Journal of Retailing 93 (2, 2017) 228–240

Journal of Retailing

Research Note

Calibrating 30 Years of Experimental Research: A Meta-Analysis of the Atmospheric Effects of Music, Scent, and Color

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Available online 27 October 2016

Abstract

Atmospheric in-store stimuli have been the subject of considerable empirical investigation for over 30 years. This research presents a meta-analysis of 66 studies and 135 effects ($N = 15{,}621$) calibrating the atmospheric effects of music, scent, and color on shopping outcomes. At an aggregate level, the results reveal that environments in which music or scent are present yield higher pleasure, satisfaction, and behavioral intention ratings when compared with environments in which such conditions are absent. Warm colors produce higher levels of arousal than cool colors, while cool colors produce higher levels of satisfaction than warm colors. The estimated average strength of these relationships ranged from small to medium. Effect sizes exhibited significant between-study variance, which can be partly explained by the moderators investigated. For instance, larger effect sizes were observed for the relationship between scent and pleasure in those samples with a higher (vs. lower) proportion of females. Data also indicated a tendency toward stronger music and scent effects in service settings as compared to retail settings. The results of this analysis, based on data aggregated across the research stream, offer retailers a guide to enhance customers' shopping experience through judicious use of in-store atmospheric stimuli.

Keywords: Music; Scent; Color; Meta-analysis; In-store atmospherics; Retail customer behavior

One of the key success factors for any retailer or service provider is presenting customers with a pleasurable consumption environment (Pan and Zinkhan 2006). A well-designed store environment may positively stimulate customers' senses, enhance their shopping experience, and ultimately translate into larger sales revenues (Doucé and Janssens 2013; Sullivan 2002). The subtlety of atmospheric effects often results in customers being unaware of their exposure to them, even though their behavior is affected (Morrin and Ratneshwar 2000). Academic researchers have explored how environmental stimuli affect customers' shopping behavior for more than 30 years (Bellizzi, Crowley, and Hasty 1983; Ludvigson and Rottman 1989; Milliman 1982). In particular, scholars have investigated how music, scent, and color influence shopping outcomes, affecting emotional reactions, satisfaction and purchase intention, and have produced a voluminous literature with substantial variation in sample composition, industry context, and study design (Bellizzi and Hite 1992; Mattila and Wirtz 2001; Sayin et al. 2015).

This body of work has produced mixed results, including significant and non-significant findings, as well as effects in opposing directions, even for the same relationship (Andersson et al. 2012; Cyr, Head, and Larios 2010; Michon, Chebat, and Turley 2005; Morrin and Ratneshwar 2000; Yalch and Spangenberg 1988). Furthermore, estimates of the strength of the relationships have ranged from small to large (Jacob, Stefan, and Guéguen 2014; Morrison et al. 2011), rendering conclusions about the elasticity of atmospheric effects, an important question for retail executives, uncertain. Generalizable estimates of effect sizes are therefore badly needed. Previous reviews of atmospheric effects have, however, been limited to narrative or vote-counting methods (Bone and Ellen 1999; Turley and Milliman 2000), and generalized estimates among the

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http://dx.doi.org/10.1016/j.jretai.2016.10.001
0022-4359/

relationships here investigated have been reported only for the effect of music on pleasure (Garlin and Owen 2006). In addition to the lack of aggregated effect size estimates, these early summaries date back more than 10 years.

The first contribution of this study is therefore to present a meta-analysis attempting to calibrate the size of atmospheric effects on shopping outcomes. The second contribution is an attempt to account for between-study variance in effect sizes and to investigate a number of moderators that reflect study design choices made by the researchers. The moderators include sampling frame (students versus customers), gender split (low versus high proportion of females in a sample), industry setting (retail versus service versus online settings), and experimental design (fictitious versus actual environments). Through these means, we aim to present retailers with a reliable guide to the effects of atmospheric stimuli on shopping outcomes based on an analysis of data aggregated across the research stream.

Theoretical Background

The framework for this meta-analysis is depicted in Fig. 1 together with the investigated variables. It follows the extant literature in using the so-called stimulus-organism-response paradigm (Mattila and Wirtz 2001; Mehrabian and Russell 1974).

Shopping Outcomes

Frequently studied shopping outcomes at the organism level include customers' emotional reactions and judgments of satisfaction. Emotional reactions are conceptualized as a combination of arousal and pleasure. *Arousal* represents the activation dimension and can be defined as the perceived degree of stimulation, while *pleasure* represents the valence dimension and refers to the perceived degree of enjoyment (Donovan and Rossiter 1982). *Satisfaction* reflects an overall evaluative judgment about the shopping experience (Mattila and Wirtz 2001). Satisfaction is distinct from pleasure in that it relates to outward-looking judgments about external entities such as a store's atmosphere ("Shopping in this store is a positive experience", as adapted from Sayin et al. 2015, p. 5); while pleasure reflects a subjective, inward focus ("I'm experiencing pleasant feelings").

At the response level, the most commonly studied variables include purchase (Fiore, Yah, and Yoh 2000), visiting (Doucé and Janssens 2013), shopping (Broekemier, Marquardt, and Gentry 2008), or patronage intention (Grewal et al. 2003). Studies also capture actual expenditures (Sullivan 2002). Together, these variables reflect the underlying objective of customers to do business with an organization, and are here subsumed under *behavioral intentions*.

Atmospheric Stimuli

The integration of prior findings into a common framework necessitates a concentration on the most frequently studied variables. Among the wide variety of investigated atmospheric stimuli, music, scent, and color have received the most research attention and are therefore the focus of this analysis (Bellizzi, Crowley, and Hasty 1983; Bone and Ellen 1999; Garlin and Owen 2006).

Music

As an atmospheric stimulus, music refers to human compositions functioning as an ambient element in the consumption environment (Garlin and Owen 2006). At the most basic level, *music* has been studied by comparing the effects of the presence and absence of music; that is customer emotions, satisfaction, and behavioral intentions are compared across conditions where music is present and where music is absent (e.g., Grewal et al. 2003).

Authors argue that music can be seen as a complementary product or service feature that is consumed during the purchase process and is therefore likely to influence shopping outcomes (Hui, Dubé, and Chebat 1997). Another explanation for the effect of music comes from optimal arousal theory, which posits that people seek to align their current level of arousal to a level they find personally optimal (Berlyne 1971). Customers who are in an "understimulated" state will be seeking heightened arousal, which they may realize through the presence of music in the shopping environment (Mattila and Wirtz 2001). Since arousal operates as an amplifier of positive in-store experiences (Oliver, Rust, and Varki 1997), downstream positive effects on pleasure, satisfaction, and behavioral intentions can be anticipated. Therefore, we hypothesize:

H1. The presence (versus absence) of music has a positive effect on (a) arousal, (b) pleasure, (c) satisfaction and (d) behavioral intentions.

Scent

Ambient scent refers to a scent present in the environment that does not emanate from a particular object (Bone and Ellen 1999). Scent has been employed as a naturally occurring stimulus (e.g., in bakeries) as well as an artificially induced stimulus to enhance store ambience (Spangenberg et al. 2006). Similar to music, *scent* effects are usually measured by comparing customers' shopping experiences in a scented environment with those in a scent-free one (e.g., Doucé and Janssens 2013).

Research suggests that, relative to other sensory cues, scent is processed in a more primitive portion of the brain (Herz and Engen 1996), and scent therefore requires little or no cognitive effort to enhance alertness, improve in-store experience, and promote positive shopping outcomes (Bone and Ellen 1999). Studies have also found a privileged neural link between the olfactory nerve and the area responsible for emotional memory (Herz 2004). This is understood as the physiological explanation for why smell evokes significantly stronger emotional memories compared to those triggered by auditory and visual stimuli (Herz 2004). Therefore, when evoked in-store, such memory associations may stimulate positive emotions and lead to a more enjoyable shopping experience (Bone and Ellen 1999). Hence, we propose:

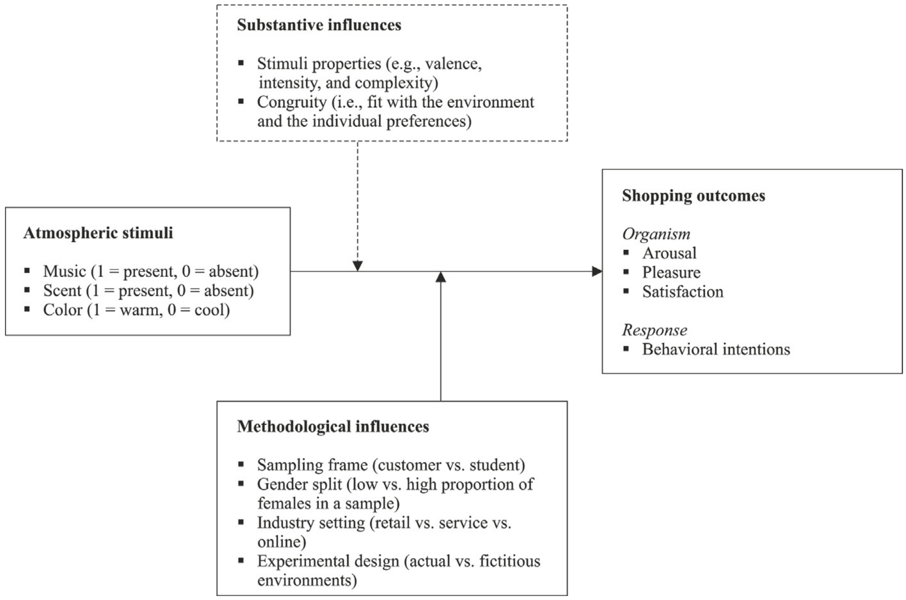

Fig. 1. Meta-analytic framework.

H2. The presence (versus absence) of scent has a positive effect on (a) arousal, (b) pleasure, (c) satisfaction and (d) behavioral intentions.

Color

As an atmospheric variable, color describes the visual appearance of the consumption environment (Bellizzi, Crowley, and Hasty 1983). Scholars usually compare non-white colors as these can be ordered by wavelength, i.e., from long to short (Crowley 1993). Research defines those with a longer wavelength—such as red, orange, and yellow—as warm colors, while those with a shorter wavelength—such as green, blue, and violet—are described as cool (Crowley 1993). Although white is generally regarded as neutral, it is sometimes ascribed to the cool color category (Chebat and Morrin 2007). Accordingly, researchers have predominantly studied *color* by comparing customers' internal dispositions and behavioral intentions in response to warm or cool conditions in a manner analogous to the present versus absent comparison used in studies on music and scent (e.g., van Rompay et al. 2012).

For conceptualizing color effects in retail settings, studies draw on physiological and psychological findings reported for human behavior in general in response to color (Bagchi and Cheema 2013; Bellizzi and Hite 1992). Physiologically, red (relative to blue) has been found to be more activating in terms of blood pressure, respiratory rate, and skin-conductance. Psychologically, warm colors (especially red) are seen as emotionally arousing, exciting, and distracting, while cool colors (especially blue) are linked to feelings of relaxation, peacefulness, calmness, and pleasantness (for more detailed summaries, see Bellizzi, Crowley, and Hasty 1983 and Labrecque, Patrick, and Milne 2013).

Findings in the atmospherics domain mirror these results. Red (compared to blue) has been linked to greater arousal, and blue (compared to red) is reported to be more relaxing and pleasant and to facilitate purchase incidence within a shopping environment (Bagchi and Cheema 2013; Bellizzi and Hite 1992; Crowley 1993). However, the overall empirical evidence remains inconclusive, with some studies being unable to identify differences in response to warm and cool colors, and others revealing effects opposite to the direction hypothesized (Babin, Hardesty, and Suter 2003; Bagchi and Cheema 2013; Bellizzi and Hite 1992; Cyr, Head, and Larios 2010). For our hypothesis, we follow the main theoretical perspective and propose:

H3. Warm (versus cool) colors have a positive effect on (a) arousal and a negative effect on (b) pleasure, (c) satisfaction, and (d) behavioral intentions.

Moderators

Substantive Influences

Substantive influences relate to boundary conditions that describe how a stimulus should be designed in order to maximize the impact of its presence. Variations in stimuli investigated in the context of music, scent, and color can be categorized as structural and congruity characteristics (Bone and Ellen 1999; Mattila and Wirtz 2001). Although the number of empirical operationalizations of these characteristics was insufficient for them to be included and compared in the meta-analysis, we describe them here briefly as they do figure in the research we are reviewing.

Structural characteristics describe the 'components' of a stimulus and include valence, intensity, and complexity. Valence reflects whether a stimulus carries a positive or negative connotation and reflects distinctions such as happy versus sad music, the bright-to-dark gradation of color, and the hedonic or utilitarian tone of a scent (Cheng, Wu, and Yen 2009; Hui, Dubé, and Chebat 1997; Knasko 1995). Stimulus intensity captures, for example, the tempo and volume of music, the concentration of scent in the air, and the degree of saturation of a given color (Bone and Ellen 1999; Cheng, Wu, and Yen 2009; Herrington and Capella 1996). Complexity describes the simplicity versus elaboration of a stimulus, including, for instance, how easy it is for a customer to follow a piece of music (North and Hargreaves 1996), to identify a scent (plain versus blended odors; Herrmann et al. 2013), or to understand a color scheme (plain versus gradient color compositions).

Congruity is defined as the fit of a stimulus to the overall store ambience. Since a perceived incongruence interferes with customers' information processing, studies provide consistent evidence that the fit of a stimulus to either a part (e.g., a product assortment) or to an entire store environment enhances its impact on shopping outcomes (Mattila and Wirtz 2001; Mitchell, Kahn, and Knasko 1995; Spangenberg et al. 2006). The same also applies to the fit of a stimulus to individual preferences (Broekemier, Marquardt, and Gentry 2008). In consequence, researchers typically employ stimuli with structural characteristics that suit the shopping environment, as for instance was implemented by Grewal et al. (2003, p. 262), who used classical music "because it 'fits' the context of luxury goods".

Methodological Influences

Study designs used in research on atmospheric effects reflect the differences in methodological decisions made by researchers. One objective of this research was to consider the impact of these methodological decisions on the effect sizes observed in the primary studies and to use coded variables reflecting these methodological decisions in an attempt to account for between-study variance in effect sizes. Four potential moderators were included: sampling frame (student versus customer), gender split (low versus high proportion of females in a sample), industry setting (retail versus service versus online), and experimental design (actual versus fictitious environments).

Variations between *student and customer* (i.e., non-student) samples may be ascribed to differences in personality development. Specifically, students are regarded as "unfinished personalities" (Carlson 1971, p. 212) with less defined preferences. Peterson's (2001) second order meta-analysis shows that effect sizes from student samples frequently differ from those derived from non-student subjects. However, no systematic pattern with respect to effect sizes or direction of effects between students and customers could be firmly established. Expecting a similar unsystematic variation, we use a non-directional hypothesis and propose:

H4. The effect sizes of atmospheric stimuli on shopping outcomes vary between student- and customer-based samples.

Although some authors have made suggestions regarding music and color (Andersson et al. 2012; van Rompay et al. 2012), empirical findings on *gender* effects have been reported mainly in relation to scent (Bone and Ellen 1999). Physiological evidence points to women as being emotionally more sensitive and responsive to scent (Herz and Engen 1996). Yousem et al. (1999) for instance find that scent activates a larger area in a woman's brain than in a man's. In the atmospherics domain, Lehrner et al. (2000) indicate that the presence of an ambient orange scent in the waiting room of a dental surgery evoked more pleasure in women than in men. Consequently, we propose:

H5. The effect size of scent on (a) arousal and (b) on pleasure is larger in samples with a higher proportion of females as compared to samples with a lower proportion of females.

Industry setting (retail, service, or online) may account for between-study variance in the effect size of atmospheric stimuli. Among investigations into settings, the differences between service contexts and product retail settings have been particularly discussed (Bitner 1990). Relative to products, services are defined by their inherently larger degree of intangibility (Bitner 1990). It is suggested that, in the absence of tangible product features, environmental cues regarding services serve as subtle messages that help customers to know what to expect from a certain offering (Booms and Bitner 1982). Accordingly, customers may depend to a larger extent on atmospheric stimuli when in contact with a service environment than in a retail setting. This leads to the following hypothesis:

H6. The effect sizes of music, scent, and color are larger in service than in retail settings.

Finally, *research designs* in the literature on experimental atmospherics can be grouped into those based on fictitious versus actual (i.e., in-store) environments. Extant research provides mixed findings. On the one hand, Bateson and Hui (1992) find evidence for the ecological validity of fictitious environments. On the other hand, fictitious environments can lead to inflated effect sizes because they allow researchers more control in isolating extraneous factors that may have bearing on the hypothesized relationships and in directing the attention of the study participants (Shadish, Cook, and Campbell 2010). Thus, we hypothesize:

H7. The effect sizes of atmospheric stimuli on shopping outcomes are larger in fictitious than in actual environments.

Method

Database Development

A bibliographic keyword search was conducted to identify studies reporting on customers' reactions to the atmospheric stimulus variables as specified in Fig. 1. Databases used included *EBSCO Business Source Complete*, *Science Direct*, *Emerald Management Xtra*, *ABI/Inform*, *PsycINFO*, *Google Scholar* and the *Social Science Citation Index*. In addition, a reference analysis was conducted on previous summaries (Bone and Ellen 1999; Garlin and Owen 2006; Turley and Milliman 2000), and a citation analysis of pertinent articles was made (Bellizzi, Crowley, and Hasty 1983; Milliman 1982; Spangenberg, Crowley, and Henderson 1996). Unpublished work was also obtained by searching the *SSRN database* and *Google Scholar*.

A study was included in the final data set if (1) music, scent, and color were manipulated experimentally, (2) the study was independent (i.e., if the results of two different studies were derived from the same sample, the study which provided more detail was used), (3) the measurement item(s) of an outcome variable accurately reflected our construct specification, and (4) an effect size or sufficient statistical information was provided for at least one of the relationships specified in Fig. 1. A study was excluded if the experimental design prevented the isolation of effects for a single stimulus (i.e., multiple manipulations were not fully crossed).

The search identified 66 studies (64 articles published in academic journals, 2 unpublished working papers) that met the criteria for inclusion. The included studies referred to 74 independent samples from the time period 1982 to 2016 (March) with a combined total N of 15,621 respondents. Overall, the average sample had a median age of 33.2 years (student samples = 22.0 years, general customer samples = 39.1 years) and a median gender split of 61.7% in favor of female respondents. Following the removal of two outliers,[1] we obtained a final data set of 135 study effects.

Effect Size

Computation

Common meta-analytic guidelines were followed for the experimental studies reviewed in the meta-analysis. First, the standardized mean differences (Cohen's d) were computed, followed by conversion of these to correlation coefficients (De Matos, Henrique, and Rossi 2007). The choice of using correlation coefficients as the effect-size metric was based on the relative ease with which these can be interpreted, and their general utility as a standard meta-analytic metric in the marketing literature (Gelbrich and Roschk 2011; Palmatier et al. 2006).

When calculating r, a positive (negative) value indicates that—in the case of music and scent—the presence compared to the absence condition increases (decreases) the value of the outcome variable. Likewise, in the case of color, a positive (negative) value indicates that the warm (i.e., red, orange and yellow) compared to the cool (i.e., green, blue, violet, and white) color scheme increases (decreases) the value of the outcome variable.

Integration

Correlation coefficients were directly derived from the studies at hand or were calculated through statistical data such as Student's t, η^2, and F-ratios (Cohen 1988; Glass, McGaw, and Smith 1981). In some cases, the study authors provided more than one measure of correlation for the same relationship by analyzing different response measures or multiple experimental comparisons between a stimulus-absent group (e.g., no music) and a stimulus-present group (e.g., different styles of music). If this was the case, we averaged the effect sizes in order to avoid bias from the overrepresentation of samples (Palmatier et al. 2006).

The effect sizes were next adjusted for reliability to correct for attenuation from random measurement error (Hunter and Schmidt 2004). For studies that did not provide reliability indices or used single-item measures, the mean sample size-weighted reliability across all studies was used. We then computed the sample-size weighted means of all available effect size estimates for each relationship, which we refer to as r (Hunter and Schmidt 2004).

Calculation of Associated Statistics

We calculated the 'fail-safe N' statistic to find the average number of discarded null results necessary to render the relationships non-significant. For a meaningful, robust result Rosenthal (1979) suggests that the obtained fail-safe N should be greater than or equal to five times the number of observations plus 10 (referred to as 'required fail-safe N'). Heterogeneity of the integrated effect sizes (i.e., between-study variance) was assessed via the Q-Statistic (Hedges and Olkin 1985). Moderator analyses are justified when between-study variance is significant, indicating that results of extant studies do not converge on a common population value.

Coding

Two judges independently coded the dependent and moderating variables based on the theoretical definitions of the constructs. The two judges concurred on more than 95 percent of independently determined coding decisions; disagreements were resolved by discussion. A table of the codings is provided in the Appendix.

Results

Atmospheric Effects

The results of the impact of atmospheric stimuli on arousal, pleasure, satisfaction, and behavioral intentions are shown in Table 1. Following Cohen's (1988, p. 82) criteria, an effect size of .10 can be considered as small, .30 as medium, and .50 as large.

Our findings indicated that the presence of music (compared to its absence) was significantly and positively related to pleasure (r = .098), to satisfaction (r = .226), and to behavioral intentions (r = .130). Fail-safe N values exceeded the required fail-safe N (see Table 1). Presence of music did not significantly affect arousal. Hence, H1b, H1c, and H1d were supported while H1a was not.

Scent was significantly related to all outcome variables. Presence of scent led to higher arousal (r = .079), pleasure (r = .093), satisfaction (r = .183), and behavioral intentions (r = .054) as compared to scent-absent conditions, supporting H2a, H2b, H2c, and H2d. The effect of scent on arousal should be treated with caution because the obtained fail-safe N was below the normative value.

Color schemes significantly affected both arousal and satisfaction. As hypothesized, these effects were in opposing directions. Warm as compared to cool color schemes produced higher arousal (r = .157) but lower satisfaction (r = −.254). Both effects had robust fail-safe Ns. Color was not significantly related to either pleasure or behavioral intention. Thus, H3a and H3c were supported while H3b and H3d were not.

[1] The outliers were excluded because they lay outside of the range of three standard deviations to the respective sample-size weighted mean effect size.

Table 1
Meta-analytic results for the influence of the atmospheric stimuli on the shopping outcomes.

	k	N	r	95% CI		SD	p	Fail-safe N		Min	Max	Q-Statistic[a]
				Lower bound	Upper bound			Obtained	Required			
Music (present = 1, absent = 0)												
Arousal	11	2441	.042	−.021	.106	.108	.193	–	–	−.272	.265	28.87**
Pleasure	12	2489	**.098**	.043	.153	.097	<.001	77	70	.000	.334	24.47*
Satisfaction	5	877	**.226**	.170	.282	.064	<.001	63	35	.151	.354	4.03 *ns*
Behavioral intentions	19	3116	**.130**	.078	.181	.114	<.001	314	105	−.059	.395	43.03***
Scent (present = 1, absent = 0)												
Arousal	14	2763	.079	.033	.124	.087	<.001	49	80	−.071	.277	20.96 *ns*
Pleasure	18	3793	**.093**	.039	.148	.117	<.001	184	100	−.193	.331	53.36***
Satisfaction	4	938	**.183**	.099	.268	.086	<.001	30	30	.031	.293	7.40 *ns*
Behavioral intentions	21	5280	**.054**	.013	.094	.094	.009	129	115	−.154	.458	49.32***
Color (warm = 1, cool = 0)												
Arousal	9	1724	**.157**	.020	.294	.210	.025	156	55	−.198	.522	85.69***
Pleasure	8	1499	.031	−.129	.192	.232	.704	–	–	−.380	.446	88.46***
Satisfaction	7	947	**−.254**	−.299	−.210	.060	<.001	79	45	−.320	−.105	3.52 *ns*
Behavioral intentions	7	1225	−.057	−.190	.076	.179	.402	–	–	−.292	.301	40.47***

Note: *k*, number of effects; *N*, total sample size; *r*, sample size-weighted mean correlation coefficient adjusted for reliability; *SD*, standard deviation. Obtained/required fail-safe *N* are not calculated for insignificant relationships (indicated by a dashed line). Figures in bold indicate significance and, with regards to the fail-safe *N*, robust correlations. *ns*, not significant.

[a] $df = k - 1$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Moderating Effects

The last column in Table 1 depicts the Q-statistic. Results indicated that between study variance was non-significant for four relationships (music → satisfaction, scent → arousal, scent → satisfaction, color → satisfaction). For the remaining eight relationships, the results were significant, indicating the appropriateness of moderator analyses in attempting to explain between-study variance. Moderator analyses were conducted by partitioning studies according to coded levels of study characteristics and calculating *r* within subgroups. For gender, we used the median proportion of females to create two sub-groups (≤61.7% versus >61.7%). Subsequently, a *t*-test for small samples, as described by Winer (1971), was used (Palmatier et al. 2006).[2] It should be noted that the small number of study effects render these tests low in statistical power, and therefore Type II error is more likely than Type I error (Brown 1996). The results of these moderator analyses are depicted in Tables 2 and 3, and are reported below.

For most relationships, effect sizes did not differ significantly between student and non-student samples. Only music had stronger effects on behavioral intentions in non-student samples ($r = .169$) than in student samples ($r = .069$). Overall, H4 was not confirmed.

With regard to gender effects, significantly larger effect sizes were found for the relationship between scent and pleasure among samples with a higher proportion of females ($r = .176$) compared to those with a lower proportion ($r = .069$). A similar between-group difference was evident for arousal, but was not statistically significant. Hence, H5b was supported while H5a was not. Additionally, the presence of music had a significantly stronger effect on behavioral intention among samples with a lower proportion of females ($r = .165$) as compared to those with a higher proportion ($r = .006$).

The industry setting analyses indicated a tendency toward stronger music and scent effects in service as compared to retail settings. However, the results were significant only for the effect of music on behavioral intentions (service $r = .200$, retail $r = .112$), and they were marginally significant for the effect of music on pleasure (service $r = .263$, retail $r = .073$) and for the effect of scent on behavioral intentions (service $r = .342$, retail $r = .041$). Thus, H6 was partially supported for music and scent. The results also showed significantly larger effect sizes in online compared to retail settings for the relationships between color and arousal (online $r = .401$, retail $r = .040$) and between color and pleasure (online $r = .208$, retail $r = -.059$).

Finally, seven relationships had a sufficient number of available effects to make it possible to compare effect sizes between experiments carried out in actual versus fictitious environments. Results showed that none of the analyzed differences were of statistical significance and H7 was not supported.

General Discussion

In the light of the volume of the literature that is uncertain about the impact of atmospheric stimuli on shopping outcomes, the first objective of this meta-analysis was to calibrate effect sizes. On an aggregate level, the results revealed predictable

[2] The small sample *t*-statistic is based on the single reliability corrected correlation coefficients and is calculated by $t = \frac{(\bar{x}_a - \bar{x}_b)}{\sqrt{(s_a^2/n_a) + (s_b^2/n_b)}}$, with $df = \frac{(V+W)^2}{[V^2/(n_a-1)] + [W^2/(n_b-1)]}$, where $V = s_a^2/n_a$ and $W = s_b^2/n_b$.

Table 2
Meta-analytic moderation results for the influence of the moderators on the effect sizes between atmospheric stimuli and shopping outcomes.

	Sampling frame								Gender split (% female)							
	Level	*r*	*k*	LB	UB	*t*	*df*	*p*	Level	*r*	*k*	LB	UB	*t*	*df*	*p*
Music (present = 1, absent = 0)																
Arousal	Customer	.045	6	−.063	.152	0.53	8	.305	≤61.7	.081	4	−.037	.199	1.29	4	.133
	Student	.041	5	−.032	.114				>61.7	.033	5	−.028	.094			
Pleasure	Customer	.099	6	−.011	.208	0.01	7	.496	≤61.7	.065	4	−.043	.173	0.05	6	.481
	Student	.098	6	.055	.140				>61.7	.115	5	.037	.194			
Satisfaction																
Behavioral intentions	Customer	**.169**	**10**	**.102**	**.235**	**1.76**	**17**	**.048**	≤61.7	**.165**	**8**	**.089**	**.240**	**3.78**	**9**	**.002**
	Student	**.069**	**9**	**.006**	**.132**				>61.7	**.006**	**3**	**−.044**	**.056**			
Scent (present = 1, absent = 0)																
Arousal	Customer	.084	9	.030	.138	0.25	8	.404	≤61.7	.059	7	.004	.115	1.25	8	.124
	Student	.058	5	−.028	.144				>61.7	.132	4	.061	.203			
Pleasure	Customer	.087	13	.025	.149	0.69	8	.255	≤61.7	**.069**	**8**	**.000**	**.138**	**3.00**	**11**	**.006**
	Student	.130	5	.016	.245				>61.7	**.176**	**5**	**.124**	**.227**			
Satisfaction	Customer	.158	2	.148	.168	0.04	1	.489	≤61.7	.213	2	.046	.381	0.04	1	.489
	Student	.213	2	.046	.381				>61.7	.158	2	.148	.168			
Behavioral intentions	Customer	.042	14	−.011	.094	0.67	19	.254	≤61.7	.091	5	.018	.165	1.47	7	.093
	Student	.096	7	.054	.138				>61.7	−.002	6	−.048	.044			
Color (warm = 1, cool = 0)																
Arousal	Customer	.130	5	−.041	.301	0.37	7	.362	≤61.7	.286	3	.073	.499	0.90	4	.209
	Student	.237	4	.013	.462				>61.7	.050	4	−.104	.204			
Pleasure	Customer	.087	3	−.077	.250	1.45	6	.098	≤61.7	.239	2	−.069	.547	1.80	2	.107
	Student	−.038	5	−.294	.219				>61.7	−.035	4	−.146	.077			
Satisfaction	Customer	−.260	3	−.317	−.203	0.05	5	.483								
	Student	−.233	4	−.315	−.151											
Behavioral intentions	Customer	−.075	4	−.210	.060	0.49	3	.330	≤61.7	.087	2	−.102	.276	2.29	2	.074
	Student	−.025	3	−.286	.235				>61.7	−.150	4	−.280	−.020			

Note: *r*, sample size-weighted mean correlation coefficient adjusted for reliability; *k*, number of effects; LB/UB, lower/upper bound of the 95% CI. Due to missing information, the combined number of observation across subgroups can be lower than the total from Table 1. Subgroup comparisons are conducted if at least two observations in each subgroup could be identified. Significant differences are highlighted in bold.

patterns for the effects of music (presence vs. absence), scent (presence vs. absence) and colors (warm vs. cool) on shopping outcomes. The effect sizes for the significant relationships were estimated at an average *r* that spanned from .054 to .254 (in absolute terms). These values indicated that the relationships were small-to-medium in strength, which can be seen as reflecting the subtle nature of the atmospheric stimuli. Overall, the results provide researchers with a quantitative summary that figures the pattern of the effects that have been included within the research stream. Specific insights for music, scent, and color are as follows:

For music, the results revealed significant and positive aggregate effects on pleasure, satisfaction, and behavioral intentions. A link with arousal could not be established. It appears that music is, against a background noise such as customer chatter, too subtle to trigger customers' arousal. Hence, musical stimulation may be seen as a pleasure-inducing substitute for distracting in-store sounds, which will enhance the shopping experience. Furthermore, the generalized estimates reported here add to and update those provided by Garlin and Owen (2006), thus providing researchers with two complementary summaries which may be used as references for further research into the effects of atmospheric music.

At a meta-analytic level, scent positively influences customers' pleasure, satisfaction, and behavioral intentions. A positive effect of scent on arousal was also evident, with the limitation that its robustness against discarded null-results could not be verified. These findings suggest a need to reconsider the conclusion in Bone and Ellen's (1999) review, which states that "counting on such [scent] effects is an unwise strategy at this point in time" (p. 259). Instead, scent may be regarded as a reliable means for enhancing the shopping experience.

The integrated effects show color to be bipartite in nature. While warm colors cause higher levels of arousal than cool colors, the opposite is true for satisfaction. Researchers can draw on these results when conceptualizing color effects for specific in-store behavioral phenomena. For instance, Labrecque, Patrick, and Milne (2013) discuss the arousing yet dissatisfying effect of warm (vs. cool) colors on the perception of customers who are waiting in the check-out line. Our data did not confirm a significant effect of color on pleasure or on behavioral intentions. Opposing color effects may, due to interrelationships among the

Table 3
Meta-analytic moderation results for the influence of the moderators on the effect sizes between atmospheric stimuli and shopping outcomes.

	Industry setting								Experimental design							
	Level	*r*	*k*	LB	UB	*t*[a]	*df*	*p*	Level	*r*	*k*	LB	UB	*t*	*df*	*p*
Music (present = 1, absent = 0)																
Arousal	Retail	.022	5	−.084	.129	1.31	2	.160	Actual	.041	7	−.055	.138	0.82	8	.219
	Service	.142	2	−.032	.316	.37	2	.374	Fictitious	.043	4	−.040	.126			
	Online	.043	4	−.040	.126	1.26	7	.124								
Pleasure	Retail	.073	6	−.020	.166	2.79	2	.054	Actual	.104	7	.005	.203	0.41	8	.346
	Service	.263	2	.152	.374	2.45	2	.067	Fictitious	.093	5	.049	.138			
	Online	.094	4	.044	.145	.76	8	.234								
Satisfaction	Retail	.236	2	.200	.272	.51	1	.349								
	Service	.273	2	.153	.393											
Behavioral intentions	Retail	**.112**	**8**	**.031**	**.194**	**2.03**	**13**	**.032**	Actual	.169	10	.102	.235	1.53	16	.073
	Service	**.200**	**7**	**.142**	**.258**	**4.40**	**7**	**.002**	Fictitious	.076	8	.007	.144			
	Online	**.022**	**3**	**−.036**	**.081**	1.64	9	.067								
Scent (present = 1, absent = 0)																
Arousal	Retail	.107	9	.057	.158	.14	6	.446	Actual	.089	7	.029	.149	1.17	9	.135
	Service	.037	4	−.042	.116				Fictitious	.051	6	−.024	.126			
Pleasure	Retail	.078	12	.008	.148	.11	6	.459	Actual	.090	11	.023	.157	0.09	12	.466
	Service	.120	5	.031	.208				Fictitious	.115	6	.011	.219			
Satisfaction									Actual	.158	2	.148	.168	0.04	1	.489
									Fictitious	.213	2	.046	.381			
Behavioral intentions	Retail	.041	17	.006	.076	3.88	1	.080	Actual	.051	13	.000	.101	0.27	15	.395
	Service	.342	2	.191	.493				Fictitious	.064	7	−.012	.140			
Color (warm = 1, cool = 0)																
Arousal	Retail	**.040**	**4**	**−.096**	**.177**	.78	2	.260								
	Service	.088	2	−.122	.297	1.89	1	.155								
	Online	**.401**	**3**	**.283**	**.518**	**3.63**	**5**	**.008**								
Pleasure	Retail	**−.059**	**4**	**−.219**	**.101**											
	Service															
	Online	**.208**	**3**	**−.095**	**.511**	**2.33**	**4**	**.040**								
Satisfaction	Retail	−.237	2	−.279	−.196	.67	1	.311								
	Service	−.277	2	−.346	−.207	.27	2	.405								
	Online	−.179	3	−.292	−.066	1.11	3	.174								
Behavioral intentions	Retail	−.094	5	−.216	.027											
	Service															
	Online	.037	2	−.280	.354	1.14	1	.229								

Note: *r*, sample size-weighted mean correlation coefficient adjusted for reliability; *k*, number of effects; LB/UB, lower/upper bound of the 95% CI. Due to missing information, the combined number of observation across subgroups can be lower than the total from Table 1. Subgroup comparisons are conducted if at least two observations in each subgroup could be identified. Significant differences are highlighted in bold.

[a] Subgroup comparisons in the following sequence: retail vs. service, service vs. online, online vs. retail.

shopping outcomes, indirectly exhibit a joint effect on pleasure and on behavioral intentions, which thus cancel each other out.

The second objective of this meta-analysis was to attempt to explain between-study variance in effect size estimates. The results of primary studies show significant effect size variations for the majority of relationships, indicating that the effectiveness of atmospheric stimuli is likely to depend on the specific context in which they are employed. Part of this variation can be accounted for by the researchers' study design choices. Specifically, gender split and industry setting provide the following insights.

For gender, the moderation results indicate that women derive more pleasure from scent than men. This confirms physiological research on scent (Yousem et al. 1999) and encourages researchers to pay attention to gender differences in scent effects. It further suggests that prior research using female-only samples (Morrison et al. 2011) may have experienced inflated effects for this particular relationship. Additionally, our data shows that music has a weaker impact on the behavioral intentions of women than on those of men, confirming recent findings in the atmospherics literature (Andersson et al. 2012).

With regard to industry setting, the effect sizes for music and scent tended to be stronger in service compared to retail settings. This finding is in line with prior research suggesting that atmospheric stimuli, as subtle signals for customers, gain greater salience when tangible product cues are absent (Bitner 1990). A similar logic may also explain the larger effects of color on arousal and pleasure in online as compared to retail settings. Additionally, a lack of data regarding scent effects in online settings reflects the need for a better understanding of how virtual environments can leverage scent effects (e.g., by scenting product packages).

Between-study variance of effect sizes could not be explained by either sampling frame or by experimental design. Thus, the effect sizes appear not to vary systematically in relation to these methodological specifications. One exception was a weaker link between music and behavioral intentions in student than in customer samples, which may be seen as a preliminary indication that there is less explicable variance in student (versus customer) behavioral intentions.

In addition to the heterogeneity of effect size estimates, moderator analysis also indicated that between-study variance was not significant for four relationships: music → satisfaction, scent → arousal, scent → satisfaction, and color → satisfaction. For these relationships, extant primary studies appear to converge of what is tentatively, and pending further research, considered to represent a population estimate of the elasticity of the atmospheric effects.

Managerially, establishing reliable effect patterns has the potential to provide retail executives with the necessary predictability over the uncertainty currently conveyed by the literature and thus to enable them to purposefully implement music, scent, and color to enhance their customers' shopping experience. In doing this, two aspects need consideration. First, congruence of the stimuli with the environment needs to be ensured otherwise the stimuli may cause adverse effects (Mitchell, Kahn, and Knasko 1995). Second, the small-to-medium size of the effects suggests that the stimuli are of a subtle nature and thus should be considered as long-term strategies. Specifically, music and scent foster the shopping outcomes with the exception of arousal. Music offers the greatest potential for being tailored to the purchase setting, while scent bears the advantage that pleasant scents may occur naturally (e.g., roasted coffee beans) and can be vented to aligning store areas. Further, warm colors cause higher levels of arousal than cool colors, while the opposite is true for satisfaction. To benefit from these effects, warm colors may be favored for new product aisles, leveraging on their arousal property, while cool colors may be preferred for complaint handling desks, leveraging on their satisfying property, for instance.

Finally, two main limitations that offer potential for future research are discussed. First, considerable variation in conceptual frameworks and inconsistent evidence preclude definitive conclusions on the causal priority among arousal, pleasure, satisfaction, and behavioral intentions (Babin and Darden 1996; Chebat and Michon 2003; Donovan and Rossiter 1982; Morrison et al. 2011). Therefore, our analysis is based on bivariate correlations. This choice was due to the main study focus, i.e., calibrating effect sizes to understand their direction and strength, and accounting for moderators to understand specific boundary conditions. Therefore, future work is encouraged to test for causal effects using larger meta-analytic datasets as downstream sequential effects relate to many additional types of exogenous influences besides those of atmospheric stimuli.

Second, the meta-analytic design relies on secondary data and thus only those relationships for which there was a sufficient quantity of empirical evidence were included. In particular, substantive moderators (valence, intensity, and complexity) could not be integrated and therefore represent an under-researched field worthy of future investigation and meta-analytic integration. Further, examining the extent to which atmospheric stimuli variables affect non-purchase related behavior, like in-store product trial participation, would be worth exploring.

Executive summary

Retailers use subtle atmospheric stimuli to purposefully enhance customers' shopping experience. Academic research has studied atmospheric stimuli with a particular emphasis on music, scent, and color in a large variety of study designs. The findings of this voluminous body of work, spanning more than 30 years, are however inconclusive, rendering reliable predictions about the stimuli's effects on shopping outcomes uncertain. We therefore synthesized the quantitative evidence from 66 experimental studies and examined the effects of music (presence vs. absence), scent (presence vs. absence), and colors (warm: red, orange, and yellow vs. cool: green, blue, violet, and white) on shopping outcomes. Shopping outcomes comprise customers' arousal (emotional stimulation), pleasure (emotional enjoyment), satisfaction (evaluation of the shopping experience), and behavioral intentions (e.g., purchase- or visiting intentions).

Results offer two key insights relevant to retail executives. First, in the light of the current uncertainty about the stimuli's atmospheric effects, the findings show predictable patterns for how music, scent, and color impact on shopping outcomes. More specifically, environments in which either music or scent is present, yield higher pleasure, satisfaction, and behavioral intention ratings compared with environments in which such conditions are absent. Warm colors produce higher levels of arousal than cool colors, while the opposite is true with respect to levels of satisfaction. It is important to note that the stimuli typically should fit the consumption context. Retail managers can use these findings as a guide, based as they are on data aggregated across the research stream, to enhance customers' shopping experience. As one such stimulus, music offers a flexible tool that easily can be tailored to the shopping context, pleasant scents may occur naturally and can be vented to aligning store areas, and colors can be used specifically in those areas where either arousal (e.g., new product aisles) or satisfaction (e.g., complaint handling areas) should be triggered.

Second, the size of the effect of stimuli on shopping outcomes varied across studies. We attempted to explain these variations by conducting subgroup analyses using coded moderators to reflect the study design decisions. Results showed, for instance, a tendency toward larger music and scent effects in service as compared to retail environments. We also found evidence indicating that women derive more pleasure from scent than men. Effect size variations point toward the context dependence of atmospheric effects, justifying the efforts of marketing intelligence to design and implement the stimuli according to the individual consumption environment. Overall, the average strength of the relationships across contexts was small-to-medium, which can be interpreted as a reflection of the subtle nature of stimuli. Therefore, their implementation should be considered as a long-term strategy.

Financial Support

The authors received no financial support or technical assistance for the research and/or authorship of this manuscript.

Acknowledgments

The authors are very grateful to three anonymous reviewers and the editor for their helpful and constructive comments. The first author also likes to thank Wendy Trabold for her constant support during the development of this project.

Appendix. Coded characteristics of included samples

	Sample (in alphabetical order)	Independent variables			Dependent variables				Moderating variables			
		Music	Scent	Color	Arousal	Pleasure	Satisfaction	Behavioral intentions	Sampling frame	Gender split (% female)	Industry setting	Experimental design
1	Alpert and Alpert (1990)	×				×		×	Student	NA	Retail	Fictitious
2	Andersson et al. (2012 – Study 1)	×			×	×		×	Customer	43.3	Retail	Actual
3	Andersson et al. (2012 – Study 2)	×			×	×		×	Customer	56.5	Retail	Actual
4	Babin, Hardesty, and Suter (2003)			×	×		×	×	Customer	100.0	Retail	Fictitious
5	Bagchi and Cheema (2013 – Study 3)			×	×				Customer	59.0	Online	Fictitious
6	Barli et al. (2012)			×				×	Customer	52.0	Retail	Actual
7	Baron (1997)		×			×			Customer	NA	Retail	Actual
8	Bellizzi and Hite (1992 – Study 1)			×				×	Customer	100.0	Retail	Fictitious
9	Bellizzi and Hite (1992 – Study 2)			×	×	×	×	×	Student	NA	Retail	Fictitious
10	Bouzaabia (2014)		×		×	×		×	Customer	NA	Retail	Actual
11	Bramley, Dibben, and Rowe (2016)	×						×	Student	64.2	Online	Fictitious
12	Chebat and Michon (2003)		×		×	×			Customer	57.0	Retail	Actual
13	Chebat and Morrin (2007)			×	×	×			Customer	64.6	Retail	Actual
14	Chebat, Morrin, and Chebat (2009)		×					×	Customer	NA	Retail	Actual
15	Cheng, Wu, and Yen (2009)			×	×	×			Customer	NA	Online	Fictitious
16	Cyr, Head, and Larios (2009 – Canadian sample)			×			×		Student	76.7	Online	Fictitious
17	Cyr, Head, and Larios (2009 – German sample)			×			×		Student	66.7	Online	Fictitious
18	Cyr, Head, and Larios (2009 – Japanese sample)			×			×		Student	86.7	Online	Fictitious
19	de Wijk and Zijlstra (2012)		×		×	×			Customer	59.1	NA	Fictitious
20	Dijkstra, Pieterse, and Pruyn (2008 – Study 2)			×	×				Student	63.6	Service	Fictitious
21	Doucé and Janssens (2013)		×		×	×		×	Customer	89.7	Retail	Actual
22	Fiore, Yah, and Yoh (2000)		×		×	×		×	Student	100.0	Retail	Fictitious
23	Grewal et al. (2003)	×					×	×	Student	47.0	Retail	Fictitious
24	Guégen and Petr (2006)		×					×	Customer	NA	Service	Actual
25	Harrington, Ottenbacher, and Treuter (2015)	×						×	Customer	NA	Service	Actual
26	Herrington and Capella (1996)	×						×	Customer	20.0	Retail	Actual
27	Herrmann et al. (2013 – Study 1)		×					×	Customer	NA	Retail	Actual
28	Herrmann et al. (2013 – Study 3)		×					×	Student	NA	Retail	Fictitious
29	Hui, Dubé, and Chebat (1997)	×					×	×	Student	49.1	Service	Fictitious
30	Jacob, Stefan, and Guéguen (2014)		×					×	Customer	NA	Service	Actual
31	Kim and Lennon (2012)	×			×	×			Student	100.0	Online	Fictitious
32	Kim, Kim, and Lennon (2009)	×			×	×			Student	100.0	Online	Fictitious
33	Knasko (1995)		×		×	×			Student	NA	Retail	Fictitious
34	Lehrner et al. (2000 – Female sample)		×		×	×			Customer	100.0	Service	Actual

Appendix (*Continued*)

Sample (in alphabetical order)	Independent variables			Dependent variables				Moderating variables			
	Music	Scent	Color	Arousal	Pleasure	Satisfaction	Behavioral intentions	Sampling frame	Gender split (% female)	Industry setting	Experimental design
35 Lehrner et al. (2000 – Male sample)		×		×	×			Customer	0.0	Service	Actual
36 Lehrner et al. (2005)	×	×		×	×			Customer	49.5	Service	Actual
37 Lorenzo-Romero, Gómez-Borja, and Mollá-Descals (2011)	×			×	×	×	×	Student	NA	Online	Fictitious
38 Ludvigson and Rottman (1989)		×					×	Student	70.8	NA	Fictitious
39 Madzharov, Block, and Morrin (2015 – Study 3)		×					×	Customer	NA	Retail	Actual
40 Mattila and Wirtz (2001)	×	×		×	×	×	×	Customer	75.0	Retail	Actual
41 McDonnell (2007)		×			×			Customer	45.0	Service	Actual
42 McGrath, Aronow, and Shotwell (2015)		×					×	Customer	NA	Retail	Actual
43 Michon and Chebat (2007)		×					×	Customer	62.0	Retail	Actual
44 Michon, Chebat, and Turley (2005)		×			×			Customer	NA	Retail	Actual
45 Middlestadt (1990)			×		×			Student	100.0	Retail	Fictitious
46 Milliman (1982)	×						×	Customer	NA	Retail	Actual
47 Mitchell, Kahn, and Knasko (1995 – Study 2)		×		×	×			Customer	NA	Retail	Fictitious
48 Moore (2014)		×					×	Student	54.3	Retail	Fictitious
49 Morrin and Chebat (2005)		×					×	Customer	61.7	Retail	Actual
50 Morrin and Ratneshwar (2000)		×		×	×			Student	NA	Retail	Fictitious
51 Morrison et al. (2011)		×		×	×	×	×	Customer	100.0	Retail	Actual
52 North and Hargreaves (1996)	×						×	Student	62.0	NA	Fictitious
53 North, Shilcock, and Hargreaves (2003)	×						×	Customer	50.0	Service	Actual
54 Novak, La Lopa, and Novak (2010)	×			×	×			Student	62.8	Service	Actual
55 Parsons (2009)		×					×	Customer	NA	Retail	Fictitious
56 Poon (2014)		×		×	×			Student	54.3	Retail	Fictitious
57 Price (2010)			×		×		×	Student	71.5	Online	Fictitious
58 Sayin et al. (2015 – Study 2)	×					×		Student	NA	Service	Fictitious
59 Sayin et al. (2015 – Study 3)	×						×	Student	NA	Service	Fictitious
60 Sayin et al. (2015 – Study 4)	×						×	Student	NA	Service	Fictitious
61 Schifferstein and Blok (2002)		×					×	Customer	NA	Retail	Actual
62 Schifferstein, Talke, and Oudshoorn (2011)		×		×	×			Customer	50.1	Service	Actual
63 Spangenberg, Crowley, and Henderson (1996)		×				×	×	Student	46.0	Retail	Fictitious
64 Spangenberg et al. (2005)		×		×	×	×	×	Student	50.7	Retail	Fictitious
65 Sullivan (2002)	×						×	Customer	NA	Service	Actual
66 van Hagen et al. (2008)			×	×	×			Student	50.0	Service	Fictitious
67 van Rompay et al. (2012)			×	×	×		×	Customer	61.8	Retail	Fictitious
68 Vinitzky and Mazursky (2011)		×					×	Student	29.8	NA	Fictitious
69 Wilson (2003)	×						×	Customer	54.6	Service	Actual
70 Wu, Cheng, and Yen (2008)	×		×	×	×		×	Student	49.0	Online	Fictitious
71 Yalch and Spangenberg (1988)	×			×	×		×	Customer	NA	Retail	Actual
72 Yalch and Spangenberg (1993)	×			×	×			Customer	68.6	Retail	Actual
73 Yildirim et al. (2012)			×			×		Customer	100.0	Service	Fictitious
74 Yildirim, Akalin-Baskayab, and Hidayetoglu (2007)			×			×		Customer	51.0	Service	Actual

Note: NA, not available (i.e., characteristics that were either absent from or not codeable in the studies). Individual studies may contain dependent variables which are not considered in this analysis since the statistical data was not sufficient to calculate an effect size. A reference list of the included studies is available from the authors upon request.

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