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Unraveling Desire: Neurophysiological Prediction of Repurchase in Men's Fragrances.

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1. Introduction

The male fragrance market has evolved beyond olfactory signatures to encompass emotionally resonant experiences capable of forging lasting consumer bonds. Scents have long been recognized as powerful triggers of autobiographical memory and emotional recall. This privileged role stems from the anatomical and functional organization of the olfactory system, which directly connects to limbic structures involved in affective processing, such as the amygdala and hippocampus [1-3]. Unlike other sensory modalities, olfactory input reaches these regions with minimal synaptic relays, allowing odors to provoke immediate and affect-laden responses—often before conscious recognition occurs [4].

These emotionally charged associations are not innate but are largely shaped through associative learning. Neutral odors acquire hedonic value after being paired with emotionally salient experiences, forming strong links to memory and guiding future behavior [5,6]. This mechanism also underpins how fragrance preferences are established and sustained, particularly in marketing and branding contexts where products are designed to evoke specific feelings or identities.

In the male consumer landscape, fragrance use is particularly influenced by sociocultural and relational factors. Historically, the gendering of perfume is a relatively recent phenomenon. While women have worn fragrance since the Renaissance, men rejected its use in the early twentieth century, only to re-embrace it as a prestigious fashion statement by century's end [4]. Even so, studies show that most heterosexual men wear fragrances given to them by women, and when they do purchase their own, their motivation is often driven by the desire

to attract female partners [4]. These findings highlight how gendered norms and psychological motives shape fragrance engagement differently across populations.

Traditional approaches to assessing fragrance preference and consumer engagement rely predominantly on verbal reports, which may not fully capture the implicit affective and motivational dynamics involved. In contrast, neuroscientific tools such as electroencephalography (EEG) offer a window into the underlying emotional processes as they unfold in real time. One well-established index is frontal alpha asymmetry (8–13 Hz), where greater relative left-frontal activation (i.e., lower alpha power) reflects approach motivation and positive affect, while greater right-frontal activation is associated with withdrawal and negative valence [7,8]. Complementary EEG bands also provide insight into emotional and cognitive processing: theta activity (4–7 Hz) has been linked to emotional attention and integration [9], and beta activity (13–30 Hz) is associated with alertness and arousal [10,11].

The olfactory modality is especially well-suited to evoke such neural dynamics. Odor-evoked experiences can trigger complex emotional states with a unique immediacy and vividness, often accompanied by heightened memory recall [12]. This is particularly relevant to the fragrance industry, where emotional engagement is central to product success and brand differentiation.

Importantly, recent affective neuroscience research emphasizes the temporal evolution of pleasure and motivation, distinguishing between the immediate hedonic impact of a stimulus (“liking”) and the anticipatory, goal-directed drive to pursue it again (“wanting”) [13]. In the context of fragrance, this framework suggests that the neural activity underlying an initial pleasurable response may evolve into motivational engagement over time, ultimately influencing repurchase behavior.

Building on this theoretical foundation, the present study investigates how a masculine fragrance—designed to evoke attributes such as seduction, confidence, and spontaneity—modulates brain activity across time. By combining real-time EEG recording with behavioral measures of repurchase intention, we aim to identify whether specific temporal patterns of neural engagement, particularly increased approach-related activity, predict consumer desire to re-experience and repurchase the fragrance. This approach advances the understanding of how emotional responses to scent unfold neurologically and how they translate into meaningful consumer behavior in the domain of olfactory products.

2. Materials and Methods

2.1. Participants

A total of 36 male participants (age 25-45 years old) residing in São Paulo, Brazil, participated in this study. All reported using fragrances at least three times per week, and belonged to socioeconomic levels B and C according to the Brazilian Criteria.

All participants gave informed consent. The study protocol followed ethical standards for non-invasive consumer neuroscience research.

2.2. Stimuli and Procedure

The study employed a within-subjects design to assess the neurophysiological and conscious responses to olfactory stimuli. Each participant evaluated a masculine fragrance presented in a sequential monadic design using scent strips, which was presented three times with at least 15 seconds between exposures. During each exposure, participants were instructed to smell the strip for 10 seconds.

To establish individual baseline states, each session began with the presentation of three affective image stimuli: a neutral scene, a happy scene, and a sad scene. These were used to calibrate emotional and attentional baselines prior to fragrance exposure.

After each exposure, participants completed a set of explicit, self-reported measures regarding their conscious evaluation of the fragrance using standardized rating scales.

2.3. EEG Acquisition

Electroencephalographic (EEG) signals were recorded using a wireless 20-channel Quick-20m EEG headset (Cognionics, USA). The headset captures cortical activity from key brain regions associated with emotional and sensory processing.

EEG data were collected during all fragrance exposures. The equipment recorded continuous activity, focusing on the first 15 seconds of each exposure period. Standard preprocessing and artifact rejection procedures were applied.

The EEG protocol included the measurement of frequency bands associated with affective processing. The primary outcome variables were derived from frontal alpha asymmetry patterns and temporal dynamics of affective responses, which were later aggregated across participants.

2.4. Data Analysis

EEG data were analyzed using proprietary algorithms developed in collaboration with academic institutions and validated in prior consumer neuroscience studies. They rely on established neurophysiological markers such as anterior alpha asymmetry (AAA), which has been widely used to infer approach–avoidance tendencies and hedonic valence.

Positive affective responses were inferred from greater relative left frontal activation, while negative responses were associated with greater right frontal activation. These patterns were assessed across repeated exposures to determine both initial affective responses and their consistency over time—a factor linked to potential repurchase intention.

Additionally, facial expression data were recorded and used as supplementary input to validate affective responses in synchrony with EEG metrics.

The statistical analysis included one-sample Z-tests comparing EEG-derived metrics to the baseline (neutral condition) within each individual. Group-level significance was determined by aggregating individual results and assessing deviation from the neutral midpoint ($z = 0$), considering standard deviations and sample size.

3. Results

The algorithm presents results on a bilateral scale ranging from -1 to +1, with a neutral zone defined between -0.1 and 0.1, and 0 as the theoretical midpoint. For male participants, the fragrance initially elicited a Subconscious Pleasantness score of -0.06, placing it within the neutral zone. However, when assessed over time, the Subconscious Pleasantness score increased to 0.15. This shift suggests an affective trajectory from neutrality toward a positive valence.

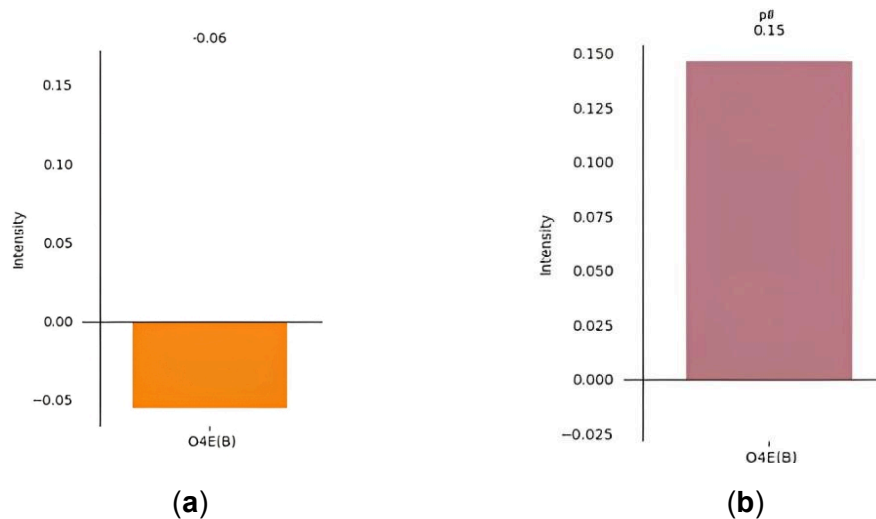


Figure 1. Subconscious Pleasantness (a) and Subconscious Pleasantness Over Time (b) based on EEG-derived frontal alpha asymmetry in male participants. Scores are plotted on a bilateral scale with a neutral zone between -0.1 and 0.1. Panel (a) shows an initial neutral response, while panel (b) reveals a shift into the positive range, indicating temporal growth in subconscious affective engagement.

The temporal increase in affective engagement surpasses the neutral threshold and is considered statistically relevant at an 80% confidence level (one-tailed). These findings indicate that the fragrance progressively activates approach-related emotional responses in male participants. When interpreted in light of consumer neuroscience, this temporal pattern may be predictive of a higher repurchase potential in this demographic.

4. Discussion

The neurophysiological data collected from male participants revealed a progressive increase in left-frontal cortical activation over time, suggesting a temporal build-up of approach-related emotional engagement with the fragrance. This finding aligns with the framework of frontal alpha asymmetry, a well-established biomarker of affective and motivational states [7,8]. In this context, decreased alpha power in the left prefrontal cortex—indicative of increased cortical activity—is associated with positive affect and the initiation of goal-directed behavior [14,15].

Unlike instantaneous hedonic evaluations commonly used in consumer testing, this study employed a temporal window of analysis, enabling the observation of dynamic changes in affective states. This is particularly relevant given the growing recognition that emotional responses are not static events but evolve over time in response to sustained sensory stimulation [16,17]. The gradual left-frontal activation observed may reflect a neurophysiological signature of anticipatory pleasure, linked to the dopaminergic "wanting" system theorized by [13]. This system is distinct from "liking" mechanisms and plays a critical role in reward prediction, motivational salience, and behavioral repetition—all key factors in consumer loyalty and repurchase behavior.

The analysis employed an EEG-based algorithm that interprets alpha-band asymmetries in conjunction with behavioral micro-responses, such as facial muscle activity. Although the precise architecture of the algorithm is proprietary, it builds upon converging evidence from affective neuroscience and psychophysiology, where multimodal integration is known to improve emotion decoding reliability [18,19]. By incorporating facial cues—such as blinking rate, smiling, and frowning—alongside EEG, the algorithm contextualizes neural signals within observable behavioral patterns, allowing for a more ecologically valid interpretation of subconscious responses.

Interestingly, the sustained activation in the left anterior region not only indicates subconscious pleasantness but also aligns with neural patterns implicated in Initial Romantic Attraction (IRA), a motivational state characterized by increased attention, elevated arousal, and idealized social cognition [20,21]. Previous research using EEG and fMRI has shown that romantic and aesthetic stimuli can evoke overlapping patterns of prefrontal activation, particularly when linked to personal relevance or reward expectation [22,23]. The overlap between affective engagement and social attraction further supports the relevance of left-frontal activation as a holistic indicator of subconscious motivational salience in the context of masculine fragrances.

From a commercial and applied neuroscience perspective, these findings suggest that the emotional arc elicited by a fragrance—its ability to sustain and deepen engagement over time—may be more predictive of consumer behavior than static measures of liking. Traditional preference ratings often fail to capture the depth and durability of emotional resonance, particularly at the non-conscious level. EEG-based methods offer a promising avenue for evaluating these subtler dimensions of affective experience, which may be critical in product categories such as perfumery, where the decision to repurchase often involves layers of personal, emotional, and even identity-related meanings [24,25].

Moreover, such insights contribute to the broader field of neuroaesthetics and consumer neuroscience, which increasingly emphasizes the importance of time-dependent neural markers in capturing authentic responses to multisensory stimuli [26,27]. The fact that emotional activation increased across exposures may indicate that the fragrance elicited a cumulative emotional effect, potentially enhancing memory consolidation, brand association, and the formation of positive olfactory-emotional schemas [28,29].

In summary, the results underscore the utility of EEG as a temporally sensitive tool for decoding affective engagement with fragrance, particularly among men. The observed increase in approach-related brain activity over time suggests that emotional resonance with a fragrance is not instantaneous but develops through repeated olfactory encounters. This dynamic and subconscious engagement may play a critical role in predicting consumer preference, loyalty, and the likelihood of repurchase—especially in emotionally charged product categories like masculine perfumery.

5. Conclusion

This study introduces a novel neurophysiological methodology capable of anticipating consumer repurchase intention through EEG-derived affective signals. Rather than relying solely on verbal feedback or conscious preferences, the proposed approach captures

dynamic, subconscious markers — especially those related to affective valuation and reward anticipation — offering a new lens into consumer decision-making.

By operationalizing emotional engagement as a measurable predictor of product desirability, we move beyond traditional fragrance testing toward a more predictive and emotionally intelligent framework. This positions neuroaffective tools not only as evaluative instruments, but as strategic allies in guiding product development, marketing, and innovation.

Future directions may include validating this model across product categories, consumer profiles, and cultural contexts — expanding the reach of neuroscience in understanding what truly drives desire.

6. References

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