OLFACTORY – TACTILE INTERACTIONS AND THEIR IMPLICATIONS FOR RETAILING

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A Thesis
In
The John Molson School of Business

Presented in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Administration (Marketing) at
Concordia University
Montreal, Quebec, Canada

August 2010

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Your file Votre référence
ISBN: 978-0-494-71020-3
Our file Notre référence
ISBN: 978-0-494-71020-3

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Abstract

Olfactory-Tactile Interactions and Their Implications for Retailing

Si Chang

While research suggests that sensory modalities, such as olfaction or touch, influence consumer evaluations and behavior, the interaction of these sensory modalities are not well investigated. Focusing on the interaction of ambient scent and tactile input, this research explores the effect of ambient scent on consumers' perceptions of tactile product properties in terms of softness and temperature. Scent and tactile input are manipulated in a 5 (scent: cinnamon, pine, jasmine, eucalyptus) between-participants lab experiment with replication across selected product categories differing in tactile characteristics. Ambient scent did not significantly enhance the tactile perceptions, willingness to pay, and purchase intentions. Tactile perceptions, willingness to pay, and purchase intentions were influenced by product, however. Implications for marketing and retailing are discussed.

ACKNOWLEDGEMENT

I would like to show my deepest gratitude to my supervisor, Professor Bianca Grohmann for her patience, advice, guidance, and support from the very beginning to the final stage of this thesis. She has lead me into the field of retailing and brought me fantastic experiences in this work. Besides, she has provided me continuous encouragement during my graduate study. Her knowledge and passion have always guided me throughout this research and inspired my growth as a student. I'm indebted to her in the years with her, more than she imagines.

I wish to express my sincere thanks to the rest of thesis committee members: Professor H. Onur Bodur and Professor Hakkyun Kim, for their valuable comments, support and advice.

Finally, I would like to thank my parents, for their support and encouragement throughout my studies in the university and in my life. I would also like to thank all of those who have supported me and helped me during the completion of this thesis.

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Chapter 1 Introduction

Research has recognized the importance of individual sensory modalities (e.g. olfaction, touch, and auditory cues) and found support for significant effects of sensory cues on consumers' evaluations and perceptions. Using sensory stimuli in a retail context is considered an effective way to influence consumers' shopping behaviors (Spangenberg et al. 1996). For example, ambient scents are usually used in order to affect consumers' emotional responses and influence their behaviors in the store (Bosmans 2006). The sense of touch is also considered important for the evaluation of product (Peck and Childers 2003a, b). However, cross-modal sensory perception and its implications for marketing practice are not well investigated. Although recent research has begun to study the interactive effect of olfaction and audition (Mattila and Wirtz 2001), and the combined effect of touch and taste (Krishna and Morrin 2008), there is a lack of knowledge regarding how ambient scent interacts with tactile perceptions to influence consumers' behaviors.

This research examines the impact of ambient scent on consumers' perceptions of tactile product properties in terms of softness and temperature. It empirically tests whether ambient scents with connotations of softness/roughness and coolness/warmth affect consumers' evaluation of a product's softness and warmth, and whether consumers' need for touch the product mitigates or enhances this effect. We expect that the interaction of ambient scent and tactile input will have significant impact on consumers' evaluations and their purchasing intentions. By examining this interactive effect, this research seeks to understand how certain sensory modalities interact,

which offers important knowledge of the effect of combined sensory in the marketing literature. This research also seeks to provide guidelines to the retailers who allow consumers to touch products and consider using ambient scent in their stores.

Chapter 2 Literature Review

Ambient Scent

Scents are used in many stores to influence consumers' evaluation of products or their evaluation of the store itself. Specialty stores frequently use the inherent scents of their products to affect customers. Retailers also use ambient scents in the store environment when the existing products do not contain specific scents (Bone and Ellen 1999, Donovan and Rossiter 1982, Mitchell et al. 1995). The ambient scent influences consumers' emotional responses, which in turn affects their evaluation of the product and the store (Bosmans 2006).

Researchers differentiate product-specific scent from ambient scent. Product-specific scent is scent that is inherent to products (e.g. the scent of scented candles, laundry detergent, or coffee), whereas ambient scent is present in the environment (e.g., in stores using scent diffusers, in homes using air fresheners). Research shows that ambient scent can influence consumers' perception and evaluation of products (Gulas and Bloch 1995). It serves as an effective memory cue for people to retrieve memories for different experiences (Frank 1991). In an environment where people are strangers, ambient scent can have positive effect on the social interactions in the environment (Zemke and Shoemaker 2007). Scents shape

perceptions of the store environment and produce emotional effects in consumers; the emotions generated by the environment can then determine consumers' behavior in the store (Darden and Babin 1994, Donovan and Rossiter 1982).

The olfactory information can be used systematically to facilitate consumers' cognitive processing. Compared to physical context cues (e.g., location), olfactory context cues can be transported more easily. At certain time required, the olfactory stimulus can be released in order to influence consumers' responses (Cann and Ross 1989). In addition, including odor in the environment will influence employee productivity in the service businesses (Bitner 1992). Some artificial odors, which are consistent with product information, can be used as an effective cue for recognition (Cann and Ross 1989). Consumers differ in terms of their affective responses to scent. The extent of customers' liking and disliking of the scent may lead to different evaluations of the product (Wrzesniewski 1999). Herz (2004) found that memories are more emotional and evocative when they are presented with scent than when they are recalled by the visual or auditory cues. Sometimes consumers have to rely on contextual cues to identify the odor that they are experiencing. For example, Ellen and Bone (1998) suggest that a lemon-scented product can be better recognized if it is shown in a yellow container.

The fact that olfactory cues in the environment can influence consumers' responses has been supported in past studies. The presence of scents can affect cognitive elaboration, affective and evaluative responses, purchase intention and behaviors (Bone and Ellen 1999, Mitchell et al. 1995, Spangenberg et al. 1996,).

Ambient scents can work as affective cues and gives affective information about the products. Consumers' affective reactions influence final product evaluation. The effect of congruence of the scent is also mediated by their affective responses (Bosman 2006).

Consumers have more positive responses when products contain certain scents and when the scent is congruent with the product (Bone and Jantrania 1992, Spangenberg et al. 1996). The scents can also affect mood. People who have positive mood are more likely to provide positive evaluations (Dawson 1990). However, the effects of odor are not necessarily mediated by mood. Instead, consumers may transfer impressions of scent pleasantness or unpleasantness to the product (Cann and Ross, 1989, Ehrlichman and Halpern, 1988, Spangenberg et al., 1996).

Chebat and Michon (2003) used a shopping mall environment to test the effects of ambient scent. They found that ambient scent has a direct effect on consumers' perception. In an environment with ambient scent, consumers evaluate products more positively than in an unscented environment. The intensity of the scent and the type of scent does not influence this effect (Spangenberg et al. 1996). Ambient scent is considered an effective environmental cue that can affect consumers' emotional responses and purchasing behavior. Research supports that the effects of ambient scents are mediated by consumers' perception of the environment and product quality. Morrin and Ratneshwar (2000) found that a pleasant ambient scent can increase cognitive processing of unfamiliar brand information. When pleasant ambient scent is presented, brand evaluations are more positive, especially for some

unfamiliar brands. Ambient scent also improves the recall of unfamiliar brand names. Pleasant odors may improve the memory through increasing the amount of time used to evaluate the brands. Hirsch (1995) found that when the casino is scented, gamblers will spend more money on slot machines than when it is not.

Three major dimensions of scent have been discussed in the literature. The first dimension is the affective quality of the scent (i.e., how pleasant it is). This dimension is perceived to dominate scent perception, because the scents come into the limbic system, which is the center of emotions in the brain (Spangenberg et al. 1996). Pleasantness or unpleasantness has been the primary consideration of odor (Ehrlichman and Halpern 1988). The second dimension is the arousing nature of the scent (i.e., how likely it is to evoke a physiological response; Spangenberg et al. 1996). Scent can lead to arousal as shown in electroencephalographs (EEG) and respiratory patterns (Lorig and Schwartz 1988). However, there is a non-linear relationship between arousal and pleasantness (Richardson and Zucco, 1989). The third dimension is the intensity of the scent (i.e., how strong it is; Spangenberg et al. 1996). People may have more negative reactions as the intensity of the scent increases (Richardson and Zucco, 1989). Pleasantness of scent affects the relationship between people's reactions to the intensity of the scent. There may be an inverted U-shaped function, such that for more pleasant scents, there may be an optimal level of intensity, under which consumers' preference increases as intensity increases. The optimal level of intensity is expected to be higher for more pleasant scents than less pleasant ones (Spangenberg et al. 1996).

Spangenberg et al. (1996) apply the S–O–R paradigm to ambient scent effects. The S–O–R paradigm originates in environmental psychology and relates the environmental stimuli with responses and approach/avoidance behaviors. This stimulus–organism–response (S–O–R) paradigm has provided theoretical basis for much of the marketing research of ambient scent. The stimulus cues (S) include consist of ambient scents. These environmental cues combine to generate affective response or arousal, which influence consumers' internal evaluation (O), and finally lead to their approach or avoidance responses (R) (Spangenberg et al. 1996). Affect is considered as a positive or negative state of emotion or feeling. Affective response is the emotional reaction to the environment which people have psychological contact with (Brower 1981). Arousal is a psychological feeling state related to the environment (Mehrabian and Russell 1974). Approach responses are positive behaviors related to the environment, while the avoidance behaviors are the negative behaviors (Spangenberg et al. 1996). Approach and avoidance behavior occur because olfactory cues in a more primitive portion of the brain rather than in high-level centers (Herz and Engen 1996).

Research has focused on the effect of ambient scent on avoidance and approach behavior. Scent can lead to either positively valenced arousal or negatively valenced arousal. Positive arousal leads to approach behavior, which make people more willing to stay in the environment, explore the environment and communicate with other people in the environment. It may enhance their satisfaction in the environment. Negative arousal leads to avoidance behavior, which results in less

active behaviors in the environment, less communication with other people and a lower level of satisfaction. The two behaviors are judged on the basis of the amount of time people spend in the store (Morrin and Ratneshwar 2000). It is suggested that pleasant scents can increase people's willingness to visit the store and increase the time they spend in the store environment. It also improves their evaluations and ratings of the store (Spangenberg et al. 1996).

In an experiment in which consumers are presented with a persuasive message, Debono (1992) found that participants who are exposed to a pleasant scent are more likely to be affected by the attractiveness of the spokeswoman than by the strength of the arguments, while people who are not exposed to a pleasant scent are more likely to be affected by the strength argument than the attractiveness of the spokeswoman. This difference happens because those people who are exposed to a pleasant scent use the peripheral route to processing information, while those who are not exposed to scent are engage in central route processing. People who are in an environment with pleasant scent also have a more positive mood when they evaluate the message. Thus, a pleasant scent can influence consumers' information processing.

The appropriateness and congruity of ambient scents have been investigated by past studies. The appropriateness and congruity of scent can moderate the effect of olfaction and determine the impact of scents (Bone and Jantrania 1992). Pleasant scents may not successfully lead to certain effects if there is no congruity between the scents and consumers' preferences (Spangenberg et al.1996, 2005). Bosmans (2006) suggests three moderators of the effect of pleasant scents on evaluations: (1) the

congruity of the scent with the product; (2) the salience of the scent; (3) consumers' motivation to correct for extraneous influences. It is suggested that only when consumers have the perception that the scent is incongruent with the product, they correct for the influence of scent. When ambient scent is highly incongruent with the product category, consumers correct. When ambient scent is congruent with the product category, even when ambient scent becomes salient or consumers discount the potential influences, their evaluations and judgments are still influenced. Scents that are not salient still influence consumers' decisions when they are incongruent with the product category. Bosmans also suggests that the congruence dimension can explain how ambient scents affect product evaluations.

The congruity between a scent and a product offered or the environment has been considered important (Bone and Jantrania 1992, Bone and Ellen 1999, Bosmans 2006, Mitchell et al. 1995). Congruity has been found to have a positive effect on consumer's purchasing behavior, affect their decision making and improve the information processing in the shopping process. When there is congruity between the scent and the product category, people spend more time processing the data than when there is no congruity presented. They are more likely to look for inferences and self-reference and go beyond the existing information. They are more holistic and will consider more attributes and options (Mitchell et al. 1995). Fiore et al. (2000) found that adding appropriate environmental fragrance to a product display enhances approach responses.

Congruity has a positive effect on overall product evaluation (Bone and

Jantrania 1992). In an arousing environment, people will have positive responses if the environmental cues are congruent with their expectations, which may lead to a higher level of approach behavior. However, negative responses may lead to a higher level of avoidance behavior (Spangenberg et al. 1996). The congruity between ambient scents and a non-scent characteristic has also been studied. The ambient scents which are gender-congruent with the products can alter consumers's responses and enhance product evaluation. Consumers may have approach behavior in a store where the product presented and the ambient scents are gender-consistent. They may present avoidance behavior when the product and the ambient scents are gender-inconsistent (Spangenberg et al. 2006).

The implicit memory of odor has been discussed. Degel and Koster (1999) have found that if people perceive the odors unconsciously, the rate of errors in the mathematical and letter counting tests will be affected. People make less error when the odor of lavender is presented than when there is no odor or the odor of jasmine is presented. However, it only influences the number of correct responses, but does not affect the quality of the test. They have also confirmed that when people smell the odor and visually detect the odor source, they will connect the two. People expect more odors in certain environment than in others. There is an implicit odor memory which drives people to connect an unknown odor to their memory. Since this research focuses on ambient scent–touch interactions, the literature on touch is discussed next.

Touch

People often use touch to obtain information in the environment (Klatzky et al.1993). The importance of using touch is recognized by many consumers. Although some purchases are made through direct mail, Internet, and catalogs, most consumers still prefer to purchase in environments where they can touch the products physically (McCabe and Nowlis 2003). Research on the sense of touch is increasing. Recent research has emphasized the significant effect of tactile input in the process of product evaluation (Peck and Childers 2003b). The need for touch also reduces purchasing on the Internet, where no touch information can be obtained (Citrin et al. 2003, McCabe and Nowlis 2003). Consumers not only prefer the products which can be touched in their purchasing process, but also make their purchasing decisions depending on the tactile information they extract from the products. With the help of tactile input, they get the useful information that they cannot obtain through the sense of vision (McCabe and Nowlis 2003).

The haptic system provides people with effective observations (Lederman and Klatzky 1987). It helps people identify objects quickly and accurately. In general, the identification through touch is more accurate than identification of odor (Klatzky et al. 1985). The tactile system encodes object properties differently than the visual system (Citrin et al. 2003, Klatzky et al. 1987, Lederman et al. 1986). The visual system captures the size, shape and physical location of an object, while the tactile system captures texture, weight, roughness, hardness, and temperature (Citrin et al. 2003, Klatzky et al.1987).

The modality of touch relies on exploratory procedures (EPs), which are considered as the types of contact and movement people have between their skin and the actual object. An EP can encode the properties and provide efficient information (Klatzky et al.1993, Lederman and Klatzky 1987). Several EPs are described in past studies: Lateral motion is related to the roughness of product and is considered as the repetition of movement between people's skin and object. Pressure is an EP related to the hardness of the product. Static contact is related to the temperature, and is referred to the contact between skin and object without motion. The unsupported holding, which indicates how people can lift the product without external help, is related to weight of the object. The enclosure is related to the size and coarse shape. Contour following describes how hand can move along the lines of contour of objects, and is related to the precise shape of objects (Klatzky et al. 1993, Lederman and Klatzky 1987).

How people choose between EPs depends on constraints they need to satisfy. These constraints include the nature of the information that they intent to obtain from a certain object and the associations between the EPs and the objects. The nature of desired information is often associated with their goals or expectations and what they are looking for from an object. Another constraint is related to compatibility between EPs, as sometimes there is a loss of information when the EPs that are performed at the same time are not compatible. There is also a constraint of cost for using the EPs, which is related to the duration and the speed of the EPs (Klatzky et al.1993).

Tactile input can help people encode the properties relating to texture,

hardness, roughness, temperature, weight, size and shape (Klatzky et al.1993, Lederman and Klatzky 1987). There are two general categories of objects—geometric and material. The main attribute of a geometric object is its size or shape, while the main attribute of a material object is its texture, hardness, roughness, temperature and weight. People rely most on vision when they perceive geometric objects. They rely most on the modality of touch when they perceive material objects (Klatzky et al. 1993, McCabe and Nowlis 2003). Picard et al. (2003) studied the perceptual dimensions of tactile texture and suggest soft/harsh, thin/thick, relief and hardness as four perceptual dimensions of tactile texture. They connect semantics with tactile input to describe these perceptual dimensions.

Different products are judged by the material properties they possess. By using their hand, consumers can access the attributes related to certain products (Peck and Childers 2003b). Four attributes, namely texture, hardness, temperature, and weight, are the main attributes which can be diagnosed by touch. These are considered as the material properties that serve as motivation for people's touching behaviors (Klatzky et al.1993, Lederman and Klatzky 1987). There is also an integration of dimensions. For example, texture and hardness are integrated in haptic input (Klatzky et al. 1989).

Considering the type of tactile information, two types of information are suggested: instrumental and autotelic information (Peck and Childers 2003). Instrumental information is less related to the sensory experience of the product, while autotelic information is more related to the sensory enjoyment. Instrumental information, on the other hand, is related to people's goals of purchasing in their

product evaluation process, while autotelic information is associated with the hedonic enjoyment of the product (Peck and Childers 2003b, Holbrook and Hirschman 1982).

Individual differences may be an important factor influencing the processing of touch information. Tactile input is more effective for some people compared to others (Peck and Childers 2003b). Gender differences can lead to different levels of involvement with touch. Women involve more tactile input in their evaluation process than men (Citrin et al. 2003). Some of people have more preference and motivation to use touch in the information acquisition process than others. These individual differences are captured by need for touch (NFT), which is "a preference for the extraction and utilization of information obtained through the haptic system" (Peck and Childers 2003a, p. 431). This pertains basically to a person's preference for touch in the information gathering process (Peck and Childers 2003b).

Consistent with the previous discussion of two types of tactile information, there are also two dimensions of NFT: instrumental NFT and autotelic NFT. People with a high level of instrumental NFT consider the utilization of touch as a way to help them collect information in the evaluation process. Tactile input helps them successfully access the information that they cannot gather through other types of information acquisition. People with a high level of autotelic NFT find more fun and enjoyment when they use tactile input. They touch the products as they prefer to focus on the sense of touch itself (Peck and Chidlers 2003a, Peck and Childers 2003b).

Previous studies have included both the discussion of instrumental NFT and autotelic NFT (Citrin et al. 2003, Peck and Wiggins 2006). Depending on their level

of NFT, some of people are more frustrated and have less confidence in their shopping process if there is no opportunity for them to touch the products directly (Peck and Chidlers 2003a). People with high NFT show less confidence in product evaluations when there is no touch involved. For high-NFT consumers, an instrumental written description can compensate when they cannot touch, but it cannot compensate them for their hedonic need. Low-NFT consumers only need a presentation of a visual cue or picture when touch information is not presented to reduce their frustration and increase their confidence (Peck and Chidlers 2003b). High-NFT consumers can better discriminate high quality products when tactile information can be obtained, which helps them increase their confidence and increase the accuracy of their evaluation. Tactile input does not have negative influence on the low quality product (Grohmann, Spangenberg, and Sprott 2007).

Providing tactile cues is more effective to persuade people with a high level of autotelic NFT than those with a low level of autotelic NFT. Persuasion increases as high NFT consumers experience positive affective responses to the tactile component of a persuasive message (e.g., a brochure with a piece of satin) in the evaluation process. Consumers who are low in autotelic NFT, however, do not show the same response. In addition, for people who are high in autotelic NFT, involving tactile elements in a persuasive message increases persuasion, even if the touch element is incongruent with the overall message; for people low in autotelic NFT, however, an incongruent message decreases the effect of persuasion (Peck and Wiggins 2006).

NFT moderates the relationship between the usage of internet in purchasing

products and the prior usage of internet in collecting information. Although prior internet usage helps people gather the information they need, whether people use the internet to make the final purchase is still influenced by their need for touch. As tactile input helps consumers to assess the intrinsic quality of the product, products that require tactile cues (e.g., apparel) are less likely to be purchased online (Citrin et al. 2003).

Both in-store environment and internet environments have been studied in order to compare the differences in consumers' processing of and response to tactile information. Whether there are opportunities to touch in the environment has been found to influence consumers' choices. An in-store environment is considered as the environment where people can touch and examine the actual products. The products could be seen in three-dimensions in this environment. Consumers can obtain important information which cannot be obtained only though vision. In a remote situation, consumers cannot touch the products. They can only use their sense of vision to judge the two-dimensional representation of products (McCabe and Nowlis 2003). Research has shown that more involvement of tactile input will reduce the usage of Internet in consumers' purchasing process (Citrin et al. 2003). Consumers prefer to touch the products with material properties in an in-store environment than in a remote environment. However, for the products which possess geometric properties, past research found no difference of consumers' preference between the two types of environment, as consumers use sense to judge the objects in their evaluation (McCabe and Nowlis 2003). It is confirmed that both visual input and

touch have positive effect on the evaluations. Compared to people who do not use their sense of touch, people who can touch in the evaluation process evaluate the product more positively (Grohmann et al. 2007, McCabe and Nowlis 2003).

Previous research has studied both diagnostic and non-diagnostic tactile input. For products with diagnostic tactile input, involving touch leads to more positive consumer responses, as tactile input reduces people's frustration and increase their evidence in the evaluation process (Peck and Childers 2003b, Grohmann et al. 2007). When tactile input is diagnostic, people who prefer to touch products are more affected by the sense of touch (Peck and Childers 2003a, Peck and Childers 2003b). However, Krishna and Morrin (2008) offered some additional insights. They found that consumers who prefer tactile input are not always more influenced by the sense of touch compared to those who do not need tactile input. When the tactile cues are non-diagnostic, people who like to involve tactile input are less influenced. In this situation, other cues, such as the haptic information of the container or the package of a product, can influence people's evaluation. The perception of tactile input is transferred to evaluations of non-tactile properties (such as taste of the product) in this process.

Product quality has been considered as another factor. Tactile input positively affects the evaluation of products, especially if they are of high quality. However, for low quality products, tactile input is likely to result in negative evaluation when people evaluate high quality products and low quality products simultaneously (Grohmann et al. 2007). Peck and Childers (2006) studied the effect of touch on

impulse-purchasing behavior. They found that people with a high level of autotelic NFT have more impulse purchasing behaviors than those with lower level of autotelic NFT. For both high and low autotelic people, increasing tactile input will increase impulse purchasing. Besides tactile impact, the interaction of different sensory modalities may also have great impact on consumers' evaluations and purchasing behaviors.

Sensory Interactions

Consumers may get information from multiple sensory modalities in order to perform search or evaluation tasks. They integrate information from different senses in order to detect and evaluate products and reduce ambiguity. This integration plays an important role in their perception (Molholm et al. 2002). For example, consumers perceive the texture of certain objects by integrating information from both vision and touch (Heller 1982). Past studies have examined some interactions of different sensory modalities, such as the interaction of scent and sound, touch and taste, taste and smell, vision and sound, and touch and vision (Heller 1982, Krishna and Morrin 2008, Kritikos and Brasch 2008, Lederman et al. 1986, Mattila and Wirtz 2001, Molholm et al. 2002, Shimojo and Shams 2001). An interaction of scent and music in retail environments has been supported: Mattila and Wirtz (2001) found that when there is a congruity of ambient scent and music in terms of their arousing qualities, consumers evaluate their shopping experience more positively and experience higher levels of satisfaction. Consumers also show more approach behaviors and impulse

purchasing. For example, the use of grapefruit ambient scent, which is a high arousal scent, in a store with fast tempo music, results in more approach behaviors and more positive consumer responses than using a low arousal scent with fast tempo (i.e., high arousal) music. In a store with low tempo music, a low arousal scent, such as Lavender, leads to a higher level of evaluation. This research supports that when a perception of a coherence of the arousing qualities of music and the scent is created, consumers respond more positively.

Krishna and Morrin (2008) studied the connection between touch and taste. They discuss the perceptual transfer of haptic cues from product containers to products themselves and find support for transfer of touch-related characteristics to products. Depending on consumers' need for touch, they are not affected equally by haptic input. When there are non-diagnostic cues presented, people who prefer to touch are less affected by the haptic cues. These non-diagnostic cues only significantly affect the people who have a low level of autotelic need for touch. For example, only people who have low level of autotelic need for touch are influenced when they are asked to touch a flimsy cup. However, both the high and low need for autotelic touch groups can detect that the tactile feeling of the firm cup is better than that of the flimsy one. When consumers imagine drinking water from a firm cup bottle and a flimsy bottle, the imagination influences people with a low level of autotelic need for touch to a greater extent.

Psychology research has also provided some basis for the study of sensory interactions. One approach is to look at a person's immediate response to conflicting

information when two senses are provided, which is considered as the intersensory bias paradigm. It is suggested that each modality can have certain functions, but it only has one or more functions that if can perform better than other modalities (Welch et al. 1980). Vision strongly affects other modalities. However, visual perception is influenced by other modalities, such as sound (Shimojo and Shams 2001). Some studies claim dominance of vision, while others question this claim (Lederman et. al 1986, Schifferstain 2006). Schifferstain (2006) found that when there is a large number of a product, vision is not the dominant modality. The importance of the sensory modalities may depend on the type of products, the usage frequency, and the importance of the activity.

The interaction between vision and auditory system has also been discussed. Vision may dominate spatial tasks, while audition plays the most important role in temporal tasks. Sound may also change visual perception. When the auditory input is presented, there is an increase in the perceived intensity of the stimuli. The quality of visual perception is also changed by sound. However, the effects of sound on vision and the effect of vision on sound are asymmetrical. There is only strong alteration of vision when sound is more discontinuous than the visual stimulus. Similarly, vision only strongly affects sound when the visual stimulus is discontinuous. The appropriateness of the modalities also influences the direction of the sensory interaction (Shimojo and Shams 2001).

The interaction of touch and vision has also been studied by different researchers. Some studies in the phenomenological and psychophysical literature have

shown that tactile location is also noticed by vision location (Lederman et al. 1986, Shimojo and Shams 2001). Similarly, the perception of spatial density and roughness of surface patterns are influenced by both vision and touch, to the extent that it is not possible for people to ignore the tactile information in their evaluation. For judgment of size, shape and spatial location, vision may dominate touch. However, when people need to focus on the texture of certain surfaces, the intersensory bias is different depending on how much texture is emphasized. When people need to judge the spatial density of patterns, vision may dominate touch. When they need to judge the roughness, touch may have a greater effect. When they need to judge texture without emphasis, the effect of touch and vision are equally considered. It appears that each modality has certain functions, but it only has one or more functions that it can perform better than other modalities (Lederman et al. 1986). Heller (1982) found that involving only one sensory modality may reduce the accuracy of people's perception. A combination of both touch and vision leads to a higher level of perception and better judgment of texture, as each of them perform a different task and assist each other in the perception process. However, people may ignore the effect of vision in the perception of texture. They may prefer tactile cues when their vision can guide their hands. In judging the smoothness of the object, vision and touch are similarly accurate, but they work most efficiently when they are both included in the judgment process. Jones and O'Neil (1985) asked participants to judge the roughness of two abrasive papers by vision, touch, or by both. It is found that a combination of the two sensory modalities leads to accurate judgments. Kritikos and Brasch (2008) studied congruent

and incongruent visual and tactile input in people's comprehension process. Both of the sensory modalities are important in comprehension, but vision may have a greater influence than touch.

Of interest to researchers are the conditions of cross-modality matching. People may have different abilities to process the information that they gather from different sensory modalities (Connolly and Jones 1970, Milewski and Iaccino 1982). The study of the asymmetries in cross-modality matching not only shows the transfer of intersensory and suggests that whether the asymmetries exist depend on whether the stimulus is spatial, haptic, or kinesthetic. When people have some early knowledge of the comparison modality, their performance is affected (Milewski and Iaccino 1982).

The availability of sensory stimuli influences people's affective responses. When people have positive affective responses to certain stimuli, involving more sensory cues positively influences their affective responses. In contrast, when people have negative affective responses, involving more sensory cues leads to more negative affective responses. When the sensory cues match the affective memory, there will be more positive affective responses (Compeau, Grewal, and Monroe 1998). Past studies also indicate that taste and smell interact. People can detect the combination of a concentration of an odor compound and a concentration of a taste compound, which proves people's neural integration of taste and smell (Dalton et al. 2000, Delwiche 2004). However, specific pairings of taste and smell are needed for the integration to occur. There is evidence from both psychophysical and

neuroimaging findings of the integration of taste and smell. Taste and smell are considered necessary for perception of flavor (Delwiche 2004). Forde and Delahunty (2003) showed how three sensory systems (taste/smell, texture and irritation) contribute to people's preference for orange juices. In examining people's liking and sensitivity to different stimuli and the effect of sensory interaction on older and younger consumers, the authors find that young consumers' preferences for juice are more dependent on the predominant chemosensory attributes, such as taste and smell, while older consumers' preferences are more based on non-chemosensory attributes, such as texture and irritation of the product.

Although the effect of ambient scent and impact of tactile input have been studied separately, no prior research has investigated how the interaction of touch and ambient scent affects consumers' evaluation of products. Studies on olfaction have not presented how ambient scent influences the tactile input. Thus, the current study examines the impact of ambient scent on consumers' perceptions of tactile properties. More specifically, this research empirically tests whether ambient scents with connotations of softness/roughness and coolness/warmth affect consumers' evaluation of a product's softness and warmth, and whether consumers' need for touch the product mitigates or enhances this effect.

Chapter 3 Hypotheses

Ambient scent might affect consumers' tactile evaluations by priming haptic product characteristics, such as warmth or softness. Based on the conceptualization

of the priming effect in Wyer and Srull's (1980a, 1980b) storage bin model, a category that is primed recently is considered to be put on top of a mental storage bin. If this category, which is at the top of the bin, is considered relevant and applicable, it will be accessed first in order to encode new information. For a relevant category, priming a category will increase the possible application of the category to the incoming information (Higgins et al. 1985). It is also suggested that when the activated category is relevant to the incoming information, it provides an important basis for the interpretation of the incoming information, which results in a consistent judgment of the new information with the existing category (Herr 1986). Thus, we expect that the cues of ambient scents may influence consumer perceptions, priming relevant dimensions of the product that is touched. Priming influences consumers' perceptions by relating the important cues of the ambient scent to the relevant dimensions of the products. Priming a relevant tactile characteristic through ambient scent increases the likelihood that this characteristic is highly accessible in the tactile evaluation of the product (Higgins et al. 1985); ambient scent may thus enhance the perception of the dimension that is diagnosed by touch. As priming can change people's judgments by making some categories more accessible than others (Boush 1993), it increase the accessibility of certain attributes of the products. It makes some tactile properties that are closely related to the ambient scents more accessible to the consumers. For example, an ambient scent which provides significant cues of warmth may increase consumers' attention to the temperature characteristics when they touch products. A cool ambient scent is likely to increase the accessibility of the temperature

dimension of the products that they could touch and enhance their evaluation of coolness in the perception process. Therefore, we propose that:

H1: Ambient scent enhances evaluations of the tactile dimension they are most closely associated with.

H2: Ambient scent increases the willingness to pay and purchase intentions for products whose tactile properties are cued by scent.

Finally, it is expected that consumers high in need for touch more easily relate the tactile properties of a product to the ambient scent, as tactile information is more accessible to them in general (Peck and Childers 2003a). Need for touch should thus moderate the effect of ambient scent on evaluation of tactile product properties they are related with.

H3: The effect of ambient scent on the evaluation of the tactile dimension they are most closely associated with is stronger for consumers high in need for touch than for consumers low in need for touch.

Chapter 4 Method

This research consists of pretests to (1) select ambient scents with connotations of softness/roughness, and coolness/warmth, and (2) select products for which softness and temperature are relevant tactile characteristics. The main study is a 5 (scent: soft, rough, warm, cool, no-scent control) between-participants experiment with replications across selected product categories differing in tactile characteristics (softness and warmth). Dependent variables are product evaluation, purchase

likelihood, and willingness to pay. A potential moderator is need for touch (Peck and Childers 2003).

Chapter 5 Product Pretest 1

Design, Stimuli and Procedure

In order to identify the products to be used in the main experiment, two product pretests were conducted. The purpose of the first pretest was to determine for which products sense of touch is important. Fifty undergraduate students participated in the first pretest (19 male, 31 female; median age = 21 years). A range of consumer products were used: paper tissue, bed sheet, sweaters, hand towel, blanket, aluminum pot, scrub sponge, plastic plate, pottery plate, glass cup, pens, erasers, rubber bands, headbands, pillows, wooden products, pepsi cans, camera, cell phone, pocket calculator, jewellery, and T-shirts.

Measures

Participants rated each product based on how important it was for them to use their sense of touch in the evaluation on a 7-point scale (anchored 1= not important at all to 7= very important). Need for touch (Peck and Childers, 2003a) was also measured. The final questions pertained to demographic information (sex, age, and language skills).

Results

A one sample t-test was conducted to compare importance ratings to the scale midpoint (4). Table 1 summarizes mean evaluations and results of these comparisons. Products for which touch was important in the evaluation process (paper tissue, bed linens, sweaters, hand towels, blankets, headbands, pillows, cameras, cell phones, jewellery, T-shirts, scrub sponge, and wooden products) were retained for the second pretest, which determined the importance of specific tactile characteristics.

Table 1

Importance of Touch Compared to Scale Mid-point

Product	Mean	Std. Deviation	t(49)	*p*-value
Paper tissue	5.40	1.68	5.90	.00
Bed sheet	6.00	1.34	10.55	.00
Sweaters	5.94	1.25	10.96	.00
Hand towel	5.40	1.39	7.15	.00
Blanket	5.96	1.48	9.34	.00
Aluminum pot	2.70	1.57	-5.86	.00
Scrub sponge	3.64	1.93	-1.32	.19
Plastic plate	2.42	1.67	-6.70	.00
Pottery plate	3.16	1.90	-3.13	.00
Glass cup	3.42	1.93	-2.13	.04
Pens	3.32	1.92	-2.50	.02
Erasers	2.82	1.72	-4.84	.00
Rubber bands	2.58	1.80	-5.59	.00
Head bands	4.16	1.973	.57	.57
Pillows	6.30	1.374	11.84	.00
Wooden products	4.52	1.951	1.89	.07
Pepsi can	2.00	1.604	-8.82	.00
Camera	4.14	2.050	.48	.63
Cell phone	4.90	2.033	3.13	.00
Pocket calculator	3.06	1.942	-3.42	.00
Jewellery	4.78	2.270	2.43	.02
T-shirts	5.70	1.488	8.08	.00

Chapter 6 Product Pretest 2

Design, Stimuli and Procedure

Based on the result of the first product pretest, paper tissue, bed linens, sweaters, hand towels, blankets, headbands, pillows, cameras, cell phones, jewellery, T-shirts, scrub sponge, and wooden products were included in the second pretest. The second pretest was conducted among 25 undergraduate students (10 male, 15 female) in the library building of the same university. The median age of the sample was 20 years old.

Measures

The second pretest was conducted in terms of the importance of the product characteristics to the evaluation of the product. A seven-point scale (from 1 = not important at all to 7 = very important) was used to measure how important temperature, weight, softness and design characteristics are to their evaluation of the product. In order to determine participants' need for touch, Peck and Childers (2003a, 2003b) NFT scale was administered. The questionnaire concluded with demographic questions.

Results

Repeated measures ANOVAs were conducted to identify the products for which temperature, weight, softness were more important than for other products. There was a significant difference in the importance of warmth for different products

($F(12, 264) = 40.35, p < .001$). Mean values are shown in Table 2.

Table 2

Importance of Warmth

Product	Mean	Std. Deviation	N
Paper tissue	2.96	1.94	23
Bed linens	5.39	1.62	23
Sweaters	5.83	1.03	23
Hand towels	4.13	2.12	23
Blankets	6.17	1.11	23
Headbands	2.09	1.54	23
Pillows	4.87	1.94	23
Cameras	1.22	.60	23
Cell phones	1.43	1.31	23
Jewellery	1.39	1.27	23
T-shirt	4.22	1.76	23
Scrub sponge	1.78	1.65	23
Wooden product	1.78	1.28	23

Warmth was more important for blankets (Mean = 6.17, SD = 1.11), bed linens (Mean = 5.39, SD = 1.62), and hand towels (Mean = 4.13, SD = 2.12) than other products. For blankets, the importance of warmth was significantly different from paper tissues ($t(24) = 7.22, p < .001$), hand towel ($t(23) = 4.59, p < .05$), headbands ($t(24) = 9.16, p < .001$), cameras ($t(24) = 15.93, p < .001$), cell phones ($t(24) = 10.65, p < .001$), jewellery ($t(24) = 10.28, p < .001$), T-shirts ($t(24) = 4.66, p < .05$), scrub sponge ($t(24) = 11.27, p < .001$) and wooden products ($t(24) = 10.57, p < .001$). For bed linen, the importance of warmth was significantly different from paper tissue ($t(24) = 5.05, p < .001$), head bands ($t(24) = 6.29, p < .001$), cameras ($t(24) = 10.79, p < .001$), cell phones ($t(24) = 7.75, p < .001$), jewellery ($t(24) = 7.58, p < .001$), scrub

sponge (t(24) = 7.86, $p < .001$), and wooden products (t(24) = 8.05, $p < .001$). For hand towels, the importance of warmth was significantly different from sweaters (t(23) = -4.41, $p < 0.05$), blankets (t(23) = -4.59, $p < .05$), headbeads (t(23) = 5.27, $p < .001$), cameras (t(23) = 7.31, $p < .001$), cell phones (t(23) = 5.60, $p < .001$), jewellery (t(23) = 5.57, $p < .001$), scrub sponge, (t(23) = 5.15, $p < .001$) and wooden products (t(23) = 5.36, $p < .001$).

The results also indicated a significant difference in the importance of softness (F(12, 264) = 35.39, $p < .001$). Mean values are shown in Table 3.

Table 3

Importance of Softness

Product	Mean	Std. Deviation	N
Paper tissue	5.98	.97	23
Bed linens	6.15	.92	23
Sweaters	5.38	1.23	23
Hand towels	5.27	1.70	23
Blankets	6.28	1.13	23
Headbands	2.57	1.53	23
Pillows	6.22	1.11	23
Cameras	1.35	.99	23
Cell phones	1.86	1.51	23
Jewellery	2.07	2.09	23
T-shirt	4.54	1.70	23
Scrub sponge	3.87	2.37	23
Wooden product	2.60	2.103	23

Softness was more important for blankets (Mean = 6.28, SD = 1.13), pillows (Mean = 6.22, SD = 1.11), bed linens (Mean = 6.15, SD = 0.92), paper tissues (Mean

= 5.98, SD = 0.97), and hand towels (Mean = 5.27, SD = 1.70) than other products. For blankets, the importance of softness was significantly different from headbands ($t(24) = 7.69, p < .001$), cameras ($t(24) = 12.32, p < .001$), cell phones ($t(24) = 9.55, p < 0.00$), jewellery ($t(24) = 7.74, p < .001$), scrub sponge ($t(24) = 4.40, p < .05$) and wooden products ($t(24) = 6.07, p < .001$). For pillows, the importance of softness was significantly different from headbands ($t(24) = 9.20, p < .001$), cameras ($t(24) = 15.31, p < .001$), cell phones ($t(24) = 11.81, p < .001$), jewellery ($t(24) = 8.01, p < .001$), scrub sponge ($t(24) = 5.41, p < .001$) and wooden products ($t(24) = 7.19, p < .001$). For bed linens, the importance of softness was significantly different from headbands ($t(24) = 8.17, p < .001$), cameras ($t(24) = 12.85, p < .001$), cell phones ($t(24) = 9.66, p < .001$), jewellery ($t(24) = 7.81, p < .001$), T-shirts ($t(24) = 4.50, p < .05$), scrub sponge ($t(24) = 4.63, p < .05$) and wooden products ($t(24) = 6.43, p < .001$). For paper tissues, the importance of softness was significantly different from headbands ($t(24) = 7.87, p < .001$), cameras ($t(24) = 13.42, p < .001$), cell phones ($t(24) = 10.26, p < .001$), jewellery ($t(24) = 8.01, p < .001$), scrub sponge ($t(24) = 4.40, p < .001$) and wooden products ($t(24) = 5.89, p < .001$). For hand towels, the importance of softness was significantly different from headbands ($t(23) = 5.32, p < .001$), cameras ($t(23) = 9.29, p < .001$), cell phones ($t(23) = 7.13, p < .001$), jewellery ($t(23) = 5.44, p < .001$), and wooden products ($t(23) = 4.56, p < .05$).

There was a significant difference in the importance of weight ($F(12, 276) = 9.69, p < .001$). Mean values are shown in Table 4.

Table 4

Importance of Weight

Product	Mean	Std. Deviation	N
Paper tissue	2.42	1.86	24
Bed linens	3.71	2.37	24
Sweaters	4.04	1.57	24
Hand towels	2.79	1.87	24
Blankets	4.67	2.20	24
Headbands	2.79	1.93	24
Pillows	4.67	2.04	24
Cameras	5.50	1.98	24
Cell phones	5.50	1.91	24
Jewellery	4.83	2.16	24
T-shirt	3.37	2.20	24
Scrub sponge	3.00	2.04	24
Wooden product	4.71	2.12	24

Camera (Mean = 5.50, SD = 1.98), cell phones (Mean = 5.50, SD = 1.91), jewellery (Mean = 4.83, SD = 2.16), blankets (Mean = 4.67, SD = 2.20), and pillows (Mean = 4.67, SD = 2.04) were rated more important on the weight dimension than other products. However, because of the high cost of purchasing five cameras or cell phones which could be used in the experiment, cameras and cell phones were excluded from the main experiment. For jewellery, the importance of weight was significantly different from paper tissue ($t(23) = 4.70$, $p = .01$), hand towel ($t(23) = 4.26$, $p < .05$), headbands ($t(23) = 3.61$, $p < .05$) and scrub sponge ($t(23) = 3.29$, $p < .05$). However, as jewellery is highly gender-specific, it was not included in the main experiment. For blankets, the importance of weight was significantly different from paper tissue ($t(24) = 5.12$, $p < .001$) and bed linens ($t(24) = 2.59$, $p < .001$). For

pillows, the importance of weight was not significantly different from most of the products, it was only significantly different from paper tissue ($t(24) = 4.46, p < .05$).

To examine the importance of the product attributes for each product, a series of repeated measures ANOVAs and t-tests were conducted, in which the mean importance was compared to the scale midpoint (4). Dimensions rated higher than 4 were considered more important. For paper tissues, the results showed that there was a significant difference in the importance of different attributes ($F(1, 22) = 3.25, p < .05$). Softness was rated important for paper tissues (Mean = 5.76, SD = 1.01). The importance of softness attribute was significantly different from both weight ($t(24) = -4.27, p < .001$) and warmth ($t(24) = -2.89, p < .001$). For bed linens, the results indicated a significant difference in the importance of different attributes ($F(1, 22) = 5.34, p < .05$). Both softness (Mean = 6.00, SD = 1.00) and warmth (Mean = 5.36, SD = 1.66) were rated important on the scale. The importance of softness ($t(24) = 10.00, p < .001$) and warmth ($t(24) = 4.11, p < .001$) was significantly different from weight. For hand towels, softness (Mean = 5.21, SD = 1.67) and warmth (Mean = 4.12, SD = 2.07) were rated important on the scale. The importance of softness and warmth attribute was significantly different from weight ($t(24) = -2.98, p < .01$). For blankets, weight (Mean = 4.72, SD = 2.17), softness (Mean = 6.04, SD = 1.27), and warmth (Mean = 6.12, SD = 1.17) were rated important. There was a significantly difference in the importance of different attributes ($F(1, 22) = 3.09, p < .05$). The importance of weight was significantly different from softness ($t(24) = 8.01, p < .001$) and warmth ($t(24) = 9.09, p < .001$). For pillows, weight (Mean = 4.64, SD = 2.00), softness

(Mean = 6.02, SD = 1.08), and warmth (Mean = 4.88, SD = 1.88) were rated important. The importance of weight was significantly different from softness ($t(24) = 10.18$, $p < .001$) and warmth ($t(24) = 2.34$, $p < .05$). However, as pillows were considered too large for handling under lab conditions, they were not included in the main experiment. Based on the results, paper tissues, bed linens, hand towels and blankets were chosen to be used in the main experiment.

The results were not influenced by gender or NFT. Gender did not have a significant main effect on weight, softness or warmth (all p's > .10). NFT did not have a significant main effect on weight, softness, or warmth (all p's > .05). There were no significant interactions involving gender or NFT (all p's > .05). None of the three-way interactions involving product, gender, and NFT was significant (p's > .06).

Chapter 7 Scent Pretest

Design, Stimuli and Procedure

A pretest was conducted to determine the ambient scents to be used in the main experiment. Fifty undergraduate students (19 male, 31 female; median age = 21 years) recruited from marketing courses participated in this pretest in groups of up to five people. The scents were natural essential oils obtained from a single supplier. A total of 18 scents were used in the study, including cinnamon, clove bud, ginger, lavender, chamomile, peppermint, lemon, orange sweet, mandarin, amber, cedarwood, pine needle, eucalyptus, jasmine, patchouli, cajeput, vanilla, and sandalwood. To make sure that the task was not too overwhelming, 24 participants evaluated a subset

of nine of the scents, and 26 participants evaluated the remaining nine scents.

The scents were presented in random order in tightly closed vials on each table. Three drops of essential oil were applied to a cotton ball in each vial. Participants read and signed a consent form, which described procedures and screened participants for allergies, sensitivities and pregnancy. Then participants were asked to open one vial at a time, smell the scent as much as they liked and fill in a questionnaire about the scent. Most of the participants sniffed several times during their evaluation. A container of coffee beans was provided to clear participants' sensory system before they moved on to the next vial.

Measures

Twenty-two items were used to measure the overall evaluation of scent on seven-point scales: calming/energizing, rough/smooth, hard/soft, unattractive/attractive, cold/warm, light/heavy, unpleasant/pleasant, weak/intense, simple/complex, unfamiliar/familiar, bad/good, negative/positive, tense/relaxed, uncomfortable/comfortable, boring/ stimulating, unlively/lively, dull/bright, unmotivating/motivating, uninteresting/interesting, discreet/loud, depressing/cheerful, and unpleasurable/pleasurable.

Results and Discussion

The goal of the scent pretest was to identify scents that differ significantly in terms of warmth/coldness and softness/roughness, but are similar in terms of

evaluation, activation (Spangeberg et al. 1996), familiarity, intensity, and complexity. Based on the study by Spangeberg et al. (1996), principal components factor analysis was conducted to construct the evaluation and activation scales in our study. Two factors emerged, with the evaluation dimension explaining most of the variance (72.01%), while the activation dimension explained less of the variance (11.23%). Items related to evaluation included unattractive (factor loading = .84), unpleasant (.90), bad (.87), tense (.81), negative (.86), uncomfortable (.86), unpleasurable (.81). Items related to activation included boring (.81), unlively (.86), dull (.73), unmotivating (.73), uninteresting (.73), and depressing (.65). The evaluation and activation scales had high levels of reliability with Cronbach's alpha of .98 and .94, respectively. The results also showed a significant correlation between the two dimensions ($p < .001$).

T-tests were conducted to determine the scents that differ significantly in terms of warmth/coldness, softness/roughness and lightness/heaviness, without differing in activation, evaluation (Spangenberg et al. 1996), familiarity, intensity and complexity. Jasmine and pine needle were significantly different in softness/roughness ($M_{jasmine}$ = 4.69, M_{pine} = 3.25; $t(48) = 2.53$, $p < .05$), but not significantly different in familiarity, evaluation, activation, intensity, and complexity (all p's > .15). In addition, eucalyptus and cinnamon were significantly different in warmth/coldness ($M_{eucalyptus}$ = 4.81, $M_{cinnamon}$ = 2.75, $t(48) = 4.34$, $p < .001$), but not significantly different in familiarity, evaluation, activation, intensity, and complexity (all p's > .12). Based on these results, two pairs of scents, jasmine and pine needle, and eucalyptus and cinnamon were

selected as the scents that could be used in the main experiment.

Chapter 8 Experiment

Design, sample and procedure

To test our hypothesis, a 5 (no scent, pine, eucalyptus, cinnamon, jasmine) × 4 (product: hand tower, fleece blanket, pillow case, paper tissue) mixed design experiment was implemented in a lab setting. Compared to a real retail setting, the lab provides an environment which better controls the olfactory and tactile stimuli. Scent served as a between-participants factor, while product served as a within-participants factor.

The sample consisted of 134 undergraduate students (66 male, 68 female). The median age of the participants was 20 years. In the experiment, the participants evaluated characteristics of four selected products with a focus on tactile characteristics. They were randomly assigned to one of the five scent conditions, including the four scent conditions and a control condition with no scent. The study was conducted over five days across two weeks. The control condition was applied on the first day to ensure that participants in this condition were not exposed to any scent stimuli. In the other four days, the scents were changed each day. In order to make sure that the olfactory stimuli were not mixed, only one scent stimuli was applied per day. For each day, six sessions took place, with a maximum of five participants per session.

A commercial scent diffuser appropriate for the room size was placed in the

lab to diffuse the scent (an essential oil – water mixture). It was hidden before the participants entered the lab to prevent participants from being aware of the scent diffusion. In the morning, the room was scented for 30 minutes before the experiment started. When one session finished, the room was scented again for no more than 30 minutes in order to keep constant scent intensity during the day across different sessions. The intensity of the scent in the lab environment was at a barely perceptible level and not overbearing. At the end of each day, the ventilation system was activated to clear any remaining scent over the night. Prior to running the next scent condition, the researchers checked again to make sure no scent remained in the lab. When possible, scent conditions were run on non-consecutive days to ensure a well ventilated lab environment.

Participants were informed that the study pertained to product evaluations, but they were not informed of the scent manipulations to avoid hypothesis guessing and demand effects. Four products were put on each table, including a hand towel, fleece blanket, pillow case and paper tissue. Individuals came in the lab in groups of no more than five people. Upon entering the lab, participants read the consent form and were given instructions. Then they started the evaluation and filled in the questionnaires corresponding to each product. After evaluating the products, an additional questionnaire was provided.

Measures

Participants rated product softness (rough/soft) and warmth perceptions (cool/warm) on seven-point semantic differential scales. Purchase intentions were measured by asking, "If you were in the market for this product today, how likely is it that you would buy it?" Two seven-point scales were used (very unlikely to buy/very likely to buy, very improbable/very probable). The prices participants were willing to pay for the four products were measured by asking, "If you were in the market for this product today, how much would you be willing to pay for it?" To assess individuals' need for touch, Peck and Childers (2003a, 2003b) NFT scale was administered (see Appendix A).

Results

To examine the effects of scents associated with warmth (cinnamon) and coolness (eucalyptus) on product perceptions, a repeated measures ANOVA was conducted with product (paper tissue, pillow case, hand towel, and fleece blanket) serving as the within-participants factor and scent (warm: cinnamon, cool: eucalyptus, control: no scent), autotelic need for touch (low, high) and instrumental need for touch (low, high) as between participants factors. The dependent variable was perceived warmth of the product (cool/warm, on a seven-point scale).

There was a significant main effect for product ($F(3, 68) = 39.72$, $p < .001$) and a significant product × autotelic need for touch interaction ($F(3, 68) = 3.43$, $p < .05$). For the blanket, people high in autotelic NFT rated the product higher in

warmth than those low in autotelic NFT (M_{high}=6.00, M_{low}=5.46, $p < .05$). There were significant differences in warmth perceptions between all of the products included in the study (all Bonferroni-adjusted p's < .01): The fleece blanket was perceived as warmest (M = 5.73, SD = 1.17), followed by the hand towel (M = 4.76, SD = 1.25), paper tissue (M = 3.60, SD = 1.12), and pillow case (M = 3.20, SD = 1.30). There was no other significant main or interaction effect (all p's > .09). The hypothesis that the temperature associations of ambient scent would affect warmth perceptions of products was not supported.

A repeated measures ANOVA with product (paper tissue, pillow case, hand towel, and fleece blanket) serving as the within-participants factor, scent (warm: cinnamon, cool: eucalyptus, control: no scent), autotelic need for touch (low, high) and instrumental need for touch (low, high) as between participants factors, and willingness to pay serving as the dependent variable resulted in a significant main effect of product ($F(3, 67) = 59.51$, $p < .001$). Participants were willing to pay significantly more for the fleece blanket (M = 11.30, SD = 5.28) compared to all other products (all Bonferroni-adjusted p's < .001). No significant differences emerged for willingness to pay for the pillow case (M = 6.12, SD = 4.22) and hand towel (M = 6.85, SD = 3.90; p > .07). Participants expressed significantly less willingness to pay for paper tissues (M = 2.11, SD = 1.64) compared to all other products (all Bonferroni-adjusted p's < .001). These differences can be explained by the price levels of the product categories used. No other main or interaction effect was significant (p's > .05).

Finally, in repeated measures ANOVA product (paper tissue, pillow case, hand towel, and fleece blanket) serving as the within-participants factor and scent (warm: cinnamon, cool: eucalyptus, control: no scent), autotelic need for touch (low, high) and instrumental need for touch (low, high) as between participants factors, and purchase intention index (very unlikely to buy/very likely to buy; very improbable/very probable, on seven-point scales) as dependent variable, there was a significant main effect of product ($F(3, 68) = 26.76$, $p < .001$), and a significant product × autotelic need for touch interaction ($F(3, 68) = 3.24$, $p < .05$). For the blanket, people high in autotelic NFT had greater purchase intentions than those low in autotelic NFT ($M_{high}=5.34$, $M_{low}=4.30$, $p < .05$). For the other products, there were no differences between the groups. Purchase intentions were highest for the hand towel ($M = 5.07$, $SD = 1.20$) and the fleece blanket ($M = 4.82$, $SD = 1.41$) and did not differ significantly between these two products (Bonferroni-adjusted $p = 1.00$). Participants were least likely to buy the pillow case ($M = 3.38$, $SD = 1.49$) compared to the paper tissues ($M = 4.00$, $SD = 1.77$), the fleece blanket and the hand towel (all Bonferroni-adjusted p's $< .05$). No other main or interaction effect reached significance (p's $> .05$). Overall, there was no effect of temperature perceptions associated with ambient scent on product perceptions of warmth, willingness to pay, or purchase intentions. Mean values are shown in Table 5.

Table 5

The effects of scents associated with warmth/coolness on tactile evaluation, willingness to pay and purchase intentions

Product			Tactile Evaluation		Willingness to Pay		Purchase Intentions	
			Warmth /Coolness		Warmth /Coolness		Warmth /Coolness	
			Mean	SD	Mean	SD	Mean	SD
Paper Tissue	Control	NFT Autotelic Low	4.23	1.17	2.44	1.33	4.04	1.89
		NFT Autotelic High	4.73	0.96	2.00	1.26	3.70	1.94
		NFT Instrumental Low	4.44	1.03	2.64	1.11	4.00	1.99
		NFT Instrumental High	4.58	1.17	1.65	1.32	3.67	1.81
	Eucalyp tus	NFT Autotelic Low	4.50	1.27	1.78	1.06	3.69	1.68
		NFT Autotelic High	3.92	1.04	2.25	1.24	4.00	1.90
		NFT Instrumental Low	4.29	1.16	1.98	1.17	3.53	1.66
		NFT Instrumental High	4.17	1.27	2.00	1.17	4.25	1.88
	Cinnam on	NFT Autotelic Low	4.00	0.95	2.12	1.45	4.42	1.87
		NFT Autotelic High	4.92	1.11	2.20	3.03	4.31	1.48
		NFT Instrumental Low	4.33	1.30	2.79	3.19	4.21	1.66
		NFT Instrumental High	4.62	0.96	1.58	1.02	4.50	1.68
Pillow Case	Control	NFT Autotelic Low	4.92	0.95	5.92	5.31	3.15	1.01
		NFT Autotelic High	4.53	1.30	6.13	4.88	2.43	1.29
		NFT Instrumental Low	4.69	1.30	7.20	5.72	3.13	1.43
		NFT Instrumental High	4.75	0.97	4.58	3.57	2.29	0.58
	Eucalyp tus	NFT Autotelic Low	5.12	1.54	6.22	4.02	3.75	1.66
		NFT Autotelic High	4.69	1.65	6.65	4.50	3.96	1.69
		NFT Instrumental Low	5.06	1.35	6.00	3.81	3.41	1.21
		NFT Instrumental High	4.75	1.91	7.00	4.74	4.46	2.02
	Cinnam on	NFT Autotelic Low	4.92	1.24	6.54	4.14	3.75	1.32
		NFT Autotelic High	4.62	1.04	5.23	2.71	3.35	1.52
		NFT Instrumental Low	5.00	1.28	6.54	4.12	4.29	1.21
		NFT Instrumental High	4.54	0.97	5.23	2.74	2.85	1.25
Hand Towel	Control	NFT Autotelic Low	3.69	1.25	6.42	3.34	4.81	1.51
		NFT Autotelic High	3.00	1.20	8.44	4.58	4.53	1.58
		NFT Instrumental Low	3.50	1.37	8.67	4.55	4.56	1.41
		NFT Instrumental High	3.08	1.08	6.13	3.19	4.79	1.71
	Eucalyp tus	NFT Autotelic Low	3.50	1.03	7.09	4.85	5.19	0.81
		NFT Autotelic High	2.62	0.87	7.35	3.36	5.31	1.05
		NFT Instrumental Low	3.29	1.05	7.32	4.23	5.06	0.88
		NFT Instrumental High	2.83	1.03	7.04	4.30	5.50	0.93
	Cinnam on	NFT Autotelic Low	3.17	1.85	6.50	3.45	5.75	0.99
		NFT Autotelic High	3.46	1.13	4.92	2.66	4.92	0.81
		NFT Instrumental Low	2.92	1.38	5.66	2.35	5.50	0.95
		NFT Instrumental High	3.69	1.55	5.69	3.77	5.15	1.01

Fleece Blanket	Control	NFT Autotelic Low	2.23	0.60	13.10	7.72	4.19	1.21
		NFT Autotelic High	2.07	1.22	11.03	2.84	4.97	1.14
		NFT Instrumental Low	2.25	1.13	12.61	6.51	4.06	1.00
		NFT Instrumental High	2.00	0.74	11.12	4.16	5.33	1.11
	Eucalyp tus	NFT Autotelic Low	2.44	1.10	11.12	6.61	4.56	1.82
		NFT Autotelic High	2.15	1.41	11.19	3.38	5.69	1.18
		NFT Instrumental Low	2.65	1.22	11.71	6.29	4.68	1.75
		NFT Instrumental High	1.83	1.12	10.37	3.65	5.63	1.37
	Cinnam on	NFT Autotelic Low	3.00	1.54	10.62	5.32	4.08	1.47
		NFT Autotelic High	1.77	0.73	10.92	5.09	5.42	0.76
		NFT Instrumental Low	2.92	1.31	10.54	4.33	4.38	1.61
		NFT Instrumental High	1.85	1.14	11.00	5.89	5.15	0.90

To investigate the effects of scents associated with roughness (pine) and softness (jasmine) on product perceptions, a repeated measures ANOVA was conducted with product (paper tissue, pillow case, hand towel, and fleece blanket) serving as the within-participants factor and scent (rough: pine, soft: jasmine, control: no scent), autotelic need for touch (low, high) and instrumental need for touch (low, high) as between participants factors. Perceived softness of the product (rough/soft, on a seven-point scale) served as dependent variable. There was a significant main effect of product on softness perceptions ($F(3, 65) = 48.48$, $p < .001$). The fleece blanked was perceived as softer than all other products ($M = 6.29$, $SD = .99$; Bonferroni-adusted p's $< .001$). The hand towel ($M = 5.30$, $SD = 1.25$) was perceived as softer than the pillow case ($M = 4.14$, $SD = 1.37$) and the paper tissues ($M = 4.05$, $SD = 1.59$; Bonferroni-adjusted p's $< .001$). There was no difference in softness perceptions of pillow case and paper tissue (Bonferroni-adjusted $p = 1.00$). No other significant main or interaction effect emerged (all p's $> .55$). Softness associations of ambient scent did thus not affect consumers' softness perceptions of products

presented in the scented environment.

In a repeated measures ANOVA with product (paper tissue, pillow case, hand towel, and fleece blanket) serving as the within-participants factor and scent (rough: pine, soft: jasmine, control: no scent), autotelic need for touch (low, high) and instrumental need for touch (low, high) as between participants factors, and willingness to pay as the dependent variable, there was a significant main effect of product ($F(3, 65) = 75.98$, $p < .001$). Participants were willing to pay significantly more for the fleece blanket ($M = 11.69$, $SD = 5.93$) compared to all other products (all Bonferroni-adjusted p's $< .001$). There were no significant differences for willingness to pay for the pillow case ($M = 7.51$, $SD = 5.87$) and hand towel ($M = 7.64$, $SD = 4.61$; $p = 1.0$). Participants had significantly less willingness to pay for paper tissues ($M = 2.25$, $SD = 1.53$) compared to all other products (all Bonferroni-adjusted p's $< .001$). No other main or interaction effect was significant (p's $> .05$).

In a repeated measures ANOVA with product (paper tissue, pillow case, hand towel, and fleece blanket) serving as the within-participants factor and scent (rough: pine, soft: jasmine, control: no scent), autotelic need for touch (low, high) and instrumental need for touch (low, high) as between participants factors, and purchase intentions as the dependent variable, there was a significant main effect of product ($F(3, 66) = 23.65$, $p < .001$). Purchase intentions were highest for the hand towel ($M = 5.03$, $SD = 1.25$) and the fleece blanket ($M = 4.89$, $SD = 1.48$) and did not differ significantly between these two products (Bonferroni-adjusted $p = 1.00$). Participants were less likely to buy the pillow case ($M = 3.30$, $SD = 1.43$) and the paper tissue (M

= 3.84, SD = 1.64) compared to the fleece blanket and the hand towel (Bonferroni-adjusted p's < .01). Purchase intentions did not differ significantly between the paper tissue and the pillow case (Bonferroni-adjusted p > .2). No other main or interaction effect reached significance (p's > .05). Overall, there was no effect of softness perceptions associated with ambient scent on product perceptions of softness, willingness to pay, or purchase intentions. Mean values are shown in Table 6.

Table 6
The effects of scents associated with softness/roughness on tactile evaluation, willingness to pay and purchase intentions

Product			Tactile Evaluation		Willingness to Pay		Purchase Intentions	
			Softness /Roughness		Softness /Roughness		Softness /Roughness	
			Mean	SD	Mean	SD	Mean	SD
Paper Tissue	Control	NFT Autotelic Low	3.54	1.45	2.44	1.33	4.04	1.89
		NFT Autotelic High	4.27	1.62	2.00	1.26	3.70	1.94
		NFT Instrumental Low	3.75	1.73	2.64	1.11	4.00	1.99
		NFT Instrumental High	4.17	1.34	1.65	1.32	3.67	1.81
	Pine Needle	NFT Autotelic Low	3.55	1.92	1.99	0.89	3.83	1.48
		NFT Autotelic High	4.14	1.70	2.49	1.66	3.32	1.58
		NFT Instrumental Low	3.67	1.78	2.41	1.25	3.88	1.52
		NFT Instrumental High	4.08	1.85	2.13	1.47	3.29	1.53
	Jasmine	NFT Autotelic Low	4.33	1.40	2.59	2.48	4.23	1.51
		NFT Autotelic High	3.64	1.57	1.88	0.69	3.91	1.46
		NFT Instrumental Low	3.85	1.28	2.34	1.41	4.35	1.42
		NFT Instrumental High	4.23	1.69	2.25	2.42	3.85	1.53
Pillow Case	Control	NFT Autotelic Low	3.62	1.19	5.92	5.31	3.15	1.01
		NFT Autotelic High	4.20	1.32	6.13	4.88	2.43	1.29
		NFT Instrumental Low	3.81	1.33	7.20	5.72	3.13	1.43
		NFT Instrumental High	4.08	1.24	4.58	3.57	2.29	0.58
	Pine Needle	NFT Autotelic Low	3.18	1.17	11.29	8.38	4.54	1.42
		NFT Autotelic High	3.93	1.64	8.07	6.27	3.04	1.12
		NFT Instrumental Low	3.42	1.44	8.46	5.32	3.58	1.33
		NFT Instrumental High	3.77	1.54	10.50	8.82	3.86	1.60

	Jasmine	NFT Autotelic Low	4.20	1.42	6.27	4.89	3.13	1.26
		NFT Autotelic High	3.82	1.33	8.00	4.05	3.86	1.73
		NFT Instrumental Low	4.08	1.44	6.92	4.94	3.15	1.42
		NFT Instrumental High	4.00	1.35	7.08	4.33	3.73	1.56
Hand	Control	NFT Autotelic Low	2.92	1.12	6.42	3.34	4.81	1.51
Towel		NFT Autotelic High	2.87	1.25	8.44	4.58	4.53	1.58
		NFT Instrumental Low	2.94	1.18	8.67	4.55	4.56	1.41
		NFT Instrumental High	2.83	1.19	6.13	3.19	4.79	1.71
	Pine	NFT Autotelic Low	2.55	1.13	8.00	3.91	5.17	1.42
	Needle	NFT Autotelic High	2.71	1.38	7.78	5.37	5.36	1.01
		NFT Instrumental Low	2.50	1.09	8.92	5.50	5.13	1.46
		NFT Instrumental High	2.77	1.42	7.00	3.78	5.39	0.94
	Jasmine	NFT Autotelic Low	2.67	1.40	6.87	4.55	4.83	0.72
		NFT Autotelic High	2.36	1.36	8.36	6.05	5.68	0.81
		NFT Instrumental Low	2.62	1.33	7.85	4.54	4.88	0.74
		NFT Instrumental High	2.46	1.45	7.15	5.91	5.50	0.89
Fleece	Control	NFT Autotelic Low	1.62	0.96	13.10	7.72	4.19	1.20
Blanket		NFT Autotelic High	1.67	0.98	11.03	2.84	4.97	1.14
		NFT Instrumental Low	1.75	1.07	12.61	6.51	4.06	1.00
		NFT Instrumental High	1.50	0.80	11.12	4.12	5.33	1.11
	Pine	NFT Autotelic Low	1.45	0.82	11.75	5.28	4.88	1.80
	Needle	NFT Autotelic High	1.86	1.10	10.75	7.33	5.29	1.68
		NFT Instrumental Low	1.50	0.67	11.96	6.98	5.29	1.53
		NFT Instrumental High	1.85	1.21	10.57	5.97	4.93	1.90
	Jasmine	NFT Autotelic Low	2.07	1.22	12.10	6.18	4.63	1.49
		NFT Autotelic High	1.45	0.69	11.64	6.25	5.45	1.42
		NFT Instrumental Low	2.00	1.16	13.12	4.76	4.81	1.52
		NFT Instrumental High	1.62	0.96	10.69	7.17	5.15	1.51

Chapter 9 Discussion

The results of this study indicate the main effect of product on people's tactile perceptions. The study shows that people have different warmth perceptions, willingness to pay and purchase intentions between different products included in the study. There is also an interactive effect of product and people's autotelic need for touch on their warmth perceptions of the products and their purchase intentions. No

effect of temperature perceptions associated with ambient scent on product perceptions of warmth, willingness to pay, or purchase intentions was found in this study. In addition, people have different softness perceptions, willingness to pay and purchase intentions across products. There is an interactive effect of product and people's autotelic need for touch on their softness perceptions of the products. However, the study shows no effect of softness perceptions associated with ambient scent on product perceptions of softness, willingness to pay, or purchase intentions.

Hypothesis 1, 2 and 3 are not supported. The effect of the products and the differing perceptions of tactile dimensions are supported, while the associated effect of ambient scent and tactile dimensions are not demonstrated. The hypotheses are supported to the extent that people's perceptions of the tactile dimensions, such as warmth and softness, and their willingness to pay and purchase intentions would be different when the products possess different tactile properties. That tactile properties of the products are cued by the ambient scent is not evident in the study. Consistent with prior studies (Peck and Childers 2003), the effect of people's need for touch (NFT) is confirmed. The current study found that the interaction of products and autotelic need for touch affects people's warmth and softness perception of the products. As an association of ambient scent and tactile dimensions of products is not supported, the moderating effect of NFT of ambient scent on the evaluation of tactile dimensions is not established.

Several reasons may explain why the hypothesized effect was not found. Sample size could serve as one of the explanations. 134 undergraduate students were

included in the main study. Cell sizes may not have been adequate to show an effect. A larger sample size is needed to increase the power of the statistical tests. In addition, the effect of the ambient scent may be influenced by other environmental factors in the lab. As the ambient scents were diffused in the lab, the warmth and softness characteristics of the scents may have been affected by the humidity and the temperature in the room, although attempts were made to keep the temperature constant at all times. Although the intensity of the scents diffused in the room was tested and monitored, it may have decreased during the experiment. Participants were asked to not bring food and beverages to the lab to prevent contamination of the ambient scent stimuli. It is possible, however, that personal care products (deodorants, fragrances, hair products) worn by participants introduced some variation to the ambient scent level. In order to avoid demand cues, we did not mention that the experiment was about scents or ask participants to refrain from wearing scents when coming to the lab. This may have resulted in the ambient scent levels not being intense enough for the purposes of this study.

A second explanation is that the information of the ambient scent is much more abstract compared to the information passed by the tangible products that could be touched, the effect of the product itself may be too strong, which makes the scents easier to ignore. While people automatically focus on the products, it may be difficult to judge how much the warmth/softness information of the scent influences them. The perceptions and evaluation of tactile characteristics of the products—which were the obvious objective of the study—may have dominated people's judgment.

While the hypothesis are proposed based on the expectation that ambient scent could affect consumers' tactile evaluations by priming haptic product characteristics, such as warmth and softness, it is possible that the hypothesis could not be supported when people do not perceive the information to be interpreted (i.e., product evaluations) as ambiguous, and may thus need to rely on additional information for judgment. As a results, people may not have found it necessary to draw on implicit cues (such as warmth and softness of the ambient scent) to provide an evaluation of the products.

Chapter 10 Limitations and Directions for Future Research

There are several limitations of this study. We did not successfully demonstrate an association between ambient scent and tactile dimensions of products, and whether this effect increases willingness to pay and purchase intentions. This study was conducted in a lab setting, which may limit the generalizabiliy of the research findings to retail environments. The sample size for the study was probably not large enough for detection of a probably small effect. In addition, a sample of undergraduate students was used in the study, which represents a certain small group of the general population. Although a homogeneous sample increases the internal validity of research, it is possible that consumers of different age groups or different levels of experience differ in their ability to access the ambient and haptic information. Alternative sample composition may thus provide more insight about the joint effects of olfaction and touch. An extension to real retail environments and different types of

retail stores might also be informative.

It is also important to note that this research focuses on warmth/coldness and softness/roughness dimension of touch. Extending this research to other dimensions, such as weight, may contribute to our understanding of olfaction-touch interactions. Although the current study does not show an effect of ambient scent on evaluations of warmth and softness, it is possible that ambient scent may have effect on other tactile dimensions.

The scents and products used in this research were necessarily limited. Although we used scent pretest to select the scents, the scents included in the pretest were chosen based on past literature and aromatherapy references. Scent selection was limited by the absence of a theoretical basis that could be used to choose the scents. Future research might thus include alternative scents as cues of warmth and softness. Similarly, we used products for which warmth and softness are the most important haptic attributes. Most products thus were textiles. These products may deliver unambiguous tactile information regardless of whether ambient cues are presented. Including products from other categories may lead to different outcomes.

As the scent cues employed in this study may not have been strong enough, a higher level of intensity or a less familiar combination of different scents with the same tactile associations could be used. For example, a mixture of scents with salient warmth or softness attribute could be diffused. In addition, some other tactile dimensions could be studied in the future, such as weight.

This research could also be extended by inclusion of additional variables.

People's intention to touch and duration of touch could be tested. Another question pertains to additional cues that enhance make associations to tactile characteristics more obvious and easier to diagnose, such as the color of the environment, the layout of the store, the lighting condition, and the sound in the environment. Ambient scent may only be obvious enough if supported by a third factor. For example, it is possible that an ambient scent which contains a warmth cue can only enhance people's perception of warmth of the product when the environmental color also signals warmth and is thus congruent. On the other hand, some environmental cues may block associations evoked by the scent and product when it is not appropriate or not congruent with the two. Indeed, a relatively cold-looking lab environment may have inhibited a relatively weak scent effect. Future studies could investigate if this influence exists, and what factors support or prevents people from building associations in their evaluation process. In a real retailing environment, the tactile effect is quite possibly influenced by a complex combination of scent and other information.

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Appendix A

Need-for-Touch items (Peck and Childers 2003b)

1. Touching products can be fun.
2. I place more trust in products that can be touched before purchase.
3. I like to touch products even if I have no intention of buying them.
4. I feel more comfortable purchasing a product after physically examining it.
5. When browsing in stores, I like to touch lots of products.
6. When walking through stores, I can't help touching all kinds of products.
7. I feel more confident making a purchase after touching a product.
8. If I can't touch a product in the store, I am reluctant to purchase the product.
9. The only way to make sure a product is worth buying is to actually touch it.
10. When browsing in stores, it is important for me to handle all kinds of products.
11. I find myself touching all kinds of products in stores.
12. There are many products that I would only buy if I could handle them before purchase.