Pleasant Ambient Scents: A Meta-Analysis of Customer Responses and Situational Contingencies

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Abstract
To prevail in the fierce competition of in-store experiences, some firms have focused on providing pleasant ambient scents. However, equivocal results on scent effects make generalizations and managerial guidance uncertain. While efforts to consolidate research findings have been conducted, a comprehensive quantitative integration is notably lacking. In this meta-analysis, the authors integrate 671 available effects from ambient scent experiments and show that exposure to pleasant ambient scents on average produces a substantial increase in the level of customer responses (3%–15%). The effects of ambient scent depend on situational contingencies and are, for example, positively related to congruency, unidimensional aroma structure, ascribed familiarity of a scent, service exchange, proportion of female participants in the sample, and imagined (vs. fictitious) offering. Thus, the authors estimate expenditures would increase by 3% and 23% for an average and a most favorable condition, respectively. The authors also examine effect patterns, identifying, for example, ambient scent as more cognitive than affective and nonlinear effects of perceived concentration. Using the insights, they develop a research agenda and provide clear strategic guidance to leverage ambient scent effects.

Keywords
pleasant ambient scents, meta-analysis, expenditures, in-store customer experience, atmospheric stimuli

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Despite these successes, research has also presented opposite findings, showing that the presence (vs. absence) of a pleasant ambient scent increases or decreases expenditures by up to 60% (Madzharov, Block, and Morrin 2015; Morrin and Chebat 2005). This pattern is observed across customer responses, with findings being unclear about the degree to which ambient scent influences customer responses. In addition, little is known about how situational contingencies influence ambient scent effects and whether there is an effect of gender. Findings are also inconclusive about a suggested but unproven nonlinear effect of scent intensity (Spangenberg, Crowley, and Henderson 1996). Given these equivocal results, key managerial questions remain difficult to answer. For instance, how powerful are pleasant ambient scents in shaping customer responses, particularly expenditures? What situational contingencies account for variations in the strength of effects? What is the nature of these effects?

In a large body of literature that spans over 30 years, the contradictions can be partly attributed to the large variety of study contexts. By summarizing the results and taking this diversity into account, a meta-analysis resolves certain inconsistencies and so answers key managerial questions. These insights may increase return on firms’ scent investments and provide researchers with ways to build stronger tests for future findings (Palmatier et al. 2006). In addition, by taking stock of what is empirically known, a meta-analysis represents an important step for a field’s knowledge development (MacInnis 2011). Previous efforts to consolidate research findings are largely qualitative (e.g., Bone and Ellen 1999; Morrin 2010; Nibbe and Orth 2017). For atmospheric cues in general, Roschk, Loureiro, and Breitsohl (2017; RLB hereinafter) provide a quantitative attempt. Our analysis is focused on ambient scent and includes more variables than RLB, as indicated in Figure 1. This, combined with a larger database, enables us to provide a thorough summary with rich and distinctive insight into ambient scent effects. The objectives of this investigation are the following.

First, we provide a comprehensive review of the effects of pleasant ambient scent on customer responses. Our analysis is based on 71 samples from 64 articles, covering 15,447 respondents and 671 effects (compared with 34 samples and 57 effects in RLB). Our results reveal positive and robust effects of ambient scent on mood, evaluations, memories, intentions, and behaviors, yielding a 3%–15% average increase in the level of the response variables. The results indicate larger effects on evaluation and memory than on mood, contributing insight as to whether ambient scent serves as a cognitive or an affective stimulant. Furthermore, the first insight into the causal relationships indicates that ambient scent links to expenditures through mood and evaluation responses, which work along parallel rather than sequential pathways.

Our second objective is to better understand how situational contingencies account for variations in findings. Results revealed that the following factors influence the effect strength of ambient scent on customer responses: congruency, dimensionality, familiarity, and perceived concentration of the scent; service versus nonprofit exchange; presence versus absence of incongruent music; controlling versus not controlling for extraneous influences; imagined versus experienced offering; and the proportion of females in a sample. Furthermore, we provide evidence for nonlinear effects of perceived concentration and interactions among the factors (pleasantness with other scent-related factors, imagined vs. experienced offering with scent-related factors).

Finally, pleasant ambient scents may be considered an unobtrusive way to stimulate in-store behavior. We analyze whether ambient scent influences customers’ expenditures and predict the strength of the effect under more and less favorable conditions. Our findings indicate that the presence (vs. absence) of ambient scent results in a 3% increase in expenditures in an average setting. In assessing how sensitive this effect is to the influence of the situational contingencies, we predict a theoretical 23% increase in expenditures for the most favorable condition and a 17% decrease for the least favorable condition. Similar results are obtained for lingering of customers in the environment, rendering a substantial increase in both outcomes achievable.

Theoretical Background

We use the theoretical framework shown in Figure 1. We lay out the relationship between ambient scent and customer responses. We then explain how situational contingencies influence the effect sizes of customer responses (i.e., the standardized relationship between two variables, which we measured using the Pearson correlation coefficient; Durlak 2009).

Ambient Scent and Customer Responses

“Ambient scent” is defined as a scent present as a part of the retail or service environment, and its effect is measured by comparing customers’ responses in an unscented condition with those in a scented condition (Doucé and Janssens 2013). The literature discusses three functions of ambient scent—attracting attention, priming affect, and facilitating information retrieval—which trace back to the unique biological features of olfaction. One such feature is that basic olfactory processing, such as odor detection, occurs in more primitive areas of the brain, requiring little to no cognitive effort (Herz and Engen 1996). Thus, ambient scent may attract attention because of an unprompted processing of olfactory information. Another feature is the privileged neural link that the olfactory nerve shares with the neural area for emotional memory (Herz 2010). Thus, a scent may trigger the remembrance of positive emotions and memories and so prime affect (Herz and Engen 1996). It may also serve as an especially good cue for retrieving information stored under its presence (Herz and Engen 1996).

Studies on pleasant ambient scents test their effects in experiments on numerous customer responses, such as mood activation, mood valence, and mood control; product evaluations, environmental quality, and shopping satisfaction; recall and time elusiveness; purchase intentions and intentions to recommend; and expenditures and lingering. Their organization follows Morrin (2010) and Nibbe and Orth (2017). Table 1
provides the operational definitions used to integrate the constructs of the individual studies.

As a starting point for our framework (Figure 1), we propose that the presence (vs. absence) of a pleasant ambient scent positively influences customer responses. RLB found scent-facilitated mood valence, satisfaction, and behavioral intentions, and physiological evidence suggests that scents attract attention, prime affect, and facilitate information retrieval (Herz 2010; Herz and Engen 1996). However, scholars also caution about scent effects on customer responses, because the underlying processes are poorly understood and the evidence to date offers inconsistent results, partially depending on the type of response (Nibbe and Orth 2017). We thus also examine the relative effect sizes of affective (mood) and cognitive (evaluations and memory) responses. For mood, research describes the results as mixed and not always clear; the results for evaluations are comparatively more compelling and robust (Bone and Ellen 1999; Morrin 2010; Nibbe and Orth 2017). The results also seem to favor memory effects, though they are less frequently studied (Nibbe and Orth 2017). Overall, the evidence appears stronger for cognitive than for affective responses. Thus,

\[ \textbf{H}_1: \] The presence (vs. absence) of pleasant ambient scent (a) has a positive effect on customer responses from Table 1 and (b) produces larger effect sizes for evaluation and memory responses than for mood responses.

We next discuss how situational contingencies influence the effect sizes of customer responses (Figure 1). Situational variation may explain why the influence of ambient scent varies across studies, providing insight into scent selection and usage in different settings and the expected change in outcomes. That insight allows reflection on industry reports, such as by Nike, claiming a scent-elicited 80% increase in purchase intent (Scent Australia 2019).

**Scent Characteristics**

Scent characteristics describe morphological aspects of a pleasant ambient scent and include quality (in-kind description),
Table 1. Operationalizations of the Customer Responses to Integrate Individual Study Constructs.

| Customer Responses | Definitions | Common Aliases | Representative Papers |
|--------------------|-------------|----------------|-----------------------|
| **Mood**           | A general affective state (Nibbe and Orth 2017) that is typically measured by self-reports and conceived as arousal, pleasure, and dominance dimensions (Bone and Ellen 1999), which we define in more general terms as: | Activation, alertness, activeness | Chebat and Michon (2003); Doucé and Janssens (2013); Mattila and Wirtz (2001) |
| **Activation**     | The degree of felt stimulation in terms of arousal or alertness. | Arousal, alertness, activeness | Chebat and Michon (2003); Doucé and Janssens (2013); Mattila and Wirtz (2001) |
| **Valence**        | The degree to which the felt affective state is positive (vs. negative or neutral), in terms of pleasantness or unpleasantness or feeling good or bad. | Pleasure, positive affect, mood valence, cheerful | Chebat and Michon (2003); Doucé and Janssens (2013); Mattila and Wirtz (2001) |
| **Control**        | The degree of felt power over the situation in terms of dominance or feelings of independence. | Dominance, control, independence | Spangenberg, Grohmann, and Sprott (2005) |
| **Evaluations**    | An attitude toward a product or an issue and/or the extent to which an individual likes or dislikes a certain thing (Spangenberg, Crowley, and Henderson 1996), often measured as self-reports, including the following: | | |
| **Product evaluations** | Evaluations about a store’s products and service offerings (common dimensions are style, selection, quality, and attitudes). | Product quality, evaluations of merchandise, service excellence | Chebat and Michon (2003); Doucé and Janssens (2013); Spangenberg, Crowley, and Henderson (1996) |
| **Environmental quality** | Evaluation about the attractiveness of a store’s environment (typically captured with the Fisher scale). | Environmental (affective) quality (Fisher scale and its items, e.g., liveliness, brightness), evaluations of the environment, mall atmosphere | Doucé and Janssens (2013); Mattila and Wirtz (2001); Morrin and Chebat (2005); Spangenberg, Crowley, and Henderson (1996) |
| **Shopping satisfaction** | Overall judgment about the shopping experience as satisfying. | Satisfaction, satisfaction with the shopping experience, store evaluations and attitudes, shopping enjoyment | Mattila and Wirtz (2001); Morrison et al. (2011); Spangenberg, Grohmann, and Sprott (2005) |
| **Memories**       | Retrieved information that was encoded while ambient scent was present or absent, often measured as consumers’ remembrance of information and time for the shopping episode, including the following (Krishna, Lwin, and Morrin 2010; Morrin, Chebat, and Chebat 2010): | | |
| **Recall**         | Remembered attributes about the product or service offering. | Recalled product attributes, recalled brands | Mitchell, Kahn, Knasko (1995); Morrin and Ratneshwar (2003) |
| **Time elusiveness** | Failure to remember what happened during a given time, resulting in the perception that less time has passed (i.e., “time flies” phenomenon) and in a smaller overestimation or a larger underestimation of actual time. | Perceived and estimated time in relation to actual time, perceived distance traveled in relation to actual distance. | Morrin, Chebat, and Chebat (2010); Spangenberg, Crowley, and Henderson (1996) |
| **Intentsions**    | An individual’s readiness to perform a given behavior (Motyka et al. 2014), often measured as self-reports indicating willingness to behave in a certain way, including the following: | | |
| **Purchase intentions** | Intentions that reflect willingness to engage in business transactions with the firm, such as the acquisition of products, the price willing to pay, or the usage of its offered services. | Purchase intentions, intention to (re)visit, purchase intent, price willing to pay, shorter acquisition times. | Doucé and Janssens (2013); Herrmann et al. (2013); Spangenberg, Crowley, and Henderson (1996) |
| **Intention to recommend** | Willingness to spread positive word of mouth and encourage others to do business with the firm. | Intended word of mouth | Adams and Doucé (2016) |
| **Behaviors**      | Acts performed by the customer (Motyka et al. 2014), often measured by observing customers during the shopping episode, including the following: | | |
| **Expenditures**   | The amount of money spent during the shopping episode. | Various aliases referring to the amount of money spent, number of items or products purchased, impulsive buying | Morrin and Chebat (2005); Morrison et al. (2011); Herrmann et al. (2013) |
| **Lingering**      | Behaviors that reflect a lengthy shopping episode or a more extensive stay. | Shopping duration, dwell timings, retention time, chatting with personnel, number of products examined or picked up | Doucé et al. (2013); Morrison et al. (2011); Spangenberg, Crowley, and Henderson (1996) |

a Authors analyzed further customer responses, such as variety seeking (Mitchell, Kahn, and Knasko 1995), ease of search (Morrin and Chebat 2005), and estimated price (Fiore, Yah, and Yoh 2000). These were not integrated because only a few studies analyzed them and most were unique in our data set. Thus, in line with prior meta-analytic research and to ensure a meaningful number of integrated effects, our analysis includes those responses for which at least ten study effects from two different articles were available (Kirca et al. 2005; Rubera and Kirca 2012).

b Some measures can be seen as proxies for the focal customer response measure, such as items purchased for the amount of money spent or number of items examined for the amount of time spent. We therefore checked if the effect sizes for the proxy measures differed from the other measures. Including a dummy variable marking the proxies in Model 3 from Table 5 indicated that this was not the case ($b = .006, p = .820$).
congruency (fit with the environment and its products and services), and structure (single vs. multiple aroma dimensions). Quality characterizes the perception of the scent in kind and so differentiates it to others (Dravnieks 1982). While people distinguish well among many scents they have previously smelled, they have difficulty providing a verbal or semantic label for them and thus often experience a feeling of recognizing a scent, without being able to identify it (tip-of-the-nose effect; Morrin 2010). Because scents act as a memory cue even without identification (Herz and Engen 1996), the specific pleasant ambient scent used is often based on other scent characteristics and perceptual properties.

One such characteristic is congruency. Our conceptualization of it follows suggestions that people respond not necessarily to discrete elements but rather to their total configuration (Bitner 1992). We therefore combine prior fit considerations that use the environment and particular offerings as reference points (Bosmans 2006; Herrmann et al. 2013). Congruency may facilitate effect sizes, as people are positively predisposed to it (Herz 2010) and incongruent ambient scents interfere with information processing (Mitchell, Kahn, and Knasko 1995). In terms of structure, whether pleasant ambient scents contain a single aroma dimension (unidimensional) or multiple aroma dimensions (multidimensional) represents a version of Herrmann et al.’s (2013) simple versus complex differentiation to allow for greater cross-study generalizability. Herrmann et al. (2013) find that the ambient scent orange-basil with green tea (multidimensional) is less effective than orange (unidimensional) because it is more challenging to process. Thus,

**H3:** The effect sizes of pleasant ambient scent for customer responses are (a) positively related to congruency and (b) smaller for multidimensional versus unidimensional ambient scents.

**Scent Perceptual Properties**

Scent perceptual properties refer to the hedonic perception of a scent, which is an affective evaluation, centering on whether someone likes it or not (Herz 2010). Liking a scent is due to acquired emotional associations learned over time and carries hedonic meaning (Herz 2010). Thus, in contrast to scent characteristics, which are analytical and unrelated to acquired associations, the perceptual properties reflect feelings and meanings that are linked to and result from the sensation of an ambient scent. Because scent liking is learned, it is also more subjective and emphasized as culture bound (Morrin 2010). The cultural context is relevant because most studies were conducted in North America and Europe. Researchers use pleasantness, activation, familiarity, and intensity, which are not necessarily independent and refer to scent liking in terms of meaning and physiological perception (Nibbe and Orth 2017).

We propose that pleasantness, familiarity, and activation are positively related to effect sizes. In theory, a scent must be perceived as pleasant (i.e., enjoyable) to positively prime affect, because scent-based associations and hedonic perceptions are contingent on each other (Herz and Engen 1996). To stimulate customers through emotionally potent memories, a scent also needs to be familiar (Herz and Engen 1996). Familiarity is not about identifying a scent by name but rather being acquainted with its aroma. If a scent is unfamiliar, no meaningful associations that can be remembered and elicit affect could have been formed (Herz and Engen 1996). Familiarity also leads to liking (Rindfleisch and Inman 1998), which may transfer to the environment and its elements. Finally, certain ambient scents can induce greater activation (i.e., their perception as stimulating; Mattila and Wirtz 2001) than others do. Activating customers may amplify the positive in-store experience (Spangenberg, Crowley, and Henderson 1996) and result in responses that are more positive. Thus,

**H4:** The effect sizes of pleasant ambient scent for customer responses increase at a decreasing rate with higher perceived concentrations.

The nonlinear relationship is part of an interplay between pleasantness and intensity. We apply this logic to the interactions of pleasantness with congruency, dimensionality, familiarity, and activation. This interplay for scents in general (not only pleasant ones) is described as follows: while intensity makes pleasant scents more positive (up to a point), it decreases the hedonic value for scents that may only be acceptable, such as a weak fishy smell (Herz 2010). Thus, the inverted U-shaped curve occurs because pleasantness shifted the turning point, allowing people to experience scents at higher intensities (Spangenberg, Crowley, and Henderson 1996). Similarly, pleasantness may buffer against (1) less congruent scents by increasing tolerance for a perceptual misfit, (2) multidimensional scents by easing their processing, (3) less familiar scents by evoking (less but) additional positive emotional associations, and (4) less activating scents by making them more attractive. Thus, we propose that pleasantness buffers against...
levels in scent characteristics and perceptual properties that are associated with smaller effect sizes. Thus,  

**H₅:** Pleasantness weakens the positive effect of (a) congruency, (b) familiarity, and (c) activation and weakens the negative effect of (d) dimensionality.

**Environmental Factors**

Given the wide applicability in retail stores, entertainment venues, and medical facilities, we are next interested in the following factors proving (un)favorable ambient scent conditions: service versus nonservice exchange, multi- versus single-store environment, and presence versus absence of (in)congruent music (Mattila and Wirtz 2001; Morrin and Chebat 2005; RLB).

Service exchanges refer to activities performed on or for the customer (e.g., by a spa). Compared with nonservice exchanges, service exchanges may favor pleasant ambient scents for two reasons. First, service exchanges have a high degree of intangibility (Bitner 1990). If there are no tangible features, environmental cues may gain importance as decision criteria. Such a shift is reflected in the stronger reliance on word of mouth when consumers cannot try an offering (You, Vadakkepatt, and Joshi 2015). Second, service exchanges include a high degree of person-to-person interactions, where scent is shown to facilitate peer perceptions and helping behaviors (Baron 1997; Bitner 1990).

Multistore environments, such as a mall or a bookstore with a café, contain multiple single stores. A pleasant ambient scent may render an environment distinct and so attract attention by setting off the particular object from its environment (e.g., a single store from other stores). Krishna, Lwin, and Morrin (2010) argue that the capability to enhance an object’s contextual distinctiveness lies not in the uniqueness of the scent itself but in the number of objects with which it is associated. Thus, by being associated with multiple stores (e.g., a mall) compared with a single store (e.g., a florist shop), an ambient scent’s capability to render the environment distinct is stretched over many objects, making it less effective.

Finally, we consider whether music is playing in the environment and, if so, whether it matches the pleasant ambient scent. Such a cross-modal congruency goes back to findings showing that customers respond more positively when the music tempo matches the ambient scent in terms of being activating (fast) or relaxing (slow), compared with a mismatch (Mattila and Wirtz 2001). In addition, Spangenberg, Grohmann, and Sprott (2005) found similar results for the cross-modal congruency of music theme (Christmas) with scent quality (pine). The presence of incongruent music likely interferes with ambient scent effects because customers respond holistically to an environment (Mattila and Wirtz 2001). For congruent music, no prediction can be made. Its presence may amplify, attenuate, or fail to change the effect of ambient scent (Stein et al. 2009). We explore this constellation without a hypothesis. Thus,  

**H₆:** The effect sizes of pleasant ambient scent for customer responses are (a) larger for service than nonservice exchanges, (b) smaller in multistore than in single-store environments, and (c) smaller when incongruent music is present than when it is absent.

**Research Operational Factors**

In their experiments, researchers obtain control over extraneous factors through statistical control (controlling vs. not controlling for extraneous influences) and the design of the research setting (fictitious vs. actual) and the stimuli (imagined vs. experienced offering). To assess a statistical method of isolating factors besides the ambient scent manipulation, we distinguish whether the absence–presence comparison of ambient scent controls for effects from other variables or not (based on raw means). These are controlled for when the effect size is extracted from a multivariate model or the reported univariate statistic itself is adjusted for covariates. Raw means may lead to larger effect sizes, as they capture other variables with which they are collinear. However, controlling for other effects may also lead to larger effect sizes, as variance from extraneous factors is partialled out (Carlson and Wu 2012). We follow the latter argument because it reflects scholars’ attempts to achieve precision in results.

The design of research settings can be differentiated as based on fictitious (artificial laboratory) or actual (field or in-store) environments. Fictitious environments may allow researchers to better isolate extraneous factors (Shadish, Cook, and Campbell 2002) and so may lead to larger effect sizes than actual environments do. The design of the experimental stimuli may provide control over response errors. Photographic or video materials require respondents to imagine (parts of) the product or service offering. In such cases, respondents must make projections about reality, which translate into overstated reactions (Wilson and Gilbert 2003). In contrast, simulated store environments or field settings allow respondents to actually sense and experience the offering. Thus,  

**H₇:** The effect sizes of pleasant ambient scent for customer responses are larger (a) when they are controlled for extraneous influences than when not, (b) for fictitious than actual settings, and (c) for imagined than experienced offerings.

**Individual Factors**

Age and gender represent the final set of variables. First, physiological evidence shows women outperforming men in odor response (detection, discrimination, identification, and memory) and being emotionally more sensitive and responsive to scent than men are (Doty and Cameron 2009; Herz and Engen 1996). In the atmospherics domain, Lehrner et al. (2000) find support for this and show that women exhibited a more positive mood from ambient scent than men. Other tests could not detect gender differences in responses to ambient scent (e.g., Baron 1997; Krishna, Lwin, and Morrin 2010), which may be
due to lower power than in an aggregated analysis. Second, Chebat, Morrin, and Chebat (2009) observed scent-facilitated expenditures for younger (<35 years) but not for older (≥35 years) respondents. Differences in individuals’ susceptibility to ambient scent trace back to olfactory capabilities that change during a life span. Loss of olfactory function in old age is well established (Correia et al. 2016). Research indicates that olfactory performance peaks between 20 and 40 years of age and notably declines afterward, with a rapid decrease after age 70 (Correia et al. 2016). Thus,

**H3:** The effect sizes of pleasant ambient scent for customer responses are related (a) positively to the proportion of females and (b) negatively to the mean age of the respondents.

**Method**

**Database Development**

**Literature search.** To ensure extensive and complete coverage, we first searched electronic databases (EBSCO, Science Direct, Emerald, ABI/INFORM, and PsycINFO), using keywords such as “ambient scent,” ”scent,” and the general term “atmospheric stimuli” combined with “customer/consumer behavior,” and manually reviewed leading journals of ambient scent research (Journal of Marketing, Journal of Consumer Research, Journal of Business Research, Journal of Retailing, Journal of Service Research, Psychology & Marketing, and Environment and Behavior). Second, we consulted the references of major research summaries on pleasant ambient scents (e.g., Bone and Ellen 1999; Morrin 2010; Nibbe and Orth 2017; RLB). Third, we searched the Social Science Citation Index and Google Scholar for articles referring to these summaries. Fourth, to address the “file drawer” problem, we searched the internet (e.g., Google Scholar, SSRN database, key authors’ web pages) to retrieve unpublished work. We also emailed the authors of each study deemed appropriate for inclusion and asked for unpublished material and, to minimize study exclusion due to missing data, for additional statistics. Finally, for each study appropriate for inclusion, we performed steps two through four until no further work was found.

Inclusion criteria were that (1) ambient scent had to be manipulated experimentally, (2) the data reported on a sample needed to be independent (i.e., if the results of two different studies were derived from the same sample, the study that provided more details was used), (3) the measurement item(s) accurately reflected our construct specifications for customer responses, and (4) either an effect size could be directly derived or sufficient data (e.g., Student’s t, \( \eta^2 \), F-ratios; Cohen 1988; Lipsey and Wilson 2001) were reported so that we could calculate an effect size. An exclusion criterion was when the ambient scent manipulation was collapsed with another factor (e.g., presence of ambient scent and product display compared with the absence of both; Fiore, Yah, and Yoh 2000) so that the effect is not due to ambient scent alone.

The constructed database contained 71 independent samples reported in 64 articles from 1989 to 2018 (May) referring to a combined sample of 15,447 respondents. The average sample had a mean age of 32.6 years and a mean proportion of female respondents of 60%. For those samples that had an origin available, 91% were from Western countries (North America 48%, Europe 41%, and Australia 2%) and 9% from others (Asia 7%, Africa 2%). Theme 1 in the Web Appendix provides a list of included samples, and the bibliography is available from the authors. The accumulated data across the samples allowed for the extraction of 671 effect sizes. Of these, 11% are based on unpublished material (working papers, dissertations, and one data set).

**Effect size computation.** In accordance with guidelines for the meta-analysis of experimental work (Lipsey and Wilson 2001), we calculated effect sizes as standardized mean differences (Cohen’s d) converted into Pearson correlation coefficients using formulas provided by Cohen (1988, pp. 23, 82). A positive (negative) correlation indicates that the presence versus the absence of ambient scent increases (decreases) the value of the customer response variable. Although the correlation coefficient is widely used and easy to interpret (e.g., Yang et al. 2019), scholars have criticized it and its squared expression as explained variance. For instance, a correlation of .15 corresponds to an explained variance of 2%, leaving 98% unaccounted for, a potentially misleading reflection of the importance of an effect relative to the percentage change in the outcome (Eisend 2015).

We assessed the percentage change in two supplementary ways. First, we calculated it based on the raw means by (value of the customer response variable in the ambient scent presence condition/the value in the absence condition) – 1. The values typically represent scale-based scores (mood, evaluations, and intentions) or observed quantities (recalled information, spent time and money), reflecting the level of the customer response (e.g., degree of positive mood, amount of expenditures) in the respective ambient scent condition. For 515 effect sizes, the raw means were available and the percentage change could be calculated. To avoid bias due to outliers, we excluded 15 values (2.9%) that were larger than ±60%. These cases had values more than three times the interquartile range (the middle 50% of the records). Second, we calculated it by converting effect sizes, using Cohen’s improvement index. For example, a correlation of .15 moves from the median of a normal distribution to its 60th percentile and represents a 10% change in the outcome in standardized terms (Durlak 2009). The advantage of the raw mean assessment is its direct reflection of the study findings. In comparison, converting effect sizes presents a standardized and so more precise approach that also leverages the full data. We use both to provide a more comprehensive picture than would be possible with either alone.

**Coding of variables.** We prepared two coding forms (Table 2). The first form specified the coding of the environmental, research operational, and individual factors, following their
theoretical conceptualizations. The second form specified the coding of ambient scents. We used nine-point scales to rate the scent characteristics and perceptual properties, as they enabled the capture of nuanced differences among the scents (Mitchell, Kahn, and Knasko 1995). We made an exception for the distinction between multidimensional and unidimensional scents, because a continuous scale would not be adequate. In total, 80 different pleasant ambient scents were used across the samples, and 61 were rated by the coders. The remaining 19 represented compounds of some of the other scents (e.g., a

| Table 2. Coding Scheme and Statistical Properties of the Situational Contingencies. |
|----------------------------------|----------------------------------|----------------|
| Level: Variable                  | Coding Scheme                    | M (SD)         |
| **Scent Characteristics**        |                                  |                |
| 1: Congruency                    | How well does the ambient scent fit the environment and the products and services included therein? (1 = “not at all,” and 9 = “very much”) | 4.99 (1.21)    |
| 1: Dimensionality                | Does the aroma structure of the ambient scent contain a single dimension or multiple dimensions? (1 = multiple dimensions, 0 = single dimension) | .36 (.47)      |
| **Scent Perceptual Properties**  |                                  |                |
| 1: Pleasantness                  | How enjoyable is the ambient scent, in general? (1 = “not at all,” and 9 = “very much”) | 6.02 (1.19)    |
| 1: Familiarity                   | How familiar is the ambient scent, in general? (1 = “not at all,” and 9 = “very much”) | 6.44 (2.00)    |
| 1: Activation                    | How stimulating is the ambient scent, in general? (1 = “not at all,” and 9 = “very much”) | 6.44 (1.54)    |
| 2: Perceived concentration       | Proportion of respondents in the ambient scent presence group who detected the scent in the environment | .58 (29)       |
| **Environmental Factors**        |                                  |                |
| 2: Service exchange\(^b\)       | Was a service exchanged in the environment? | −.16 (.38)     |
|   • 2/3 = service/single-store    |                                  |                |
|   • −1/3 = nonservice/single-store |                                  |                |
|   • −1/3 = nonservice/multistore |                                  |                |
| 2: Multistore environment\(^b\) | Does the environment contain multiple stores, or does it represent a single store? | −.20 (.41)     |
|   • 1/2 = multistore/nonservice  |                                  |                |
|   • −1/2 = single-store/nonservice |                                  |                |
|   • 0 = single-store/service     |                                  |                |
| 2: Incongruent music\(^c\)       | Proportion of effect sizes within a sample when cross-modally incongruent music was present | .08 (.23)      |
| 2: Congruent music\(^c\)         | Proportion of effect sizes within a sample when cross-modally congruent music was present | .05 (.19)      |
| **Research Operational Factors** |                                  |                |
| 1: Statistical control           | The absence–presence comparison of ambient scent was or was not statistically controlled for effects from other variables (extraneous influences)? (1 = controlled for, 0 = not controlled for [based on raw means]) | .30 (.46)      |
| 2: Fictitious setting\(^b\)      | Did the research design use a setting that is fictitious (laboratory experiments) or actual (field experiments)? | −.13 (.40)     |
|   • 1/2 = fictitious setting/experienced offering |                                  |                |
|   • −1/2 = actual setting/experienced offering |                                  |                |
|   • 0 = fictitious setting/imagined offering |                                  |                |
| 2: Imagined offering\(^b\)       | Did the respondents need to imagine the product or the service offering, or did they experience it? | −.05 (.45)     |
|   • 2/3 = imagined offering/fictitious setting |                                  |                |
|   • −1/3 = experienced offering/fictitious setting |                                  |                |
|   • −1/3 = experienced offering/actual setting |                                  |                |
| **Individual Factors**           |                                  |                |
| 2: Proportion of female participants\(^d\) | The proportion of female participants in a sample | .60 (.18)      |
| 2: Mean age\(^d\)                | The average age of respondents in a sample (in years) | 31.7 (5.89)    |

\(^a\)In their question whether an ambient scent was detected, some researchers attempted to avoid a direct reference to smell, such as by asking for anything special (or this information was not available). We checked via a dummy, marking if a reference to smell was present and influenced the results, which it did not (B = .014, p = .576).

\(^b\)These variables used contrast codes according to Cohen et al. (2003), as service exchanges were exclusively studied in single-store environments and imagined offerings in fictitious settings.

\(^c\)Captured as proportion of effect sizes within a sample as the presence versus absence of (in)congruent music varied on the sample and effect-size level. For music’s match with ambient scent, we followed Mattila and Wirtz (2001) and assessed whether the music was more or less arousing (based on volume and tempo) and matched this to whether the scent was more or less activating (defined as scoring above or below average on the activation factor). For Spangenberg, Grohmann, and Sprott (2005), we made an exception and followed their study conditions.

\(^d\)Missing values were imputed with the sample-size-weighted mean (Chang and Taylor 2016).
floral complex made of rose and jasmine), requiring the following adjustments. We defined these compounds as multidimensional in aroma structure and calculated their perceptual properties as averages from the coded values of the ambient scents they contained. Finally, perceived concentration was measured as the proportion of respondents in the ambient scent presence group who detected the scent.

We coded the data according to the definitions in Table 2. The first author initially coded all data, then the second author independently coded all data (Rubera and Kirca 2012). Inter-coder reliability was calculated according to Rust and Cool (1994) and Shrout and Fleiss (1979) for the categorical and continuous variables, respectively. The reliability values ranged from .89 for congruency of ambient scent to 1.00 for fictitious (vs. actual) settings and were comparable to those in other analyses (e.g., Edeling and Himme 2018; Palmatier et al. 2006). We resolved inconsistencies for the categorical and continuous data by discussion and by averaging the ratings between coders, respectively. In addition, we compared our codings of the two perceptual properties, pleasantness and activation, with the values provided by Spangenberg, Crowley, and Henderson (1996). For a subset of 27 ambient scents, the pleasantness and activation values correlated with .87 and .84 between both data sets, respectively.

**Data Analysis**

Effect size integration. We adjusted the effect sizes for reliability to correct for attenuation from random measurement error (Hunter and Schmidt 2004). If reliability indices were not available, we used the mean sample-size-weighted reliability across all studies. Next, within samples, multiple effect sizes for the same relationship could be extracted. This was the case when a response was broken down into single facets and/or repeatedly measured (e.g., product evaluations were assessed in terms of style, selection, and quality and/or for different product categories). We kept the effect sizes separate and assigned each a weight of 1/number of effect sizes for this relationship (Eisend 2014). Thus, when all available effect sizes for a relationship are averaged, multiple effects within one sample do not lead to its overrepresentation. We then computed the sample-size-weighted means ($r$) of all available effect size estimates for each relationship (Hunter and Schmidt 2004). Theme 2 in the Web Appendix presents the formulas for these calculations. Because the effect sizes depend on the situational contingencies, we provide an adjusted value for $r$ ($r_a$), which would be expected when all situational contingencies were at their mean and, to represent field conditions, when an experienced offering was assumed (i.e., more conservative estimates). In interpretational terms the $r_a$s represent the integrated $r$s under average field conditions. Theme 3 in the Web Appendix provides the technical details of these calculations.

Hierarchical linear modeling. We investigated how the situational contingencies influence effect sizes of customer responses. The analysis is justified when there is sufficient variation among effect sizes. This variation is assessed by the $I^2$ statistic, which indicates the percentage of total variation in effect sizes due to heterogeneity rather than chance (Higgins and Thompson 2002). Values less than 30% represent mild, between 30% and 50% represent moderate, and more than 50% represent severe heterogeneity (Higgins and Thompson 2002). Table 3 shows the $I^2$ values, which indicate mild to severe heterogeneity, justifying our analysis.

To examine the influence of the situational contingencies, we regressed the reliability-corrected effect size estimates on the scent characteristics, the scent perceptual properties, and the environmental, research operational, and individual factors. Because the variables (see Table 2) vary at the effect size (Level 1: individual effect size) and sample (Level 2: experiment[s] within an article) levels, we used a two-level hierarchical linear model (HLM) to account for within-sample error correlation between estimates. Theme 3 in the Web Appendix presents the calculation details. Analogous to effect size integration, we weighted effect sizes to correct multiple counts within a sample and represent sample size.

Before calculating the HLM, we checked data properties. First, we assessed whether the data formally required a hierarchical approach. The amount of variance in effect sizes due to sample membership (intraclass correlation coefficient) equaled 36.9%, indicating that the HLM was necessary. Second, we assessed multicollinearity as a major threat to the robustness of results. Theme 4 in the Web Appendix shows the correlations between the situational contingencies. Because no direct diagnostic is available for multicollinearity in the HLM, we regressed the reliability-corrected effect size estimates on the situational contingency variables in a conventional model that applied the same weights as the hierarchical model (Rubera and Kirca 2012). The results yielded a sufficiently low degree of multicollinearity, with a maximum variance inflation factor of 1.74 (Rubera and Kirca 2012).

Meta-analytic correlation matrix and path analysis. We constructed a meta-analytic correlation matrix to inform about the correlations among the customer responses. The matrix has a reduced set of responses due to data availability and the way it is constructed, which we explain in Theme 9 in the Web Appendix. We used the meta-analytic correlation matrix and the median sample size of $N = 1,632$ across the matrix’s effect size estimates as model input for our path analysis, in which we explore the links from ambient scent to expenditures and the causal priorities for mood and evaluations. Theme 9 in the Web Appendix presents the analysis. We discuss the results in the final section.

**Results**

**Integrating Ambient Scent Effects**

Table 3 shows the results from the meta-analytic effect size integration. The presence (vs. absence) of ambient scent
produced significant \((p < .01)\) and positive effects on customer responses, except for mood control and expenditures. Of the significant effects, the \(r_s\) ranged from .078 to .177 and the fail-safe \(N\)-values from 49 to 3,018. The results largely supported \(H_1a\). In regard to \(H_1b\), the \(r_s\) show that ambient scent caused larger effects on evaluation and memory responses \((r_s = .131)\) than on mood responses \((r_s = .094)\). Contrasting both response types through a dummy variable yielded a significant result \((p = .023)\), in support of \(H_1b\). Furthermore, the presence \((vs.\ absence)\) of ambient scent increased the level of the customer responses by 3.2\% to 15.4\%, with the standardized values tending to be somewhat lower than the raw mean values. Table 4 presents the meta-analytic correlation matrix, providing a first indication that the presence \((vs.\ absence)\) of ambient scent exhibits downstream links to expenditures.
Explaining Variations in Effect Sizes

**Linear effects.** Table 5 presents the HLM results for the impact of the situational contingencies on effect sizes of customer responses. We calculated three models. Model 1 represents our baseline model, explaining 13.1% of the within-sample variance (Level 1) and 40.2% of the across-sample variance (Level 2). In support of the respective hypotheses ($p < .05$), larger effect sizes were caused by congruency ($\beta = .053; 2a$), familiarity ($\beta = .018; 3b$), service (vs. nonservice) exchange ($\gamma = .131; 6a$), controlling (vs. not controlling) for extraneous influences ($\beta = .075; 7a$), imagined (vs. experienced) offering ($\gamma = .085; 7c$), and proportion of female participants ($\gamma = .287; 9d$).
.287; 8a). We observed smaller effect sizes for multidimensional compared with unidimensional scents (β = .064; 2b) and the presence (vs. absence) of incongruent music (γ = −.083; 6c). Contrary to our expectations, effect sizes were not larger for more (vs. less) pleasant scents (3a), more (vs. less) activating scents (3b), multistore (vs. single-store) environments (6b), and fictitious (vs. actual) settings (7b). Effect sizes also were not negatively related to the mean age of the respondents (8b). The results were inconclusive for congruent music, indicating a nonsignificant effect in the more comprehensive Model 3.

In Model 2, we added the scent interaction terms to the baseline model, which increased the explained Level 1 variance by 2.1%, to 15.2%. As expected, pleasantness weakened the positive effect of familiarity (β = −.012, p = .031; 5b) and the negative effect of dimensionality (β = .075, p = .004; 5d). Figure 2, Panels A and B, show the interactions. More pleasant ambient scents yielded a smaller reduction in effect sizes due to unfamiliarity and multidimensionality than less pleasant scents did. We found no support for H3a and H5c, which suggested weaker positive effects of congruency and activation due to pleasantness.

In addition to the hypothesized effects, we explored the data for other interactions among the situational contingencies. We found three interactions, shown in Model 3 and plotted in Theme 5 in the Web Appendix, which increased the explained Level 2 variance by 12.6%, to 52.2%. For a higher (lower) proportion of female participants, the positive effect of familiarity on effect sizes was stronger (weaker) (γ = .096, p = .070). Furthermore, for imagined compared with experienced offerings, the positive effect of congruency on effect sizes was weaker (γ = −.069, p = .075) and that of familiarity stronger (γ = .039, p = .039).

Finally, Models 1 through 3 included a set of dummy variables to control for the type of customer response. The dummy variables accounted for 2.6% of Level 1 variance, indicating that the situational contingencies in Models 2 and 3 explained 12.6% of additional Level 1 variance (15.2% − 2.6%). Omitting the dummies did not alter the result pattern, with one exception. When they were removed from Model 3, the significance value of the proportion of female participants × scent familiarity interaction decreased from .070 to .045. Moreover, using a dummy that marks the mood responses, we checked whether mood interacted with any of the 14 situational contingencies. We tested the interactions separately and thus adjusted the p-value for multiple comparisons, following Benjamini and Hochberg (1995). Pleasantness was positively related to effect sizes for mood but not for the other responses (p = .056), as plotted in Theme 6 in the Web Appendix. This interaction did not influence the result pattern, nor did mood interact with any of the scent interactions. Proceeding likewise, we found no interactions (ps > .10) with the other responses.

**Nonlinear effects.** Testing scent intensity effects required a different approach. Information on perceived concentration was available for a subset of 21 samples and 165 effect size estimates, which were selected for analysis. To keep the information from the full data set, we corrected each effect size for the influence of the situational contingencies, sample affiliation, and measured customer response as obtained from Model 3 (Table 5). Theme 3 in the Web Appendix provides the technical details of these calculations. In a conventional model, we regressed the corrected effect sizes on perceived concentration and its quadratic term, applying the same weights as in the hierarchical models. The model explained 10.4% of variance in effect sizes. Figure 3, Panels A and B, show the resulting
curve, with an increase in effect sizes that levels off toward the upper range of the perceived scent concentration values ($B_{linear} = .466, p = .006; B_{quadratic} = -.287, p = .048$), in support of $H_4$. When not controlling for the type of customer response, the result pattern remained.

**Assessing Sensitivity of Effect Sizes and Percentage Change**

Drawing on the parameter estimates of Model 3 (Table 5), we calculated the percentage change of customer expenditures through the raS (standardized approach) that the model predicts for different levels of the significant situational contingencies. Theme 3 in the Web Appendix provides the statistical details for this analysis, and Table 5 shows the results in the last column of Model 3. On average, when all situational contingencies are at their mean, the presence (vs. absence) of ambient scent produced a 3% increase in expenditures. Combining more favorable conditions, the presence (vs. absence) of a congruent, unidimensional, and familiar ambient scent resulted in a 10% increase. If a service exchange without incongruent music and a female-dominant sample were also predicted, the increase was 23%. If the respective less favorable conditions were combined, the presence of ambient scent caused a reduction of 17%, compared with its absence. Set in relation to the distribution of the raw mean values, the estimated range of $+23\%$ to $-17\%$ falls within the average deviation from the mean ($\pm 1$ SD), rendering the estimates adequate to gauge the percentage change. We also obtained similar results for lingering and for an average across all customer responses, summarized in Theme 7 in the Web Appendix.

**Discussion**

From the empirical evidence, we provide more definite conclusions on the existence and magnitude of ambient scent effects, identify situational contingencies that explain the variations in study findings, and provide insights into the nature of these effects. Table 6 summarizes our findings, compares them with those of RLB, and offers implications. Next, we discuss key findings, suggest directions for future research, and conclude on ambient scent’s role in meeting current market challenges.

**Theoretical Implications**

**Existence and magnitude of ambient scent effects.** Opposite effects, different study settings, and limitations in response and data coverage made it difficult for prior work to deduce general inferences about the existence of ambient scent effects (Nibbe and Orth 2017; RLB). The present findings overcome these challenges and allow us to conclude that pleasant ambient scents positively influence consumer responses. More importantly, we provide insight into the magnitude of effects, especially the percentage change as a managerially relevant metric. We found an average increase in the level of the responses between 3% and 15%, which is why we consider the magnitude of ambient scent effects as substantial. The findings also illustrate the value of percentage change assessments and, though uncommon, of Cohen’s Improvement Index.

**Situational contingencies explaining variations in ambient scent effects.** Prior work has referred to various situational contingencies that presumably influence ambient scent effects. However, there are few actual tests of these factors and scant empirical generalizations (Table 6). Extending prior
### Table 6. Summary of Findings and Implications.

| Area                  | Findings from RLB                                      | Findings from the Present Study                                      | Research Implications                                                                 | Managerial Implications                  |
|-----------------------|-------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------|
| Customer responses    | Positive effect sizes\(^a\) on pleasure, shopping satisfaction, and behavioral intentions | Positive effect sizes\(^a\) on mood activation and valence, product evaluations, environmental quality, shopping satisfaction, recall, time elusiveness, purchase intentions, intention to recommend, and lingering | Results provide more definite conclusions for ambient scent effects, taking situational contingencies into account. | Ambient scent may enhance the in-store experience, potentially providing a competitive edge in a fierce market. |
| Scent characteristics | Congruency is positively related to effect sizes (qualitative account). | Effect sizes are related positively to congruency and negatively to dimensionality. Scent familiarity is positively related to effect sizes. | Results provide empirical informed guidance for scent selection. Congruent, unidimensional, and familiar scents may be favored over their counterparts. | Selection of the right ambient scent is important to ensure its effectiveness. For less obvious criteria, such as familiarity, pre-testing is recommended. |
| Scent perceptual properties | Perceived concentration increases effect sizes at decreasing rates. The curve flattens when around 60%–80% of respondents detected the ambient scent. | Scent pleasantness buffers small effect sizes from multidimensional and unfamiliar ambient scents. | Pleasantness may exert a supporting role among the scent factors in general. | If unidimensionality or familiarity cannot be met, pleasantness should be ensured. |
| Environmental factors | There is a tendency for larger effect sizes in service (vs. retail) environments. | Ambient scent exhibits larger effect sizes in service (vs. retail) environments. | Results provide novel evidence for an effect so far observed only in tendency. | Service environments appear favorable for leveraging on ambient scent effects. |

(continued)
evidence, we found eight factors that account for variations in findings.

One area is the scent-related factors—congruency, dimensionality, familiarity, pleasantness, and activation—that guide researchers’ scent selection (for an overview, see Theme 8 in the Web Appendix). Our findings substantiate the general tenet that congruency drives effect sizes and is thus used as a selection criterion. We also found dimensionality and familiarity, the least-often-considered criteria, to influence effect sizes, while pleasantness and activation, the most-often-considered criteria, did not. This unexpected result may be due to the absence of explicit tests of these factors (for an exception, see Herrmann et al. [2013]), making it reasonable to select scents based on pleasantness and activation, as established by Spangenberg, Crowley, and Henderson (1996). We also discuss additional reasons that may account for the absence of significance and how pleasantness and activation may be relevant in different contexts. Overall, we advise a stronger reliance on the factors (even congruency was pretested in only 31% of samples), with the present findings providing insight and guidance.

Combining ambient scent and music presents two questions. Should they match? Does their combination eventually lead to larger or smaller effects of ambient scent? Our results confirm prior findings that both should match (Mattila and Wirtz 2001). They further indicate that the stimuli’s arousing properties are useful for establishing their cross-modal congruency. This may explain why Morrin and Chebat (2005) observed negative sentiments—shoppers’ expenditures dropped by an average of 40%—when slow-tempo music was combined with a citrus (i.e., activating) scent compared with when either stimulus or both were absent. Whether both stimuli should generally be combined was not conclusive, requiring further research.

Many findings were obtained in fictitious settings (51% of samples), and it remains unclear how their differences from actual (field) settings influence ambient scent effects. When fictitious settings allowed respondents to experience the offering (as naturally happens in field settings), we could not detect response differences, making both tentatively comparable. However, fictitious settings that required respondents to imagine the offering yielded inflated responses compared with experienced offerings (in fictitious and actual settings). We corrected our results to represent an experienced offering. Researchers may favor experienced over imagined offerings in their laboratory experiments, or they may wish to verify their results accordingly.

**Nature of effects.** Our results also offer insight that allows for a more detailed description of the effects in terms of effect patterns, nonlinear relationships, and interactions. Drawing on the response pattern, we corroborate qualitative findings that ambient scent serves more as a cognitive than affective stimulant (Bone and Ellen 1999; Morrin 2010). Typically, affective-based arguments, such as the emotional power of scent-evoked memories, speak to ambient scent effects (Herz 2010). In contrast, our result suggests supplementing the affective perspective with cognitive-based frameworks, which has been advocated in previous research (e.g., Chebat and Michon 2003; Morrin 2010). In addition, initial results from a path analysis (see Theme 9 in the Web Appendix) showed that ambient scent links to expenditures through mood and

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**Table 6.** (continued)

| Area                         | Findings from RLB | Findings from the Present Study | Research Implications | Managerial Implications |
|------------------------------|-------------------|--------------------------------|-----------------------|-------------------------|
| Research factors             |                   | Effect sizes are larger when researchers statistically control for factors outside of the ambient scent manipulation than when not. | Factors outside the experiment’s control should be captured and raw effects validated for their influence. | Field data may show weaker effects due to other factors apart from ambient scent. |
| Individual differences       |                   | Imagined (vs. experienced) offerings yield larger effect sizes. In imagined offerings, congruency is (in tendency) weaker and familiarity is more strongly related to effect sizes. | Experienced offerings may be favored over imagined ones. For the latter, results may be verified and scent selection then retested. | If an ambient scent strategy is pretested in the lab, this should be with experienced offerings (tentatively similar to the field). |

*aEffect sizes for the presence versus absence of ambient scent on customer responses.

*bResults provided in Theme 9 in the Web Appendix.
evaluation responses and indicated that these responses work along parallel rather than sequential pathways. In light of different frameworks (e.g., Chebat and Michon 2003; Morrison et al. 2011), the findings provide a first empirical consolidation of the observed causalities and suggest studying mood and evaluation responses as a space in which ambient scent is positioned.

Our results also revealed a gender effect, which remained largely undetected in individual studies, and allow a first estimation of its magnitude. Effectively 60% of extant research is based on a female respondent perspective, which is associated with larger effect sizes. Set in relation to an equal gender split (50%), the deviation accounts for a change of .03 in r (~2%). Slight discrepancies in the gender composition between the sampled respondents and the target group are not of serious concern; however, researchers should be cautious about making inferences when deviations are larger. It is inconclusive whether these results indicate a general gender bias in the research stream. The higher proportion of female participants may, in the early stages of a field’s development, be needed to offset other (unknown) unfavorable conditions.

For scent intensity and a nonlinear relationship with effect sizes, prior research provided inconclusive results (Spangenberg, Crowley, and Henderson 1996). Capturing scent intensity through perceived concentration, we found support for a nonlinear relationship: effect sizes increased at a decreasing rate. The curve indicates that effect sizes level off when around 60%–80% of respondents detect the ambient scent, which may provide scholars initial guidance in calibrating scent concentration on a perceptual level.

The nonlinear relationship follows from predictions for scents in general (not only pleasant ones), according to which pleasantness creates a larger tolerance to scents at a higher intensity. We observed an extension of this: pleasantness buffered against larger reductions in effect sizes when the ambient scent was unfamiliar or multidimensional. To the best of our knowledge, this is a newly observed behavior, giving initial support to the idea that pleasantness may generally play a supporting role for scent characteristics and perceptual properties.

**Expenditures and Managerial Recommendations**

Both increases and decreases in the levels of the responses span up to 60%; success stories from the industry claim even larger positive changes (Scent Australia 2019). We estimated that the presence (vs. absence) of ambient scent yields a 3% increase in expenditures for an average setting and a 23% increase for a most favorable condition, with similar results for lingering and an average across the response variables (see Theme 7 in the Web Appendix). Thus, industry reports such as increased breakfast sales (Novotel) and a 16% rise in store traffic (Dunkin Donuts) lie within our predictions, whereas claims of an 80% higher purchase intent (Nike) do not (Scent Australia 2019). Moreover, the success stories inevitably portray the positive side. While a less favorable condition may often lead to diminished effects, our predicted 17% decrease for a least favorable condition and the negative percentage changes in the data also show the possibility for negative effects.

The predictions need to be set in context. Although they combine a large volume of data, they represent forecasts, which are not free from error. They inform about the potential of ambient scent and its situational sensitivity according to currently available evidence. Larger numbers are typically more attractive. However, situational considerations (such as wide reach or great leverage on profit) may make even small changes desirable. Overall, ambient scent is able to facilitate expenditures, either by doing so directly or by moving consumers down the purchase funnel, thus supporting the business press belief “smell sells” (Bone and Ellen 1999).

Ambient scent positively affected most responses. Nevertheless, recommendations are not straightforward, because scent-facilitated responses may not always be desirable or occur for alternative mechanisms. Undesirable responses may include scent-enhanced recall and activation intensifying negative experiences (e.g., complaint handling, waiting) and scent-facilitated lingering worsening performance indicators (e.g., the number of processed consumers). Responses occurring for alternative mechanisms may include that ambient scent reduces cognitive efforts (Morrin, Chebat, and Chebat 2010), which can be responsible for better evaluations and the perception that less time has passed than is actually true.

To leverage ambient scent effects, marketing executives should consider situational aspects, guided by two questions. First, which pleasant scent should be selected? Using lavender in a French florist shop (Jacob, Stefan, and Guéguen 2014) may illustrate a best-practice example. Lavender is a fit to the store, is familiar to most French people (who were interviewed), and contains a single aroma. Other cases may be less obvious, especially regarding familiarity, which is not about identifying a scent but rather being acquainted with its aroma and the memories and emotions attached to it. Popular scents may be known but are not necessarily familiar. Thus, firms may need to test the responses from their target group.

Second, which contexts are beneficial? Service exchanges favor ambient scent effects, making the 1 Hotels group a positive example (Minsky, Fahey, and Fabrigas 2018). Scent also appears to be beneficial when female consumers represent the main group in the facility or in a spatially separated area (e.g., women’s sections in retailing and spa facilities). In either context, the scent needs to be perceived, which is different from consumers often being unaware that scents affect them (Herz 2010). If ambient music is present, it should match the ambient scent (via both stimuli’s arousing properties). We also saw the possibility of negative effects. Even a pleasant ambient scent may create negative sentiments, such as when it leads to over-stimulation (Chebat and Morrin 2005), is so strong that it turns aversive (Herz 2010), or distorts the perception of the environment. Because also other as-yet-undiscovered individual
differences may account for ambient scent effects, it is again advisable to use field tests.

A special strategy of firms is to use bespoke fragrances, such as Hyatt Place’s unique “Seamless” scent (Minskey, Fahey, and Fabrigas 2018). Because people can distinguish between many thousands of scents they have previously smelled, signature scents appear suited to build an olfactory identity. At the same time, positive associations have yet to be formed. Thus, there is little margin for failure, a challenge for services (Gelbrich and Roschk 2011), and they may elicit effect only after repeated exposure. Furthermore, because they are often compounds, unidimensionality appears more difficult to achieve, which pleasantness can partially compensate for.

Limitations
Meta-analyses have strengths but also inherent limitations. First, they are constrained by the available primary data. Thus, our framework should be considered a summary of the most commonly studied variables. Data constraints are also reflected in the focus of this meta-analysis on pleasant scents and its geographic focus on North America and Europe. The scent perceptual properties are learned and carry culture-bound meaning. In consequence, generalizations may be more difficult, which probably accounts for the absence of main effects for scent pleasantness and activation, and our results may not extend to other cultures. Furthermore, the results on multistore versus single-store distinction and mean respondent age were not predictive. The store distinction may be too coarse to reflect the idea that ambient scent creates distinctiveness as a function of the number of associated objects. The absence of significance for age is likely because olfactory deficits become salient after 70 years old (Correia et al. 2016), an age group that is only barely covered by the average sample (mean age 32.6 years). The second limitation is that situational contingencies accounted for 12.6% of the within-sample variance in effect sizes, indicating that variability could not be explained fully and heterogeneity remained. To explain variability, the model assumed linearity. However, the situational contingencies may exhibit non-linear effects, leading to positive but not negative effect sizes or vice versa. They may also exert response-specific effects that our analysis could not reveal. Third, though we attempted to address publication bias, studies that failed to establish ambient scent effects may not have been available, positively biasing our summarized results.

Future Research
Table 7 offers a compilation of six areas for future research and various questions on meeting market challenges. While firms attempt to perfect their in-store experience with pleasant ambient scents, unpleasant smells may cause detrimental effects, likely to a larger extent than pleasant scents yield positive effects (Herz 2010). Given the lack of research and the various conceivable sources for malodors (e.g., kitchens, building sites), an exploration and understanding of unpleasant ambient scents is encouraged (area 1). To stand out in the crowd, marketers also use ambient scents to create an olfactory identity in the form of signature scents. While such trends illustrate the markets’ interest in ambient scents, we have little understanding of why we observed our reported effects. Thus, insights into process explanations (area 2) and relations with other stimuli (area 3) are needed to fully leverage ambient scent effects and expand its fields of application (areas 4–6).

Hyatt Place, for example, is currently active in 23 countries. However, cross-cultural knowledge on ambient scent is scarce (area 4). Because scent preferences are culture bound, should Hyatt Place adapt its “Seamless” scent to local preferences, or can it use its scent to target a multinational audience? Like using music to cue healthier choices (Dong, Huang, and Labroo 2019), ambient scent may also be viewed as a nudge for social betterment (area 5). For instance, by making time pass faster, it may promote health-related behaviors, such as spending more time in physical activities. For prudent use, it is also necessary to understand when this leads to undesired consequences. Finally, are ambient scents doomed to be relevant only in the physical world (area 6)? People are capable of imagining a scent, so scents provide a sensory appeal that can be reexperienced in a digital environment (Bleier, Harmeling, and Palma-tier 2019; Krishna, Morrin, and Sayin 2014). Scholars also see potential solutions to problems in artificial intelligence through the way olfactory information is processed (Cepelewicz 2018). Because ambient scent facilitates social interactions (Baron 1997), might it also support human–computer interactions, such as with robots?

Conclusion
Overall, the idea of using pleasant ambient scents to connect to consumers is well founded. Scent positively influences consumer responses. More importantly, the magnitude of its effects appears substantial, as gauged by the percentage changes. However, it requires judiciously considering the various situational contingencies and the nature of the effects because they are eventually decisive for the success of an ambient scent strategy. This is reflected in the sensitivity of expenditures, for which we predicted an increase between 3% and 23% across an average and a most favorable condition, respectively; however, negative effects are also possible. Exciting questions for future research also make ambient scent a promising topic. Although it seems unlikely that a pleasant ambient scent can turn a poor in-store experience into a great one, we see it as an enhancement that, in the fierce competition for the perfect in-store experience, may be the decisive factor in a firm’s ability to thrive and prevail in the market.

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Table 7. A Research Agenda.

| Areas                                      | Research Gap and Questions                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Unpleasant ambient scents              | - While firms attempt to perfect their in-store experience with pleasant ambient scents, many sources for unpleasant scents exist (e.g., kitchens, chemicals, animals) that may counter such efforts. As virtually all studies focused on pleasant ambient scents, questions remain.                                                             |
|                                           | - Where do malodors occur? Are they detected in the environment at lower intensities than their pleasant counterparts? To what extent do they elicit ill effects, and are the effect magnitudes larger than the ones we found for pleasant ambient scents? Across pleasant and unpleasant ambient scents, do the situational contingencies exhibit nonlinear effects, so that some factors yield negative but not positive effects and vice versa? How can presumed elicited ill effects be mitigated? |
| 2. Process explanations                   | - To meet the strong interest in ambient scent and expand its usage to other fields, we need a better understanding of why we observe the effects we report herein. So far, the research stream offers little evidence for needed process explanations.                                                                                                           |
|                                           | - How do the biological idiosyncrasies of the sense of smell link to consumer responses? Do other biological features, such as odor adaptation (saturation of receptor cells) and intermittent dispense (desaturation), account for consumer responses? Do other factors, such as processing fluency, olfactory imagery, or distinctiveness perceptions, explain ambient scent effects? |
| 3. Cross-modal effects                    | - For similar reasons, a theoretical advancement and insight into ambient scent’s relation with music and other stimuli, such as temperature (Sinha and Bagchi 2019), is desirable. Because little evidence is yet available and consumers perceive the environment as a whole (Mattila and Wirtz 2001), questions remain.                                             |
|                                           | - According to which criteria can the match among ambient scent and other stimuli be ensured, what cross-modal congruency facets prove viable for this, and are there other criteria than congruency conceivable? In consequence, does the integration of ambient scent with other stimuli lead to more positive responses that exceed or fall behind the sum of the unisensory effects? May the integration overstimulate and cause negative effects? Which conditions account for the different constellations? |
| 4. Ambient scent on international markets | - Most studies were conducted in North American and European contexts. Scent-attached meanings do not travel across cultures, and specific scents, such as Arabian rose water and Indian oud, carry strong positive connotations in their cultural heritages. Thus, various cross-cultural questions emerge.                          |
|                                           | - To which extent should ambient scents be differentiated across countries and cultures? Can ambient scents similar to, for instance, numbers (Westjohn, Roschk, and Magnusson 2017) serve as symbols to convey a local image? Can they, like other cultural symbols (e.g., the “8” in China), be used to trigger positive superstitious beliefs that translate into willingness to pay a higher price? Do cross-cultural differences exist in the extent to which consumers are moved by ambient scents? |
| 5. Ambient scent for social betterment    | - Marketing may serve social objectives (White, Habib, and Hardisty 2019). By leveraging its effects, ambient scent may do the same and be seen as a behavioral nudge.                                                                                                                                                                                                 |
|                                           | - Does scent-facilitated lingering translate to other areas, such as more time spent with physical activities and the processing of health-related information? Do the mood and evaluation responses translate into enhancing environments with social purposes, such as public transport and museums? Given its time-related effects, does ambient scent lead to an underestimation of traveled time with buses and trains? In which contexts do such effects have undesired consequences? |
| 6. Ambient scents in the digital age      | - We discussed ambient scents from the perspective of the physical world, but are they doomed to it? Basic questions can be asked about the role of ambient scents in the digital age and especially for digital environments.                                                                                                           |
|                                           | - Given that we are capable of olfactory imagery, to which extent can we re-experience an ambient scent from the physical store in a digital environment, and does this imagination evokes similarly positive effects? Given that ambient scent is able to facilitate human interactions, can it also facilitate human–computer interactions (with avatars or robots), such as by reducing technological anxiety, facilitating “peer” perceptions, or putting consumers in a more positive mood? |

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