Combining virtual reality and physiological measurement to assess emotions triggered by fragrances

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Introduction:

Robertet Group is the worldwide leader of aromatic natural raw materials. The company creates aromatic ingredients, perfumes, flavours and actives. Analyzing emotional dimension became very popular for a lot of companies whatever the field, automotive, textile, food, fragrances and so on. The main reason for this interest is that the emotions evoked by products, services and brands often have an impact on consumers' buying behaviour. Emotions are a key factor on several components of customer satisfaction such as trust, loyalty and likelihood of recommendation. In this context, Robertet Group is looking to qualify and quantify emotions associated with its products, starting with perfumes. In addition to optimizing consumer experience, this analysis is useful for understanding the success or failure of fragrance compositions.

Defining emotions is a central step in their study. Most emotions are characterized by neurophysiological responses (Kreibig 2010) without a consensus to identify them on this basis (Kreibig 2010). Behavioural analysis is often used to recognize certain basic emotions (Ekman 1992), but this recognition is limited by the type of stimulation. In many studies, self-report questionnaires are used to associate an emotion with a stimulus in a simple way. Evaluations are based on a subjective assessment without taking into account the subject's unconscious reaction. According to (Zhu et al., 2019), the best way to analyze emotions is to combine subjective assessment with physiological measures and behavioral analysis. However, combining these 3 types of measurements is too complex for industrial applications. The objective of this study is to find a reliable way to analyze emotion by combining physiological signals with self-reported data.

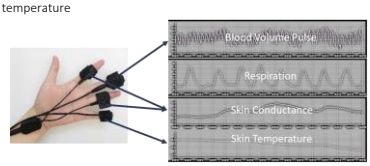
Materials & Methods:

Participants
33 Participants (23 women, mean age: 40.07 +/- 10.06). Participants with history of epilepsy, taking substances with psychotropic effect or affecting the cardiac system were not selected. Participants have signed a consent form.

Stimulations
31 perfumes, 23 ingredients and 40 videos in virtual reality were tested.

Assessments
- Valence and arousal scale of self-assessment manikin (Bradley 1994)
- Visual analog scale for intensity and naturality (ingredients and perfumes)
- Assessment with 18 emotional terms (Videos)

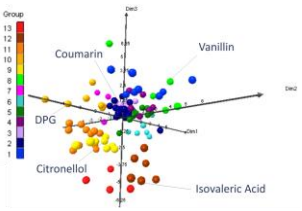
Physiological data
- Heart data
- Electrodermal activity data
- Respiratory data
- Skin temperature



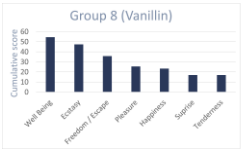
Visual Representation
From distance between stimulation matrix with the same variable as k-means, a multi dimensional scaling analysis was done to reduce the number of axis to 3.

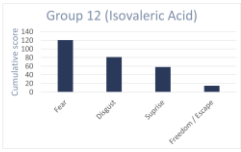
Clustering Method
K-means clustering was done with some physiological data score and with valence and arousal scale.

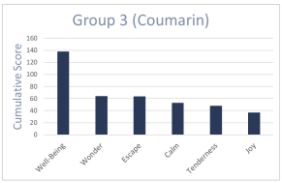
Results & Discussion:

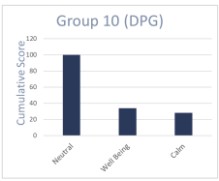


Representation in 3D space of olfactory and visual stimulations. This representation is resulting from multidimensional scaling that reduced 5 variables in 3 dimensions. K-means groups are represented by colors.









Main emotions' cumulative score for vanillin, coumarin, DPG and isovaleric acid group. Scores are calculated by adding scores of videos classified in those groups.

Emotion recognition results
k-means analysis leads to 13 independent groups of stimulations.
Each group is characterized by significative emotions associated with videos that are classified to the group.

Classification is based on scores attributed to physiological changes induced by the olfactory stimulation (student paired t-test p<0,05; p<0,01; p<0,001; p<0,1 and p>0,1).

Conclusions:

This study aims to find a model for emotion recognition based on physiological responses and virtual reality video. Emotions triggered by each video were evaluated by the panel and the induced physiological responses were analysed. An emotion rarely exists alone and is often associated with other emotions (Wang 2013), therefore each group is defined by several emotions. The physiological responses induced by odors are similar to those induced by visual stimuli.

In this way, this method makes it possible to associate a fragrance with an emotion. For this study, the fragrances were classified into different groups characterized by several emotions. Finally, this methodology allows to classify emotionally odors in a reliable way.

Acknowledgements:

A patent has been deposit on the methodology (BR116327/BDR/VRE – France).

No conflict of interest.

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