

How do the characteristics of the physical environment impact online consumption behavior?

The effect of ambient scents on e-commerce experience

Abstract :

The present research examines how ambient olfactory atmospheric cues affect consumers' responses while browsing on a merchant website. Building on the DAST model, scent congruence with the product category is manipulated and its effect on purchase intentions is explored. Possible underlying mechanisms, either affective (pleasure) or cognitive (inferences of manipulative intent), are also studied. The results of two experiments demonstrate no direct effect of the presence of an (in)congruent ambient scent on purchase intentions, but an improvement of pleasure while exploring the website and an increase of inferences of manipulative intent when an incongruent scent is present, extending knowledge on offline and online atmosphere.

Keywords: *atmosphere; DAST; (in)congruent ambient scents, affective reactions, inferences of manipulative intent*

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INTRODUCTION

Whether in managerial practices or in academic works, the concept of atmosphere has been widely used to respond to an increasingly dense competitive context and to offer consumers enjoyable experiences. Retailers know in-store atmospheric sensory cues influence customer behavior (Garlin and Owen 2007; Krishna 2012, 2013) and thus manipulate them to improve experience (Berry, Carbone and Haeckel 2002; Varley 2005).

The way offline atmosphere cues impact consumer behavior is abundantly documented, as well as how online atmosphere plays a role on consumers' online behavior. Interestingly, most of the work focuses on the study of a specific, lone factor, even though atmosphere is, by essence, multifactorial (Spence et al. 2014) and perceived holistically by the consumers (Bitner 1992).

Still, a few studies have focused on atmosphere cues interactions, offline (e.g., music and scent, Mattila and Wirtz 2001; Morrison et al. 2011) and online (e.g., ambient factors and design, Bouchetara 2017; Lemoine and Charfi 2022; Zafri 2019). Nevertheless, when it comes to the interaction between offline and online atmospheres, only scarce work exists (Flavián, Ibáñez-Sánchez and Orús 2021; Vinitzky and Mazursky 2011). This observation is central here, as long as an online experience necessarily takes place in a non-neutral offline environment: either while shopping on a computer, a smartphone or in a connected store, the consumers' senses are grounded in the surrounding atmosphere during the online experience, so the "physical" atmosphere in which the Internet users evolve can impact also their online behavior.

The aim here is therefore to study how the physical (offline) atmosphere impacts web users' behaviors during their visit to an e-commerce site. In order to address this question embedded at the border of sensory and digital marketing, the DAST (design–ambient–social–trialability) model, described as based "on two related streams of research that conventionally have been investigated independently: retail atmospherics (...) and sensory experiences" (Roggeveen, Grewal and Schweiger 2020), is adopted here.

Regarding atmosphere, the overall website atmosphere will be taken under consideration, and the ambient atmosphere will be considered through the influence of ambient scents. This specific cue of offline atmosphere was picked first for its undeniably well documented effects in the retailing literature (Krishna 2012, 2013; Roschk and Hosseinpour 2020; Spence et al. 2014). Second, for retailers, the use of ambient scents should be considered seriously as a part of their central marketing levers, as "it is probably among the least expensive techniques to enhance shoppers perceptions" (Chebat and Michon 2003, p.537). To this day, olfactory marketing is still considered as one of the most powerful sensory ways to improve consumer experience across contexts, as even unconsciously processed scents can do so (Oberwegner et al. 2025). Third, managers are increasingly interested in "digital olfaction", either with the many developments of technologies² linking the online experience to an offline scented atmosphere or with the examples of cross canal distributing strategies developments where retailers seek out the support of online devices to create a full experience for consumers instore, (see the scented Sephora connected stores for example³) that will soon be made possible (Szocs et al. 2023) by the progressive development of sensory enabling technologies (Petit and Velasco and Spence 2019).

Through a literature review, the development of a conceptual framework and the presentation of the results of two studies, this research aims at answering the following question: to what extent and how the ambient scent of the offline atmosphere impacts the consumers' online behavior?

LITERATURE REVIEW

Atmosphere at points-of-sale: interaction effects and theoretical frameworks

From the offline atmosphere to the online atmosphere

An important literature span exists on the concept of atmosphere, since the 1960's. It began with a focus on physical environments such as restaurants or grocery stores (Kotler 1973; Mattila and Wirtz 2001; Sharma and Stafford 2000). Many definitions exist, starting with Kotler's (1973 p.50): atmosphere is the « effort to design buying environments to produce specific emotional effects in the buyer that enhance his purchase probability ». Later, Eroglu and Machleit (1993

¹ <https://digital-olfaction.com>

² <https://sloanreview.mit.edu/article/business-scents-the-rise-of-digital-olfaction/>

³ <https://www.retaildive.com/ex/mobilecommercedaily/sephora-blends-mobile-with-bricks-and-mortar-for-first-connected-boutique-experience>

p.34) broadened the definition: “all of the physical and non-physical elements of a store that can be controlled in order to enhance (or restrain) the behaviors of its occupants, both customers and employees”. Throughout the years, atmosphere was demonstrated as able to elicit varied consumer responses, either cognitive, affective and/or conative. While the study of atmosphere components effects on purchase intentions remains the majority (Baker, Levy and Grewal 1992; Chen, Hsu and Lin 2010; Hausman and Siekpe, 2009; Lazaris et al. 2022), other dependent or mediating variables have been studied, for instance: affective reactions (Babin, Levy and Grewal 2004; Chebat and Michon 2003; Ha and Lennon 2010; Pantano and Viassone 2015) or time spent in the store (Morrison et al. 2011; Spangenberg, Crowley and Henderson 1996), brand choice and satisfaction (Turley and Milliman 2000), etc.

In the beginning of the 2000's the concept of atmosphere was transposed to merchant websites and defined by Dailey (2004, p.796) as: “the conscious designing of web environments to create positive effects (e.g., positive affect, positive cognitions, etc.) in users in order to increase favorable consumer responses (e.g., site revisiting, browsing, etc.)”. When it came to classifying the atmospheric cues, either in marketing or in information systems, many authors adapted Baker's typology (1986) to the digital environment (store atmospheric elements rely on Design, Ambient and Social cues), while others proposed new typologies (e.g: Eroglu, Machleit and Davis 2001, 2003; Hausman and Siekpe 2009; Lemoine 2008; Vrechopoulos, O'Keefe, Doukidis and Siomkos 2004). Recently, Roggeveen, Grewal and Schweiger (2020) proposed an evolution of Baker's model (DAST model) by integrating a new dimension to atmosphere: Trialability factors, including virtual and augmented reality. These latter enable customers to try out a product using technology, rendering the model as fit for offline and online atmospheres' study, along with their interactions.

In the study of how web atmosphere factors impact internet users' behavior, research shares the specificities observed in the studies devoted to physical retail: they consider only one atmospheric cue (Ben Mimoun and Poncin 2015; Cherif and Lemoine 2019; Gefen and Straub 2003, 2004; Lu, Fan and Zhou 2016; Wang et al. 2007) and studies of more comprehensive settings are relatively rare.

Study of atmospheric cues: from a single-factor approach to an approach advocating the study of interaction effects

Either offline or online, almost all of the studies have examined the specific role of an atmospheric factor on behavior, as we have seen in the previous paragraphs. Although this approach makes it possible to establish experimental protocols that are relatively simple to implement, it does not correspond to the reality in the field, given the presence of a significant number of atmospheric factors in both physical and digital environments.

Offline, a few attempts to study the effects of the interactions of the atmosphere components were published (Mattila and Wirtz 2001; Morrison et al. 2011; Spangenberg, Grohmann and Sprott 2005), clearly disclosing the relevance of engaging in a more comprehensive understanding of atmosphere (Mattila and Wirtz 2001; Spence et al. 2014).

Online, Bouchetara (2017) studies the interaction between ambient factors (background color, type and rhythm of music), and Zafri (2019) focused on the interaction effects of design factors by studying the font size and layout of the products, but all in the same component of Baker's (1986) typology. The recent work of Lemoine and Charfi (2022) goes further as it does not simply study an interaction effect between tools belonging to the same atmosphere component, but carries out an inter-components study: the authors study the combined effects of the presence of a virtual agent (social factor), a control command (design factor) and a 3D environment (ambiance factor) on the user's environment (ambiance factor) on the user's immersion. The results show that a shopping environment simultaneously made of these three atmospheric components generates more immersion than a site that displays only one of these dimensions. Lemoine (2022) actually calls for further research on atmosphere, and more specifically by apprehending it in a more holistic, non-atomized way.

It so appears that the literature is abundant in both contexts (offline and online), but the interaction of several cues or the interaction offline and online atmospheres is scarcely documented. Nonetheless, recent works developed an interest in the customer journey and consider that the study of atmosphere needs to be broadened as to consider the various touch points with the company and thus comprehend more than the only in-store experience. Thus, experiences outside the stores, such as the website, flyers or social networks are to be considered (Roggeveen, Grewal and Schweiger 2020), especially because, from an ecological and managerial point of view, it is difficult to conceive an online consumer experience taking place in a totally neutral offline environment, especially when it comes to ambient scents.

From this perspective, the DAST theoretical framework is entirely relevant to the hereby studied issue. Compared to Baker's model, the authors of the DAST model emphasize the opportunities available to retailers to take control of elements present at the point of sale, but also outside the point of sale, such as the company's website, social media accounts and catalogues. The model thus places the shopping experience within a more holistic and omnichannel approach.

Consumers are also able to use their devices within the point of sale. For example, while the social dimension, in its more traditional considerations (Baker, 1986), considers the possible presence of other actors within the point of sale, new technologies are expanding the possibilities for social interaction, as individuals can 'shop with their friends and family, even if they are not physically present in the store, by connecting with them via Facetime to get their opinions' (Roggeveen, Grewal and Schweiger, 2020, p.132). Thus, this model fits to the study of offline and online atmospheres and is fit for the study of their interactions.

The influence of offline atmosphere on online consumer behavior: how ambient scents impact Internet user behavior?

Ambient scents and the central role of congruence

Ambient scents are defined as present in the environment but not emanating from a particular object, being present in the background but not actively contributing to the main activities of the setting (Krishna 2013) and having a significant effect on consumers' emotional state, attitudes and behaviors (Spangenberg et al. 2006; Vinitzky and Mazursky 2011). It potentially creates positive mood states that in turn produce positive overall consumer responses, such as more favorable product/store evaluations and higher sales (Morrin in Krishna, 2011), because of the nonconscious influence that olfactory cues have on thinking and doing (Holland, Hendriks and Aarts 2005). Overall, the effect of offline pleasant ambient scents has been widely documented (Pappu et al. 2022), with positive results over a variety of consumer behavior outcomes (see appendix A for an overview).

Nevertheless, several authors claim that the mere presence or the pleasantness of the scent may not suffice to generate improved effects on consumer behavior (Schifferstein, and Blok 2002; Spangenberg, Grohmann and Sprott 2005), and a large set of studies on ambient scent resorts to the concept of cue congruence, that is actually central to sensory marketing (Krishna 2012). Congruence, defined as the fit between concepts, and more precisely "[...] the degree of fit among the characteristics of a stimulus" (Krishna, Elder and Caldara 2010, p. 410), is thus the degree of fit, correspondence, or level of appropriateness of cues with each other in a given context or cue (Caldara 2010; Helme Falk and Hultén 2017). Several types of cues were attached to the study of pleasant scent congruence over the decades, through varied operationalizations and in the end, with overall converging results (see appendix A). Basically, the effect of scents is highly dependent on congruence to elicit positive responses (Flavián, Ibáñez-Sánchez and Orús 2021; Helme Falk and Berndt 2018; Morrin in Krishna 2011), and moreover, if the scent is perceived as incongruent, it would not affect consumer evaluations, rendering the use of ambient scents irrelevant or even become counterproductive (Flavián, Ibáñez-Sánchez and Orús 2021; Schifferstein, and Blok 2002; Spangenberg, Grohmann and Sprott 2005). Roschk and Hosseinpour (2020) actually show in their meta-analysis that effect sizes determined by the presence of ambient scents are related positively to scent congruence, this being explained by the fact that consumers might misattribute the effects of liked ambient scents to the products being evaluated (Bosmans 2006), and tend to prefer experiences that convey similar messages to the senses because of prior experience and learning (Helme Falk and Berndt 2018). Overall, ambient scents congruence hence plays a decisive role on the impact of ambient scents on consumer responses on a wide variety of consumer behavior outcomes and contexts (see appendix A for more details).

The influence of ambient congruent scents on online consumer behavior

Considering that offline congruent ambient scents have a widespread impact on a variety of contexts, it is here assumed that it can impact consumers responses when they visit a website, in accordance with Petit, Velasco and Spence's (2019), stating that the positive impact of the sensory atmospherics in store, facilitated by cue congruence, are likely to hold in the online environment. Regarding the impact of offline ambient scents on online shopping behaviors, Vinitzky and Mazursky's (2011), and Flavián, Ibáñez-Sánchez and Orús's (2021) works are of interest. The first one studied the effect of the interaction between cognitive variables and presence of scent on online search motivation, purchase characteristics and telepresence in a virtual store, and showed a positive impact of the presence of ambient scents on online behaviors. The second one, in virtual reality settings, added the idea that ambient scent congruence also has an impact on online behaviors.

CONCEPTUAL FRAMEWORK AND HYPOTHESES

In the study of atmosphere, the Stimulus-Organism-Response (SOR) paradigm (Mehrabian and Russel 1974) is

the most common framework employed to study the effect of the shopping environment on behavior, offline (Doucé and Janssens 2013; Spangenberg et al., 2006; Vinitzky and Mazursky 2011), and online (Fei et al. 2021; Friedrich, Schlauderer and Overhage 2019; Kamboj et al. 2018; Lyu, Krasonikolakis and Vrontis 2022).

However here, where the aim is to combine characteristics of the retail atmosphere with elements of sensory experience, it is relevant to rely on Roggeveen, Grewal and Schweiger's (2020) DAST model that broadens existing conceptualizations by comprehending both in-store and out of store experiences the retailers can control. This expansion of view offers a way to include the multiple touchpoints the consumers will meet in their experience, thus offering a more dynamic and contemporary view of atmosphere.

Furthermore, pleasant scents are a critical component of the physical environment (Chebat and Michon 2003; Pappu et al. 2022) and their congruence is suggested to be an essential condition to lead to positive outcomes offline and online (Flavián, Ibáñez-Sánchez and Orús 2021; Spangenberg, Crowley and Henderson 1996; Spangenberg, Grohmann and Sprott 2005; Vinitzky and Mazursky 2011). Scent congruence is even important enough to deem the scent as pleasant (Leenders, Smidts and El Haji 2019; Helme Falk and Hultén 2017), and it is proven to hold independently of its operationalization or context of application (Morris in Krishna 2011; Vinitzky and Mazursky 2011). In other words, the presence of a congruent ambient scent is supposed to lead to more positive outcomes than the absence of an ambient scent, especially regarding purchase intentions:

H1a: the presence of a congruent ambient scent (vs no ambient scent) with a website's product categories will lead to higher purchase intentions.

However, the presence of an incongruent ambient scent might cancel or even reverse the positive effects of a congruent ambient scent (Mitchell, Kahn and Knasko 1995; Schifferstein and Blok 2002; Spangenberg, Grohmann and Sprott 2005; Spangenberg et al. 2006). Krishna (2013) clearly posits that the cost of identifying a congruent ambient scent might be "worth the pain" as, otherwise, the benefits of an ambient congruent scent can easily be lost when the scent is incongruent within the atmosphere. Accordingly, in the interaction of the offline and online atmospheres, incongruent ambient scents could present the same harming results:

H1b: the presence of a congruent ambient scent (vs incongruent) with a website's product categories will lead to higher purchase intentions on the website.

Regarding ambient scents, the literature also establishes a link between scent and affect (Ardelet et al. 2022), as olfaction is more connected to emotions than any other sensory modality (Krishna 2013). In the brain, smell is closely linked to experiencing emotions (Bosmans 2006; Herz and Engen 1996; Herz in Krishna 2011), and in offline retailing, scents were showed to have an effect on consumers behaviors through their emotions (Petit and Velasco and Spence 2019), hence the scent might activate thoughts related to pleasure (Vinitzky and Mazursky 2011):

H2: the presence of a congruent ambient scent congruent (vs no ambient scent) with a website's product categories will lead to higher pleasure.

Moreover, previous research not only validates a mediating role of emotions in this context (Lyu et al. 2022; Pappu et al. 2022; Roschk and Hosseinpour 2020) but also shows that the emotional responses elicited by ambient scents can influence subsequent judgments (Bosmans 2006) and that the affective dimension can explain most of the variance (Spangenberg, Crowley and Henderson 1996), thus:

H3: higher pleasure will lead to higher purchase intentions on the website.

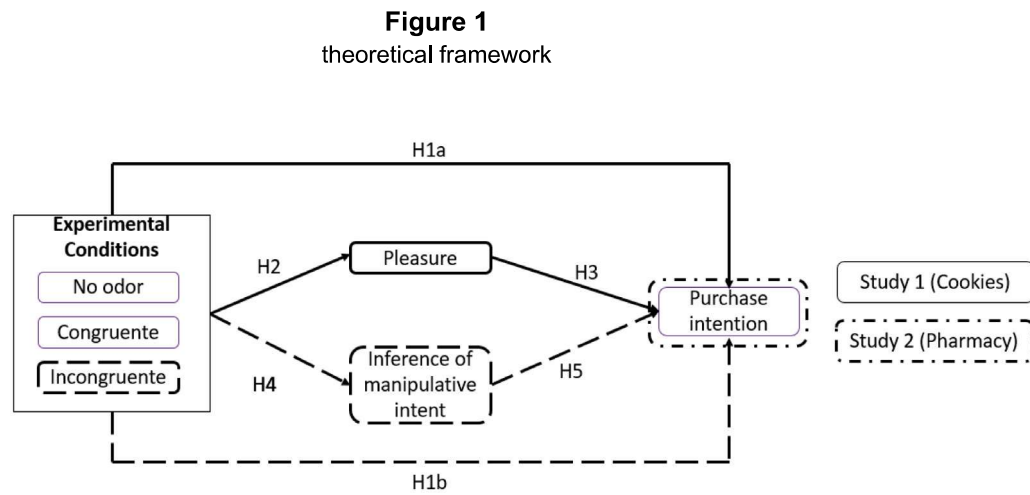
Ambient scents would also induce not only affective responses but also cognitive ones (Doucé et al. 2014). Specifically, regarding incongruent ambient scents (Morris in Krishna 2011), the underlying induced mechanisms can be more cognitive than affective (Roschk and Hosseinpour 2020), as the emotional route does not always emerge (Chebat and Michon 2003). Offline, Lunardo and Mbengue (2013) compared the effect of congruent and incongruent ambient scents and identified that consumers exposed to incongruent ambient scents would infer that, by using scents, the retailer intends to manipulate their reactions. It is thus expected that another possible, more cognitive, route would emerge in the exposition of incongruent ambient scents:

H4: the presence of an incongruent ambient scent (vs congruent ambient scent vs no scent) with a website's product categories will lead to higher inferences of manipulative intent.

The effect of the inferences of manipulative intent caused by the exposition to an incongruent ambient scent is demonstrated to have a negative impact on the outcome variables (Lunardo and Mbengue 2013):

H5: higher inferences of manipulative intent will lead to lower purchase intentions on the website.

Figure 1 summarizes the conceptual framework studied:



METHOD

Two studies with similar protocols were conducted. Study 1 (no scent vs congruent ambient scent) tests hypotheses H1a, H2 and H3, and thus explores the “affective route” of the model (direct effects and mediating role of pleasure). Study 2 (no scent vs congruent ambient scent vs incongruent ambient scent) tests hypotheses H1b, H4 and H5, or the “cognitive route” (direct effects and mediating role of inference of manipulative intent).

Studies protocol

The studies were developed on different product categories (online cookies store and para-pharmaceutical products store) to ensure external validity and avoiding cognitive dissonance out of the mere presence of a scent (“smells like bakery” or “smells like drugstore”). Ambient scent congruence is thus operationalized through its fit with the product category sold.

Two fictitious websites were designed, aligned with the practices of each market regarding merchant websites developments (see Appendix B for screenshots). For each study, data collections took place in a major French university. On the same day and the same time slot, to control for outside atmosphere conditions (light, temperature, etc.), two (study 1) or three identical computer rooms (study 2) (in terms of size, number of desks and computers) were simultaneously used. This also ascertained the presence of the same computer models and the same screen settings were set up before by the researchers at the beginning of the sessions (definition, brightness, etc.) ensuring identical visual web atmosphere. A scent diffuser was installed in all the rooms and the intensity and frequency of the scent diffusion was equally calibrated beforehand. To make sure that the scents were detected, about a dozen random students, not taking part to the final study, were asked to enter the rooms and to declare whether they smelled something and whether it was overwhelming. The intensity of the scent was thus established in both studies.

In both studies, the participants were recruited in the school lobby and offered to take part to a study in exchange for a food incentive they obtained after leaving the room (small candy packs). The respondents (if not allergic to essential oils or prone to epilepsy) were assigned randomly to the experimental conditions. They sat in front of a computer and were

instructed to browse the online shop. Once this visit was complete, they answered an online questionnaire, that included the variables measures and checked on whether they had perceived a scent in the room. In study 2, involvement with the product category was measured and showed no differences between the three experimental cells ($p = 0.719$).

Measures

In study 1, pleasure was measured using a French scale for measuring emotions experienced in a distribution context (Lichtlé and Plichon 2014) adapted to online distribution (Bataoui 2022), along with Pelet's (2010) French measure of purchase intentions. Constructs were measured using seven-point Likert scales (all measures' psychometric qualities presented in Appendix C).

FINDINGS

Study 1 data analysis

The study final sample was 71 respondents, with 29 respondents in the no scent condition and 42 in the congruent scent condition (wherein a "cookies" essential oil was diffused; the average perceived congruence, adapted from the Fleck-Dousteyssier (2006) was 4.62).

Regarding convergent validity, standardized indicators share more variance with their constructs than with their measurement errors (Fornell and Larcker 1981). AVE averages are above 0.5 for each construct and the minimum CR value is greater than 0.7, confirming the quality of the latent variables (Henseler, Ringle and Sinkovics 2009). With regard to discriminant validity, crossloading (see Appendix D) is used to check that items belonging to one construct do not contribute significantly to another construct present in the model. The heterotrait-monotrait ratio of correlations (HTMT) approach of Henseler, Ringle and Sarstedt (2015), specifying that the integrality of the corresponding indices must be less than 0.85 to ensure that the concepts mobilized in the model are empirically distinct, is also verified (see Appendix C).

Factor scores were calculated for each measure. Table 1 summarizes the main results:

Table 1
study 1 - main results

/	Homogeneity Test		ANOVA		Descriptive statistics		
	Leven Stat	p	F (68 ; 1)	p	Experimental cell	$\bar{x}$	St. Dev
Purchase intention	0.012	0.913	0.251	0.618	No scent (n=29)	0.071	0.949
					Congruent scent (n=42)	-0.049	1.012
Pleasure	0.035	0.852	7.538	0.008	No scent (n=29)	0.309	0.807
					Congruent scent (n=42)	-0.214	0.825

ANOVAs show no significant difference in purchase intentions ($F=0.251$; $p=0.618$) with the participants assigned to the control group ($\bar{x}_{no_scent}=0.071$; $SD = 0.949$; $\bar{x}_{congruent_scent} = -0.049$; $SD=1.0123$), invalidating hypothesis 1a. Regarding experienced pleasure, a significant difference exists: $F=7.538$, $p= 0.008$, ($\bar{x}_{no_scent}=0.310$; $SD=0.807$ vs $\bar{x}_{congruent_scent}=-0.214$; $SD= 0.825$), validating H2 and a linear regression analysis invalidates H3: $F = 10.328$; $p= 0.002$; $R = 0.361$; $R^2 = 0.130$. Moreover, a mediation analysis was carried out (process macro, model 4) and showed the absence of any direct or total effect, as showed in table 2:

Table 2
study 1 - mediation tests

Cookies (no scent vs congruent) n = 71	Variables			Effects decomposition			
	IV.	Mediator	DV.	X → M		M → Y	
	X	M1	Y	Effect	p	Effect	p
	Scent	IPleasure	Intentions	0.262	0.006	0.350	0.206
Total effect			Direct effect				
Effect	p	[LLCI - ULCI]	Effect	p	[LLCI - ULCI]		
0.100	0.3730	-0.229 - 0.602	-0.031	0.889	-0.477 - 0.415		

The results from study 1 show that the presence of a congruent ambient scent has no direct impact on purchase intentions, even though the respondents experience more pleasure during their browsing time.

Study 2 data analysis

The aim of study 2 was threefold: 1) replicating study 1 results on the dependent variable (purchase intentions), 2) exploring the effect of an incongruent ambient scent and, 3) considering the cognitive route through inferences of manipulative intent (measured with Lunardo and Mbengue's 2013 items). To this end, three experimental conditions were developed (no scent, congruent scent, incongruent scent) with a para-pharmaceutical online store, to test hypotheses H1b, H4 and H5. The experimental protocol was the same as in study 1.

The selection of the diffused congruent and incongruent scents was pretested. 7 essential oils were first selected (from the same brand, ensuring a stable level of quality). A panel of fellow marketing experts was briefed on the purpose of the study and pre-selected the two scents that could correspond to the experimental conditions. The final selected scents were eucalyptus (congruent) and orange-cinnamon (incongruent) essential oils. 40 business school students were asked to evaluate both scents, presented in random order to the respondents. They renewed their olfactory palette by smelling coffee grounds before and between samples (Krishna, Elder and Caldara 2010). Seven-point scales were used to measure each of the constructs and the calculated factor scores for perceived congruence with a para-pharmaceutical retail store exhibited a significant difference ($\bar{x}_{eucalyptus} = 5.51$; $\bar{x}_{orange-cinnamon} = 4.11$; $p<0.001$), whereas the scents did not differ on perceived pleasantness, natural dimension, perceived quality, familiarity and overall likeability.

106 respondents took part to the study ($n_{no_scent}=33$, $n_{congruent_scent}=37$, $n_{incongruent_scent}= 36$). The convergent and divergent validity criteria are also met for this second study (see appendix C). Table 3 summarizes the main results:

Table 3
study 2 - main results

/	Homogeneity Test		ANOVA (103 ; 2)		(I) Website	(J) Website	$\bar{x}$ Difference	p
	Leven Stat	p	F Value	p	A ; $\bar{x}$ = -0.095	B ; $\bar{x}$ = -0.166	0.057	0.967
Intentions	0.131	0.877	0.660	0.519	B ; $\bar{x}$ = -0.166	C ; $\bar{x}$ = 0.247	-0.193	0.687
						C ; $\bar{x}$ = 0.247	0.251	0.518
Inferences of manipulative intent	Leven Stat	p	F Value	p	A ; $\bar{x}$ = -0.346	B ; $\bar{x}$ = 0.338	-0.685	0.008
	2.857	0.062	4.665	0.011	B ; $\bar{x}$ = 0.338	C ; $\bar{x}$ = -0.0202	-0.326	0.313
						C ; $\bar{x}$ = -0.0202	-0.359	0.232

A = control group (no scent) - n = 33; B = incongruent scent, n = 36; C = congruent scent, n = 37.

The perceived congruence of the scent with the website's product categories was checked on the final sample and showed significant difference ($\bar{x}_{\text{congruent_scent}}=0.642$ vs $\bar{x}_{\text{incongruent_scent}}=0.188$; $p < 0.001$). Gender, age and involvement with the product category⁴ were also checked and no significant differences were found in the three experimental conditions (respectively: $X^2_{\text{Pearson}} = 1.496$, $p = 0.473$; $F = 2.347$, $p = 0.103$; $F = 0.332$, $p = 0.719$).

An ANOVA on purchase intentions showed no statistically significant difference between the conditions: $F=0.660$; $p=0.519$ ($\bar{x}_{\text{no_scent}}=-0.095$; $SD = 0.953$; vs $\bar{x}_{\text{congruent_scent}} = -0.166$; $SD=0.991$; $\bar{x}_{\text{incongruent_scent}} = 0.257$; $SD=0.980$). Post-hoc tests confirm the absence of differences between the three experimental conditions (see table 3). Hypothesis 1b is thus not validated, replicating study 1 results on the dependent variable. Regarding inferences of manipulative intent, a significant difference was found: $F=4.665$, $p = 0.011$ ($\bar{x}_{\text{no_scent}}=-0.346$; $SD=0.826$, $\bar{x}_{\text{congruent_scent}}=-0.202$; $SD=0.959$; $\bar{x}_{\text{incongruent_scent}}=0.338$; $SD=0.993$), therefore validating H4. More specifically, the post-hoc test (table 3) shows that a significant difference is observed between the control group and the incongruent scent group ($\bar{x}_{\text{difference}}=0.685$; $p=0.008$). A regression analysis was performed to test hypothesis H5: $F = 0.056$; $p = 0.813$; $R=0.023$; $R^2=0.001$, invalidating it. Finally, a mediation analysis was carried out (process macro, model 4) to check on a possible mediating role of inferences of manipulative intent between the factor (scents) and purchase intentions. The mediation analysis showed no direct and total effect, as showed in table 4:

Table 4
study 2 - mediation tests

Pharmacy (no scent vs congruent vs incongruent) n = 105	Variables			Effects decomposition			
	IV.	Mediator	DV.	X → M		M → Y	
	X	M	Y	Effect	p	Effect	p
	Scent	Manip.	Intentions	0.153	0.186	0.013	0.899
Total effect				Direct effect			
Effect	p	[LLCI - ULCI]	Effect	p	[LLCI - ULCI]		
0.100	0.395	-0.132 - 0.331	0.098	0.410	-0.137 - 0.332		

4 Involvement with product category: measure from Pelet (2008), based on the work of Strazzieri (1994).

This study replicates the results of study 1 regarding the dependent variable: the presence of an (in)congruent ambient scent has no effect on purchase intentions. However, the presence of an incongruent ambient scent impacts inferences of manipulative intent, where respondents tend to infer the company intends to manipulate their behavior over the presence of a scent in their environment while browsing the merchant website. Interestingly though, contrary to our expectations, this assessment has no effect on the purchase intentions either. The results from both studies tend to show that the presence of a scent, while potentially pleasurable to consumers, may, when incongruent, raise defiance towards the merchant, but still fail to harm or be beneficial to the web companies in terms of sales.

DISCUSSION

This research focusing on how the characteristics of the offline atmosphere influence online purchasing behavior is one of the first aiming at partially responding to Lemoine's (2022) and Roggeveen, Grewal and Schweiger's (2020) calls to extend the study of combined offline (and/or) online atmospheric factors. In this study, the DAST model (Roggeveen, Grewal and Schweiger, 2020) was used to assess the extent to which the offline environment (hereby, driven by a scent) influences online behaviors, through the use of (in)congruent ambient pleasant scents. The expected direct effects on purchase intentions were not found, but the relevance of considering the (in)congruence of ambient scents for the online consumer was identified. Our two studies showed that a congruent scent can increase pleasure when browsing a website, while an incongruent scent can increase the inferences of manipulative intent. Interestingly, in contrast with our expectations, neither of these variables have an impact on purchase intentions. Our findings thus make theoretical contributions to two streams of research (sensory and digital marketing) regarding the use of ambient scents, exhibiting it is relevant to explore the intertwining of offline and online atmospheres.

The fact that no direct effects were found on the intention of behavior, rather counterintuitively regarding past findings on both the DAST model and offline ambient scent findings, opens up to several possible explanations. First, although the literature specific to atmosphere invites consideration to the interaction effects between offline and online factors (Lemoine 2022; Roggeveen, Grewal and Schweiger 2020), consumers may distinguish between these two settings, leading to limited 'transfers' from a physical to a virtual environment, and vice versa. This could also explain why variations in pleasure levels and manipulative inferences were observed, without affecting behavior, even though these two variables have been identified in the literature as key factors in atmosphere and ambient scent usage (e.g. Leenders, Smidts and El Haji 2019; Lichtlé et Plichon 2014; Lunardo and Mbengue 2013). In addition, even if cognitive and affective routes triggered by ambient scents play an important role in the buildup of the consumers' experience, they contribute very little on actual spending (Chebat and Michon 2003), and may need to be completed by other variables to better explain actual behavior (Vinitzky and Mazursky 2011).

Second, the DAST model aims to "better reflect the multifaceted contemporary retail environment" (Roggeveen, Grewal and Schweiger 2020 p.135). To this end, the authors emphasize that the shopping experience is completely different, as the consumers themselves can "import" their own atmospheric factors by wearing perfume (ambience), using their app to find their way around (design), or even asking a friend for advice via video call (social). Here, the respondents were never told where the scent came from. They could have made inferences, as the scent could have come directly from the website via the computer, been worn by someone present in the room, or been diffused directly into the experimental room. It is therefore possible that these modalities, although presenting the same scent, could generate different behaviors. In other words, the source of the atmospheric factor (generated by the distributor vs. by the consumer themselves or by a third party) was not considered in our study and could be the cause of specific behaviors.

Third, a few past findings suggest a more nuanced view of the supposed positive effect of the presence of a pleasant (in)congruent scent itself, as it is not always sufficient to affect specific dependent variables such as intentions of behavior and effective sales (Knasko, 1989; Schifferstein and Blok 2002). It finally seems that the impact of ambient scents can differ in strength depending on the studied outcomes. For instance, in Spangenberg, Crowley and Henderson's (1996) offline work, even if the presence of pleasant ambient scents led generally to more positive outcomes than their absence, the effect was found to be stronger on the store environment evaluations than on product judgements. Interestingly, the same observation was made by Vinitzky and Mazursky in 2011, as they found that the scent has an effect on online behaviors, but only on some of the behavioral variables considered in their model. It is thus probable that purchase intentions were not influenced as expected, but the evaluation of the website and actual behavior may be impacted positively, both by the factor and the hereby considered mediators. Moreover, the mere fact that the consumer is determined to purchase the product or not plays a significant role in the intention to do so, independently from the presence of a scent (Schifferstein and Blok 2002).

In the end, our results align with the few past research crossing the offline and online atmospheres (Flavián,

Ibáñez-Sánchez and Orús 2021; Vinitzky and Mazursky 2011) in contributing to the idea that (in)congruent olfactory ambient cues play a role on online consumer responses. They build up on past findings while tending to open perspectives on the use of ambient scents where (in)congruence with the product category displayed online has to be thoroughly manipulated in order to trigger specific underlying mechanisms possibly able to improve the overall consumers' shopping experience.

Managerial implications

In terms of managerial inputs, our research confirms the use of ambient scents is crucial even in contexts where it might not be seen as central such as online shopping: the offline sensation impacts online experience. Thus, when aiming at immersing the consumers in meaningful environments, ambient scents can play a relevant role. This would be a claim for retailers to develop trademark signature scents (Szocs et al. 2023), congruent with the products sold, in order to create overall shopping experiences, coherent for offline and online settings. For instance, Krishna (2013) recalls that in matters of retail and the development of sensory signatures, it is crucial to build coherent strategies in any of the companies' distribution canals.

More specifically, managers should keep in mind the centrality of scent congruence. It was showed here that pleasant scents congruent with the product category could elicit pleasure, whereas incongruent scents could elicit inferences of manipulative intent. In line with past research, it is central that the congruence with the store or even the department level (Chebat and Michon 2003; Szocs et al. 2023), is maintained to support the development of positive perceptions over risking negative ones, such as inferences of manipulative intent. This way, in line with retailers well known for their strong olfactory identity in store (such as Sephora, Abercrombie and Fitch, The North Face Soho), companies will be able to develop omnichannel approaches congruent with their products and positioning online too. In the future, scent will be brought by technologies such as scent cartridges stored in the electronic devices, filled with oils and aromatic gels⁵, or other means, as scent technologies will be available by 2030 (Szocs et al. 2023), giving retailers opportunities to develop new ways to engage their customers offline and online.

Limitations and further research

The results of this research need to be broadened by following a few paths, starting with addressing its limits and following the DAST model. First, regarding the stimuli, here we worked on the manipulation of the perceived congruence of only one variable of the offline atmosphere (ambient scents). It would be next interesting to explore the possible cue congruence interactions between the offline and online settings, such as, for instance, manipulating the congruence of one variable of the offline ambient elements (scents) with one variable of the ambient elements of the websites, to see if multisensory cue congruence effects acknowledged in the literature hold in the interaction of the real and virtual worlds, and in order to create a holistic multisensory experience. In turn, regarding the overall atmospheres, the optimum stimulation level (Helmefalk and Hultén 2017) could be then studied as it would lead to the exploration of how many variables of both atmospheres should be manipulated in both offline and online to create a positive experience for customers, finding the optimal balance (Petit, Velasco and Spence 2019). Second, regarding the underlying mechanisms, other affective variables over pleasure need to be considered, such as arousal, along with other cognitive routes, such as perceived fluency, for example, in order to deepen the exploration of the phenomenon at play here. As it was showed by past research, pleasure fails to play as an actual mediator in some models and the cognitive route should rather take into account the meaning of the ambient for the shopper (Chebat and Michon 2003). Third, in an attempt to improve relevance for practitioners, future research needs to imply the use of other dependent variables, such as actual sales, evaluation of the website and products, approach and avoidance behaviors, and overall customer experience.

Regarding scent characteristics a few complementary elements need to be checked as the only congruence might not be enough to explain our findings: its perceived quality, arousing nature, intensity and detection thresholds (Leenders, Smidts and El Haji 2019; Spangenberg, Crowley and Henderson 1996), its complexity (Helmefalk and Berndt 2018), the aroma structure, or the familiarity of a scent (Rosch and Hosseinpour 2020) can also play a role.

Moreover, a few studies demonstrate that the positive effect of (in)congruent ambient scents might be moderated by a set of variables (Bosmans 2006; Leenders, Smidts and El Haji 2019; Sandell 2019; Spangenberg, Grohmann and Sprott 2005). It is thus crucial to place the consumer as "the processor of the scent" (Vinitzky and Mazursky 2011), and to include potential moderators, through the inclusion of individual differences (Morrin in Krishna 2011). Need for Smell differences (Pappu et al. 2022), the determination to purchase the products (Schifferstein and Blok 2002), the motivation to correct for extraneous influences (Bosmans 2006), or the perceived diagnosticity of the scent (Schifferstein, Talke and

5 <https://emotions.market/blog/digital-scents-how-technology-is-bringing-smell-to-the-digital-world/>

Oudshoorn 2011), for instance, might play a role in the offline and online settings as well.

In any case, the future of digital olfaction will be thoroughly impacted by the developments of sensory enabling technologies (Petit, Velasco and Spence 2019) by 2030 (Szocs et al. 2023), as the future personal computers and smartphones could soon be improved with olfactory devices. The practitioners will be then able to develop their own olfactory identity to be displayed at every touchpoint with the customers, raising more avenues for study about this very important sensory modality in its impact on offline and online atmosphere.

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APPENDICES**APPENDIX A****Overview of offline ambient scent references**

Reference	Consumer Behavior studied outcomes	Scent characteristics	Congruence cue	Main results
Ardelet, Fleck and Grobert 2022	Service space sharing with strangers	Cleanliness evocating scent	<i>Perceived appropriateness of the scent</i>	More positive attitudes towards space sharing (vs no ambient scent)
Biswas and Szocs 2019	Healthy food choices in store	Indulgent food-related scent	<i>Relatedness with indulgent food</i>	Lower purchases of unhealthy foods for indulgent food-related ambient scent (vs no ambient scent or a non-indulgent food-related ambient scent)
Bosmans 2006	Product evaluation	Pleasant ambient scent	(In)Congruence with the product category	Positive effect (vs no scents or incongruent scents)
Chebat and Michon 2003	Perceived retail environment, product quality spending behaviors	Pleasant ambient scent	Congruence with the product category	Positive effect (from pleasant ambient scents and particularly congruent scents)
Doucé et al. 2014	Product, store environment and store evaluations	Neatness-evocating pleasant scent	<i>(Un)Relatedness with the perceived neatness/messiness of the layout</i>	Better evaluation of the tidy store (negative effect of the mismatch between the pleasant scent not associated with neatness and a messy store)
Helmefalk and Hutlén 2017	Emotions and purchase behavior	Pleasant ambient scent	Congruence with the retail setting and other sensory cues	Positive effects of multi-sensory congruent cues (olfactory and auditory)
Holland, Hendriks and Aarts 2005	Cleaning concept, lexicon and cleaning behavior	Cleaner (pleasant) scent	N.A.	Increased mental accessibility to cleaning concept and lexicon, increased cleaning behavior of the direct environment
Leenders, Smidts and El Haji 2019	Perceptions of time spent in the store and increase of actual time spent	Pleasant ambient scent	Congruence with the supermarket ambient	Improved store evaluation, time spent and sales (depending on the scent intensity level)
Madzharov, Block and Morrin 2015	Need for power and preference for premium products and brand purchase	Perceived temperature of the scent	N.A.	Higher perceived social density, power compensatory preferences, increased purchasing of premium products, multiple-item purchases and overall spending (for warm vs cool scents)
Mattila and Wirtz 2001	Approach and impulse behavior, overall experience and store perception	Arousing pleasant ambient scent	(in)Congruence with the level of arousal of the music	Positive perception of the environment, increased approach, impulse buying behaviors and enhanced experience satisfaction for congruent cues
Mitchell, Kahn and Knasko 1995	Information processing, variety seeking	Pleasant ambient scent	(In)Congruence with the product category	Increased processing time, more holistic processing, higher willingness to go beyond given information, increased variety seeking for congruent scents (over incongruent)
Morrin and Ratneshwar 2000	Brand evaluation, attention and memory	Pleasant ambient scent	N.A.	Increased brand name memory and brand evaluation (vs no scent)
Morrin and Chebat 2005	Unplanned and impulsive purchase, store evaluation	Pleasant ambient scent	Congruence with shopping styles	Positive effects for contemplative shoppers (over no scent)
Schifferstein, and Blok 2002	Instore purchase	Pleasant ambient scent	(In)Congruence with product thematic (magazines)	No direct effect on sales (neither for incongruent scents)
Schifferstein, Talke and Oudshoorn 2011	Dancing activity, evaluation of the evening, music and mood	Pleasant ambient scent	Congruence with nightclub environment	Increased dancing activity and improved evaluations (over no scent)
Spangenberg, Crowley and Henderson 1996	Evaluation of department store, store environment and assortment	Inoffensive ambient scent	N.A.	Positive effect of the presence of the scent
Spangenberg, Grohmann and Sprott 2005	Evaluation of department store, store environment and assortment	Thematic pleasant ambient scent (Christmas)	(In)Congruence with music	More positive evaluations of the store, its merchandise, its environment and improved intentions to visit (vs incongruent scent and music)
Spangenberg et al. 2006	Evaluation of department store, store environment, assortment and actual sales	Pleasant ambient scent	(In)Congruence with gender associated with the sold items	Overall positive effects (vs incongruent scent)

Overview of offline ambient scent references exhibiting studied outcomes, scent characteristics, congruence cue and overall mains results (N.A. = "Not applicable", congruence related concepts = *italic font*) and main results

APPENDIX B

used sites designs for studies 1 & 2.⁶



Boutique Panier Evènements Livraison

Les meilleures ventes



COOKIES BANANE
CHOCOLAT AU LAIT



COOKIES CACAHUÈTE
CHOCOLAT NOIR



COOKIES CARAMEL
BEURRE SALÉ



COOKIES CHOCOLAT
BLANC



Rechercher un produit ...



MÉDICAMENTS HOMÉOPATHIE SANTÉ VÉTÉRIINAIRE COMPLÉMENTS ALIMENTAIRES PLANTES VISAGE CORPS HYGIÈNE CHEVEUX



Bariésun - Huile Sèche SPF50+ 200
MI
Uriage
21,90 €



Sebium - Gel Moussant Actif 200ml
Bioderma
9,95 €



Black Diamond - Skin Complex - 30
Ampoules
MartiDerm
56,99 €



Contours - Alpha-Contour - 15 MI
Yon-Ka
45,00 €

⁶ Cookies images used for the first site were taken from Vectorportal.com

APPENDIX C**measurement scales psychometric qualities**

Scales	Items	Study 1 - Cookies							Study 2 - Pharmacy						
		KMO	Bartlett	Exp.V	α	L	AVE	CR	KMO	Bartlett	Exp.V	α	L	AVE	CR
Pleasure (Lichtlé and Plichon, 2014; Bataoui 2022)	On this site, I feel happy	0.666	<0.001	60.95 %	0.680	0.749	0.590	0.812							
	On this site, I am enthusiastic					0.754									
	On this site, I feel pleased					0.829									
Purchase intentions (Pelet 2010; Bataoui 2022)	I plan to purchase on this site	0.853	<0.001	81.62 %	0.924	0.960	0.864	0.962	0.813	<0.001	84.09 %	0.937	0.872	0.834	0.955
	I intend to buy on this site					0.960							0.944		
	I would certainly buy products from this site					0.917							0.905		
	It is likely that I buy products from this site					0.937							0.931		
Inferences of manipulative intent (Lunardo and Mbengue 2013):	The way this atmosphere tries to persuade people does not seem acceptable to me								0.743	<0.001	70.98 %	0.861	0.706	0.708	0.906
	The elements present in this room try to manipulate the participants in a manner I do not like												0.909		
	The atmosphere in this room annoys me because it tries to control the participants in a manner I do not find appropriate												0.894		
	I think the atmosphere of this room is deceptive												0.841		
Perceived congruence (Fleck-Dousteyssier 2006; Caldara 2010)	For a store that sells cookies/parapharmaceutical products, this olfactory ambient is appropriate								0.849	<0.001	89.63 %	0.961	0.949		
	For a store that sells cookies/parapharmaceutical products, this olfactory ambient is adequate												0.966		
	For a store that sells cookies/parapharmaceutical products, this olfactory ambient corresponds												0.932		
	For a store that sells cookies/parapharmaceutical products, this olfactory ambient fits perfectly												0.94		

APPENDIX D**crossloading and HTMT approach**

Crossloading study 1 (Cookies)		
Items	Pleasure	Intentions
Pleasure1	0,829	0,321
Pleasure2	0,749	0,152
Pleasure3	0,754	0,349
Intention1	0,345	0,960
Intention2	0,245	0,917
Intention3	0,294	0,937
Intention4	0,421	0,960

HTMT (study 1, cookies):

Pleasure		
Intentions	0.457	
	Pleasure	Intentions

Crossloading study 2 (Para-pharmacy)		
Items	Inference manipulative	Purchase intent
InferencesManipulativeIntent1	0,707	0,023
InferencesManipulativeIntent2	0,910	0,027
InferencesManipulativeIntent3	0,894	0,107
InferencesManipulativeIntent4	0,841	-0,098
Intention1	-0,022	0,873
Intention2	-0,005	0,944
Intention3	0,042	0,905
Intention4	0,029	0,931

HTMT (study 2, Para-pharmacy):

Inference		
Intentions	0.011	
	Inference	Intentions