*"*A Sleeping Mask Cream for Enhanced Relaxation, Improved Sleep Quality and Well-being: A real-time Multimodal Neuroscience & AI-Driven Evaluation of Emotional Responses*"*

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1. Introduction

In recent years, the convergence of neuroscience, artificial intelligence (AI), and cosmetic science has opened new frontiers in the development of skincare products that go beyond traditional aesthetic benefits. This multidisciplinary integration is transforming cosmetics into experiences for promoting holistic well-being [1]. As consumers increasingly seek products that support mental and emotional health, the cosmetic industry is responding with innovations aimed at delivering not only visible results but also psychological and physiological benefits.

However, the objective measurement of emotional impact and wellbeing remains a challenge for the cosmetics industry as emotion is a muti-faceted concept and requires multimodal evaluation [2-3]. Among the most promising developments in this area is the use of neuroscience-based methodologies and AI-powered technologies to assess emotional and behavioral responses to cosmetic products in real-world contexts. These approaches enable researchers to understand how skincare products affect users in real-time on both conscious and unconscious levels, providing valuable insights into user experience and product effectiveness.

This study introduces a novel nightmask, designed to improve skin condition and enhance emotional well-being and sleep quality. To evaluate its efficacy on emotions, we employed a cutting-edge real-time, multimodal AI-driven system capable of capturing real-time emotional responses—verbal (semantic, topic clustering), paraverbal, (prosody, voice emotion), non-verbal (facial expressions, gesture, inspiration, cardiac rhythm)—during in-home product usage.

The primary objective of this research is to assess the emotional and experiential impact of the mask through a combination of spontaneous speech & self-reported data (explicit) and objective physiological and behavioral indicators (implicit). This comprehensive evaluation aims to determine the product's potential to foster a sense of well-being and support restorative sleep. By providing deeper insights into the emotional dimension of cosmetic use, the findings can inform future product development and optimization strategies within the emerging field of neurocosmetics.

2. Materials and Methods

2. 1 Subjects

50 French women have been recruited between 25 and 45 years old, with all skin types and after questioning their ritual and habits in terms of facial care. 49 of them completed the study. The inclusion criteria ensure that the selected panelists are representative of the target market, with a focus on regular cream users and a diversity in terms of skin type. They all purchased their skincare products through selective channels and looked for a global well-being solution (practicing yoga, meditation, paying attention to a balanced diet, being interested in massages…) and having an expanded vision of beauty (such as being comfortable with their age).

All the evaluations were conducted following the principles of the Declaration of Helsinki and compliance with local applicable laws, regulatory and ethics requirements. All the subjects provided written consent to allow their participation prior to the study.

2. 2 Study organization

To maximize accessibility, engagement from the panelists and use of the product in real conditions, the study on the tested product is organized at home with a real-time discovery and application during an AI-simulation in digital.
Evaluation is conducted digitally on our proprietary innovative platform, projected on PC / tablet / smartphone, with interactive access to the digital AI-simulation and a multimodal evaluation process in real-time. This approach enables rich and flexible data collection while ensuring that panelists can interact with the avatar and share their impressions in real time during the nightmask experience, while maintaining a solid ethical and methodological framework.

Modalities:
The study is organized into a 2-step interview of 15 minutes each: one session is realized in the evening to discover and apply the mask before the night and a second session is realized on the next morning to share the impressions after a night of use.
The panelists received an anonymization number and a web access link to connect individually to their panelist space in order to carry out their product evaluations at home.
Both evaluations are guided by a conversational-avatar. Panelists, facing their electronic device, interact with the AI avatar and apply the product, and share in real-time their experience with the mask.

The interface provides an immersive and detailed experience to allow for in-depth evaluation of the mask by the panelists.

During the evaluation, panelists interact with the conversational AI directly from their device. The virtual avatar asks questions about the mask and its benefits, encouraging panelists to explain their preferences and critiques.

2. 3 Data Collection Method

The objective is to collect quantitative and qualitative data from both explicit (verbally expressed) and implicit (emotional impact) while ensuring consistent measures of the emotional impact of the mask and potential future evolutions. Data are collected on PC in real-time:

● **Explicit Data:** Spontaneous speech during conversational AI, click and choices for liking and purchase intention (questionnaires).
● **Implicit Data:** Voice analysis, gesture, facial expressions, cardiac rhythm, inspiration.

Discovery and application of the night mask (evening) to evaluate the panelists' perceptions of the mask, to identify the strengths and pain points based on the emotional impact and user expectations.

Steps:
● Discovery: discovery of the product in hand without applying it
● Application: application of the mask on the face and sharing of impressions in terms of emotional and sensory benefits.
● Sleep habits: spontaneous sharing of sleep patterns
● Liking: appreciation scoring of the mask after application

Feedback after use (morning) to the panelists' perceptions of the mask after one night of use, to identify the strengths and pain points based on the emotional impact and user expectations.

Steps:
● Sleep benefit: collection of the effects of the night mask on the quality and quantity of sleep
● Feedback after use: spontaneous collection of impressions of the mask (in terms of emotional and sensory benefits)

Data Collection via Conversational AI Avatar
Objective: Facilitate smooth and interactive dialogue between the panelists and the study while ensuring accurate collection of opinions, emotions, and suggestions with no-bias.
Role of the Conversational AI Avatar:
● The AI avatar is used to guide the exchanges with the panelists in an intuitive and interactive manner. This avatar simulates natural conversations and asks both open and closed questions to gather user impressions.
● The AI is programmed to adapt its questions based on the panelists' responses, enabling deeper exploration of certain aspects (e.g., asking for more details about a design preference or criticisms of the features).
● The AI avatar can also provide clarifications on the sleep mask features, answer panelists' questions, and guide them through the evaluation process
● 3 Types of questions were asked by the AI: closed questions, open questions, exploratory Questions

Data Collection Method:

● **Choices and Voice:** Panelists can interact with the AI via voice interface, making the experience smoother and more interactive. The responses are then automatically transcribed for analysis.

● **Emotion Analysis:** The conversational AI can also detect emotions in the responses (e.g., frustration, enthusiasm) by analyzing hybrid measures (verbal / paraverbal / non verbal) to identify emotional reactions during the all experience (Fig. 2).

Analysis of Emotions and Impressions

Objective: Collect data to understand panelist insight on the mask, in order to adjust the mask experience.

Both evaluation (evening & morning) are based on a 3-step interview:

● **Emotional impact:** hybrid approach combining verbal, paraverbal and non verbal measures to reveal objective measure of real-time emotional signature.

● **Desirability factors:** Causal explicit desirability factors mentioned by panelists (desirability factors, dislike factors, sleep benefit, improvement factors).

● **Decision:** Final choices and decision (liking and purchase intention).

2. 4 Data Analysis Method

To holistically evaluate the panelists' reactions to the mask, the study employs a multimodal analysis combining several dimensions: semantics, facial expressions, voice analysis, eyetracking, gesture, and physiological measures such as heart rate and breathing. This method extracts rich and varied data, revealing not only the conscious preferences of the panelists but also their unconscious emotional and physiological reactions.

Here's how each modality is integrated into the analysis process:

Semantic and Sentiment Analysis (Conversational AI)

The conversational AI uses natural language processing (NLP) techniques to analyze the word choice, key phrases, and speech structure of panelists as they describe their feelings about the mask. The AI identifies terms that reveal preferences, dissatisfactions, or relevant decision criteria. For instance, words like "comfortable," "pleasant," or "boring" are categorized to evaluate the perceived strengths and weaknesses of the mask.

Then, the analysis relies on text sentiment to evaluate the polarity of the sentiments expressed by the panelists in their responses: positive, neutral, or negative. Each verbal response is analyzed to measure the general attitude toward evaluated aspects of the mask.

Finally, by analyzing emotional keywords used in conversations (e.g., "enthusiasm," "frustration," "disappointment"), the AI can deduce which explicit emotions predominate when panelists apply the mask.

Voice Analysis (Tone and Pitch)

The conversational AI analyzes the tone of the panelists' voices (positive, neutral, negative) and their speech rhythm (speeding up or slowing down) to infer emotional reactions. Advanced vocal analysis tools measure voice modulations (intensity, pitch variation) to identify mood or sentiment changes throughout the conversation.

Gesture Analysis (Body Tracking)

Body tracking monitors panelists' posture and gestures (crossing arms, leaning forward, etc.) to deduce their engagement or disengagement during mask application & feedback.

Facial expressions (Face Tracking)

Cameras can detect facial micro-expressions (subtle smiles, frowns) that reveal instant emotional reactions to specific criteria of the mask. This helps measure immediate, often unconscious, emotional reactions to specific elements like texture, ease of application. Measures are based on Facial Coding System Analysis.

Physiological Measurements (Heart Rate and Breathing)

A specific machine-learning algorithm was trained to track the panelists' heart rate variations with the camera.
Respiratory rate is also measured to detect emotional changes.

Multimodal Data Integration

Data are combined from all sources (voice, eye movements, gestures, heart rate, breathing) to obtain a comprehensive and objective view of the panelists' reactions. The data collected from voice, gestures, and physiological measurements are combined to identify correlations between verbal and physical responses.

Results Visualization:

Visual dashboards are generated to represent hybrid measures combining the different modalities. This helps understand where the impactful areas of the mask are—those that trigger the strongest emotional reactions while where the paint points need improvements.

3. Results

    3.1 Emotional Impact

Combined hybrid analysis from verbal, paraverbal and nonverbal evaluations reveals that the cream significantly evoked high levels of Relaxation (with an intensity of 95%) and Calm (72%) during the global experience (Fig. 1). These emotional states were not only triggered during discovery (Relaxation 95% and Calm 70%) and application (Relaxation 96% and Calm 74%), but persisted into the following morning (Relaxation 95% and Calm 74%), indicating a lasting impact.
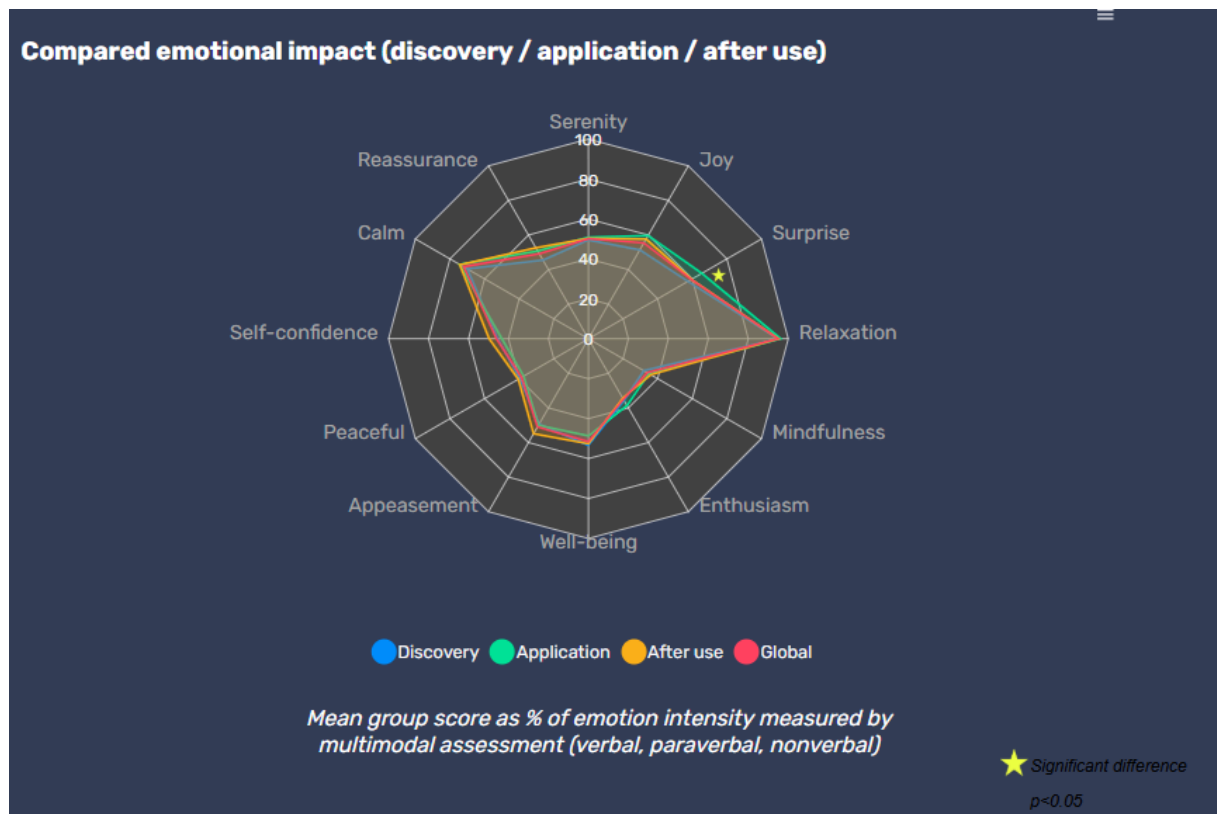
Figure 1. Compared emotional impact during customer journey: evening (discovery / application) and morning (after use). Mean group score (n=49 women) as a percentage of emotion intensity measured by multimodal assessment (verbal, paraverbal, non verbal).

The analysis of verbatim is consistent with significant positive feedback of relaxation, calm and well-being: "It's an immediate feeling of comfort and well-being." "I feel relaxed, confident and calm." "It has a beneficial effect on the mind." "I feel soothed at the moment." "It's gentle and soothing."

3.2 Desirability factors

Panelists were asked on their liking factors when discovering and applying the cream in the evening and after one night use in the morning.

Speech analysis reveals that the texture (57.1% of positivity) and the appearance (60.3%) were the most appreciated factors during application. After one night use in the morning, the speed of absorption (79.3% of positivity) emerged as the most positively perceived factor. Smell (60.9%) and texture (56.7%) retained strong positive sentiment.

Verbatim's analysis reveals that 83% of participants reported a pleasant smell "I like the smell, it's very nice", 76% appreciated the texture "I like the thickness, it feels nourishing", and 72% highlighted the speed of absorption "I can feel it melting into my skin".

3.3 Sleep Benefits

Panelists were asked about their sleep habits in the evening before the use of the night cream and after one night use in the morning.

The speech analysis reveals that the use of the cream is associated with a strong improvement in the sleep duration (39.9% of positivity / 37.1% of negativity in the evening while a strong increase to 66.8% of positivity and a strong decrease to 14.1% of negativity in the morning), the sleep quality (43.4% of positivity / 30.6% of negativity in the evening while 53.3% of positivity and 25.2% of negativity in the morning) and the well-being after the night (49.8% of positivity / 24.9% of negativity in the evening while 62.7% of positivity and 12.6% of negativity in the morning) (Fig. 2).

Verbatim's analysis reveals that approximately 67% of participants reported improved sleep continuity, describing fewer interruptions and a sensation of deeper rest. While the product did not notably alter the duration of sleep, 64% of users reported a subjective increase on well-being after night, suggesting enhanced restfulness and recovery.
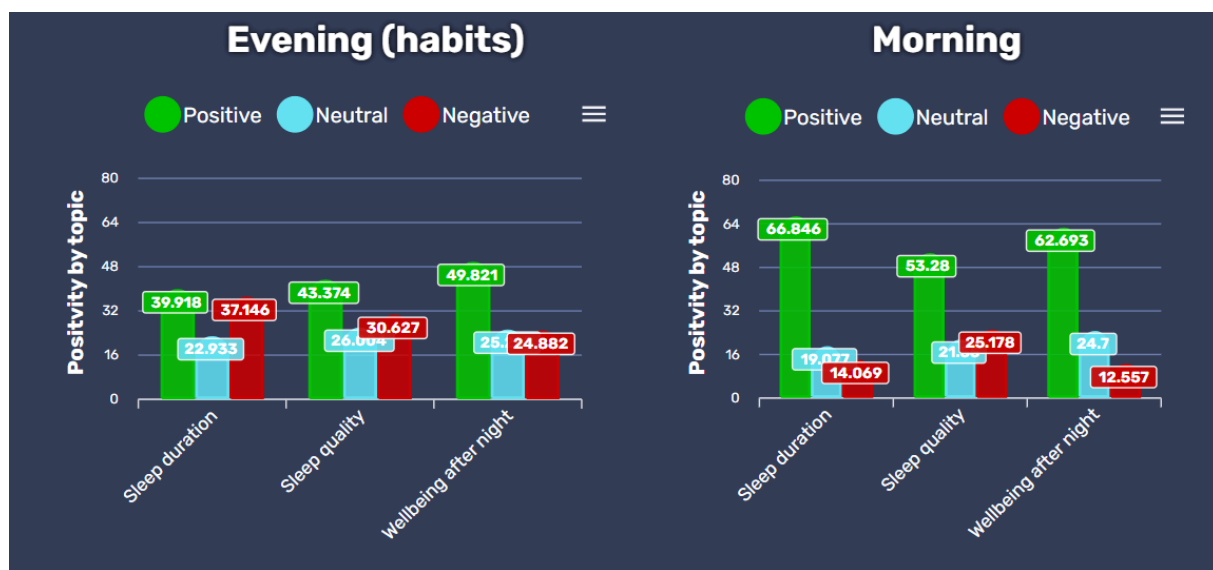

Figure 2. Sleep benefits. Sleep factors verbally mentioned on the group (topic clustering) with the % of positivity, negativity and neutrality (text sentiment) for each evoked factor.

3.4 Consumer Perception

Consistently with a strong emotional impact and positivity in the speech at the application and after the use of the ask, the product received high appreciation scores:

•   Liking: 8.5/10 in both evening and morning assessments

•   Purchase Intention: 8.1/10 on morning after one night use

Participants highlighted the product's sensory appeal and sleep benefits contributing to a strong explicit liking.

4. Discussion

This study demonstrates the potential of cosmetics to extend beyond traditional skin care by integrating emotional and physiological well-being benefits   [4]. The integration of neuroscience and AI technologies into the evaluation of cosmetic products offers a promising avenue for cosmetics, where emotional well-being becomes a central parameter alongside traditional efficacy. This study exemplifies such innovation, demonstrating how a real-time

multimodal analysis framework can provide rich insights into the emotional and experiential impact of a skincare product—in this case, a novel cream designed to promote both skin care and emotional balance.

Our findings, combining both implicit and explicit measures, strongly support the hypothesis that the cream induces a meaningful emotional shift toward states of relaxation and calm. These effects were consistently observed across multiple time points—during product discovery, application, and post-use in the morning—indicating not only an immediate but also a prolonged emotional benefit. The high consistency of relaxation (around 95%) and calm (72–74%) across the user journey suggests that the product plays a role in sustaining a restful and emotionally supportive routine, especially valuable in today's stress-laden environments. Such effects are likely facilitated by a combination of formulation actives and sensory cues (texture, scent, absorption), potentially enhancing nighttime routines into emotionally enriching rituals.

The combination of explicit self-report and implicit multimodal data allowed for a nuanced understanding of user experience. Emotionally charged keywords and tone analysis revealed a spontaneous sense of comfort, softness, and emotional relief associated with the product. These findings align with recent literature emphasizing the impact of sensory cues—such as texture, fragrance, and absorption speed—on mood regulation and emotional perception. Texture and appearance were particularly relevant during the application phase, whereas rapid absorption became a major liking factor the next morning. This shift in desirability drivers highlights the importance of temporal dynamics in cosmetic perception: users initially focus on sensory characteristics but later evaluate perceived benefits such as comfort and skin feel.

Importantly, the cream appeared to exert a beneficial influence on sleep-related experiences. Participants consistently described enhanced sleep continuity, sleep quality and deeper restfulness in the morning. The emotional data corroborated these claims with increased positivity regarding sleep quality and post-sleep well-being. This dual feedback loop—combining physiological perception and cognitive reflection—emphasizes the product's potential role as a facilitator of restorative sleep, especially when integrated into a mindful evening routine.

The study's methodology—combining facial coding, speech sentiment, voice analysis and physiological monitoring—also validates the power of AI-assisted multimodal tools in capturing real-time consumer insights. Traditional methods rely on retrospective assessments and explicit conscious reactions but miss objective unconscious reactions [5]. Our approach provides a more ecologically objective measure of the consumer's real-time reactions. These technologies, when used ethically and transparently, can revolutionize consumer testing by revealing authentic emotional experiences, minimizing recall bias, and capturing implicit drivers of satisfaction and engagement.

Limitations of the study include its relatively short time frame and focus on immediate reactions after a single night of use. While promising, the results would benefit from longitudinal follow-up to assess cumulative effects of repeated application over weeks. Additionally, although the panel was diverse in terms of skin type, future studies could expand the sample to include different cultural backgrounds and age ranges.

5. Conclusion

In recent years, the convergence of neuroscience, artificial intelligence (AI), and cosmetic science has opened promising avenues for enhancing user well-being through skincare. Beyond aesthetic skin benefits, cosmetics increasingly aim to deliver emotional and sensory value, with a growing focus on improving sleep quality and relaxation.

This study explores the efficacy of a novel sleeping mask cream designed not only to beautify the skin but also to enhance relaxation and contribute to improved sleep quality and morning well-being. Utilizing a cutting-edge, real-time multimodal AI-driven system, we evaluated users' emotional responses during actual home usage. The goal was to capture both conscious feedback and unconscious physiological and behavioral indicators of emotional experience, offering a comprehensive picture of the product's impact.

This study validates the efficacy of the sleeping mask cream on emotional wellness and sleep quality. This efficacy is associated with sensory benefits (creamy and nourishing texture, pleasant and natural smell, quick absorption). Also, its capacity to induce relaxation (with an intensity of 95%) and calm (with an intensity of 72%), while enhancing sleep quality, quantity and well-being in the morning, marks a new chapter in the evolution of skincare.

Through a pioneering multimodal AI-driven approach, we demonstrated that the emotional signature of a cosmetic product can be captured and quantified in real time, offering valuable insights into unconscious consumer reactions. Combining verbal, paraverbal and non-verbal measures, the methodology evaluates the holistic and objective impact of the skincare product. This paradigm shift paves the way for a new generation of cosmetics designed not only to beautify but also to enhance emotional wellness. Future studies may expand upon these findings to explore long-term benefits, different populations, further strengthening the bridge between cosmetic efficacy and emotional science.

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