The Semantic and Aesthetic Impact of Smell on Touch

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We contribute to the literature on multisensory interactions within consumer behavior by showing the semantic and sensory aesthetic impact of smell on touch. Across two studies we show that the scent of a product can impact haptic perceptions, with these effects being moderated by the level of congruity and semantic associations between the sensory stimuli.

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SESSION OVERVIEW
While much research in the area of sensory perception has been done in the areas of cognitive psychology and neuroscience, research on sensory marketing is relatively new with the first academic conference on the subject being organized in 2008. While the field is growing, most of the research in marketing thus far focuses on a single sense—both the antecedents and consequences of sensory perception. However, one sensory input may affect perception of another—for instance, smell may affect haptic perception as one of the papers show. Also, a second temporally distinct sensory input, even belonging to the same sense, may impact perception (and even memory) of the first by creating interference in perception and recall. This session explores the concept of sensory interaction with the four papers synergistically providing a good overview of the kinds of sensory interactions that may exist. The first three papers explore sensory interaction by a second input of the same sense where the interaction is more in the form of interference—the interference is at difference times in the first paper, and at the same time in the second and third papers. The fourth paper (and also the third) consider interference by a second sense.

More specifically, the first paper examines the notion of retroactive interference, i.e., sensory interference by a second stimulus after exposure to the primary stimuli—if one is first exposed to brand A with smell X and later exposed to brand A with smell Y (or brand B with smell X), what impact does it have on memory for brand A with smell X? The second paper examines the effect of simultaneous (in time) interference with a second input of the same sense that is incongruent with the first (subjects imagine one haptic object but actually feel another one that is haptically incongruent with the first). The third paper considers congruence of sensory inputs both from within and across senses. Specifically, it shows that an incongruent size change in one dimension (for example, if one physical dimension of a package is increasing when the other two dimensions are decreasing) as well as incongruence between vision and touch influence consumers’ perception of volume change. The fourth paper also considers congruence of sensory inputs, in this case between two different senses, smell and haptics—it focuses on how a semantically congruent versus incongruent smell affect haptic perception (does a rough paper appear rougher when it has a masculine smell?).

Together, the papers provide a big picture overview of sensory interaction with a hope of growing the field in a broad new direction that has many possibilities for future research.

EXTENDED ABSTRACTS

Is Olfactory Memory Unique?
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The sense of smell is of critical importance to humans, although it is often the most underrated of all the five senses (Martin, Apena, Chaudry, Mulligan and Nixon 2001). Perhaps not surprisingly, the sense of smell has received less attention from consumer researchers than have the visual and auditory sensory modalities. Yet interest in scent and its effects on consumer behavior is on the rise (e.g., Bone and Jantrania 1992; Bosmans 2006; Mitchell, Kahn and Knasko 1995; Spangenberg, Crowley and Henderson, 1996). To date, consumer researchers have focused primarily on the conditions under which pleasant scents enhance product, store, and advertising evaluations as well as lingering and variety-seeking behaviors.

Considerably less consumer research has looked at the effects of scent on memory. The few studies that have been conducted provide some initial evidence to suggest that scent enhances recognition and recall of brand information (Morrin and Ratneshwar 2003), and that this information decays only minimally over time (e.g., Krishna, Lwin and Morrin, forthcoming). However, the precise nature of scent’s ability to enhance memory is not well understood. Relevant research from the field of experimental cognitive psychology is limited in this respect as well. Indeed, a debate exists regarding whether or not olfactory memory possesses a special capacity to inhibit the forgetting process (Zucco 2003). Some researchers have suggested that olfactory memory possesses unique characteristics that render it distinct from memory based on information acquired from the other senses—specifically, that it is resistant to retroactive interference (Danthiir, Roberts, Pallier and Stankov 2001, Engen 1987). Others disagree (Koster, Degel and Piper 2002, Olsen, Lundgren, Soares and Johansson 2009, Walk and Johns 1984).

We contribute to the debate by exploring the effect of scent on consumer memory over time in a competitive market context. One hundred and twenty-nine undergraduates participated in the study which involved evaluating one or more brands of moisturizer. The study consisted of six different conditions: four interference groups and two non-interference groups. All participants were exposed to a hypothetical brand of moisturizer in the form of an advertisement and product sample at time 1. Two weeks later (at time 2), those in the interference groups were exposed to another moisturizer product (containing either the different brand name, a different scent, or both a different brand and different scent); those in the non-interference groups were exposed to nothing at this time. Two weeks later (at time 3), all participants’ memories were tested.

In terms of unaided attribute recall for the first brand encountered, we find that, in the absence of competition, a scented moisturizer’s attributes are much better recalled than are those of an unscented moisturizer (23% versus 12%, p < .01). This result demonstrates the basic memory-enhancing effects of product scenting. In all three of the scented interference conditions, participants’ ability to recall the first brand’s attributes was significantly lower than in the no-interference scented condition (all p’s < .05). This result provides clear evidence of retroactive interference effects. The specific nature of the scented interfering material did not matter—the second or interfering brand could have the same or a different name, and the same or a different scent. From these results we conclude that product scenting provides no special immunity to retroactive interference.

We also conducted an ANOVA on incremental aided attribute recall (i.e., additional items recalled when provided with a scent-based retrieval cue). Mean comparisons show that when participants were provided with a scented retrieval cue, they recalled a larger proportion of brand attributes (11%) if the brand had been scented and there was no interference, compared to all other conditions (0% to 7%, p’s < .05). This result is another demonstration of the overall memory enhancing effects of product scenting. Interestingly, providing the scented retrieval cue produced more incremental recall in
that the three scented interference conditions than in the two unscented conditions (all p’s < .05). This result demonstrates that, if provided with an adequate retrieval cue, in this case, the product’s scent, much of the information that was retroactively interfered with can nevertheless later again be retrieved—suggesting that such information is available, if not always accessible, in long-term memory.

The pattern of results suggest that scent is indeed an effective memory enhancer, but it appears to be so not because scent-associated information is immune to later exposure to similar information—that is, not due to some special immunity from retroactive interference effects. Rather, it appears to be a function of enhanced olfactory encoding. These enhanced encoding effects were evident in two ways: a) in the fact that unaided recall was nearly double for scented versus unscented products (in the absence of competitive interference), and b) that incremental recall was generated by exposure to a scented retrieval cue even after exposure to the interfering material. Thus, olfactory memory processing can be considered unique or distinct from that based on the other sensory modalities not because the forgetting process is different, but because the encoding process is different. The difference in encoding may be due to a hippocampal resources advantages (Wixted 2004) or to the fact that olfactory information is coded more perceptually than is information from the other sensory modalities (Engen 1987).

That’s Not What I Feel:
The Effect of Haptic Imagery and Haptic Interference on Psychological Ownership and Object Valuation
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Previous research has shown that consumers value objects more highly if they own them, a finding commonly known as the ownership effect (Thaler, 1980). This effect is not limited to legal ownership; psychological ownership, characterized by the feeling that something “is mine,” also produces the endowment effect. One antecedent of psychological ownership is the ability of an individual to control an object by touching it. Peck and Shu (2009) show that when individuals are given the opportunity to touch an object (versus not), they report a greater sense of psychological ownership and value the object more highly.

If touch is not available, could the act of visualizing touch act as a surrogate? According to MacInnis and Price (1987), imaging is a resource demanding process in which sensory information is represented in working memory. Bone and Ellen (1992) conjecture that imagery “may involve sight, taste, smell and tactile sensations” (p. 93). Although research on imagery and the tactile system is limited (Klatasky, Lederman & Matula, 1993), there is some evidence for the interdependence of touch and visual imagery (Katz, 1925).

Since imaging requires cognitive resources and the effects of imagery are mediated by resource availability (Bone & Ellen, 1992; Unnava, Agarwal & Haugtvedt, 1996), blocking out perceptual distractions during imaging may enhance its effects. Unnava et al. (1996) found that when imagery and perception compete for the same resources, the positive effects of imaging are reduced. Similarly, Petrova and Cialdini (2005) found that difficulty in imagery generation can reverse the positive effects of imagery appeals. In some instances, consumer behavior researchers have instructed participants to close their eyes when imaging (e.g., Bone & Ellen, 1992; Keller & McGill, 1994 (Experiment 1); Petrova & Cialdini, 2005 (Study 3)), although this was not the focus of these studies. We hypothesize that closing one’s eyes while imaging touching an object leads to greater psychological ownership and valuation than imaging touching an object when one’s eyes are open.

An experimental study was designed to examine the effect of touch imagery on both psychological ownership and valuation. The design was a 4 (imagery/touch: imagery eyes closed, imagery eyes open, no touch no imagery, touch with no imagery) x 2 (product: Koosh ball, blanket), with the first factor manipulated between subjects, and the second factor varied within subjects. Three hundred and twenty-six individuals participated in the study.

Our first hypothesis predicted that when participants imaged touching the product with their eyes closed, both psychological ownership and valuation would be greater than when participants imaged with their eyes open. We found a main effect of touch/imagery for both psychological and valuation. For psychological ownership, both the touch condition and the touch imagery with eyes closed condition resulted in a significantly stronger sense of ownership than the touch imagery with eyes open condition and the no touch-no imagery condition. Interestingly, there was no significant difference in either psychological ownership or valuation between the touch imagery with eyes closed condition and the condition where actual touch was possible. For valuation as the dependent measure, the results were similar.

We next conducted a second study in order to examine the process in more detail. We hypothesized that when a person closes their eyes to imagine, they are focusing their cognitive resources which results in similar effects to actual touch. In the second study, we had participants imaging touching a product (as in Study 1) but we manipulated whether haptic interference was present and also whether the interference “fit” with the imagined object. The design of this study was a 2 (vision: eyes open, eyes closed) x 3 (haptic stimulus: none, congruent, incongruent) with both factors manipulated between subjects. Three hundred and eighty seven individuals participated and we were able to replicate our first hypothesis. We also found that when a person imagines with their eyes closed, the presence or absence of a haptic stimuli does not significantly impact haptic imaging unless the stimulus is incongruent with the product being imagined.

A final study currently being conducted delves deeper into both the process and the individual difference in Need for Touch (Peck and Childers 2003). While high NFT individuals are more influenced by positive sensory information, low NFT are more affected by negative haptic sensory information (Childers and Peck). In the current study, we examine positive and negative sensory interference by high and low NFT individuals.

How do Consumers Estimate Product Downsizing and How Can they be Helped?
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The supersizing of food portions and packages has been identified as one of the prime drivers of the obesity epidemic (Nielsen and Popkin 2003). Supersizing leads to overeating partly because consumers underestimate just how large supersized portions and packages are (Chandon and Wansink 2007; Krider, Raghubir, and Krishna 2001). Some food companies have started to offer downsized options on their menus (e.g., Ruby Tuesday, TGI Friday’s “Right Portion Right Price” menu) but these initiatives have not been very successful because consumers are averse to portion downsizing. To help consumers better monitor their consumption and to help them choose smaller food portions, it is important to understand how consumers perceive package downsizing and to compare the effectiveness of informational, visual, and haptic de-biasing strategies.

Research in psychophysics has shown that estimations of object size follow an inelastic power function of actual object size (estimated size = a × actual sizeb, where b < 1), meaning that people
underestimate size increases (Stevens 1986). Research in marketing has found that the underestimation of package size changes is even stronger when an object increases in all three spatial dimensions (height, width, and length) rather than in just one dimension (Chandon and Ordabayeva 2009). However, we don’t know why these biases occur, how they can be reduced, and whether these biases, previously reported in the context of size increases, would be similar in the context of size decreases. In this research, we test attentional and computational sources of biased size perceptions, estimate several models of size change, and test informational, visual, and haptic strategies to improve the accuracy of consumers’ size estimations in the context of package downsizing.

We hypothesize that people underestimate size decreases not just because they do not pay attention to the fact that the dimensions are changing but because they do not correctly integrate these changes (i.e., there are computational errors not just an attentional error). We further hypothesize that estimations do not follow the normative model of size estimation which assumes that people multiply the changes in all of the three dimensions. Instead, we compare two models: an additive model which assumes that people just add the change in all of the three dimensions and a “surface area” model which assumes that people respond to changes in the surface area of the object instead of its actual volume.

These hypotheses imply that visual and informational strategies, such as drawing attention to individual dimensions and providing information about perceptual biases would not suffice to correct size estimations. They also predict that facilitating the computational problem by reducing the dimensionality of the size decrease (from 3D to 2D to 1D) or by allowing people to hold and weigh the product (and thus rely on haptic instead of just visual information) should improve the accuracy of size estimations. Another prediction of both the additive and surface models is that product downsizing would be more obvious when one dimension is decreased (1D downsizing) than when one dimension is actually increased while the other two are strongly decreased (elongated downsizing). Finally, because of the height/width illusion, we would expect that size estimations are more sensitive when it is the height of the object which is elongated rather than its width.

In study 1, participants saw four sizes (XL, L, M, and S) of rectangular candles and cylindrical candy boxes which decreased either in 1D (height only), 2D (width and length), or 3D. All participants were given the weight and price of the largest option (XL) and were asked to estimate the weight and to provide their willingness to pay for sizes L, M, and S. Participants in the decomposition condition were also given the height, width, and length of size XL and had to estimate the height, width, and length of the other sizes. This manipulation ensured that they would pay attention to the fact that more than one dimension may have been reduced. We found a strong underestimation bias on average (b = .85). Reducing the dimensionality of size decrease from 3D to 2D to 1D reduced and eliminated the bias (b = .67, b = .89, and b = 1.06), but drawing attention to individual dimensions did not. We also found that the additive model fit the data better than any other models. This shows that the errors are driven by computational errors and not by attention.

In Study 2, we used a similar design as in Study 1 but manipulated whether the product was downsized in 1D or through elongation because it allows us to better compare the predictions of the additive and surface area models. In addition, some of the participants were asked to hold and weigh the products while others were given information about the feedback on their estimation accuracy in a prior similar task. A control group only saw the products visually and was given no feedback (just like in Study 1). Finally, we manipulated the dominant dimension of the package by displaying the two products (soap bars or rectangular candles) either on their base (salient height) or on their side (salient width). As predicted, people noticed the size reduction more when only one dimension was changed than when the product was elongated (b = .81 vs. b = .23). Allowing people to touch and weigh the packs significantly improved estimation accuracy (b = .59 vs. b = .43). However, providing information and changing the dominant dimension of a package had no effect. Again, we found that the additive model fit the estimation data better than the alternative models.

In the third study, conducted in collaboration with a major consumer goods company, we tested the effectiveness of elongated and 1D downsizing of dog food packages. The participants were all dog owners and were asked to choose between a regular-size pack of a competitor brand and a new downsized version of the company’s product which was either downsized in 1D or elongated in height or width. As predicted, the choice share of the downsized pack was larger when the pack was downsized by elongation (57% for the height condition and 46% for the width condition) than when it was downsized in 1D (39%).

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The marketing literature has received a marked increase in scholarly attention devoted to the impact of sensory perception on consumer behavior (see Peck and Childers 2008). Not surprisingly, much of this exploration has shown the effects of the senses on consumer behavior in isolation from one another. Research on the impact of smell on memory (Morrin and Ratneshwar 2003), music on shopping behavior (Yalch and Spangenberg 2000), and touch on feelings of ownership (Peck and Shu 2009) highlight some of the fascinating results from this primary focus. Despite the need to continue exploring the impact of senses in isolation, the foundation now exists to support studies on the interaction of senses. We contribute to the literature on multisensory interactions by showing the sensory aesthetic (we define sensory aesthetics as the combined hedonically pleasing effects of sensory inputs) and semantic impact of smell on touch. Across two studies we show that the scent of a product can impact haptic perceptions, with these effects being moderated by the level of congruity between the sensory stimuli.

Multisensory Interactions and Consumer Behavior

The overall neural representations of product experiences rely on a combination of all sensory inputs. Recent studies within consumer behavior have explored these cross-modal interactions, including touch and taste (Krishna and Morrin 2008), smell and sound (Matilla and Wirtz 2001), sound and vision (Russell 2002), vision and taste (Hoegg and Alba 2007), as well as multiple sensory inputs and taste (Elder and Krishna 2010). These cross-modal interactions between senses have important consequences on consumer perceptions and behavior.

The specific combination of smell and haptics has not received attention within the marketing literature despite the acknowledgement that both scent and touch in isolation greatly impact consumer behavior (e.g., Morrin and Ratneshwar 2000; Peck and Wiggins 2006). However, recent research within psychology provides preliminary evidence that these sensory inputs do interact. Dematte and colleagues (2006) show that scent can impact touch, wherein a positive scent leads to better fabric perceptions than an unpleasant scent. In addition to this overall halo effect of smell on touch, we anticipate that semantic associations of the scent, as well as the
congruence of these associations and the tactile properties of the stimulus, will further affect perceptions of the product. Whether learned or automatic, scents are not devoid of meaning. Indeed, the meaning of scents can affect not only perceptions, but actual behavior (Holland et al. 2005). Our current work explores not the aesthetic impacts of smell on touch, as well as the importance of semantic congruence within cross-modal interactions. We exhibit our effects across two different dimensions of touch (texture, temperature), and using two sets of fragrances.

Study 1

Study 1 explores the impact of semantic sensory associations and congruity. As we were interested in drawing semantic associations from the smell to the haptic experience, we needed to find a way to match the stimuli. The specific question to be addressed is whether a masculine or feminine smell can impact texture perceptions of paper matched for congruity (rough and smooth paper, respectively). We carefully pretested masculine and feminine smells, as well as rough and smooth paper for equal likeability as well as equal distances from the midpoint on a masculine/feminine scale.

Design and Procedure. Seventy-three undergraduate participants were randomly assigned to one of the four conditions. Each was given a scented piece of paper to evaluate. In contrast to the prior studies, participants were told to touch and also smell the fragrance on the paper. Following ratings of the smell, participants rated the overall texture of the paper.

Results. We found a significant main effect of texture ($p < .001$) as well as a significant interaction of paper type and smell on perceived texture of the paper ($p < .005$). Follow-up contrasts on the interaction revealed that within the smooth paper condition, the feminine smell lead to significantly smoother perceptions than the masculine smell. Similarly, in the rough paper condition, the masculine smell lead to significantly rougher perceptions than the feminine smell. The results support the semantic associations of smell as well as congruence effects. We show that scents do have meanings, and that these meanings can have a significant impact on other sensory inputs, such as touch.

Study 2

In study 2, we replicate and extend the findings of study 1 on semantic congruence to a different dimension of touch, namely temperature. The specific question to be addressed is whether the feel or temperature of a smell can impact evaluations of haptic quality. We again pre-tested fragrances to be equal on overall likeability and familiarity, but to differ on perceived temperature of the smell. We ultimately selected pumpkin cinnamon as a warm smell and sea island cotton as the cool smell, and used therapeutic gel-packs (either hot or cold) as the product to be evaluated haptically.

Design and Procedure. We employed a 2 (fragrance: warm, cool) x 2 (gel-pack: warm, cool) between subjects design with overall evaluations as the dependent variable. Ninety-eight participants were instructed that they were to evaluate an aromatherapy hot/cold gel-pack. Each participant smelled the gel-pack and then placed the gel-pack on her hand for 15 seconds. Following this procedure, participants rated how well the gel-pack worked (very effective, very quickly, cooled/heated hand well).

Results. We find a significant main effect of gel-pack temperature, whereby the cold gel-pack is perceived as more effective than the warm gel-pack. More importantly, we also find our hypothesized interaction between gel-pack and fragrance temperature ($F(1, 94) = 8.49, p < .005$). Follow up contrasts reveal our anticipated effects as within the cold gel-packs, the cold smell leads to significantly higher evaluations than the warm smell. Similarly, within the warm gel-pack conditions, the warm smell led to significantly higher evaluations than the cool smell.

The results from study 2 replicate our findings from study 1 and add an additional dimension of touch (temperature). Furthermore, our findings explicate another instance where smell can lead to semantic associations that drive the evaluative consequences of congruence for haptic stimuli.