Personality Traits and Stimulus Characteristics as Determinants of Consumers' Scent Perception

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Abstract:
Scents influence emotions, cognition and behavior by activating memories, enhancing mood and modulating mental processes. Perception of scents is shaped by both stimulus-related dimensions, including familiarity, pleasantness and intensity and individual factors – such as mood, sensory sensitivity and personality traits. The present study systematically examined the relative impact of these determinants in a quasi-experimental design involving 51 participants. Seven scents were evaluated along perceptual dimensions (recognizability, pleasantness, familiarity, intensity) and related to participants' individual characteristics. Findings emphasize the interplay of stimulus-related dimensions and personality traits but highlight the need for refined measures of (sensory-specific) personality traits in olfactory processing for multisensory marketing and immersive applications.

Keywords:
personality traits, stimulus characteristics, scent perception, sensualist

JEL Classification:
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INTRODUCTION

Olfactory perception constitutes a critical component of consumer experience, as scents can evoke emotions, modulate mood and influence product evaluations and purchase intentions (Herz, 2009; Lehrner et al., 2005; Spangenberg et al., 1996). The processing of olfactory stimuli is a complex and multidimensional phenomenon (Herz & Engen, 1996; Mehrabian & Russell, 1974). On the one hand, stimulus-related characteristics, such as familiarity, pleasantness and intensity, exert consistent effects on olfactory responses across individuals (Distel et al., 1999; Engen, 1991; Morrin & Ratneshwar, 2003). On the other hand, person-specific factors, including mood, sensory seeking tendencies and personality traits, determine how scents are perceived, evaluated and remembered (Ferdenzi et al., 2013; Gardner & Hill, 1990; Harper's Magazine, 2025).

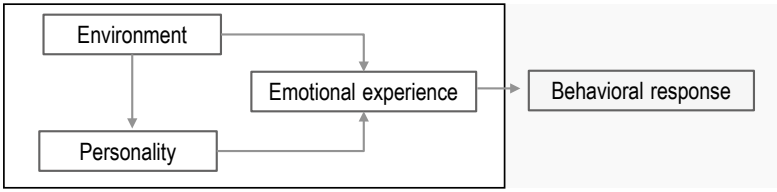
Despite these insights, the precise interplay between stimulus-related characteristics and individual predispositions in shaping olfactory evaluations remains unclear (Bone & Ellen, 1999; Donovan & Rossiter, 1982). Addressing this question, is essential for advancing theoretical models of scent perception, particularly within the Stimulus-Organism-Response (S-O-R) framework and for informing applied contexts such as product design, branding and multisensory marketing (Krishna, 2012; Peck & Childers, 2018; Spence & Gallace, 2011). Accordingly, the present study aims to provide a more nuanced understanding of stimulus and personality-related determinants on perceptual processes in olfactory evaluation.

1 THEORETICAL BACKGROUND

In environmental psychology the Stimulus–Organism–Response (S-O-R) model proposed by Mehrabian and Russell (1974) provides a fundamental framework for understanding how environmental stimuli affect human emotional experience and behaviors. According to this model, environmental stimuli (S) elicit internal organismic states (O) – emotional, cognitive and physiological reactions – which in turn drive behavioral outcomes (R) such as approach or

avoidance behaviors. Olfactory perception, in this context, highlighting a dynamic interplay between environment and organism (Bochicchio & Winsler, 2020; Vieira, 2013).

Fig. 1: Interplay between environment and personality in olfactory perception by Mehrabian & Russell (1974)



Source: own processing, 2025, according to Mehrabian & Russell, 1974

1.1 Environment: Scent characteristics

The characteristics of olfactory stimuli critically determine their perceptual and emotional impact. Characteristics such as pleasantness, familiarity and intensity elicit internal affective and cognitive states, including emotional experience of pleasure, arousal and dominance, which subsequently shape consumer behaviors, such as product evaluation, time spent with a product or purchase intention (Mattila & Wirtz, 2001; Mehrabian & Russell, 1974; Spangenberg et al., 1996).

Pleasantness, often conceptualized as hedonic valence, has been shown to promote approach-related responses and recognition, underscoring its central role in shaping consumer scent experiences (Giacalone et al., 2021; Nováková et al., 2015). Familiarity facilitates odor recognition and typically enhances hedonic evaluations, as familiar scents are processed more fluently and tend to elicit positive effects (Kärnekull et al., 2015; Sulmont et al., 2002). In contrast, unfamiliar odors may induce cognitive uncertainty or negative affective reactions (Hamzeloo et al., 2025; Stevenson & Mahmut, 2013). Intensity demonstrates an inverted-U relationship with preference: moderate intensity enhances perceptual clarity and liking, whereas excessively intense odors may

lead to sensory overload, discomfort or avoidance behavior (Baccarani et al., 2021; Moskowitz et al., 1976).

1.2 Personality

Although olfactory stimuli have universal biological and affective effects, individuals differ considerably in their perception and evaluation of scents (Croy et al., 2011; Larsson et al., 2000; Royet et al., 2003). Personality traits constitute a key explanatory factor for these interindividual differences. Drawing on the pleasure–arousal–dominance framework (Mehrabian & Russell, 1974), research has identified sensory seeking tendencies as a personality dimension accounting for differential responses to sensory stimuli (Koelega, 1970; Raju, 1980; Zuckerman, 1994).

Building on this perspective, Gröppel (1991) distinguished three consumer segments (Gröppel, 1991): *Sensualists*, characterized by high arousal-seeking and pronounced sensitivity to sensory stimuli alongside a strong desire for social engagement and novel experiences; *Indulgents*, exhibiting a comfort--oriented, socially withdrawn lifestyle with lower responsiveness to external sensory cues and *„Young" Extremists*, a hybrid type combining traits of both groups, often younger, impulsive, open to experimentation, but less stable in preferences. These segmentation approaches highlighting the relevance of person-specific traits in understanding consumer scent experiences.

2 METHODOLOGY

The face-to-face, semi-structured laboratory study was conducted in January 2025. Participants were presented with seven coded scent samples, each sealed in airtight bags and opened by the experimenter immediately prior to presentation to maintain blinding. To prevent olfactory carryover effects, natural coffee beans were provided for neutralization between samples (Grosofsky et al., 2011; Krishna, 2011). The order of scent presentation was rotated across participants to ensure that each scent appeared in different serial positions across participants, thereby minimizing sequence effects.

After each presentation, participants were asked to identify the perceived scent in an open-ended format (Distel & Hudson, 2001). Their responses were

independently coded by two experts to yield a recognition index based on recognition accuracy: *fully correct* (2), *directionally accurate* (1), or *not recognized* (0). In addition, participants rated each scent on an 11-point Likert scale (0–10) for pleasantness, familiarity, and intensity (one item per dimension) (Bensafi et al., 2002; Distel & Hudson, 2001; Sulmont et al., 2002). For each of the three evaluative dimensions, mean scores across the seven scents were calculated, resulting in decimal-scaled indices of *pleasantness*, *familiarity*, and *intensity* (Norman, 2010).

Sociodemographic information – including age, gender, education level, smoking behavior and perfume usage – was collected, along with measures of current mood, sensory variables and personality traits.

Mood was assessed using the 4-item Short Mood Questionnaire (Cronbach's alpha: .70) (Peterson & Sauber, 1983). *Sensitivity to sensory stimuli* was measured using three items from the *Low Sensory Threshold* (LST) factor of the *High Sensitivity Person* (HSP) Scale (Satow, 2022). Additionally, a single item assessing subjective situational awareness of scents during fruit shopping was included. Consistent with theoretical expectations, Low Sensory Threshold scores were strongly positively correlated with subjective situational awareness of scents ($r = 0.54$, $p < .001$), indicating that individuals with higher sensory sensitivity reported greater awareness of contextual olfactory cues. Nevertheless, a principal component analysis (PCA) revealed that the four items were not unidimensional but rather loaded onto two distinct factors: one associated with *Individual Sensory Sensitivity* and the other with *Sensitivity to unpleasant Sensory Stimuli*. For subsequent analyses, the factor related to *Individual Sensory Sensitivity* was used (KMO = 0.66; Bartlett's test: $\chi^2(6) = 36.06$, $p < .001$). This factor was represented by three items from the *Low Sensory Threshold* subscale and the additional scent awareness item, which together formed a reliable composite indicator of *Individual Sensory Sensitivity*.

Personality trait classification followed Gröppel's *Sensualist* construct, assessed using her 10-item scale representing shopping behavior and lifestyle (Gröppel, 1991). In the present study, the scale was slightly adapted by rephrasing items to refer to general shopping situations rather than to specific product categories such as textiles.

The sample consisted of 51 university students (M_age = 24 years, SD = 4), with a balanced gender distribution (51% female). One participant (2%) reported a residual respiratory condition potentially affecting olfactory perception; however, as no anomalies were observed in this participant's data, they were

retained in the sample. Thirty-one percent of participants reported wearing perfume prior to the session. The data indicated that wearing perfume had no significant effect on scent recognition, $F(1, 51) = 0.42$, $p = .522$, or perceived pleasantness, $F(1, 51) = 2.89$, $p = .137$, but did have a significant effect on perceived familiarity, $F(1, 51) = 7.06$, $p = .011$, and perceived intensity, $F(1, 51) = 9.23$, $p = .004$. Due to the small sample size, further analyses regarding the potential effects of participants' personal use of perfume could not be conducted.

3 FINDINGS

3.1 Stimulus Characteristics

Overall, the data suggest that participants perceived the scents as generally pleasant (M = 6.64, SD = 0.89), familiar (M = 6.78, SD = 1.30), and moderately intense (M = 6.82, SD = 1.17) on a 0–10 scale, whereas their ability to recognize individual scents varied more substantially (M = 6.41, SD = 2.51).

Tab. 2: Pearson Correlation of three scent evaluation items plus recognition index

	index over seven scents (scale 0 to 10)		
Pearson Correlation (N=51)	**pleasantness**	**familiarity**	**intensity**
recognition index of all seven scents (scale 0 to 14)	0.02	0.06	-0.10
pleasantness index over seven scents		**0.46****	0.22
familiarity index over seven scents			**0.43****

**. Correlation is significant at the 0.01 level (2-tailed).
Source: own processing, 2025

A correlational analysis was performed to assess the associations between recognition and the three perceptual evaluation dimensions (pleasantness, familiarity, and intensity) aggregated across all scent stimuli (see Table 2). Recognition ability did not correlate significantly with any of the perceptual indices. However, familiarity and pleasantness were strongly correlated (r = 0.46,

$p < .001$), indicating that scents perceived as more familiar were also judged as more pleasant. Familiarity further showed a positive correlation with intensity ($r = 0.43$, $p < .001$), suggesting that familiar odors tended to be perceived as more intense. No significant association emerged between pleasantness and intensity ($r = 0.22$, $p = .129$), implying that perceived hedonic valence operates largely independently from perceived strength of the olfactory stimulus.

To further explore the underlying structure of scent characteristics, a series of principal component analyses (PCA) with Varimax rotation were performed on the individual scent evaluation scores for each dimension across the seven odors. The *recognition indices* (KMO = 0.44; Bartlett's test: $\chi^2(21) = 18.21$, $p = .635$) and *pleasantness indices* (KMO = 0.44; Bartlett's test: $\chi^2(21) = 31.26$, $p = .069$) did not meet the minimum criteria for factorability. In contrast, the *familiarity indices* yielded a KMO value of 0.57, indicating limited sampling adequacy, but Bartlett's test of sphericity was significant ($\chi^2(21) = 42.01$, $p = .004$), supporting the presence of a latent factor structure. A four-factor solution was extracted (eigenvalue of fourth factor = 0.999), interpreted as follows: (1) Citrus/Floral (orange, lavender), (2) Fruity Sweetness (apple, roasted almond), (3) Indulgent Intensity (coffee, chocolate) and (4) Tropical/Exotic (pineapple). For the *intensity indices*, the KMO value of 0.76 indicated good sampling adequacy ($\chi^2(21) = 100.93$, $p < .001$). A two-factor structure emerged, which can be interpreted as *bright scents* (apple, orange, pineapple, lavender) and *dark scents* (coffee, roasted almond, chocolate).

Tab. 3: Overview of extracted factors based on familiarity indices and intensity indices across the seven odors

Factor basis	Stimulus-based scent factors	Substructure of factors (factor loading)
familiarity indices of seven scents	Citrus/Floral	orange, lavender
	Fruity Sweetness	apple, roasted almond
	Indulgent Intensity	coffee, chocolate
	Tropical/Exotic	pineapple
intensity indices of seven scents	bright scents	apple, orange, pineapple, lavender
	dark scents	coffee, roasted almond, chocolate

Source: own processing, 2025

Based on these factor structures, composite indices were computed for subsequent analyses (e.g., a pleasantness index for bright scents was calculated from the mean pleasantness ratings for apple, orange, pineapple and lavender).

3.2 Personality Traits

In accordance with Gröppel's analysis, all ten items were standardized prior to analysis to ensure comparability across scales. A k-means cluster analysis was first performed with the number of clusters fixed at three, consistent with the original segmentation framework. Items that did not contribute significantly to the clustering solution were excluded ($p > .278$), resulting in the removal of four variables – *need for relaxation, comfort, calm* and *vitality* – due to low discriminatory power. The factor loadings for the Sensualists and Indulgents closely mirrored Gröppel's three-cluster solution, whereas the Extremes cluster displayed deviations in its loading structure.

Since Gröppel's methodological approach did not yield stable results with the data from the present sample, it was subsequently decided to support the analyses of possible effects of sensuality in a more conventional way by conducting a principal component analysis (PCA) of the items followed by a clustering of participants.

Based on an analysis of the eigenvalues, PCA suggested a solution with five factors, together accounting for 76.2 percent of the variance in the initial variables (KMO = 0.62; Bartlett's test: $\chi^2(45) = 104.39$, $p < .001$).

To enhance the segmentation process, a hierarchical cluster analysis employing a single-linkage fusion algorithm was performed (Punj & Stewart, 1983). Consequently, four cases were excluded, as they could only be assigned to a cluster during the final stages of aggregation, effectively representing outliers. Based on the remaining 47 cases, a subsequent hierarchical cluster analysis using Ward's method was conducted, resulting in a four-cluster solution. Tab. 4 shows the group means of the four clusters across the five factors extracted from the 10 items (standardized values, i.e., the deviation from 0 indicates whether and to what extent a value is above or below the overall average).

Tab. 4: Four cluster analysis method: Ward's

Ward's method	1 – Disinterested Introverts Mean	SD	2 – Luxury Seekers Mean	SD	3 – Cultural Independents Mean	SD	4 – Sociable Mean	SD
Sociability	-0.1	0.5	-0.1	0.8	-0.8	0.6	1.4	0.9
Interest in local issues	-0.7	0.8	0.0	0.6	0.9	0.8	0.2	0.6
Exclusivity Need	-0.8	0.7	1.0	0.6	-0.7	0.7	0.2	0.5
Self-Focus	-0.5	0.7	-0.1	0.7	0.3	1.0	0.9	0.9
Need for rest	0.2	0.9	-0.6	0.9	-0.1	0.8	0.0	0.9

Source: own processing, 2025

Cluster 1 ("Disinterested Introverts") is characterized by low scores on exclusivity need, local issues and self-focus, as well as a below-average interest in sociability, suggesting a rather reserved and disengaged personality pattern. In contrast, Cluster 2 ("Luxury Seekers") exhibits high exclusivity need, reflecting a more status-oriented profile with a preference for distinctive or premium experiences. Cluster 3 ("Cultural Independents") shows strong interest in local issues and above-average self-focus, combined with low sociability and low exclusivity need, indicating a more autonomous and culturally aware orientation that is less influenced by social or luxury-driven motives. Finally, Cluster 4 ("Sociable") is defined by very high sociability and elevated self-focus, accompanied by a moderate need for exclusivity, representing outgoing and socially engaged individuals who value interaction and active participation.

Quality of cluster analysis and Construct validity of clusters

To assess the robustness of the four-cluster solution derived from Ward's method, a discriminant analysis was conducted based on 47 valid cases and five extracted factors from the 10-item scale representing shopping behavior and lifestyle.

Tab. 5: Discriminant analysis of four cluster analysis method: Ward's

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation	Wilks' Lambda	Chi-square	df	Sig.
1	3.42	56.8	56.8	0.88	0.04	129.79	15	<.001
2	1.66	27.6	84.4	0.79	0.19	68.14	8	<.001
3	0.94	15.6	100.0	0.70	0.52	27.55	3	<.001

Source: own processing, 2025

Box's M test indicated that the assumption of equal covariance matrices was met (Box's M = 70.46, F(45, 3613.05) = 1.21, p = .159), confirming group homogeneity. The three canonical discriminant functions jointly explained 100% of the variance (56.8%, 27.6%, and 15.6%, respectively) and showed strong canonical correlations (r = 0.88, 0.79 and 0.70), indicating substantial separation among clusters. Significant Wilks' Lambda values supported the discriminant validity of the cluster structure. The structure matrix identified *Exclusivity Need, Self-Focus* and *Sociability* as the strongest discriminating variables. Cross-validation demonstrated 100% correct classification, suggesting excellent internal validity of the four-cluster solution.

A one-way ANOVA was performed to assess the external validity of the clusters, analogous to the Sensualist construct identified by Gröppel. No significant differences were found in *Individual Sensory Sensitivity* (F(3,43) = 1.44, p = .244). Likewise, no significant effects emerged for *sensitivity to sensory stimuli* (F(3,43) = 2.10, p = .104), although post-hoc LSD comparisons revealed that *Sociable* participants scored significantly higher than *Disinterested Introverts* (p = .021). Similarly, no significant differences emerged for *situational scent awareness during fruit shopping* (F(3,43) = 0.81, p = .493).

No significant differences were observed for *mood* (F(3,43) = 0.77, p = .519). However, *gender* differences between clusters reached significance (F(3,43) = 3.30, p = .028). The share of female cluster members is as follows: in the cluster of those interested in luxury and excitement: 30.8%, in the cluster of those interested in culture: 81.8%, and among the sociable: 55.6%. It should be noted that these numbers are purely exploratory due to the small cell sizes.

Scent evaluation

Scent evaluation was analyzed with respect to the previously identified personality clusters, as well as individual personality traits (*mood, Individual Sensory Sensitivity)*, using the four general scent indices and the newly derived stimulus-based indices (see Section 3.1).

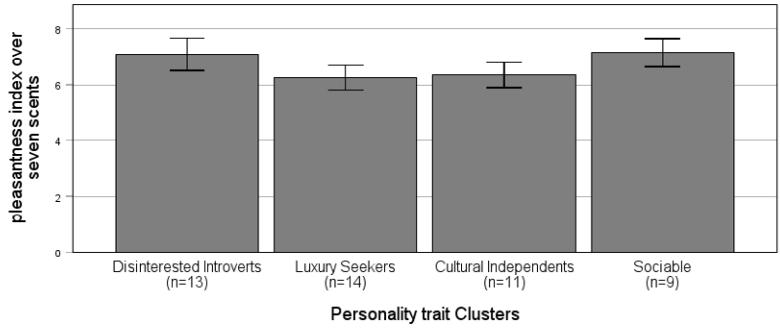
Tab. 6: ANOVA of four cluster analysis regarding scent perception dimensions across the seven odors

		indices over seven scents (scale 0 to 10 each)			
Personality trait Clusters		**recognition**	**pleasantness**	**familiarity**	**intensity**
1 – Disinterested Introverts (n=13)	Mean	5.62	**7.09**	6.79	7.13
	SD	1.45	0.96	1.25	1.13
2 – Luxury Seekers (n=14)	Mean	5.00	**6.26**	6.83	6.66
	SD	2.77	0.77	1.47	1.15
3 – Cultural Independents (n=11)	Mean	4.82	**6.35**	6.86	6.96
	SD	1.33	0.67	0.75	0.73
4 – Sociable (n=9)	Mean	5.11	**7.14**	6.84	6.71
	SD	2.37	0.66	1.14	1.27
Total (N=47)	Mean	5.15	**6.68**	6.83	6.87
	SD	2.04	0.86	1.17	1.07
Significance of group differences		F(3) = 0.79, p = .502	**F(3) = 4.21, p = .011**	F(3) = 0.01, p = .999	F(3) = 0.51, p = .678

Source: own processing, 2025

ANOVA revealed a statistically significant difference only for the *pleasantness index* (F(3,43) = 4.21, p = .011), whereas *recognition, familiarity* and *intensity* did not differ significantly across clusters.

Fig. 7: Perceived pleasantness within the four personality trait cluster



Source: own processing, 2025

Post-hoc LSD comparisons indicated that *Sociable* participants perceived scents as more pleasant compared to *Luxury Seekers* ($p = .011$) and *Cultural Independents* ($p = .030$), but not relative to *Disinterested Introverts* ($p = .873$). No significant difference was observed between *Luxury Seekers* and *Cultural Independents* ($p = .764$).

Analysis based on the stimulus-based scent factors (factor_1: Citrus/Floral, Fruity Sweetness, Indulgent Intensity, Tropical/Exotic; factor_2: bright scents, dark scents) revealed no significant cluster differences for the familiarity or intensity factors. However, differences emerged when examining the newly derived indices. Specifically, perceived *pleasantness of Indulgent Intensity* scents (derived from familiarity indices) differed across clusters ($F(3,43) = 3.46$, $p = .024$), as did the *pleasantness of dark scents* (derived from intensity indices; $F(3,43) = 4.60$, $p = .007$). Post-hoc LSD tests showed that *Disinterested Introverts* rated *Indulgent Intensity* scents as significantly more pleasant than *Luxury Seekers* ($p = .006$) and *Cultural Independents* ($p = 0.023$), and *dark scents* as more pleasant than *Luxury Seekers* ($p = .001$) and *Cultural Independents* ($p = .015$). No significant differences were observed between *Disinterested Introverts* and *Sociable* for these indices ($p > .100$).

General personality statements

Sex did not significantly influence scent perception indices or factor-based indices. Age effects were considered negligible due to the homogeneity of the sample. Consequently, only *mood* and *Individual Sensory Sensitivity* were deemed relevant for further analysis.

Tab. 8: Pearson Correlation of (N=51) between mood, individual sensory sensitivity as personality variables on various indices of olfactory perception

	indices over seven scents			
Pearson Correlation of (N=51)	**recognition**	**pleasantness**	**familiarity**	**intensity**
Mood	-0.16	**0.27***	0.03	-0.03
Individual Sensory Sensitivity	0.05	0.00	0.20	-0.13

**. Correlation is significant at the .001 level (2-tailed).
*. Correlation is close significant at the .100 level (2-tailed).
Source: own processing, 2025

Furthermore, *mood* was marginally positively related to overall scent *pleasantness* (r = 0.27, p = .054), indicating that participants in a more positive mood tended to rate the scents as more pleasant. When examining stimulus-specific indices, mood was significantly associated with the perceived pleasantness of *Fruity Sweetness scents* (r = 0.29, p = .036) and *dark scents* (r = 0.28, p = .048).

Individual Sensory Sensitivity is not significantly associated with scent perception.

CONCLUSION

This study examined the relative contributions of person-specific factors and stimulus characteristics to olfactory perception in a sample of 51 participants exposed to seven distinct scents. Stimulus characteristics emerged as significant indicators of scent evaluation. Perceived familiarity was positively correlated with pleasantness and perceived intensity influenced familiarity

perception. Furthermore, principal component analyses revealed meaningful scent groupings (e.g., bright vs. dark (Engen & Pfaffmann, 1959); citrus/floral, fruity sweetness, indulgent, exotic), enabling the construction of stimulus--driven indices.

Contrary to our expectations, we were unable to replicate Gröppel's classification of "sensualists" in our dataset, which made it necessary to apply a different analytical methodology. Hierarchical cluster analysis identified four personality-based clusters. Cluster membership affected pleasantness ratings, but did not systematically influence recognition, familiarity or intensity. Sensory sensitivity also failed as indicator of olfactory perception. Mood showed a marginal positive association with pleasantness.

Limitations of the present study include the relatively small sample size, which may have reduced statistical power and limited the generalizability of findings. The restricted number of scent stimuli and the use of a laboratory--based setting may also constrain validity. Future research should replicate these findings with larger and more diverse samples, include a broader range of scent types and contexts and consider longitudinal or experimental approaches to better capture dynamic person–stimulus interactions.

Overall, the study highlights the need for more refined measures of sensory--specific personality traits, particularly in light of the fact that sensory seeking is considered a key determinant of scent perception yet did not contribute to the explanation of variance in the present results. Future research should focus on the complex interplay between stimulus characteristics and individual traits. Integrating stimulus, mood, and contextual variables may yield a more holistic understanding of olfactory perception (Nasello et al., 2024).

Beyond theoretical relevance, the findings also offer practical implications for applied settings. Insights into the relationship between scent characteristics and mood can inform the design of store environments, for instance by using pleasant and familiar scents to enhance approach behavior and dwell time. Similarly, understanding personality-related differences in olfactory pleasantness can guide brand communication strategies, enabling more targeted multisensory branding. Moreover, the identification of stimulus-based scent clusters provides a useful framework for sensory product testing, supporting systematic evaluation and optimization of olfactory elements in product development.

These insights have practical implications for the design of multisensory experiences and sensory marketing strategies, emphasizing stimulus-driven approaches over reliance on traditional personality constructs.

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DISCLOSURE OF INTERESTS

The authors have no competing interests to declare that are relevant to the content of this article.

DECLARATION OF ETHICAL STANDARDS

This study was approved by the Ethics Committee of University of Bayreuth under approval number 25-001. We would like to thank the committee for their support and for the ethical review of the research design. All participants were fully informed prior to the study and provided their informed consent to participate.

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