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Impact of Perceived Neuromarketing Stimuli on Brand Resonance among Retail Shoppers

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Abstract:

Purpose: This study asks whether, and by how much, the neuromarketing stimuli that shoppers perceive inside stores shape their brand resonance, using data from organized retail shoppers in Patiala, Punjab, India. It also weighs the separate contribution of each stimulus dimension. Perceived neuromarketing stimuli are taken to be the visual, auditory, olfactory, tactile and emotional cues of a store that shoppers consciously notice but that are designed to act on responses below awareness. Brand resonance is captured as one composite index built on the four components of Keller's (2001) model: behavioural loyalty, attitudinal attachment, sense of community and active engagement.

Design/methodology/approach: The data come from a single cross-sectional survey. Three hundred adult customers of organized retail outlets in Patiala, recruited through purposive and convenience sampling, completed a 37-item instrument answered on five-point Likert scales. Internal consistency was checked with Cronbach's alpha. Simple linear regression estimated the overall effect of the stimuli on brand resonance, after which the five dimensions were entered jointly in a multiple regression so that their standardised coefficients could be set against one another.

Findings: All constructs were internally consistent (α from 0.77 to 0.90). Brand resonance rose with perceived neuromarketing stimuli ($\beta = 0.442$, $p < 0.001$), which on their own accounted for nearly a fifth (19.6%) of the differences in resonance scores. With all five dimensions in one model ($R^2 = 0.206$), tactile stimuli carried the greatest weight ($\beta = 0.224$, $p < 0.001$) and visual stimuli ranked second ($\beta = 0.140$, $p = 0.046$); auditory, olfactory and emotional stimuli were not significant. Bootstrap tests of the differences between the standardised coefficients found none of them significant, so the ordering of the dimensions is indicative rather than definitive.

Originality/value: Instead of costly brain or physiological recordings, the study measures neuromarketing cues as shoppers themselves perceive and report them. It examines five stimulus dimensions together against a composite brand resonance measure based on Keller's four components in organized retail, a combination that, to the authors' knowledge, has not been tested before. It also adds evidence from Indian shoppers in a tier-2 city, Patiala, a setting where such research is scarce.

Practical implications: Store managers who want closer customer–brand relationships may gain most by investing first in what shoppers can touch and see, and by treating other sensory cues as secondary

Keywords: Neuromarketing; Perceived neuromarketing stimuli; Brand resonance; Sensory marketing; Store atmospherics; Retail shoppers; Organized retail; Patiala; Multiple regression.

1. Introduction

Retail ranks among the largest contributors to the Indian economy, generating over a tenth of national output and close to 8% of all jobs. Figures from the India Brand Equity Foundation (IBEF, 2026b) value the market at US$1,093.89 billion in 2025 and expect it to more than double, to above US$2,361.11 billion, by 2030. Within this expansion, organized formats are steadily increasing their share: they already represent roughly 41% of apparel retail and are set to outpace the market as a whole (IBEF, 2026a). Leasing by organized retailers grew by

20% over the previous year in the first half of 2026, as malls shifted towards experience-driven and mixed-use concepts (IBEF, 2026c). When assortments and prices can be copied quickly by rivals, the setting in which shopping takes place becomes one of the few lasting ways for a store to stand apart.

That surroundings influence how people shop has been recognised for decades. In Kotler's (1973) account, atmospherics means the deliberate shaping of the purchase setting to evoke particular feelings in customers, while Mehrabian and Russell (1974) proposed that cues in the environment alter emotional states, which in turn lead people either to approach or to avoid a place. Subsequent work carried these ideas over to each of the senses, and sensory marketing is now commonly described as "marketing that engages the consumers' senses and affects their perception, judgment and behavior" (Krishna, 2012, p. 332). Spence et al. (2014) brought together research on sight, sound, touch, smell and taste in stores and argued that the joint effect of these cues on the shopping experience deserves closer study. Across 135 effect sizes, adding music or scent to a setting raised pleasure, satisfaction and behavioural intention relative to comparable settings without these cues (Roschk et al., 2017).

Neuromarketing brings a further perspective to this body of work. According to Ariely and Berns (2010), brain imaging can uncover aspects of consumer experience that people do not report, although its cost is unlikely to fall below that of conventional research methods in the near term. Plassmann et al. (2012) surveyed neuroscientific work on how consumers relate to brands and identified key problems and directions for further inquiry. Because most neuromarketing research depends on neural or physiological instruments, it is expensive and hard to scale across many retail outlets. The present study therefore relies on shoppers' own perceptions. Here, perceived neuromarketing stimuli refer to the sights, sounds, scents, textures and emotional cues of a retail setting that shoppers are aware of and that are intended to act on their non-conscious reactions. Framed this way, the cues of interest to neuromarketing can be studied with a questionnaire administered to shoppers.

The dependent construct is brand resonance. Keller (2001) places resonance at the apex of his brand equity pyramid, where it reflects how intense the psychological relationship between a customer and a brand has become; it appears as repeat purchasing, emotional attachment, a feeling of belonging to a brand community and active involvement with the brand. Several studies connect sensory experience with these outcomes. Huang et al. (2015) reported that experiences with a brand shape its resonance across the channels of fashion retailers. Surveying 512 mall shoppers in China, Zha et al. (2025) showed that all five senses fed sensory brand experience, which in its turn raised satisfaction, brand attachment and lovemarks. A comparable pattern appeared among Indonesian luxury-watch buyers, whose sensory and experiential contact with the brand was significantly tied to how attached and loyal they felt (Chandra & Balqiah, 2023).

Several gaps nevertheless persist. Prior work has largely treated sensory brand experience, satisfaction or loyalty as the end point, and the studies that do address brand resonance focus on brand experience instead of the stimuli shoppers perceive. As far as the authors are aware, no prior study has examined multiple perceived stimulus dimensions simultaneously in relation to a composite resonance score built on Keller's four components in an organized retail context, and Indian evidence on this question is sparse. Retailers also lack guidance on which sensory dimensions deserve the greatest share of their investment.

With these gaps in mind, the study has two aims. The first is to estimate how perceived neuromarketing stimuli affect retail shoppers' brand resonance; the second is to establish how far each dimension of these stimuli contributes to brand resonance relative to the others. The results are intended to guide retailers in allocating spending across sensory elements and to add to scholarship connecting in-store cues with stronger customer–brand bonds. After this introduction come the literature review (Section 2), the method (Section 3), the analysis (Section 4) and a summary of findings (Section 5), followed by the discussion (Section 6), implications (Section 7), limitations and future work (Section 8) and the conclusion (Section 9).

2. Review of Literature

2.1 Neuromarketing and the neuroscience of consumers

According to Lee et al. (2018), neuromarketing became an accepted part of mainstream marketing research from about 2010 onwards. Ariely and Berns (2010) cautioned that brain imaging would probably remain more expensive than other research tools for some time, yet suggested that it could expose aspects of consumer

experience that would otherwise stay hidden and that it would be most valuable at the pre-launch stage of a product. Plassmann et al. (2012) evaluated the neuroscientific literature on how consumers process brands, pointed out weaknesses in previous studies and proposed an agenda for future research.

Both contributions rely on direct measurement of neural activity. By contrast, this study captures perceived stimuli through respondents' own reports. "Perceived neuromarketing stimuli" are therefore used as a questionnaire-based stand-in for the sensory and emotional cues investigated in neuromarketing, not as a measure of brain activity.

2.2 Sensory marketing and store atmospherics

Beyond defining the field, Krishna (2012) argued that sensory cues can work as triggers outside conscious awareness, shaping what shoppers perceive, how they judge and how they act without their noticing. Drawing together findings on sight, sound, touch, smell and taste in stores, Spence et al. (2014) urged researchers to look more closely at how combinations of sensory cues in retail spaces influence the shopping experience. The role of touch in multisensory design was the focus of Spence and Gallace (2011) and Hultén (2011), while Jha et al. (2020) studied how haptic features of the store environment affect the warmth and competence that shoppers attribute to a retailer.

The most comprehensive quantitative evidence is Roschk et al.'s (2017) meta-analysis, which pooled 135 effects from 66 studies (N = 15,621). Settings that featured music or scent produced greater pleasure, satisfaction and behavioural intention than settings without these cues, and the size of these effects was small to medium. The authors further observed that music and scent tended to matter more in service contexts than in retail contexts. Roggeveen et al. (2020) later widened the atmospherics perspective with their DAST framework, covering touchpoints both inside and outside the store.

2.3 Sensory experience, brand attachment and loyalty

Zha et al. (2025), working with 512 mall shoppers in China, showed that sight, sound, smell, touch and taste each made a significant contribution to sensory brand experience. That experience then raised satisfaction, brand attachment and lovemarks, though not every dimension of satisfaction and attachment carried through to loyalty. Vision had the largest of their sensory paths ($\gamma = 0.278$) and touch the smallest ($\gamma = 0.123$). Two further studies are relevant. Iglesias et al. (2019) examined sensory brand experience alongside customer satisfaction and the empathy of front-line staff, while Dolbec and Chebat (2013) compared the brand attachment generated by flagship outlets with that generated by ordinary brand outlets.

Chandra and Balqiah (2023), surveying 323 Indonesian luxury-watch buyers, reported that loyalty had significant ties to the sensory marketing customers encountered, to their experience of the brand, and to their commitment and emotional bond with it; the image of the store, by contrast, did not significantly change the strength of these ties. Their results imply that sensory cues may build loyalty partly by deepening emotional attachment, which supports treating attachment as a component of resonance.

2.4 Brand resonance in retail

Resonance is the top tier of the brand equity pyramid proposed by Keller (2001). Huang et al. (2015) carried the concept into retailing, showing that brand experiences shape resonance among fashion retailers that sell through several channels. The channel moderated how sensory, affective and relational experiences operated, whereas relational experiences raised awareness of the brand, and loyalty to it, whichever channel was used. In a separate line of work, EEG recordings were used by Pozharliev et al. (2015) to examine consumers' emotional responses to luxury goods.

2.5 Research gap

Most sensory marketing studies adopt outcomes such as sensory brand experience, satisfaction or loyalty, and the resonance studies reviewed here concentrate on brand experience rather than on the stimuli themselves. As far as the authors are aware, the five perceived stimulus dimensions (visual, auditory, olfactory, tactile and emotional) have not previously been examined together in relation to Keller's four components of resonance in organized retail. Indian retail, moreover, has received little attention in this literature.

Table 1: Studies Reviewed

Author(s)	Year	Journal	Focus
Ariely & Berns	2010	Nature Reviews Neuroscience	Neuroimaging in business
Spence & Gallace	2011	Psychology & Marketing	Touch and multisensory design
Hultén	2011	European Business Review	Multi-sensory brand experience
Krishna	2012	Journal of Consumer Psychology	Sensory marketing review
Plassmann et al.	2012	Journal of Consumer Psychology	Consumer neuroscience of brands
Dolbec & Chebat	2013	Journal of Retailing	Flagship vs brand store, attachment
Spence et al.	2014	Psychology & Marketing	Multisensory store atmospherics
Huang et al.	2015	Journal of Research in Interactive Marketing	Brand experience and resonance
Pozharliev et al.	2015	Journal of Marketing Research	EEG, luxury products
Roschk et al.	2017	Journal of Retailing	Meta-analysis of music, scent, colour
Iglesias et al.	2019	Journal of Business Research	Sensory brand experience, empathy
Jha et al.	2020	Journal of Retailing	Haptic cues, retailer perceptions
Roggeveen et al.	2020	Journal of Retailing	DAST retail atmospherics
Chandra & Balqiah	2023	Asia Pacific Management and Business Application	Sensory cues, loyalty, luxury watches
Zha et al.	2025	Corporate Reputation Review	Sensory brand experience and loyalty

Source: Authors' compilation.

3. Method

3.1 Study Design

A one-time quantitative survey was used, serving both descriptive and causal-explanatory aims. Data collected once through a structured questionnaire were used to estimate how perceived neuromarketing stimuli (the independent variable) relate to brand resonance (the dependent variable).

3.2 Conceptual Framework and Variables

Perceived neuromarketing stimuli (PNS) are treated as a construct with five dimensions. Brand resonance, taken from Keller's (2001) framework, enters the analysis as one composite score summarising its four components.

Table 2: Measurement Structure of the Questionnaire

Construct	Dimension	Items	Code
Perceived Neuromarketing Stimuli (IV)	Visual	5	VS1–VS5
	Auditory	4	AS1–AS4
	Olfactory	4	OS1–OS4
	Tactile	4	TS1–TS4
	Emotional	4	ES1–ES4
Brand Resonance (DV)	Behavioural Loyalty	4	BL1–BL4
	Attitudinal Attachment	4	AA1–AA4
	Sense of Community	4	SC1–SC4
	Active Engagement	4	AE1–AE4

Total: 37 items, all answered on a five-point agreement scale (1 = strongly disagree; 5 = strongly agree).

3.3 Objectives and Hypotheses

- **Objective 1:** To assess the effect of perceived neuromarketing stimuli on the brand resonance of retail shoppers.

– H0-1: PNS does not significantly affect brand resonance. H1: PNS significantly and positively affects brand resonance.

- **Objective 2:** To determine how strongly each dimension of perceived neuromarketing stimuli contributes to brand resonance among retail shoppers, relative to the other dimensions.

– H0-2a to H0-2e: Visual, auditory, olfactory, tactile and emotional stimuli, in that order, do not significantly affect brand resonance. H2a to H2e: Each of these stimuli significantly and positively affects brand resonance.

3.4 Population, Sampling Frame and Sampling Technique

- **Population:** Shoppers aged 18 or older who had made a purchase at an organized retail outlet in Patiala (a mall, supermarket, brand outlet or department store) during the preceding three months.
- **Study area:** Patiala, Punjab, India.
- **Technique:** Purposive (non-probability) sampling, supplemented by convenience sampling through store intercepts.

- **Reason:** Because no full list of retail shoppers is available, a situation typical of consumer studies, probability sampling was not feasible, which restricts how far the results can be generalised (see Section 8).

3.5 Determining the Sample Size

Sample size was set with two criteria in mind. Hair et al. (2019) recommend 5 to 10 respondents for each item, which for a 37-item questionnaire means between 185 and 370 cases. G*Power (Faul et al., 2009) was also run, assuming five predictors, $f^2 = 0.15$ (a medium effect; Cohen, 1988) and $\alpha = 0.05$; this put the minimum at roughly 92 cases for 80% power and 138 for 95% power. Collecting 300 responses therefore satisfied both criteria, and all 300 were usable.

3.6 Data Gathering Procedure

- **Primary data:** Gathered with a structured questionnaire that respondents completed themselves.
- **Respondent instruction:** Each respondent identified one retail brand or store they shop at most frequently, and then responded to each item with that retail brand in mind.
- **Sections:** Screening, Section A (demographics), Section B (PNS, 21 items) and Section C (brand resonance, 16 items).
- **Secondary data:** Journal articles, books and reports provided the background for the conceptual framework and for drafting the items.

3.7 Development of the Questionnaire

Item sources: All 37 items were adapted from earlier work on store atmospherics, sensory marketing and brand resonance. The 21 PNS items (visual, 5; auditory, 4; olfactory, 4; tactile, 4; emotional, 4) draw on four sources (Krishna, 2012; Spence et al., 2014; Roschk et al., 2017; Zha et al., 2025). Sixteen resonance items, four for each of Keller's (2001) components (codes BL, AA, SC and AE in Table 2), form the composite measure; their wording was also guided by Huang et al. (2015). Wording was adapted to organized retail in India, and each respondent answered with reference to the retail brand or store they visited most often. The note under Table 2 gives the response format.

Reliability: Every construct cleared the usual reliability benchmark, with α values between 0.771 and 0.904 (Table 6).

3.8 Assessment of Measurement Quality

Table 3: Measurement Quality Checks and Whether They Were Conducted

Test	Purpose	Acceptance Criterion	Status
Cronbach's alpha	Internal consistency	≥ 0.70 (Nunnally, 1978)	Performed
Composite reliability	Construct reliability	≥ 0.70	Not performed
Average variance extracted (AVE)	Convergent validity	≥ 0.50 (Fornell & Larcker, 1981)	Not performed
KMO and Bartlett's test	Sampling adequacy for factor analysis	KMO ≥ 0.60; $p < 0.05$	Not performed
Exploratory / confirmatory factor analysis	Construct validity	Loadings ≥ 0.50–0.60	Not performed

Test	Purpose	Acceptance Criterion	Status
Fornell-Larcker / HTMT	Discriminant validity	√AVE > inter-construct correlation; HTMT < 0.85	Not performed
Harman's single-factor test	Common method bias	First factor < 50% of variance	Not performed

Alpha values for the five stimulus dimensions lay between 0.771 (olfactory) and 0.847 (visual); the values were 0.904 for the full 21-item PNS scale and 0.881 for the 16-item brand resonance scale (Table 6), all above the 0.70 level recommended by Nunnally (1978). Collinearity among the predictors was acceptable (tolerance 0.559 to 0.708; VIF 1.412 to 1.790). Beyond alpha, none of the further measurement checks listed in Table 3 was run. Construct validity therefore rests on the items having been adapted from validated scales, a limitation discussed in Section 8.

3.9 Statistical Tools and Techniques

IBM SPSS Statistics was used for the main analyses, and JASP and Python statsmodels were used for the bootstrap and robustness checks. All p-values are reported as two-tailed even though the hypotheses specify a direction (see the notes to Tables 10 and 14). PNS and BR were scored by averaging each respondent's answers within the relevant scale.

Table 4: Analytical Plan

Step	Technique	Purpose
1	Frequencies and percentages	Respondent profile
2	Mean, SD, skewness, kurtosis	Descriptives and normality (acceptable within ±1 or ±2; Kline, 2016)
3	Cronbach's alpha (performed); CR, AVE, EFA/CFA (not performed)	Reliability and validity
4	Pearson correlation	Strength and direction of association
5	Simple linear regression	Objective 1 (PNS → BR)
6	Multiple linear regression	Objective 2 (five dimensions → BR)
7	Standardised beta, squared semi-partial correlation	Relative influence of dimensions
8	Bootstrap (2,000 resamples) of beta differences	Whether differences between dimensions are significant

3.10 Regression Assumption Checks

- **Linearity and homoscedasticity:** Examined through scatterplots and plots of standardised residuals.
- **Normality:** Skewness values (−0.50 to −0.04) and kurtosis values (−0.37 to 0.36) were all within ±1, and the normal P-P plot of the residuals was checked visually.
- **Independence of errors:** Durbin-Watson values of 1.826 (simple regression) and 1.848 (multiple regression) both lie within the accepted 1.5 to 2.5 band.

- **Multicollinearity:** VIF ranged between 1.412 and 1.790, under the more conservative threshold of 3, and tolerance ranged between 0.559 and 0.708, above 0.20, so collinearity was not a problem.
- **Outliers and influential cases:** Cases were screened with Cook's and Mahalanobis distances. None needed to be dropped, so all 300 responses entered the analysis.
- **Missing data:** No responses were missing, and every one of the 300 cases was analysed.

3.11 Ethical Considerations

Respondents took part voluntarily and anonymously; the questionnaire opened with a consent statement that they read before answering. No information that could identify an individual was recorded, results are presented only at group level, and the data have been used for research purposes alone.

3.12 Methodological Constraints

Section 8 discusses in detail the limitations arising from the design, the instrument and the sample.

4. Data Analysis and Interpretations

Perceived neuromarketing stimuli were measured with 21 items covering five dimensions (Visual, Auditory, Olfactory, Tactile and Emotional), and brand resonance with 16 items spanning Keller's four components (Table 2), averaged into one composite score. All items used the same five-point format.

4.1 Objective 1

To assess the effect of perceived neuromarketing stimuli on the brand resonance of retail shoppers.

4.1.1 Hypotheses

- H0-1: Perceived neuromarketing stimuli do not significantly affect the brand resonance of retail shoppers.
- H1: Perceived neuromarketing stimuli significantly and positively affect the brand resonance of retail shoppers.

4.1.2 Analysis

Table 5: Respondent Profile (N = 300)

Characteristic	Group	n	%
Gender	Male	163	54.3
	Female	131	43.7
	Other	6	2.0
Age group	18–25	79	26.3
	26–35	116	38.7
	36–45	57	19.0
	46–55	33	11.0
	Above 55	15	5.0
Education	Up to Senior Secondary	32	10.7
	Graduate	139	46.3

Characteristic	Group	n	%
	Postgraduate	117	39.0
	Doctorate / Other	12	4.0
Monthly household income	Below ₹25,000	44	14.7
	₹25,001–50,000	119	39.7
	₹50,001–1,00,000	92	30.7
	Above ₹1,00,000	45	15.0
Visit frequency	Weekly	56	18.7
	Fortnightly	74	24.7
	Monthly	114	38.0
	Occasionally	56	18.7

Source: Primary survey data

Close to two-thirds of the sample (65.0%) fell in the 18–35 age band, and 89.3% had completed at least a graduate degree.

Table 6: Internal Consistency of Study Constructs

Scale	Items	α
Visual Stimuli	5	0.847
Auditory Stimuli	4	0.811
Olfactory Stimuli	4	0.771
Tactile Stimuli	4	0.802
Emotional Stimuli	4	0.815
Perceived Neuromarketing Stimuli (overall)	21	0.904
Brand Resonance (overall)	16	0.881

Acceptable threshold: $\alpha \geq 0.70$.

Table 7: Descriptive Statistics and Distribution Checks

Variable	Mean	SD	Skewness	Kurtosis
Visual Stimuli	3.73	0.70	−0.50	0.36
Auditory Stimuli	3.55	0.71	−0.31	0.04
Olfactory Stimuli	3.29	0.68	−0.16	−0.19
Tactile Stimuli	3.59	0.70	−0.14	−0.37
Emotional Stimuli	3.78	0.71	−0.24	−0.32
Perceived Neuromarketing Stimuli (PNS)	3.59	0.52	−0.32	0.30
Brand Resonance (BR)	3.32	0.53	−0.04	−0.22

Skewness and kurtosis lie within ±1, indicating acceptable normality.

Table 8: Correlations among Study Variables (Pearson's r)

Variable	1	2	3	4	5	6	7
1. Visual	1						
2. Auditory	0.42	1					
3. Olfactory	0.51	0.43	1				
4. Tactile	0.51	0.38	0.42	1			
5. Emotional	0.50	0.41	0.33	0.42	1		
6. PNS	0.82	0.71	0.72	0.73	0.71	1	
7. Brand Resonance	0.36	0.30	0.30	0.39	0.28	0.44	1

Every correlation shown reaches $p < 0.01$ (two-tailed).

Table 9: Simple Linear Regression (PNS → Brand Resonance)

9a. Model Summary

R	R Square	Adjusted R Square	Std. Error	Durbin-Watson
0.442	0.196	0.193	0.476	1.826

9b. ANOVA

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	16.386	1	16.386	72.45	0.000
Residual	67.399	298	0.226		
Total	83.785	299			

9c. Coefficients

Predictor	B	Std. Error	Beta (β)	t	Sig.	95% CI
(Constant)	1.700	0.192		8.85	0.000	1.322–2.078
PNS	0.451	0.053	0.442	8.51	0.000	0.346–0.555

Dependent variable: Brand Resonance.

Table 10: Hypothesis Testing Summary (Objective 1)

Hypothesis	Path	β	t-value	p-value	Decision
H1	PNS → Brand Resonance	0.442	8.51	< 0.001	Supported

Note. Although H1 states a direction, the p-value shown is two-tailed. Because the coefficient is positive as predicted, a one-tailed test would lead to the same decision. Supported = significant at the 5% level and in the predicted direction.

4.1.3 Inference

As Table 8 shows, shoppers who perceived stronger stimuli also reported higher resonance ($r = 0.44$, $p < 0.01$). The size of this effect was estimated next (Table 9). The single-predictor model fitted the data significantly, $F(1, 298) = 72.45$, $p < 0.001$, with PNS alone accounting for 19.6% of the differences in resonance ($R^2 = 0.196$). Its standardised coefficient of 0.442 is positive and significant ($t = 8.51$, $p < 0.001$), so H1 is supported and H0-1 rejected. Each one-unit rise in perceived stimuli corresponds to an increase of 0.45 units in brand resonance. With a Durbin-Watson statistic of 1.83, the residuals show no sign of autocorrelation.

4.2 Objective 2

To determine how strongly each dimension of perceived neuromarketing stimuli contributes to brand resonance among retail shoppers, relative to the other dimensions.

4.2.1 Hypotheses

- H0-2a to H0-2e: Visual, auditory, olfactory, tactile and emotional stimuli, in that order, do not significantly affect brand resonance.
- H2a to H2e: Each of these dimensions significantly and positively affects brand resonance. The dimensions are compared on the basis of their standardised beta (β) coefficients.

4.2.2 Analysis

Table 11: Multicollinearity Diagnostics

Predictor	Tolerance	VIF
Visual Stimuli	0.559	1.790
Auditory Stimuli	0.708	1.412
Olfactory Stimuli	0.666	1.502
Tactile Stimuli	0.667	1.499
Emotional Stimuli	0.683	1.465

Every VIF is under 5, so collinearity does not pose a problem.

Table 12: Multiple Regression (Dimensions → Brand Resonance)

12a. Model Summary

R	R Square	Adjusted R Square	Std. Error	Durbin-Watson
0.453	0.206	0.192	0.476	1.848

12b. ANOVA

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	17.222	5	3.444	15.21	0.000
Residual	66.563	294	0.226		
Total	83.785	299			

12c. Coefficients

Predictor	B	Std. Error	Beta (β)	t	Sig.	95% CI	Rank
(Constant)	1.707	0.194		8.82	0.000	1.326–2.088	
Visual Stimuli	0.105	0.052	0.140	2.01	0.046	0.002–0.208	2
Auditory Stimuli	0.075	0.046	0.101	1.63	0.104	−0.016–0.166	3

Predictor	B	Std. Error	Beta (β)	t	Sig.	95% CI	Rank
Olfactory Stimuli	0.061	0.049	0.078	1.23	0.221	−0.037–0.158	4
Tactile Stimuli	0.170	0.048	0.224	3.52	0.000	0.075–0.265	1
Emotional Stimuli	0.039	0.047	0.051	0.82	0.415	−0.054–0.131	5

Dependent variable: Brand Resonance.

Table 13: Relative Importance of Dimensions

Dimension	Std. Beta (β)	Unique contribution (sr^2)	Share of explained variance (β × r)
Tactile	0.224	3.4%	42.3%
Visual	0.140	1.1%	24.6%
Auditory	0.101	0.7%	14.6%
Olfactory	0.078	0.4%	11.5%
Emotional	0.051	0.2%	7.0%

Table 14: Hypothesis Testing Summary (Objective 2)

Hypothesis	Path	β	t-value	p-value	Decision
H2a	Visual → BR	0.140	2.01	0.046	Supported
H2b	Auditory → BR	0.101	1.63	0.104	Not supported
H2c	Olfactory → BR	0.078	1.23	0.221	Not supported
H2d	Tactile → BR	0.224	3.52	< 0.001	Supported
H2e	Emotional → BR	0.051	0.82	0.415	Not supported

Note. Although H2a–H2e state a direction, the p-values shown are two-tailed. Every coefficient is positive as predicted, so one-tailed tests would halve these p-values without altering any decision at the 5% level (for the auditory path, $p \approx 0.052$). Supported = significant at the 5% level and in the predicted direction.

4.2.3 Inference

To compare the five stimulus dimensions, all five were entered together as predictors of brand resonance (Table 12). Jointly they explained 20.6% of its variance ($R^2 = 0.206$), $F(5, 294) = 15.21$, $p < 0.001$. Collinearity was low (maximum VIF 1.79) and the errors were independent (Durbin-Watson = 1.85). The tactile coefficient was the largest ($\beta = 0.224$, $p < 0.001$), with visual stimuli second ($\beta = 0.140$, $p = 0.046$); none of the auditory, olfactory or emotional coefficients was significant at $\alpha = 0.05$. H2a and H2d are therefore supported, whereas H2b, H2c and H2e are not.

4.2.4 Methodological Cautions

Some caution is needed in reading the order of the dimensions. Tactile stimuli produced the highest standardised coefficient ($\beta = 0.224$) and visual stimuli the next highest ($\beta = 0.140$), but when the differences between coefficients were bootstrapped with 2,000 resamples, none proved statistically significant. The 95% intervals for the Tactile − Visual difference (−0.14 to 0.30) and the Tactile − Emotional difference (−0.01 to 0.37) contain or reach zero. It is therefore more accurate to say that some dimensions showed comparatively greater or lesser influence than to claim that any one is significantly stronger or weaker than another. The visual result is also not robust: although its coefficient reached significance at the 5% level ($p = 0.046$), its bootstrap interval (−0.007 to 0.288) spans zero. Moreover, correlations of 0.33 to 0.51 among the five dimensions mean that the unique effect of each is hard to isolate. And since every measure came from the same respondents on one occasion, the findings speak to association, not causation. Further work could apply HC3 robust standard errors should heteroscedasticity be detected, and could use relative weights analysis to check the ordering of dimensions.

5. Findings

Table 15 lists the decision on each hypothesis tested in Section 4. For Objective 1, perceived neuromarketing stimuli exerted a significant positive effect on brand resonance and accounted for 19.6% of its variation. For Objective 2, the model with all five dimensions ($R^2 = 0.206$) identified tactile and visual stimuli as significant predictors, while auditory, olfactory and emotional stimuli were not significant. Ordered by standardised beta, the dimensions ran from tactile to visual, auditory, olfactory and emotional, although the bootstrap comparisons could not statistically distinguish the betas from one another.

Table 15: Decisions on H1 and H2a–H2e

Hypothesis	Path	β	t-value	p-value	Decision
H1	PNS → BR	0.442	8.51	< 0.001	Supported
H2a	Visual → BR	0.140	2.01	0.046	Supported
H2b	Auditory → BR	0.101	1.63	0.104	Not supported
H2c	Olfactory → BR	0.078	1.23	0.221	Not supported
H2d	Tactile → BR	0.224	3.52	< 0.001	Supported
H2e	Emotional → BR	0.051	0.82	0.415	Not supported

Note. H1 concerns Objective 1 ($R^2 = 0.196$); H2a–H2e concern Objective 2 ($R^2 = 0.206$). p-values are two-tailed; see the notes to Tables 10 and 14. BR = brand resonance.

6. Discussion

The positive and significant effect of PNS on brand resonance supports the environmental psychology view that the store setting partly shapes how shoppers feel and behave (Kotler, 1973; Mehrabian & Russell, 1974). It also fits the sensory marketing argument that cues reaching several senses at once reinforce brand responses and deepen attachment (Krishna, 2012). Read against Keller's (2001) pyramid, the result suggests that what shoppers sense and feel in a store may influence not only immediate purchases but also the most demanding levels of the pyramid, where loyalty, attachment, community and engagement sit.

An R^2 of around 20% means that in-store stimuli matter for brand resonance but explain only part of it. Price, product quality, service and brand history are likely to account for some of the remaining variance. Turning to the individual dimensions, only tactile and visual stimuli contributed significantly. One explanation is that shoppers deliberately attend to handling products and to how they are displayed, whereas background elements like music and scent are less noticeable or less clearly tied to a particular brand. The weaker auditory and olfactory results are also in line with the larger service-setting than retail-setting effects of music and scent reported by Roschk et al. (2017), although that review dealt with manipulated cues rather than shoppers' reports. Emotional stimuli were not significant despite their theoretical importance, possibly because they overlap with the sensory dimensions, since emotions partly arise from sensory signals. Such overlap would explain why emotional stimuli correlated positively with resonance ($r = 0.28$) yet added little unique explanation. The ordering of the five dimensions also differs from that of Zha et al. (2025), where vision had the strongest path to sensory brand experience ($\gamma = 0.278$) and touch the weakest ($\gamma = 0.123$), roughly the reverse of the present result, in which tactile stimuli came first.

The studies differ in important ways, however. Zha et al. studied shoppers in Chinese malls and used sensory brand experience as the outcome, whereas this study related perceived stimuli to a composite brand resonance score among organized retail shoppers in a single Indian city. As the betas in this study could not be statistically separated, the contrast is provisional, and further replications in other settings are required before a general hierarchy of the senses can be proposed.

Any ranking should therefore be expressed with care. Since the beta differences were not statistically significant, the appropriate conclusion is that tactile and visual stimuli displayed comparatively greater influence, not that they are significantly more influential than the remaining dimensions.

7. Implications

Managerial: Retailers may give priority to opportunities for customers to handle products (sampling, textures and fixtures) and to visual merchandising, while using scent and music as complementary cues that reinforce the brand image.

Academic: By linking brand resonance to a multidimensional construct of perceived stimuli in an Indian retail setting, the study extends the brand resonance literature.

8. Constraints and Avenues for Future Work

The findings come with several caveats. First, all measures were self-reported at one point in time, so the relationships observed are correlational, and answers may be inflated by socially desirable responding or by common method variance, for which no test (e.g., Harman's) was carried out. Second, the instrument was built from prior scales but was never piloted on its own, and alpha was the only measurement check performed; the other reliability and validity tests listed in Table 3 were not conducted. Third, respondents came from one city, Patiala, and were selected by non-probability purposive and convenience methods, so the results may not extend to other cities, regions or retail settings. Fourth, as each respondent evaluated one store of their own choosing, differences between retail formats were not controlled. Lastly, about four-fifths of the variance in brand resonance remained unexplained, the five dimensions were moderately intercorrelated, and the standardised betas did not differ significantly, so the order of the dimensions remains provisional.

Subsequent research could pilot the scale and validate it through confirmatory factor analysis, reporting composite reliability, AVE and discriminant validity, and could test for common method bias. Researchers might also draw

samples from multiple cities and regions, contrast retail formats such as supermarkets and apparel stores, employ experimental designs or in-store neurophysiological measurement, examine moderating variables such as age or shopping motivation, and use structural equation modelling to treat the four components of resonance as separate outcomes. A relative weights analysis would offer a useful check on the order of the dimensions.

9. Conclusion

The study set out to examine how the neuromarketing stimuli that retail shoppers perceive relate to brand resonance. Perceived stimuli were found to strengthen brand resonance significantly (Objective 1). Of the five dimensions, tactile and visual stimuli made the largest unique contributions, whereas auditory, olfactory and emotional stimuli added no significant explanation once the other dimensions were taken into account (Objective 2). Retailers are therefore advised to plan sensory environments as a coordinated whole, giving particular weight to touch and visual display. For scholars, the results reinforce the view that sensory experience inside the store is positively linked to stronger relationships with brands.

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