Stress-relieving aromatic scents for covid-19 mask: analysis of the brain's response to reduce the stress, to improve wellbeing and energy via the contribution of neuroscience

Celine, Carrasco-Douroux[1]; Patrice, Bellon[2]; Manon, Descoubes[1]; Lisa, Le Mauff[1]; Edison, Diaz[3]

[1]Applied Research, Symrise, Clichy, France;
[2]Cosmetoscent, Issy Les Moulineaux, France;
[3]Applied Research, Symrise, Holzminden, Germany;

Celine Carrasco-Douroux : Symrise 15 rue Mozart, 92110, Clichy, France, celine.carrasco-douroux@symrise.com, +33155462700
Lisa Lemauff: Symrise 15 rue Mozart, 92110, Clichy, France, lisa.lemauff@symrise.com, +33155462700
Manon Descoubes: Symrise 15 rue Mozart, 92110, Clichy, France, manon.descoubes@symrise.com, +33155462700
Edison Diaz: Symrise AG, Mühlenfeldstrasse 1, Holzminden, Germany, edison.diaz@symrise.com, +495531900
Patrice Bellon: Cosmetoscent, 2 Rue Eliane Jeannin Garreau, 92130, Issy Les Moulineaux, France, cosmetoscent@gmail.com, +33613451372

Abstract

Background: This research was developed to reduce stress and anxiety in the covid-19 mask wearer. Our recent neuroscientific studies have proven that certain well-defined and associated scents, such as ginger, tonka bean and vanilla, significantly reduce stress, bring well-being, and energize the person who breathes them. Using neuroscience support, we were able to measure the reduction of stress and the improvement of well-being.
Methods: A panel of 78 volunteers were divided into 3 groups of 26: placebo (alcoholic solution), neutral fragrance and active fragrance (same core of neutral fragrance with added tonka bean-vanilla-ginger complex). The volunteers wore a mask during the day. In a 15-day study, the stimulus was sprayed on the outside of the mask. Facial expressions, heart rate assessment, psychometric questionnaire and measurement of cognitive visual attention were used.
Results: After 15 days of daily use of the aroma spray, participants reported feeling more relaxed with the active mask compared with the placebo mask. Eye-tracking results showed that participants spent significantly more time on the "feel good" image while smelling the active fragrance compared to the placebo.
Discussion and conclusion: We have demonstrated the power of scents such as the vanilla-tonka bean-ginger accord to reduce stress and improve well-being, using neuroscientific methods. This research presents an innovative method for quantifying the ability of a scented product to improve the emotional experience of stress reduction.

Keywords: neuroscience; covid-19 mask; emotions; stress; well-being; aromatic scents;

Introduction.

This research was developed to provide an adaptative solution to the stress and anxiety associated with wearing a covid-19 mask. It will soon be two years that we have been living with the changing challenges and disruptions of Covid-19 and its variants. This pandemic has

profoundly influenced our lives by increasing our stress and imposing, among other things, the mandatory wearing of mask [1]. When we wear a covid-19 mask, an increase in stress and anxiety has been recognized. Breathing in and out means that our sympathetic system is involved and, if our body perceives a restriction in our airflow, it triggers several emotional reactions: stress, anxiety, difficulty breathing and increased heart rate [2].
This study follows two successive neuroscientific researches which were the subject of posters at two IFSCC Congresses. The first one was the objectivation and the comparison of the influence of fifteen fragrances raw materials on the emotional answer in a panel of 30 female subjects after a single olfactory discovery (Carrasco-Douroux, Bellon, Vial, Aubert, IFSCC 2020 Yokohama, Japan) [3]. This first assessment allows the identification of the three fragrances raw materials performing the best according to this emotional assessment: Tonka Bean, Vanilla and Ginger. This study was associated with an immersive experimental study induced by the virtual reality to define the enhancement of the sensual experience.
The second one was the evaluation of the emotional benefit of a fragrance using cognitive visual attention assessment or eye-tracking and emotional pictures (Descoubes, Carrasco-Douroux, Le Goff, Bellon, IFSCC 2021, Cancun, Mexico) [4], to demonstrate that the combination of the three odorant molecules: Vanilla, Tonka Bean and Ginger, provides wellbeing and energy.
In a pragmatic way, these recent neuroscientific [5] studies have proven that certain well-defined and associated scents, such as Ginger, Tonka Bean and Vanilla, significantly reduce stress, bring well-being, and energize the person breathing them. By using neuroscientific techniques [6] [7], such as measuring facial expressions, measuring visual cognitive attention and psychometric questionnaires, we were able to evaluate the power of these associated scents on stress and prove the well-being of the covid-19 mask wearer [8] [9].

Materials and Methods.

The context is to recognize that the study of the relation between psychology and personal care products is a relatively new science. In the field of perfumes, neurosciences will definitely bring better knowledge of the consumer into the assessment of wellbeing [10]. For this study, the combination of psychological assessment of subjective well-being, facial expressions assessment of emotional dimensions and eye-tracking allowed us to assess the emotional impact and the emotional beneficial effects of a fragrance.

The protocol was established like this: 78 Caucasian volunteers aged between 20 and 66 years (male & female) were recruited, divided in 3 groups of 26: placebo (alcoholic solution), neutral fragrance and active fragrance (same heart of the neutral perfume with the additionally tonka-bean-vanilla-ginger complex). Volunteers were people who wear a mask during the working day, who are stressed by wearing a mask throughout the day and find it difficult to wear. For the study, participants had to wear a perfumed mask for 15 days. The spray had to be used on the outside of the mask: one spray in the beginning, wait 1 or 2 minutes for the alcohol to be evaporate and then wear the mask as usual. They could repeat the procedure as often as necessary as soon as the smell has disappeared. Two weeks of field study were organized at D0 and D15 for the 3 products. Firstly, we used the measurement of facial expressions, the assessment of heart rate variability and a psychometric questionnaire during the recording of facial expressions on the self-evaluation of the tested product, combined with the measurement of cognitive visual attention (eye-tracking) during the reading of emotional images. Then, we used a psychological assessment of subjective well-being at D0, immediately after an application and after 15 days.

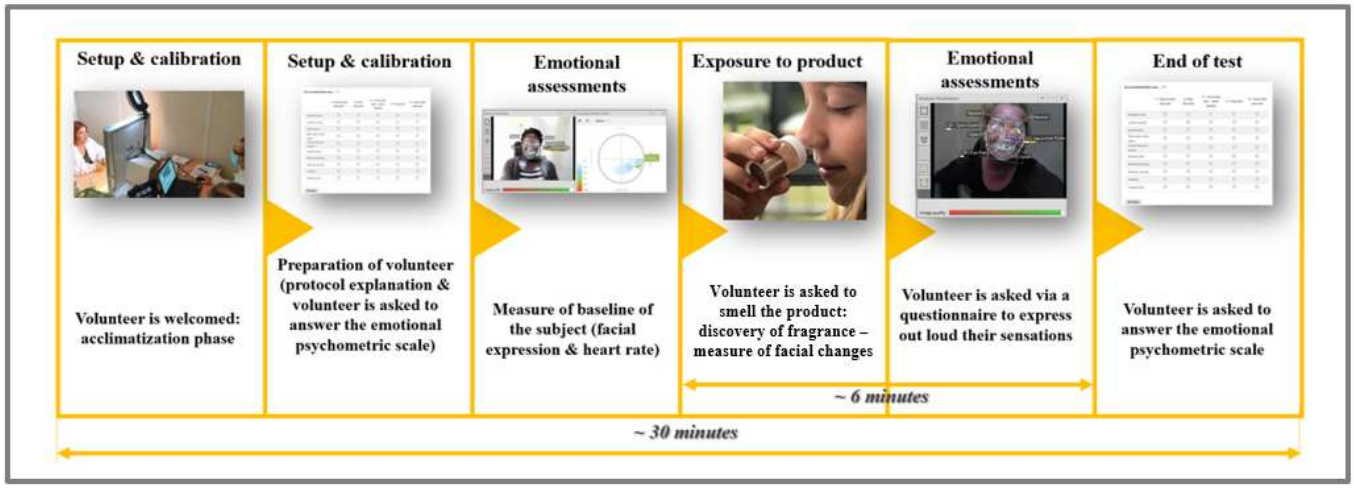

Figure 1. Protocol (part I) at D0 and D15

Tools & Parameters :

According to the protocol described above the tools and parameters used for this study were as follows (*Figure 1*):

1. Emotional scale of wellbeing completed before the test and at the end of the test
2. Facial expressions & heart rate measurement via FaceReader®
3. Questionnaire (10 - 13 questions) during FaceReader® registration on the self-assessment of the tested product
4. Cognitive visual attention measurement or eye-tracking *(unconscious)* during reading of emotional images & choice of emotional pictures *(conscious)* most in line which each stimulus.

1-Let's start with some details on the wellbeing questionnaire (WBQ, Bradley 1996, latest revision 2002) was originally designed in 1982 to provide the measure of depressed mood, anxiety and various aspects of positive well-being for use in a World Health Organization study (management of diseases). The wellbeing questionnaire is a short, reliable and valid measure of psychological well-being that is really suitable for the evaluation of the emotional benefit of a scented product. The following 13 emotions were measured : Stress, tiredness, relaxation, nervousness, joy, confidence, feel good, open to others, contrariety, irritability, protection, serenity, worry. Volunteers were asked to read each statement, e.g., "stressed", and rate their self-assessment on a scale of 0 to 10, with 10 being the highest score.

2-Regarding the facial expressions assessment: facial coding is the process of measuring human emotions through facial expressions [11]. This measurement method, that is also conveniently titled facial expression analysis, allows to quantify discrete muscular movements of the face and relating each to an emotional response. As facial expressions are so intimately tied to emotions, the analysis of them is a central approach in understanding an individual's feelings, throughout time.

Knowing how someone is feeling when presented with a stimulus can provide much-needed information in a variety of contexts, from fragrances for instance and within psychological experiments.

Indeed, the face is one of the most powerful channels of nonverbal and unconscious communication. The Facial Action Coding System (FACS), is a comprehensive, anatomically-based system for describing anatomical movement of the face. It was first developed by Paul Ekman and Wallace Friesen in 1978 and revised by Ekman, Friesen &

Hager in 2002. They described 6 major emotions (happy, sad, angry, surprised, scared & disgusted) and 46 expressive action units [12] [13].
The Facial expression system which is used, gives these six basic emotions and one neutral, plus two emotional dimensions: valence and arousal. Including 20 expressive action units, as well. The aim of this study is to assess the usefulness of facial expression recording for sensory researcher and to quantify the emotional benefits of the inhalation of a fragrance on emotions.

The facial expressions measurement system gives results such as basic expressions, custom expressions, head orientation, gaze direction, person characteristics, valence and arousal, units of action, heart rate and heart rate variability, audio and consumer behavior:
-Face finding – an accurate position of the face is found using the popular Viola-Jones algorithm.
-Face modeling – the Active Appearance Model is used to synchronize an artificial face model, which describes the location of over 500 key points as well as the texture of the face. These outcomes are combined with the results of the Deep Face algorithm to achieve a higher classification accuracy. When face modeling is not successful (for example, hand is covering the mouth, but both eyes can be found), the Deep Face algorithm, based on Deep Learning, takes over.
-Face classification – output is presented as six basic expressions and one neutral state through the artificial neural network.
There are many different types of emotions that have an influence on how we live and interact with others. At times, it may seem like we are ruled by these emotions. The choices we make, the actions we take, and the perceptions we have are all influenced by the emotions we are experiencing at any given moment.
Psychologists have also tried to identify the different types of emotions that people experience. A few different theories have emerged to categorize and explain the emotions that people feel [14].

We used an Emotional intelligent system (FaceReader® from Noldus, Wageningen, The Netherlands) which allows to record videos of the face while measuring in real-time facial expression and heart rate. For our study, we set-up a portable observation laboratory equipped with a computer-based information system for the facial expression evaluations. This system allows us to record the video of the test person's face, through a webcam camera, from a portable workstation. To acquire images of optimal quality, the laboratory is equipped with LED lighting, not dazzling. The recording of the video is done directly in the computer-based information system (*Figure 2*). This tool allows us to measure the facial expressions, the action units, the voice recording and the heart rate of your participants. The analysis of the data is done after the test and we obtain results by individuals or groups (predefined by independent variables, for example, by age group, by gender, by skin type, etc.).

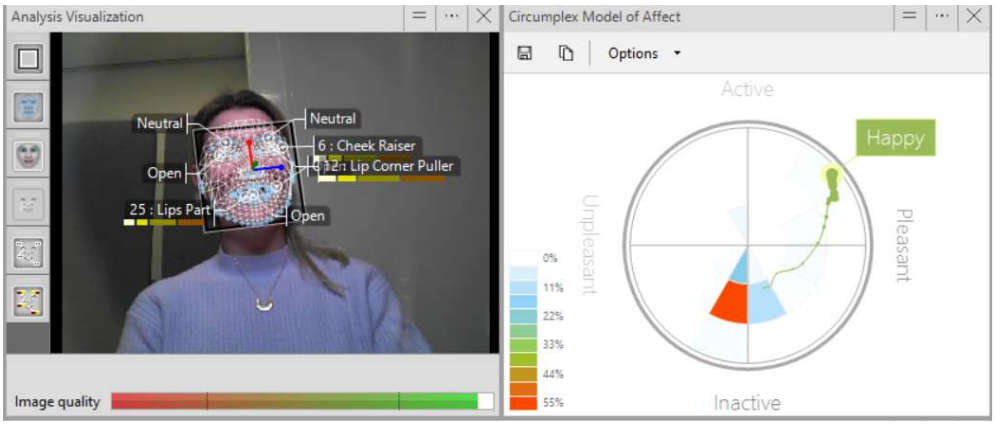

Figure 2. Example of a screen printout of FaceReader®

3- About the questionnaire during FaceReader® recording : first, participants have to answer the question with the Likert scale (strongly disagree, disagree, etc.). Then, participants have to developed their answers to maximize the chances of observing the emotions of participants:
1) Does this fragrance remind you of anything in particular?
2) Are you relaxed right now?
3) Are you stressed now?
4) Do you feel an immediate sense of well-being when you smell this scent?
5) Do you think this smell gives you energy, a boost?
6) Do you feel reassured by this smell?
7) Do you think this smell makes you feel good?
8) Have you been bothered by wearing the mask throughout the day in recent weeks?
9) Did you find the scented mask more bearable than usual?
10) Did you feel more relaxed than with an unscented mask?
11) Did you feel more energized with the scented mask?
12) Do you think that spraying this product on the mask made it easier for you to accept the mask?
13) Do you like the smell?
14) How would you rate it from 0 to 10?
Comment: The questions 9), 10), 11) & 12) were added after the 15 days of testing.

4-Finally concerning the cognitive visual attention measurement. Eye tracking measure is a non-intrusive method and an accessible tool in human behavior research that allows objective measurements of eye movements in real-time. Neuroscience and psychology use eye tracking to analyze the sequence of gaze patterns to gain deeper insights into cognitive processes underlying attention, learning, and memory. Eye tracking can provide crucial information about how we attend to the world - what we see and how we see it.
Nixon (1924) [15] and Karslake (1940) [16] first documented eye movement patterns in response to viewing print advertising stimuli. Fitts, Jones, and Milton (1950) [17] monitored airplane pilots' eye movement during aircraft landing to understand their decision-making processes (Wedel & Pieters, 2008) [18].
Russo (1978) [19] highlighted the usefulness of eye movement analysis for the evaluation of marketing effectiveness and understanding of consumer decisions and information processing. The development and improvement of eye tracking technologies since the early 1990s to the present have contributed a great deal of useful neuroscience research output (Wedel & Pieters, 2008). Eye tracking is used to measure eye movements and changes in pupil dilation and contraction (Andreassi, 2007) [20].

The iris' radial fibers produce pupil dilation because of somatic nervous system neuronal excitation. Contraction occurs when the iris' circular fibers are innervated by peripheral nervous system neurons. Pupillometry measures diameter changes in the pupil occurring during dilation and contraction. The pupil is controlled by the autonomic nervous system, which governs the iris muscles and is concerned with emotional and volitional types of thinking (Andreassi, 2007). The light and accommodation reflex mainly cause changes in pupil diameter. The light reflex denotes pupil dilation (up to 8 or 9 mm) that occurs in response to dim light and contraction (down to 1.5 mm) due to bright light. When both eyes are used during object fixation, changes in pupil diameter are referred to as the accommodation reflex. Changes below 0.5 mm occur in response to cognitive processing and behavioral changes (Andreassi, 2007).

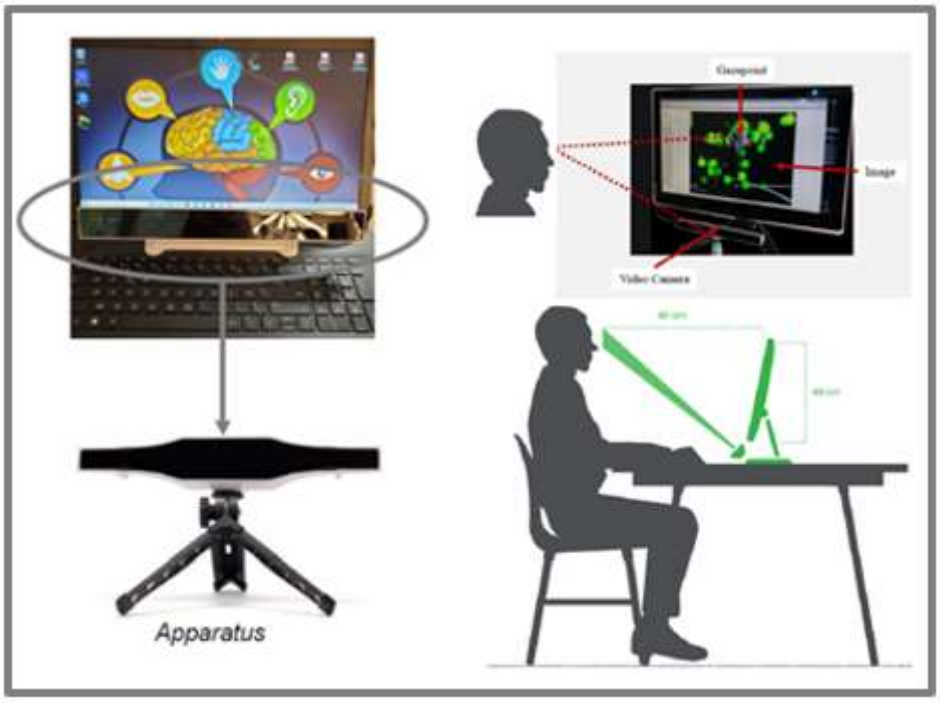

Figure 3. Apparatus used to measure gaze movements

Apparatus, settings & protocol (*Figure 3*): An Eyegaze system [Gazepoint GP3 eye tracker, 60Hz system, API/SDK included] will be used in the experiments to generate raw camera point of view location data. The Gazepoint GP3 is a research-grade eye tracker utilizing a 60Hz machine-vision camera at the heart of its imaging and processing system (High performance eye tracking, ultra-portable).
A calibration is necessary to measure the properties of the eye before the start of the experiments.
The images will be displayed on a flat screen at a good resolution. Loading 12 images (*Figure 4*) into one frame on a flat screen. The processing of the information of the eye tracking will be through a Gazepoint Analysis Professional, which is an incredibly powerful yet easy-to-use software package that simplifies developing, deploying, and analyzing the results of eye tracking studies [21].

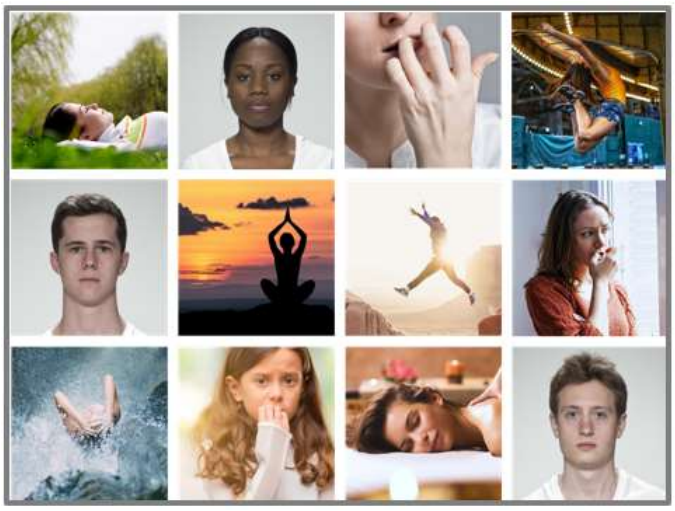

Figure 4. Mood board example

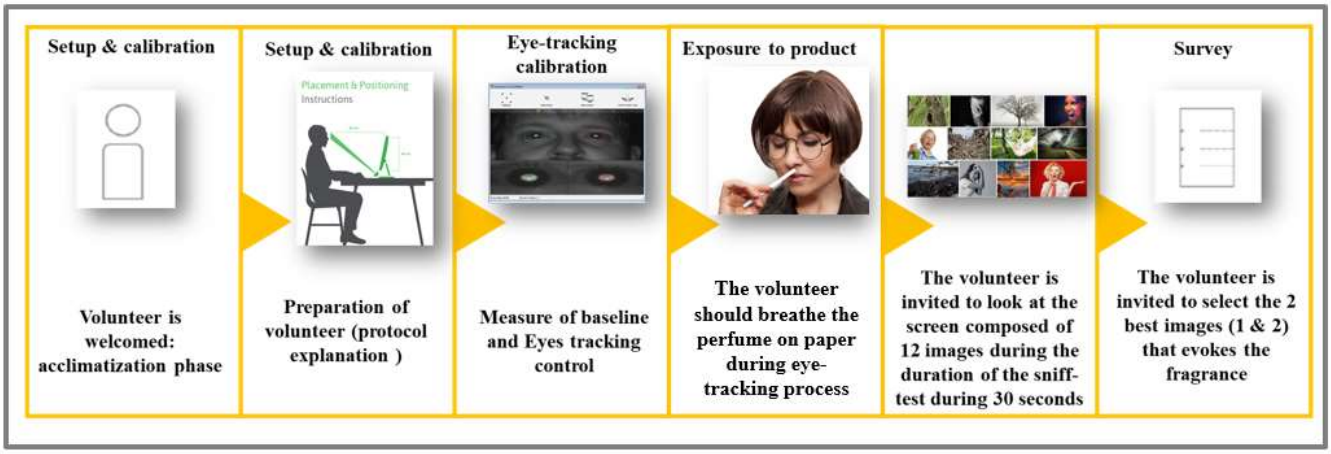

Figure 5. Eye-tracking protocol (part II) à D0 and D15

At the end of the test the volunteer is invited to select two best images (1 & 2) that evoke the fragrance, part of the conscious choice (*Figure 5*).

Results.

1-Emotional scale :
At D0, there was no significant difference between the evolution of participants' feelings between the start (pre-test, before smelling) and the end of the test (post-test, after smelling). At D15, participants felt more protected after smelling the active scent compared to the neutral scent (*Figure 6*) [22].

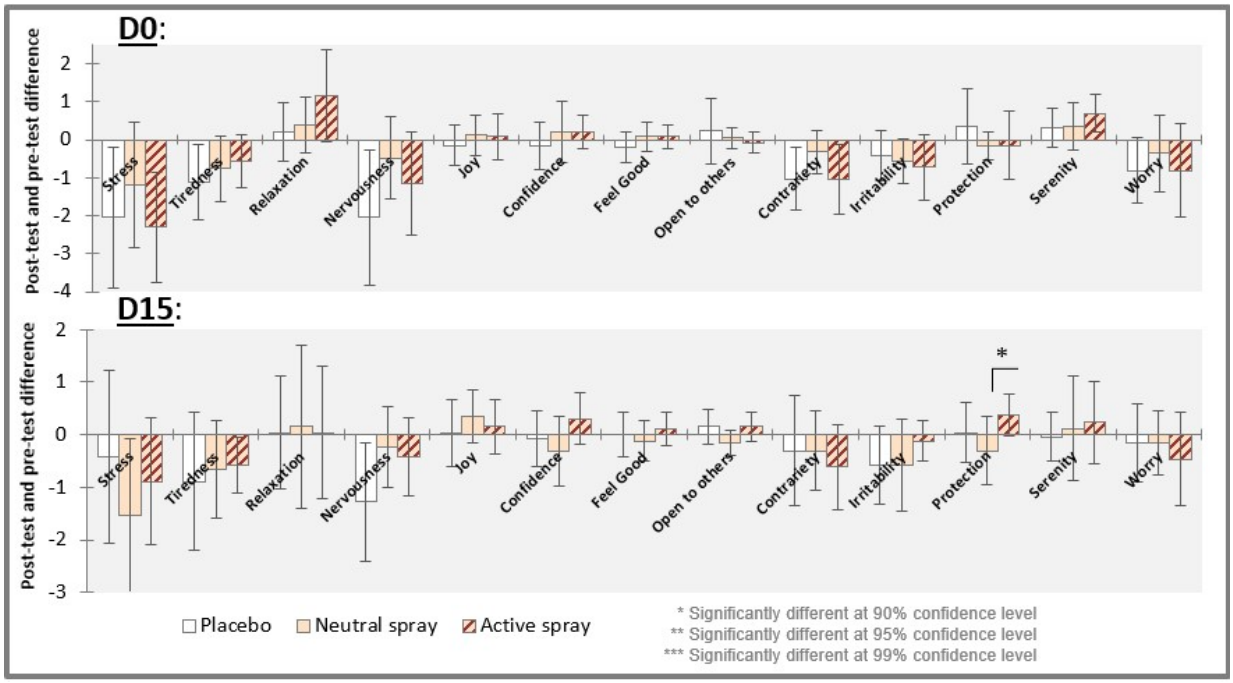

Figure 6. Comparison of the different olfactory stimuli according to participants' answers to the psychological questionnaire (analysis of the difference between post-test and pre-test results)

2- Facial recognition measurement :

At D0, participants who smelled the placebo and the active spray felt significantly more surprise than those who smelled the neutral spray. At D0 and D15, participants who smelled the active spray felt significantly more scare than those who smelled the placebo (the averages of feelings of this emotion are very weak and may correspond to the apprehension of the test). At D15, participants who smelled the neutral spray felt significantly happier than those who smelled the placebo.

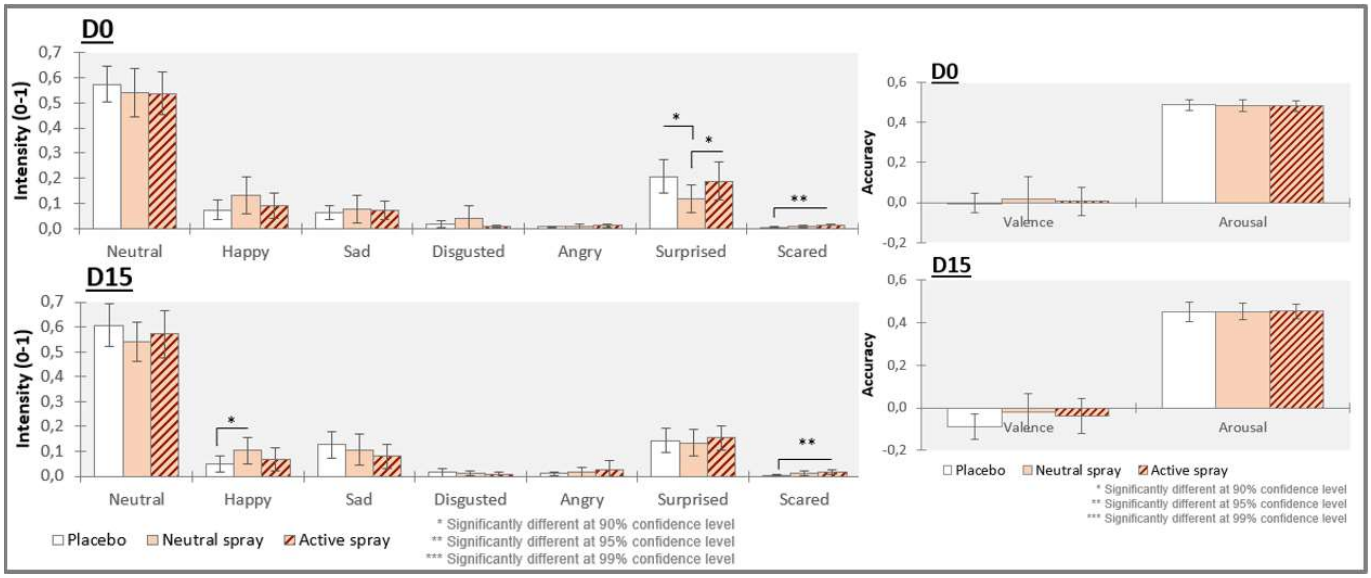

Figure 7. Comparison of the different olfactory stimuli according to participants' facial expression recognition and comparison of the different olfactory stimuli according to participants' facial expression recognition

No significant difference was observed between the variance and the arousal of the participants of the different groups, either at D0 or D15 (*Figure 7*).

3- Remote photopletysmography (RPPG) or hear rate measurement :
FaceReader® can estimate heart rate of the subject in front of the camera by means of RPPG. This non-invasive technique measures the small changes in color under the skin epidermis, caused by variations in volume and oxygen saturation of the blood in the vessels, due to heartbeats [23]. The remote measurement of these signals is useful for various reasons, even if they are not treated: for example, to observe immediately during the recording of the test, the physiological dimension of the participant who answers a question.

The average heart rate of participants who smelt the active spray was significantly lower than that of participants who smelt the placebo.

4-Questionnaire during FaceReader recording :
Questions at D0 & D15:
1-Does this scent evoke anything in particular?
2-Are you relaxed right now?
3-Are you stressed right now?
4-Do you feel an immediate feeling of well-being when you smell this scent?
5-Do you think that smell gives you energy, gives you a boost?
6-Do you think that smell reassures you?
7-Do you think that smell makes you feel good?
8-In recent weeks, have you been bothered by wearing a mask throughout the day?
Do you like this smell?

At D0 and D15, participants felt an immediate feeling of well-being significantly more important for the active and neutral sprays compared to the placebo. These participants also found that these smells reassured them and made them feel good more than the placebo.
At D0, participants who smelled the active spray felt significantly more energized than those who smelled the placebo. After 15 days, participants who had the active and neutral spray felt more energized than those who had the placebo.

Questions at D15:
1-Did you find the scented mask more bearable than usual?
2-Did you feel more relaxed than with an unscented mask?
3-Did you feel more energized with this scented mask?
4-Do you think spraying this product on the mask made it easier for you to accept the mask?

After 15 days (*Figure 8*), wearing a scented mask (with neutral or active spray) was more bearable than wearing an unscented mask (placebo). Participants who wore an active-scented mask felt more relaxed than when they wore an unscented mask. Participants who wore a neutral spray-scented mask found wearing the mask easier to accept, compared to an unscented mask.

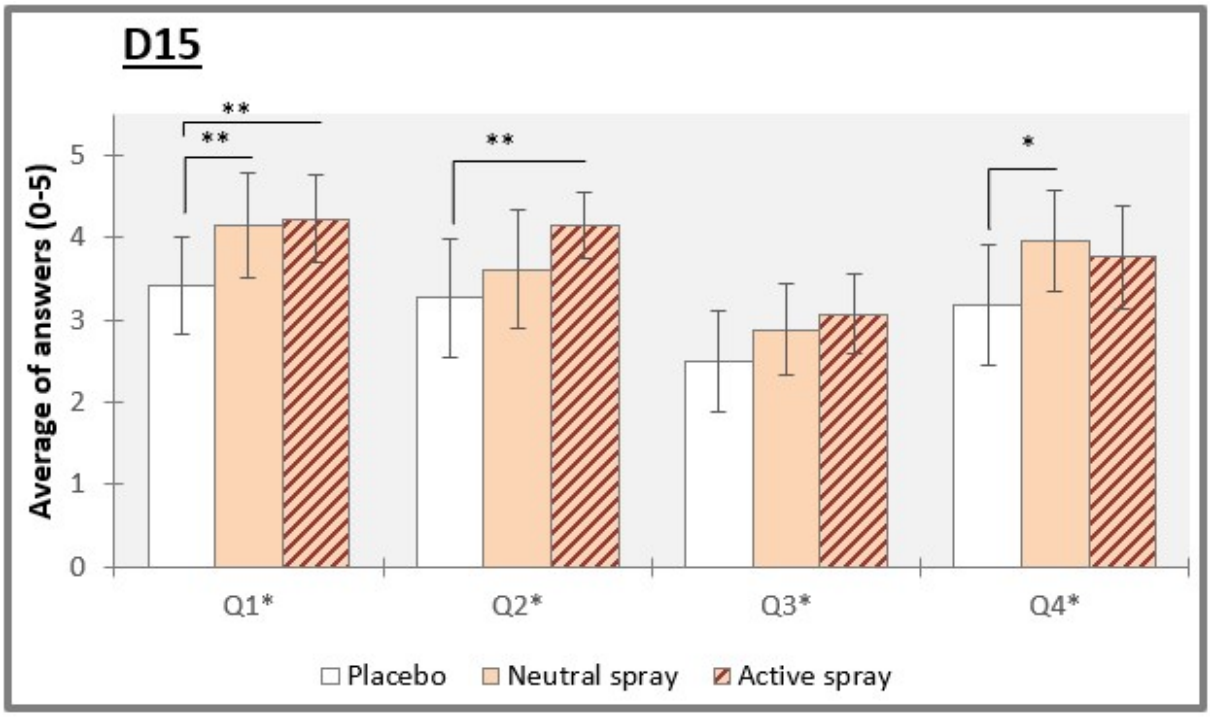

Figure 8. Comparison of the different olfactory stimuli according to participants' feelings about the scented mask

About the "liking" appreciation, participants preferred the scented sprays over the placebo, but there was no significant difference of liking between the two scented sprays.

5-Cognitive visual attention assessment or Eye-tracking:

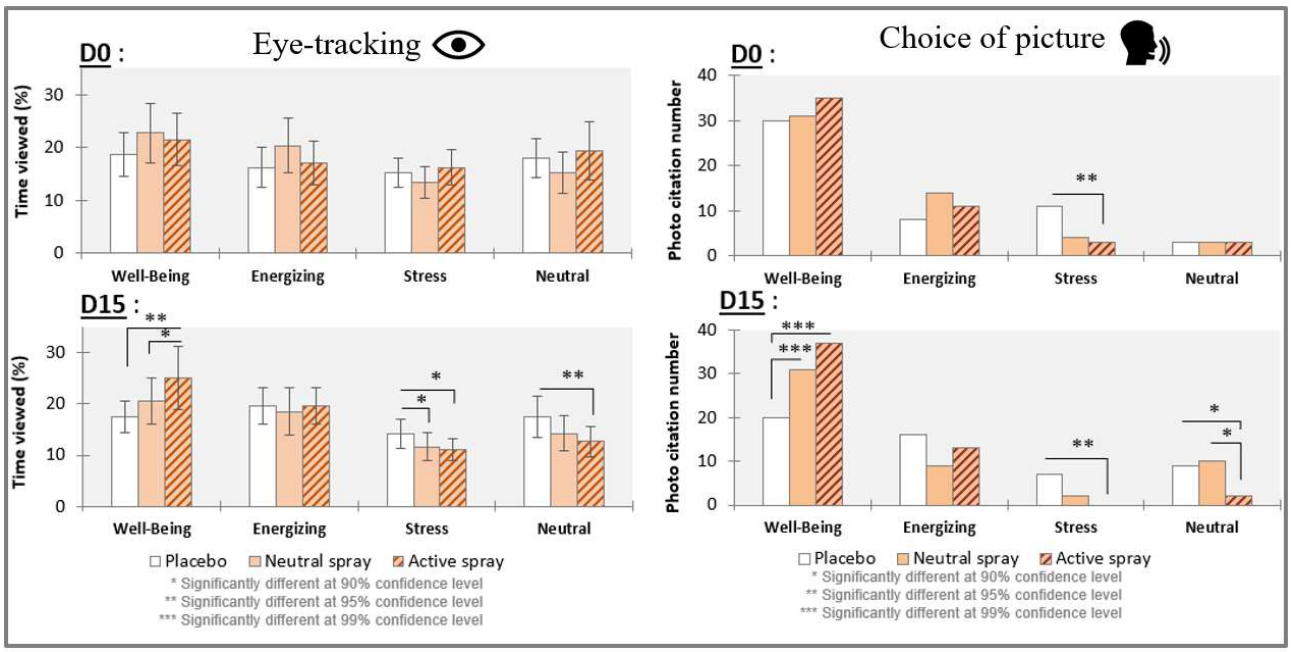

Figure 9. Comparison of olfactory stimuli according to the percentages of time spent looking at each category of emotional images and Comparison of olfactory stimuli according to the number of emotional photos cited as in line which each odor

At D0: There was no significant difference between the different fragrances.

At D15: Pictures representative of well-being were viewed significantly longer for the active spray compared to the neutral spray and the placebo. Pictures representative of stress were viewed significantly longer for the placebo compared to the active spray and the neutral spray. Finally, representative pictures of a neutral feeling were viewed significantly longer for the placebo compared to the active spray (*Figure 9*).

6-Choice of pictures:
At D0 & D15: Pictures representative of stress were significantly more cited as in line with the placebo compared to the active spray.
At D15: Pictures representative of well-being were significantly more cited as in line with the active and neutral sprays compared to the placebo. Finally, representative pictures of a neutral feeling were significantly more cited as in line with the placebo and the neutral spray compared to the active spray.

Discussion.

This study has helped us to understand that the covid mask can be the source of our unhappiness or stress and recognizing these feelings is essential to combat covid mask anxiety. We have tried to create a methodology to quantify a perfumed product capacity to enhance emotional experience. This method will be helpful to promote new claims regarding the emotional side of stress relieving aromatic scents for covid-19 face mask.

Conclusion.

We have demonstrated several positive points after 15 days : first of all, wearing a scented mask (with active or neutral spray) is more bearable than an unscented one (placebo) and people felt more well-being & energy with perfumed masks. Secondly, the active scent induced more well-being and participants felt more protected, and less “neutral feeling” in comparison to the neutral one. Participants felt less stress & more relaxed with the active scent in comparison to the placebo.

PARAMETERS	D0	D15
Emotional scale	no significant	Participants felt more « protected » with active spray compared to neutral spray
Facial recognition	More surprise for placebo and active spray in comparison to the neutral spray More scare for active spray in comparison to placebo*	More happiness for neutral spray in comparison to placebo More scare for active spray in comparison to placebo*
Heart Rate	not tested	HR lower for active spray in comparison to placebo
Questionnaire during FaceReader	More well-being for active spray and neutral spray than placebo More reassured with active spray and neutral spray than placebo More feel good with active spray and neutral spray than placebo More energized with active spray than placebo	More well-being for active spray and neutral spray than placebo More reassured with active spray and neutral spray than placebo More feel good with active spray and neutral spray than placebo More energized with active spray and neutral spray than placebo --- Active & neutral scented masks more bearable than placebo More relaxed with active scented mask than placebo Neutral scented mask easier to accept than placebo
Eye-tracking	no significant	More well-being for active spray in comparison to neutral spray and placebo More stress for placebo in comparison to active spray & neutral spray More neutral feeling for placebo in comparison to active spray
Choice of pictures	More stress for placebo in comparison to active spray	More well-being for active spray and neutral spray in comparison to placebo More stress for placebo in comparison to active spray More neutral feeling for placebo and neutral spray in comparison to active spray

** the averages of feelings of this emotion are very weak and may correspond to the apprehension of the test*

Table 1. Summary of results by parameters used at D0 & D15

To conclude, integrating the power of scents such as the vanilla-tonka bean-ginger blend accord to reduce stress and improve wellbeing will help us increase our comfort level and allow us to wear the covid mask longer. The process of measuring human emotions through neuroscientific methods [24] [25], such as facial expressions, heart rate variabilities and cognitive visual attention measurements provide the ability to induce and quantify reliable and congruent emotional non-verbal responses (*Table 1*).

Conflict of Interest Statement: NONE.

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