Role of tactile and visual inputs in product evaluation: a multisensory perspective

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Abstract

Purpose – There has been an increased interest in marketing literature in understanding the role of sensory experience. However, few researchers have addressed multisensory interaction of visual and tactile evaluation for products salient in single sensory modality. The purpose of this paper is to address this gap and investigate how multisensory evaluation influences overall attitude and purchase intentions. Further, the role of individual personality variable in influencing the interrelationship between sensory evaluation and behavioral outcomes are examined.

Design/methodology/approach – The data for this study were collected from 126 students who responded to attitude towards the product and purchase intentions after evaluating three experimental tasks. Repeated measures analysis of variance was carried out to test the multisensory interaction hypotheses.

Findings – The multisensory interaction of tactile and visual information was found to significantly increase the consumer attitudes for products dominant on single sensory modality of touch. Further, the multisensory evaluation led to greater purchase intentions than visual or tactile evaluation.

Originality/value – The paper is perhaps first to investigate multisensory interaction of tactile and visual sensory information in evaluation of products that are salient in touch properties. The current study further examines the role of individual personality variables in influencing interrelationship between sensory evaluation and purchase intentions.

Keywords Multisensory interaction, Tactile evaluation, Visual evaluation, Need for touch, Visual product aesthetics, Touch diagnostic products, Product evaluation, Purchase intention, Consumer behaviour, Students

Paper type Research paper

Introduction

Sensory information is dominantly linked to consumer's perception of products and services (Krishna, 2010). It is argued that individuals react instinctively and subconsciously to sensory stimuli such as smell as opposed to learnt stimuli such as a brand name or logo (Clarke and Macrae, 1988). This is evidenced in the marketers attempt to use consumer's sensory perception to build sensory "signatures" whereby unique identity for a brand like "Aroma of Singapore airlines" is created. Thus, understanding the role of sensory perception in evaluation of products and services is becoming increasingly relevant from both theoretical and managerial perspectives.

Academic research in sensory marketing has proliferated significantly over the last few years. Sensory marketing is broadly understood as a process of engaging consumer senses to influence their emotions, perceptions, choices, preferences and consumption (Krishna, 2010). Extant research in sensory marketing suggests that sensory aspects of a product such as looks, smell, touch, sound and taste influence consumer evaluation of a product (Alpert *et al.*, 2005; Bone and Jantrania, 1992; Bloch *et al.*, 2003; Hagtvedt and Patrick, 2008; Morrin and Ratneshwar, 2000; Peck and Childers, 2003;

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Nowlis and Shiv, 2005), and affect behavior (e.g. impulse buying, more time spent at the store, longer stimulus viewing time, more dollars spent and greater in-store traffic).

Much of sensory marketing research has focused on studying the effects of individual sensory stimulus on a product's evaluation. For example, Peck and Childers (2003, 2006) contend that elements of touch affect consumer judgment, attitude and impulse buying behavior. In another study by Morrin and Ratneshwar (2000), ambient scent was found to increase consumers' stimulus viewing time and increase their recall and recognition of unfamiliar brands. However, often consumers are exposed to more than one sensory stimulus and evaluation is likely to be through multisensory modalities. Consider when purchasing a pen, an individual may process information from both tactile (grip) and visual (design) stimuli to arrive at a preference. As Calvert *et al.* (2004, p. xi) note:

> [. . .] there can be no doubt that our senses are designed to function in concert and that our brains are organized to use the information they derive from their various sensory channels cooperatively in order to enhance the probability that objects and events will be detected rapidly, identified correctly, and responded to appropriately.

Vision and touch are dominant sensory experiences through which consumers often perceive products. Schifferstein and Cleiren (2005) in their study find that these sensory experiences are more detailed and enable individuals to be more certain about their judgment. Further, they indicate that visual along with tactile information dominate product experiences over other sensory stimuli such as smell and sound. Since product experience rarely involves just one sensory cue or type of information, the aim of this study is to examine the relative contributions of visual and tactile information when they are simultaneously presented as information cues. Interestingly, several prior studies that assessed the influence of multisensory inputs (visual and tactile) on consumer decision-making reported a one-way bias. For instance, Heller (1992) and Lederman *et al.* (1986) showed that when tactile and visual information are presented with each other, tactile information dominated visual information. In judging an object's size, shape or position, Ernst and Banks (2002) find that vision regularly dominates tactile perception as it provides more reliable estimates of task. These results suggest that individual modalities that are more appropriate in the task evaluation determine the extent to which vision or touch dominates. However, a growing body of research argues that individuals integrate multiple sensory experiences in a weighted approach (Bresciani *et al.*, 2006; Ernst and Bülthoff, 2004) resulting in an additive and synergetic effect on memory, evaluation and behavior (Paivio, 2007). Our motivation here is to investigate whether tactile and visual information are integrated into participants' evaluation of a product, and how they may interact with each other when the product is salient on single sensory modality. In this paper, we focus on product evaluation which results from the combined effects of tactile and visual (multisensory) information.

Literature review

Importance of tactile information

There has been an increased interest in assessing the role of touch or haptic perception in consumer behavior (Citrin *et al.*, 2003; Kim and Forsythe, 2008; Peck and Childers, 2003; Peck and Shu, 2009; Workman and Caldwell, 2007). The term "haptic perception" refers to aggregation of information by hand (Gibson, 1966). Touch is considered a near or "proximal" sense since it is the only sense which can be achieved by contact with skin,

unlike vision, smell, hearing and taste for which some medium exists between the sensory apparatus and the stimuli (Krishna, 2010). The taxonomy of touch includes utilitarian and hedonic touch. Utilitarian touch is used by consumers to either purchase or obtain haptic/non-haptic information about a product. Hedonic touch on the other hand is an end in itself where consumers touch a product for general exploration or for sensory experience.

Object orientation and touch. Recent research by McCabe and Nowlis (2003) has shown that touching products can influence consumer decision process for material or touch diagnostic products. These researchers posit and find that physical examination of material products increase their preference. What is more, consumers are more motivated to touch, pick-up and opt for these products in in-store environment than virtual environment. For instance, in study 1, the researchers report that 95.9 per cent of participants made a choice for material product in real condition, while the choice dropped to 86.2 per cent when the product was presented in pictorial format. In another study, Citrin *et al.* (2003) showed that for material objects, lack of tactile information had a negative impact on purchase intentions in internet. They argued that absence of touch cues can result in inaccurate product evaluations and this dissuades consumers from making online purchases. In a touch environment such as physical stores, however, consumers rely on sense of touch to make more accurate product judgments. Similarly, touch was found to increase the confidence in purchase behavior (Peck and Childers, 2003) and enhance product evaluation of high-quality products (Grohmann *et al.*, 2007). Indeed, for some individuals, touching products can lead to increased affective response and positive effect on attitude and behavior (Peck and Wiggins, 2006). In addition, hedonic aspects of touch influence consumer decision even when product related information was not provided in the advertising contents. In a recent study, Peck and Shu (2009) showed that for both buyers and non-buyers, merely touching a product or imagining the touch experience can increase perceived ownership of the product. These results suggest that for material products, tactile information is necessary and contribute to their choice process.

Personality orientation and touch. Peck and Childers (2003, p. 431) state that individuals differ in their preference for haptic perception, or need for touch (NFT), which is defined as "preference for the extraction and utilization of information obtained through the haptic system". The authors conducted a series of seven studies to develop a valid and reliable scale for NFT. Based on individual's motivation and ability, Peck and Childers (2003) conceptualized NFT with two underlying dimensions of instrumental and autotelic touch. The instrumental touch refers to individual's goal-directed evaluation (utilitarian) of a product's performance. This dimension is motivation driven and corresponds to structural elements of the product such as texture, temperature and weight, and form and steadiness (Hultén *et al.*, 2009). Contrarily, the autotelic dimension is related to hedonic aspects of touch such as seeking fun, arousal and excitement. The autotelic touch captures the sensory aspects of touch that are elicited by psychological reactions. Peck and Childers (2003) reported that individuals high in NFT preferred direct experience and showed increased confidence in their judgment for products salient on haptic properties. In contrast, for low NFT individuals, no difference in judgment confidence was observed across touch vs no-touch environments as they rely on non-haptic sensory modalities for product evaluation. In particular, individuals low in autotelic NFT are significantly affected by non-diagnostic haptic cues and elicit

negative product quality evaluations on touching products (Krishna and Morrin, 2008). These results suggest that individual differences in NFT should be considered in product evaluation and choice.

Importance of visual information

Visual information is a very effective way to obtain an individual's attention. Unlike tactile information for which the customer must make an effort, visual information is ambient (Elder *et al.*, 2010). Research on visual information in consumer behavior has predominantly focused on visual aesthetic experience (Bloch, 1995; Creusen and Schoormans, 2005; Crilly *et al.*, 2004; Desmet and Hekkert, 2007; Venkatesh *et al.*, 2010). Aesthetic experience refers to emotions and feelings derived from non-instrumental qualities of a product (Hirschman and Holbrook, 1982). These aesthetic responses are based on the product properties such as size, color, contrast, form, congruence, symmetry, proportion and prototypicality. Aesthetic products influence consumer choice by differentiating from competitors in a chaotic market. Further, they contain symbolic meaning by which consumers develop relationship with them (Bloch *et al.*, 2003).

Creusen and Schoormans (2005) indicated that aesthetic value is important and suggested that certain individuals preferred aesthetic value over functional utilities of a product in their product choice. Similarly, Veryzer (1993) examined the influence of aesthetic aspects of a product such as unity and proportion on the product evaluation and choice. The results of the study showed that product aesthetics had a significant impact on consumer choice across three product classes of microwave oven, suntan lotion and natural sound machine. This indicated that aesthetic value is pertinent in consumer choice across a range of product categories. In a study exploring the role of aesthetics in apparel evaluation, de Klerk and Lubbe (2004) proposed that aesthetic qualities to directly impact the consumer's satisfaction with a product.

Personality orientation and visual aesthetics. As presented earlier, product aesthetics play an important role in consumer decision-making process. Bloch *et al.* (2003) conducted a series of eight studies to identify and develop a scale to measure individual differences in centrality of visual product aesthetics (CVPA), defined as the importance of product aesthetics in consumer's choice. They identified three underlying dimensions of CVPA. One facet is the "personal and social value" of visual product aesthetics. This dimension refers to perceived value associated with superior product designs that improves the quality of life both at personal and at societal levels. The individual's affective reaction to a product design is identified as the "response" dimension of product aesthetics. The third dimension of visual product aesthetics is that of "acumen". It reflects an individual's ability for analyzing and assessing product designs. In addition, Bloch *et al.* (2003) showed that CVPA moderated the impact of product design on attitude towards product and purchase intentions. Individuals with high CVPA significantly evaluated high aesthetic products more favorably than low aesthetic products. Further, they were willing to pay a 20 per cent premium than low CVPA individuals for high aesthetic products. Mahlke (2004) found CVPA to moderate the relationship between perceived visual aesthetics and subjective feelings. For individuals with high CVPA, perceived aesthetics had a greater impact on valence ($\beta_{\text{HighCVPA}} = 0.32$, $p < 0.01$ vs $\beta_{\text{lowCVPA}} = 0.08$, $p > 0.05$) than individuals with low CVPA. These results suggest that individuals vary in their degree to which visual aesthetics are important and that these differences influence aesthetic product choices.

Multi-sensory interactions: touch and vision

Researchers investigating evaluation of material products have not addressed the impact of visual inputs on tactile evaluation in product preferences. The focus has been so far on the role of tactile evaluation as touch is salient in acquiring relevant information for material products. However, it is known that often products/services appeal to a range of consumer senses (Gutman, 1988). For example, visually appealing color of apparel (product aesthetics) could instantiate consumers to perceive it softer (touch). Understanding how consumers process and evaluate multisensory – tactile and visual inputs is important as it could help marketers in designing an offering that leads to a preferred response from consumers.

In studying the role of visual and tactile information, Klatzky *et al.* (1993) conducted studies where respondents were asked to evaluate products that were kept in front of them so that they could see but choose to touch or not. The study examined the influence of object properties and difficulty levels on whether consumer touched the object for evaluation. The properties examined in some cases were material properties such as weight, hardness and roughness, while other properties were more geometric such as shape, size and so on. The difficulty levels were manipulated by providing comparison contexts such as relative size of grape vs a marble (difficult) or roughness of sandpaper vs silk (easy). This study showed that people do not touch if the difficulty level for evaluation was easy or when the diagnosticity was geometric. Touch was used only when object evaluation was difficult and involved material property. Hence, the researchers concluded that consumers would use a proximal and effortful sense such as touch only when visual sense which is distant and less effortful could not be used. However, the tendency to avoid using the touch sense when judgment is easy and unnecessary leads to vision-based perceptions more than touch-based perceptions.

Heller (1992) in his study reported an improved performance in a forced-choice task when both visual and tactile inputs were provided. It was proposed that this enhancement was due to visual information supporting tactile evaluation of an object. Visual information creates expectation for tactile experience and incongruities in visual-tactile stimuli results in individuals exploring such products more, resulting in greater affect and surprise (Ludden *et al.*, 2009). Similarly, Manyam (1986) provides support for multisensory evaluation where tactile exploration was used for making fine discriminations between different stimuli along with visual evaluation. For familiar products, vision and touch perceive different aspects of texture and process inputs through independent systems in a complementary manner (Whitaker *et al.*, 2008). Even though many prior studies (Guest and Spence, 2003; Lederman *et al.*, 1986; Welch and Warren, 1980) suggest a one-way bias when both visual and tactile inputs are presented simultaneously, this study was undertaken to understand if visual information influence tactile evaluation of material products.

Some recent studies in marketing literature have also explored the multisensory integration of various sensory experiences. For example, Krishna *et al.* (2010) examined cross-modal interaction between smell and touch. Participants rated a scented paper for their perceived smell and texture. Results show significant interaction between two sensory experiences where feminine smell leads to more positive haptic perceptions for smooth papers, while for rough paper, masculine smell leads to more significant haptic experiences. This result shows that multisensory congruence between smell and touch can lead to more positive haptic perceptions. Hoegg and Alba (2006) examined taste

discrimination when consumers are presented with orange juices of difference colors. The authors show that visual information dominates actual taste in influencing preferences for orange juice, whereas verbal cues did not overwhelm taste discrimination. In another study, Zampini and Spence (2004) report joint effects of sensory cues in which auditory cues produced by biting potato chips affect the perception of crispiness of the chips. These results suggest that multiple sensory cues facilitate each other in influencing consumer perception. Additionally, media richness theory suggests that consumers better perceive multiple sensory signals (multisensory) than single or fewer sensory cues (Li *et al.*, 2003). These results highlight the role of multisensory inputs in product evaluation and choice.

Based on the review of literature, following hypotheses are presented:

H1. Tactile information dominates visual information in attitude and purchase intentions of products that are touch diagnostic.

H2. For touch diagnostic products, using both tactile and visual information (multisensory) increase attitude and purchase intentions of products than using uni-sensory evaluation.

H3. For touch diagnostic products, using both tactile and visual information (multisensory) increase the certainty of attitude towards a product.

H4. For touch diagnostic products, using both tactile and visual information (multisensory) increase the importance of attitude towards a product.

H5. The individual differences in NFT and CVPA significantly influence the impact of tactile and visual information on product evaluation when the object is highly touch diagnostic.

Methodology

Subjects and design

Participants for the current study were recruited from a graduate marketing classes in an Indian University ($N = 126$, 59 males with mean age of 23.52 years and 67 females with mean age of 21.47 years). Our study was guised as a "product evaluation" survey. Students participated in the study in exchange for partial course credit. The study was a single factor three cell-repeated measures within-subjects experimental design. All participants' responded in small groups of 7-11 and completed three experimental tasks (product evaluation: aesthetic evaluation × haptic evaluation × both aesthetic and haptic evaluation). The presentation order of the three experimental tasks was counterbalanced across subjects, following a Latin square design.

Stimuli

Two pre-tests were required to identify appropriate stimuli for the main study.

In the first pre-test, 43 business school graduate students served as sample. Pre-test subjects listed three product categories commonly used by graduate students and rated them on a five-point scale measuring the importance of tactile and visual information in product evaluation anchored by "not at all important" (1) and "extremely important" (5). Following this, product profiles were constructed in the following manner. Products that were evaluated primarily on tactile information were identified

as "touch diagnostic products", while those appraised on visual information were categorized as "visual diagnostic products". For hybrid products, both tactile and visual inputs were diagnostic in product evaluation. From the pool of 41 product categories, eight product categories were chosen with three each for touch diagnostic and visual diagnostic products, and two for hybrid products. Tissue paper (frequency (n) = 18, tactile information importance (TI) = 3.69, visual information importance (VI) = 2.20, $p < 0.05$), fountain pen ($n = 16$, TI = 3.33, VI = 2.00, $p < 0.01$) and towel/cloth napkin ($n = 13$, TI = 3.88) were profiled as haptic products. Jewelry ($n = 19$, VI = 4.27), watches ($n = 14$, TI = 2.60, VI = 4.00, $p < 0.01$) and sunglasses ($n = 14$, VI = 3.88) were identified as visually aesthetic products. Hybrid products included leather accessories ($n = 14$, TI = 3.50, VI = 3.88, $p = 0.36$) and slippers/footwear ($n = 26$, TI = 3.47, VI = 3.55, $p = 0.852$).

The second pre-test was designed to further validate the role of tactile and visual information in purchase decision for eight product categories identified in the first pre-test. The objective was to choose a touch diagnostic product for the main study. A total of 63 graduate students rated the eight product categories on a five-point Likert scale measuring the importance of tactile and visual information in product evaluation anchored by "not at all important" (1) and "extremely important" (5). The results showed that tissue paper (TI = 3.63, VI = 2.70, $p < 0.01$) and towels/cloth napkin (TI = 4.32, VI = 3.30, $p < 0.01$) were rated as haptic products, while slippers/footwear (TI = 4.19, VI = 4.43, $p < 0.05$), watch (TI = 3.94, VI = 4.67, $p < 0.01$), jewelry (TI = 4.05, VI = 4.71, $p < 0.01$) and sunglasses (TI = 3.90, VI = 4.68, $p < 0.01$) were identified as aesthetic products. Two products were classified as hybrid products as both tactile and visual inputs were equally important in their evaluation (leather accessories, TI = 4.16, VI = 4.26, $p = 0.46$; fountain pen, TI = 3.30, VI = 3.44, $p = 0.45$). Based on these results, we selected tissue paper as a study stimulus for its evaluation is based primarily on tactile information than visual information. Further, an assumption was made that tissue papers would be familiar to college students. Manipulation checks were conducted in the main experiment in order to confirm this assumption.

Stimulus material

Three different pieces of tissue papers from same brand was used for the study. The tissue papers had identical texture with same visual design on the front side. All three tissue papers were thick and light in weight. The surface of the tissue papers was finely graded – creating smooth feeling when touching it. The edges of the tissue paper were perforated with 1-inch ridge width. The three tissues papers were also visually identical with same floral designs in pink, green and blue colors in each of the tissue papers, respectively. The tissue papers were randomly assigned to the three experimental tasks.

Procedure

The main experiment was carried out in several class sessions. Experimental instructions and response measures were presented in a questionnaire format. Subjects read the instructions on the first page of the questionnaire and then evaluated the stimuli across the three experimental tasks. In the visual task, the tissue paper was presented visually to the participants; they could look at the tissue paper for as long as they wanted. They were instructed not to touch them and they were only allowed to visually evaluate the material.

When the participants had finished evaluating the stimuli, they recorded their responses on the questionnaire provided. In the tactile task the participants could only feel, but not see a tissue paper. During the tactile task, the tissue paper was placed in an opaque plastic bag and participants were instructed to feel the tissue paper inside the plastic bag. The participants were allowed to touch the tissue paper more than once and following this they rated the stimuli. In the multisensory task, participants were allowed to both see and touch the tissue paper for rating the stimuli. Each respondent had his or her own set of tissue papers and evaluated all three tissue papers (colors) that were counterbalanced across the three experimental tasks. After completing the rating of the stimuli, they filled some demographic questions and were debriefed. Carryover effect was reduced by allowing sufficient time between the experimental tasks. On average, each participant spent about 20-25 min for completing the three experimental tasks.

Measures

All of the measuring instruments were adapted from pre-validated measures in consumer behavior. The attitude towards a product measure consisted of four-item semantic differential scale anchored by "good-bad", "undesirable-desirable", "unfavorable-favorable" and "dislike-like" (seven-point scale). Attitude certainty or the extent to which a person views his or her attitude as correct (Gross *et al.*, 1995) was measured by a single item seven-point semantic differential scale anchored by "least certain" and "most certain". Attitude importance or the significance the individual attaches to the attitude (Boninger *et al.*, 1995) was measured by a single item seven-point semantic differential scale anchored by "least important" – "most important". A single item semantic differential scale anchored by "least likely to purchase" and "most likely to purchase" adapted from Ajzen *et al.* (1980) was used to measure purchase intentions. Items for measuring individual differences in NFT and CVPA were adapted from Peck and Childers (2003) and Bloch *et al.* (2003), respectively. Finally, the respondents rated the importance of visual and tactile information in product evaluation using two-item seven-point semantic differential scale anchored by "least important" and "most important".

Results

Manipulation checks

T-tests were used to determine if the three experimental tasks manipulated the repeated measures conditions as expected. Results indicated that all three experimental tasks were manipulated successfully: importance of visual information scored higher than tactile information in product evaluation in visual task ($\bar{X}_{\text{visual information}} = 5.69$, $\bar{X}_{\text{tactile information}} = 2.86$, $t = 14.48$, $df = 250$, $p < 0.01$), importance of tactile information scored higher than visual information in product evaluation in tactile task ($\bar{X}_{\text{visual information}} = 2.61$, $\bar{X}_{\text{tactile information}} = 5.80$, $t = -18.54$, $df = 249$, $p < 0.01$) and no difference was observed for importance of visual and tactile information in evaluation in multisensory condition ($\bar{X}_{\text{visual information}} = 5.71$, $\bar{X}_{\text{tactile information}} = 5.96$, $t = -1.56$, $df = 250$, $p = 0.120$). These results indicated that the three manipulations were successful. Further, 72 per cent of the respondents had purchased tissue papers in the last six months.

Carryover effects

To test for carryover effects in our repeated measures design, an analysis of variance (ANOVA) was conducted on the order of presentation of the experimental tasks

and its effect on dependant variables. The results showed no carryover effects as the purchase decision across the three orders in multisensory task ($M_{order1} = 6.11$, $M_{order2} = 6.14$, $M_{order3} = 6.43$, $F = 1.305$, $p = 0.275$), visual task ($M_{order1} = 2.62$, $M_{order2} = 3.10$, $M_{order3} = 2.55$, $F = 1.815$, $p = 0.167$) and tactile task ($M_{order1} = 4.39$, $M_{order2} = 4.62$, $M_{order3} = 4.83$, $F = 0.976$, $p = 0.380$) were not significantly different from each other. Similarly, carryover effects were not observed for other dependant variables of overall attitude (multisensory task: $F = 1.09, p = 0.339$; visual task: $F = 2.49$, $p = 0.087$; tactile task: $F = 2.40$, $p = 0.095$), attitude certainty (multisensory task: $F = 2.87$, $p = 0.061$; visual task: $F = 2.29$, $p = 0.106$; tactile task: $F = 0.67$, $p = 0.516$) and attitude importance (multisensory task: $F = 0.79$, $p = 0.452$; visual task: $F = 0.84$, $p = 0.441$; tactile task: $F = 0.11$, $p = 0.894$).

An additional ANOVA was conducted to test for differences in evaluation of the stimuli (three colors of tissue papers) used across the three evaluation tasks. The results showed no significant difference between the three tissue papers in their importance of visual and tactile information in evaluation across the three experimental tasks (multisensory task: tactile information importance – $M_{Blue} = 6.08$, $M_{Pink} = 5.98$, $M_{Green} = 5.85$, $F = 0.697$, $p = 0.50$, visual information importance – $M_{Blue} = 5.64$, $M_{Pink} = 5.71$, $M_{Green} = 5.86$, $F = 0.444$, $p = 0.64$; visual task: tactile information importance – $M_{Blue} = 3.04$, $M_{Pink} = 2.73$, $M_{Green} = 2.86$, $F = 0.348$, $p = 0.71$, visual information importance – $M_{Blue} = 5.62$, $M_{Pink} = 5.88$, $8M_{Green} = 5.58$, $F = 0.671$, $p = 0.67$; and tactile task: tactile information importance – $M_{Blue} = 5.65$, $M_{Pink} = 6.01$, $M_{Green} = 5.79$, $F = 1.014$, $p = 0.37$, visual information importance – $M_{Blue} = 2.63$, $M_{Pink} = 2.46$, $M_{Green} = 2.72$, $F = 0.301$, $p = 0.74$). The above findings suggested that the stimuli used in the study were similar in their visual and tactile properties.

Scale validation

NFT and CVPA scales were assessed using both exploratory and confirmatory factor analysis to confirm their scale dimensionality and validity in Indian context. An exploratory factor analysis (EFA) with varimax rotation carried out on the 12-items of NFT scale lead to extraction of two factors that explained 60 per cent of the total variance. Assessment of the rotated component matrix revealed that all items loaded on to their respective factors and yielded factor loadings greater than 0.5 (Nunnally, 1978). To further assess the two-factor model of NFT scale, the data were subjected to confirmatory factor analysis (CFA) along the lines suggested by Gerbing and Anderson (1988). Correlated dimensions (autotelic and instrumental) as proposed by Peck and Childers (2003) were hypothesized in the model. Global fit measures showed that data fit with the model was adequate. The two-factor correlated NFT scale was found to have an adequate fit to the data with χ^2 ($df = 49$, $N = 126$) $= 55.20$, $p = 0.252$. The goodness-of-fit (GFI = 0.938), adjusted goodness-of-fit (AGFI = 0.902) and Tucker-Lewis index (TLI = 0.988) for the model indicated an excellent fit and was well above the cut-off value of 0.9. The root mean square error of approximation (RMSEA = 0.032) was well below the acceptable ranges of 0.08, indicated an acceptable level of fit for the model as proposed by Jöreskog and Sörbom (2001). Similarly, the incremental fit index (IFI = 0.991), normed fit index (NFI = 0.927) and comparative fit index (CFI = 0.991) values were much higher than the cut-off value of 0.9. The overall fit measures indicated an acceptable level of fit for the proposed two-factor correlated model of NFT. Internal consistency measured by Cronbach's α coefficient resulted

in a value greater than 0.80 for both dimensions. Corrected item-total correlations were greater than 0.50 and individual correlations in the inter-item correlation matrix were greater than 0.30. The variance extracted levels were well above the 0.5 levels advocated for both autotelic (0.59) and instrumental (0.51) dimensions of NFT. These results corroborate the two-dimensional factor structure of NFT with autotelic and instrumental dimensions reliably in Indian context.

The factor structure, dimensionality and validity of CVPA were assessed in a manner similar to that used for NFT. Exploratory principle factor analysis with varimax rotation of CVPA data extracted three factors that explained 67 per cent of the total variance. The three factors of CVPA "value" (0.77), "acumen" (0.84) and "response" (0.79) displayed a satisfactory level of reliability with α coefficients. The internal consistency of the 11 predicted variables together was 0.84, which was well above the recommended levels proposed by Nunnally (1978). The overall fit measures of the three-factor correlated CFA model as proposed by Bloch *et al.* (2003) indicated that the hypothesized model is a good representation of the structures underlying the observed data. The three-factor correlated CVPA scale was found to have an adequate fit to the data with $\chi^2 (df = 40, N = 126) = 59.37, p = 0.025$. The GFI (0.930) and the AGFI (0.90), two descriptive overall measures, both meet the recommended value of 0.90. The RMSEA (0.062) was slightly below the recommended upper limit of 0.08. Both incremental fit measures meet the recommended levels, which are 0.91 for the NFI and 0.95 for the TLI. Thus, although the χ^2 statistic is significant for CVPA sample ($p < 0.01$) we conclude that the three-factor correlated model has been validated successfully and can be seen as appropriate for the explanation and prediction of product aesthetics in Indian context. Following the scale validation, a composite score was computed to represent the individual's NFT and CVPA in the main study.

Cronbach's α coefficient for the four-item attitude towards a product scale was 0.941 and consequently, we used average summated score for attitude towards the product in the later analysis.

Results of hypotheses tests

To test the hypotheses, data were analyzed using repeated measures ANOVA. The dependant variables were attitude towards the product, attitude certainty, attitude importance and purchase intentions. Means and standard deviations of dependant variables for the three experimental tasks are presented in Tables I and II.

The *H1* predicted more favorable attitude towards product and purchase intentions associated with tactile evaluation than visual evaluation. Results of the repeated measures ANOVA by using the Greenhouse-Geisser adjustment for asphericity show, as predicted, that there was a significant effect of tactile evaluation ($F(1, 125) = 121.531$, $p < 0.01$, $\eta_p^2 = 0.493$). More favorable attitude towards the brand was observed in tactile evaluation condition than in the visual evaluation condition

Table I.
Attitude towards the brand and purchase intentions: means and standard deviations

	Attitude towards product		Purchase intentions	
	Mean	SD	Mean	SD
Visual task	3.29	1.14	2.74	1.42
Tactile task	4.62	1.11	4.60	1.36
Multisensory task	5.99	0.98	6.23	1.01

($M_{tactile} = 4.62 > M_{visual} = 3.29$). Similarly, a significant effect of tactile evaluation on purchase intentions was observed ($F(1, 125) = 116.89, p < 0.01, \eta_p^2 = 0.483$). As can be seen in Figure 1, tactile evaluation ($M = 4.60$) elicited greater purchase intentions for material products than visual evaluation ($M = 2.74$). This supports *H1*.

The *H2* is also supported. Repeated measures ANOVA showed significant main effect of multisensory evaluation on consumers' attitude towards product ($F(2, 250) = 258.450, p < 0.01, \eta_p^2 = 0.674$) and purchase intentions (Greenhouse-Geisser $F(1.9, 406.3) = 239.72, p < 0.01, \eta_p^2 = 0.657$). The results reveal greater positive attitude towards the product in multisensory condition ($M = 5.99$) than in tactile ($m = 4.62$) and visual evaluation task ($M = 3.29$). Furthermore, multisensory evaluation ($M = 6.23$) resulted in greater purchase intentions than tactile ($M = 4.60$) or visual ($M = 2.74$) evaluation of material products.

The *H3* and *H4* analyzed the main effects of evaluation tasks on attitude certainty and attitude importance. The results of repeated measures ANOVA indicate a significant increase in attitude certainty (Greenhouse-Geisser $F(1.8, 252.3) = 169.33, p < 0.01, \eta_p^2 = 0.575$) and attitude importance ($F(2, 250) = 36.29, p < 0.01, \eta_p^2 = 0.225$) towards the product in multisensory evaluation tasks, supports *H3* and *H4*. We find that the attitude certainty towards the product was greater in multisensory evaluation task ($M = 6.16$) than in uni-sensory evaluation tasks ($M_{tactile} = 4.64$; $M_{visual} = 3.48$).

	Attitude certainty		Attitude importance	
	Mean	SD	Mean	SD
Visual task	3.48	1.52	4.77	1.49
Tactile task	4.64	1.20	5.30	1.29
Multisensory task	6.16	0.94	5.97	1.01

Table II.
Attitude certainty and attitude importance: means and standard deviations

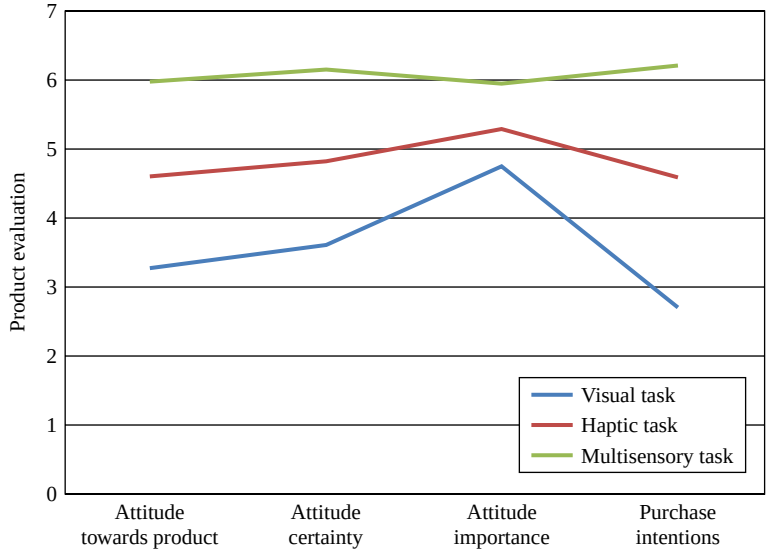

Figure 1.
Effect of evaluation tasks on attitude towards product and purchase intentions

Thus, *H3* was supported as multisensory evaluation potentiates the consumers' certainty in their attitude towards the product. The mean attitude importance rating in multisensory evaluation task (M = 5.97) was significantly greater than the mean ratings in tactile evaluation task (M = 5.30) and in visual evaluation task (M = 4.77). This result supports *H4*.

To test *H5*, we controlled for individual differences in NFT and CVPA by including them as covariates in the repeated measures ANOVA with the three evaluations task as independent variables. The findings indicate that individual differences in touch ($F(2, 246) = 0.984$, $p = 0.389$) and visual aesthetics ($F(2, 245) = 0.559$, $p = 0.569$) do not influence consumers' attitude towards products across the evaluation tasks when the objects are touch dominant. Similarly, we observed no significant effect of NFT (Greenhouse-Geisser $F(1.9, 234) = 1.18$, $p = 0.307$) and CVPA (Greenhouse-Geisser $F(1.9, 234) = 1.09$, $p = 0.336$) across the three evaluation tasks on purchase intentions. These results reject *H5*.

Discussion

The main objective of this paper was to examine the role of tactile, visual and multisensory information in evaluation of products salient on touch properties. Specifically, we wanted to investigate the combined effects of tactile and visual information on product evaluation; to explore if tactile evaluations are impacted by visual information in overall product evaluations for material products. We also wanted to explore if individual differences in touch and visual aesthetics affect the influence of tactile and visual information on product choice.

The results of our study yield significant findings of the impact of tactile information on product evaluations. Our study suggests that consumer attitude and purchase intentions are significantly impacted by tactile than visual information. As can be seen from Tables I and II, tactile evaluations lead to more positive product evaluation as touch was a preferred sensory modality for acquiring relevant information for material products, which was expected since the products were chosen to be haptic products. These findings indicate that tactile information enables consumers to make more accurate product judgment and increases diagnosticity for product performance. Further, respondents stated strong "undesirable" and "unfavorable" feelings when touch or the ability to feel a product was denied than when vision of the product was blocked. This finding corroborates with "perceptual-integration systems" in which information from different sensory modalities are integrated with the most appropriate stimulus dominating the less appropriate stimulus (Bresciani *et al.*, 2006; Ernst and Bülthoff, 2004; Iarocci and McDonald, 2006).

Our results seem to support the additive effects of visual and tactile information on product attitude and choice. We show that presence of both visual and tactile information in multisensory evaluation task lead to heightened product evaluation for touch diagnostic products. Thus, visual cues may interact with tactile information and create enhancing effects on product evaluation. Dual coding theory (Yates, 2001; Paivio, 2007) suggests a possible explanation for additive effect of visual and tactile information as observed in our study. It proposes that different sensory systems can process the same event independently resulting in increased memory traces for activation or retrieval. This suggests a multisensory modality system that involves processing of sensory information from both visual and tactile inputs for product

evaluated on touch diagnostic properties. Here, interaction of visual and tactile information was observed on products salient on haptic property of texture. Further, these results corroborate previous studies within multisensory literature that multiple sensory cues can be more diagnostic and accurate in product evaluation than uni-sensory information (Krishna *et al.*, 2010; Mattila and Wirtz, 2001; Yorkston and Menon, 2004).

This study results do not seem to support the hypothesis that individual differences in touch and visual aesthetics to influence the role of sensory information in consumer choice. Instead, we find that product/object properties to dominate individual personalities in product evaluation when products are touch diagnostic. This is in divergence from previous suggestions that individual differences in touch and visual aesthetics to moderate the relationship between tactile and visual aesthetics cues and product judgment and feelings (Bloch *et al.*, 2003; Krishna and Morrin, 2008; Mahlke, 2004; Peck and Childers, 2003). This lends support to the argument that object properties may sometimes be more influential than individual differences in evaluation of products. Furthermore, we find support for our result from attitude literature that products often constrain the influence of individual differences when objects are dominantly evaluated for a specific function (Shavitt *et al.*, 1992). This suggests that since material products are primarily evaluated through tactile evaluation, individuals use touch as a primary sensory modality to acquire relevant information in making accurate product judgments. In such a case, individual differences do not influence acquisition of information through touch for effective product evaluations.

In sum, this study demonstrates that both tactile and visual information play an important part in tactile evaluation of material products. Moreover, it also shows that visual inputs to assist/help tactile evaluation in making accurate product judgments. These findings on combined effects of visual and tactile information contribute significantly to multisensory literature within consumer behavior.

Theoretical implications

The contributions of the current research to literature on sensory marketing are twofold. First, this study advances our understanding of the impact of multisensory stimulation by offering empirical support for the additive effects of tactile and visual experience on consumer evaluation of products. In a notable departure from previous touch research (Citrin *et al.*, 2003; Grohmann *et al.*, 2007; McCabe and Nowlis, 2003; Peck and Childers, 2003), this study manipulated the availability of touch and vision sensory modalities in purchase behavior rather than just comparing touch vs no-touch conditions. The results showed that when both visual and tactile inputs are available, the respondents reported more certain and favorable attitude towards the products than when a given sensory modality was blocked.

Second, the results of the current study established the multidimensionality of NFT and CVPA in Indian context, consistent with conceptualization of Peck and Childers (2003) and Bloch *et al.* (2003), respectively. Further, this study highlights the importance of tactile cues in evaluating a product and affecting its purchase behavior. By contrast, this effect would not be greater for high NFT individuals as proposed by prior touch research (Krishna and Morrin, 2008; Peck and Childers, 2003). It is possible that tactile inputs are essential to make accurate product judgments and individual differences may not affect the need to evaluate these products by touch.

Also, product evaluation may depend on other factors, like product quality (Grohmann *et al.*, 2007), product complexity (Jahng *et al.*, 2007), ownership of the product (Peck and Shu, 2009) or brand name (Lindstrom, 2005). Incorporating these factors in future studies should shed more light on the effects of individual differences in NFT on product evaluation.

Managerial Implications

The findings from the present study provide important managerial implications. Given that the attitude towards material products are desirable when they are held in a customer's hand, the challenge for marketing managers is then to find ways for the potential customer to pick up the specific product during evaluation in in-store environment. Further, an increasing proportion of purchases are presently being made by consumers via the online shopping channel (Ward and Lee, 2000; Yu and Wu, 2007). Online shopping limits potential customers from using tactile information during evaluation and this lack of touch may inhibit them from making product purchases online. This problem can be addressed by the following ways:

- use of tactile evaluation elements in web sites such as 3D virtual touch or virtual showrooms to imitate touching products (Jin, 2011; Zhou *et al.*, 2007);
- increase interactivity by allowing customers to personalization the web site (Jahng *et al.*, 2007); and
- enabling customers to order for samples before actual purchase (Spence and Gallace, 2011).

In particular, the results of this study showed that multisensory evaluation increased individual's attitude certainty and preference for material products. Thus, marketers may significantly increase consumer's favorability towards the brand by incorporating visual components to product displays. Further, multisensory product evaluation might be extremely relevant in today's highly competitive markets where products are almost undifferentiated on critical object properties. For products of generic nature, such as tissues or detergents, it might be important to incorporate opportunities to evaluate using multisensory modalities in order to build brands that are valued more by consumers. Certainty of attitude influences purchase intentions and hence by improving attitude favorability as well as certainty, both purchase intentions as well as brand evaluation may be enhanced.

Limitations and further research directions

We list some of the shortcomings of this research which provide scope for future research in the area of multisensory evaluation of products. First, we examined the role of multisensory inputs in material products evaluation. Future studies should explore the combined effect of tactile and visual information for products salient on visual aesthetics. It would be interesting to observe whether similar additive effects are associated with tactile and visual information for aesthetic products or are these effects exclusive for material products? Second, we investigated texture property of material products in our study. Future research could investigate how tactile and visual information interact with each other for products that differ in haptic properties such as weight, or temperature. For example, unsupported exploratory procedure is used

to evaluate the weight of tennis racket (Childers and Peck, 2010). How does visual information for such haptic products improve product judgments would be an interesting area for future research? Finally, understanding how tactile information interacts with other sensory inputs of smell, olfaction and taste will help us better understand the nature of multisensory modalities in consumer choice.

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