultaneously induce response in several receptors.

These neurocosmetic products applied onto the skin are able to stimulate or reduce the activity on the cutaneous nervous system and act as skin mediators. This concept has been developed and is based on the combination of nervous, immune, cutaneous, and endocrine stimulus.

The aim of this study was to evaluate the capacity of several stimulus to induce changes detected or related with skin to evaluate how the environment can actively become a sensorial modifier and to test the existence of a new concept of environment modifier called Emossome.

Material and Methods

Study design

After Informed Written Consent 65 subjects (both genders) were submitted to a sensorial study where they were exposed to several stimulus that cover some of the main characteristics of the sensorial evaluation that could have some translation in skin parameters (Figure 1).

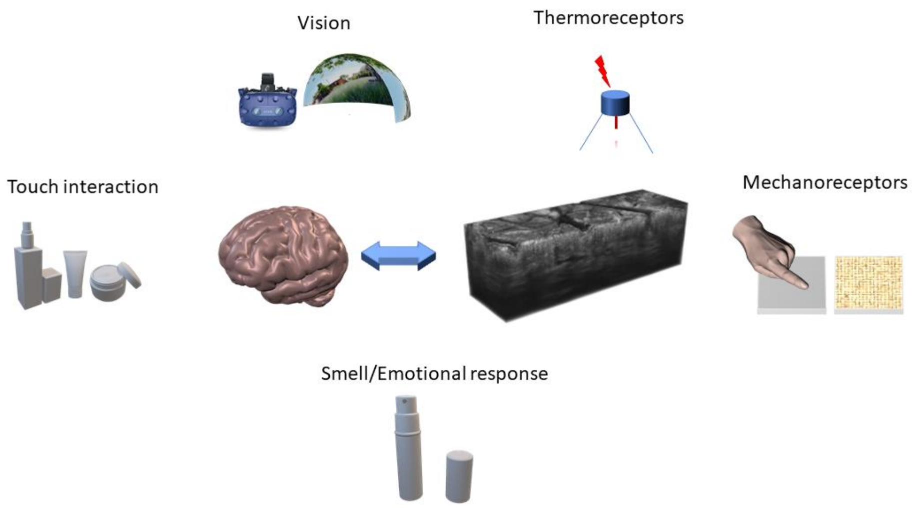

Figure 1: Summary of the stimulus presented to the subjects during the Emossome experiments

Stimulus definition: 6 types of stimuli were defined:

Stimulus 1 - Touch interaction: Specific surfaces with two main rugosity values were presented to the subjects in order to stimulate the tactile receptors. A smooth surface (Sa=2,325 μm) and a rough surface (Sa= 28,866 μm) where presented to the subjects with the eyes blinded to avoid the pattern recognition for 30 seconds, each surface.

Stimulus 2 - Thermal interaction: A temperature exposure (to stimulate temperature receptors), was performed by measuring the basal skin temperature for 1 minute followed by a continuously increase of the local skin temperature to 44ºC during 7 min.

Stimulus 3 – Vision interaction: Vision stimulation using 3D video immersion in a Virtual Reality headset (to create dynamic situations in a safe environment). 3D videos were selected to express surprise and. Additionally, 2D video stimulations was also performed using 3 sets of videos presented randomly. These videos cover the concepts of surprise, joy and aversive. Each video was exposed for 2 minutes.

Stimulus 4 - Cosmetic interaction: Subjects were exposure to different types of cosmetic emulsions with different rheological properties from completely fluid (viscosity=4000 cP), middle (viscosity= 13000 cP) and high viscosity (viscosity= 77000 cP) preparations, during 2 minutes for each product presentation. Subjects had to open the container apply a small sample on the forearm skin as a normal consumer.

Stimulus 5 - Olfactive interaction: Fragrance presentation using control fragrances (Aromaster 88 scent set, Vinofil, HK) covering the concepts of excitement, neutral, boring, and aversive obtained from the database of PhD Trials was presented to the subjects randomly for 30 seconds each. Between each fragrance subjects had to smell a neutral body part.

Biometric definition:

Skin biometric parameters were obtained before and during the stimulus presentation to detect the influence of the sensorial activity in the skin physiology. In all the stimulus we obtained the Skin microcirculation values on the hand (Periflux PF5000, Perimed), Trans Epidermal Water Loss (Tewameter TM300, C+K), Galvanic Skin Response (GSR) (Shimmer SH3+), Eye tracking evaluation (tobbi TX2 and HTC VIVE pro Eye headset), Heart Rate frequency and variability (ShimmerECG) and EEG (Actichamp 64 channels headset system).

All parameters were synchronized with the stimulus presentation in PhD Trials AFETS platform (Imotions, Denmark based system) to correlate the stimulus with the evaluated parameters. All the parameters were extracted at the times of the stimulus and in case of the eye tracking systems exposure times were also calculated, both in 2D and in 3D images. EEG mapping evaluation was performed using Matlab R2019b and Topographic EEG/MEG plot[6].

The study was submitted to the corresponding Ethical Committee and follow the general submission process to the Portuguese authorities to comply with Good Clinical Practices (RNEC nº 178567). Statistical analysis and correlation analysis was performed using EXCEL (Microsoft Corp) and SPSS 23 (IBM). Confidence level was established at 95%.

Results

Results show that during tactile vibration there is a decrease in the Heart Rate Variability (HRV), especially in the rougher surface. The GSR peak detection significantly increases when the subjects smell the fragrances related with aversive and excited and increased when an aversive 3D video is visualized in a context of 3D VR stimulation. In both situations TEWL also increased. Skin microcirculation was obtained and increase during the more extreme tactile stimulus (more viscous cosmetic emulsions) but decrease during the video stimulus. A Wavelet detection algorithm show an increase contribution of the sympathetic and local activity on the same stimulus presentation for the cosmetic product presentations.

EEG results show a reduction of the disgust frontal activation vs the joy and surprise video stimulus. Also, the joy video stimulus was the one who suggested a higher activation of the Alpha waves during the same time.

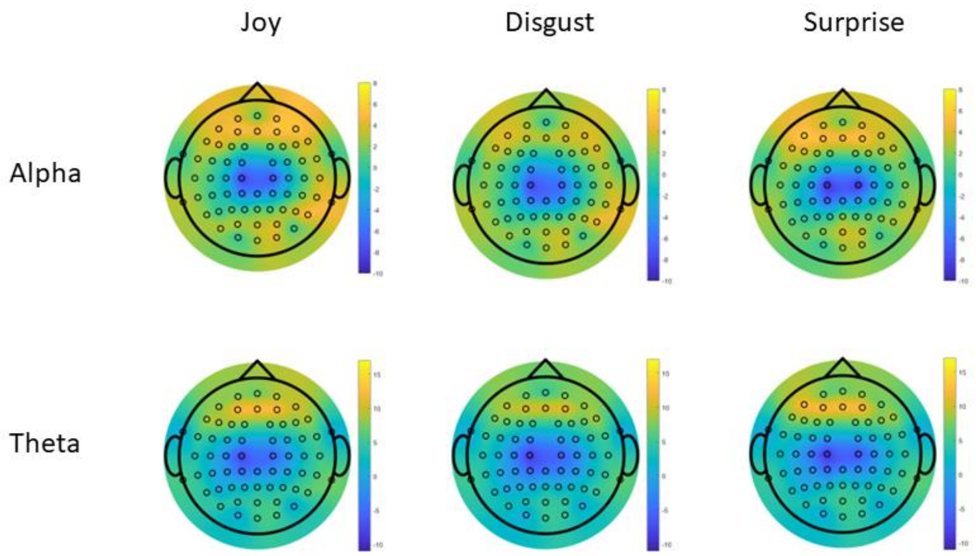

Figure 2: Summary results obtained from subject 1 during the 2D video presentations

Discussion: During vibrational stimulus the HRV is a surrogate for the Autonomic response and probably decreases due to the stress imposed by the stimulus setup (the subjects had the eyes blinded). During the fragrance presentation subjects increase the arousal (detected by the increase of the peak detection of the GSR) in the more aversive and more excited presentations, which is expected as those are the more intrusive stimulus, linking the olfactive neuronal activation to a skin related parameter. Viscous cosmetic emulsions also increase the GSR and EEG activity in the frontal area, when considering the theta waves suggesting an increase in the stimulus recognition.

The TEWL results suggest an increase in the sensorial activity triggered by aversive videos. These videos increase the stress response, and this is detected by a TEWL higher value during the presentations. Subjects were not moving during the 2D video presentations therefore only the effect of the video over the skin physiology is observed.

In summary the extreme stimulus starts an increased activity of the autonomic response that is propagated trough several physiological mechanisms until reaches the brain. These mechanisms suggest that the skin act as an anticipative neurodetector and responds to the environment where it is immersed, or when some emotional response is anticipated.

This enhancement of skin traditional functions, anticipating the response and preparing the CNS to the coming stimulus may be stimulated by several types of stimuli or even products applied. The evaluation of the induced response it’s a very challenging and technical procedure.

From these findings we suggest the concept of Emossome, an environment space that surrounds the skin, interacts with it, and modulates the sensorial response in a way that can induce neural activity similar to those induced by a cosmetic product. The creation of several scales and the validation of the Emossome concept will therefore pursuit.

Conclusion

The Emossome concept and its influence on the skin physiology was observed in all the stimulus that can interact with our skin in order to modify the emotional state of the subject, leaving our skin to act as an extension of our brain.

Acknowledgments.

None

Conflict of Interest Statement

None

References

1) Corina U. Greven, Francesca Lionetti, Charlotte Booth, Elaine N. Aron, Elaine Fox, Haline E. Schendan, Michael Pluess, Hilgo Bruining, Bianca Acevedo, Patricia Bijttebier, Judith Homberg, Sensory Processing Sensitivity in the context of Environmental Sensitivity: A critical review and development of research agenda, *Neuroscience and* Biobehavioral Reviews 98 (2019) 287–305
2) Masood, N.; Farooq, H. Comparing Neural Correlates of Human Emotions across Multiple Stimulus Presentation Paradigms. *Brain Sci.* 2021, *11*, 696. https://doi.org/10.3390/brainsci11060696
3) Slominski AT, Zmijewski MA, Skobowiat C, Zbytek B, Slominski RM, Steketee JD. Sensing the environment: regulation of local and global homeostasis by the skin's neuroendocrine system. Adv Anat Embryol Cell Biol. 2012;212:v, vii, 1-115. doi: 10.1007/978-3-642-19683-6_1. PMID: 22894052; PMCID: PMC3422784.
4) Russell, J. A. (1980). A circumplex model of affect. Journal of Personality and Social Psychology 39, 1161–1178
5) Russell, J. A. (2003). Core affect and the psychological construction of emotion. Psychological Review 110, 145–172
6) *Leah J Elias 1, Ishmail Abdus-Saboor 2, Bridging skin, brain, and behavior to understand pleasurable social touch, Curr Opin Neurobiol. 2022, pr;73:102527 DOI: 10.1016/j.conb.2022.102527*
7) Víctor Martínez-Cagigal (2022). Topographic EEG/MEG plot (https://www.mathworks.com/matlabcentral/fileexchange/72729-topographic-eeg-meg-plot), MATLAB Central File Exchange. Retrieved June 28, 2022.