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Research Review

An integrative review of sensory marketing: Engaging the senses to affect perception, judgment and behavior☆

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Abstract

I define "sensory marketing" as "*marketing that engages the consumers' senses and affects their perception, judgment and behavior.*" From a managerial perspective, sensory marketing can be used to create subconscious triggers that characterize consumer perceptions of abstract notions of the product (e.g., its sophistication or quality). Given the gamut of explicit marketing appeals made to consumers every day, subconscious triggers which appeal to the basic senses may be a more efficient way to engage consumers. Also, these sensory triggers may result in consumers' self-generation of (desirable) brand attributes, rather than those verbally provided by the advertiser. The understanding of these sensory triggers implies an understanding of sensation and perception as it applies to consumer behavior—this is the research perspective of sensory marketing. This review article presents an overview of research on sensory perception. The review also points out areas where little research has been done, so that each additional paper has a greater chance of making a bigger difference and sparking further research. It is quite apparent from the review that there still remains tremendous need for research within the domain of sensory marketing—research that can be very impactful.
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Keywords: Sensory marketing; Smell; Taste; Touch; Grounded cognition; Embodied cognition

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Sensory marketing as applied sensory perception: a review

Hershey's milk chocolate can be presented in a plain slab or as a Hershey's Kiss—the two are identical in formula but have very different personalities (see Fig. 1 below). The Kiss is unfurled using it's "flag" akin to a present, it feels like a teardrop melting on the tongue, the individual wrapping of small pieces allows one to have several treats without guilt, the name makes one feel like one is being kissed—all in all, a very indulgent experience; the slab is simple—basic chocolate made by a reputable company.



Fig. 1. Hershey's — two different sensory experiences.

In Krishna (2010: 2), I define sensory marketing as "marketing that engages the consumers' senses and affects their behaviors." This could even be broadened so that *sensory marketing implies "marketing that engages the consumers' senses and affects their perception, judgment and behavior.*" From a managerial perspective, sensory marketing can be used to create subconscious triggers that define consumer perceptions of abstract notions of the product (e.g., its sophistication, quality, elegance, innovativeness, modernity, interactivity)—the brand's personality. It can also be used to affect the perceived quality of an abstract attribute like its color, taste, smell, or shape.

From a research perspective, *sensory marketing implies an understanding of sensation and perception as it applies to consumer behavior*. Why does a Hershey's Kiss feel like a present—is it because one "unwraps" it? Does a hidden object have more mysterious appeal? What haptic interactions lead to perceive better taste? How is the feeling of greater indulgence created? What is the interaction between sensory satiety and guilt?

The arena of sensory marketing offers many questions to explore for managers and for researchers. According to Peck and

Childers (2008), out of the 81 sensory studies in consumer behavior focusing on taste, touch, smell, and hearing, over one-third (28) have been published within the last 5 years. Clearly, sensory perception and sensory marketing is a growing field and there is much research yet to be done. The focus of this review is to summarize some of the research that has been done on the senses while pointing out gaps in the literature where more work is needed.

What exactly is sensory marketing?

The Swedish grocery retail chain, ICA Sverige AB, has recently decided to adopt more sensory labels for their produce section. They feel that more sensory labels (e.g., juicy oranges rather than Florida oranges; succulent seabass rather than seabass filet) would inspire their consumers to eat more food and vegetables. This move is wholeheartedly backed by the Swedish government (author's correspondence with Swedish Knowledge Foundation). In the U.S., many food manufacturers are emphasizing how their product appeals to the different senses. For instance, Lindt chocolate's recent ad discusses the art of chocolate tasting and tells the reader exactly how to employ all five senses in tasting their chocolate. Many upscale hotel chains have adopted signature scents with the hope that the scents will helps their customers better remember other features of their hotel that they loved, and bring them back. For instance, the Westin hotel chain has the signature scent of white tea with geranium and Freesia. Intel, NBC, MGM, and many other brands have signature sounds which announce that it is indeed their brand that the consumer is listening to. Bottles like those for Orangina have adopted shapes and textures that resemble the raw material of the product itself, in this case the orange, to stand out from other products, and also to appeal to consumers' haptic sense.

Given the gamut of advertisements (ads) that consumers see every day for the thousands of products that are available in the marketplace, it seems that unconscious triggers, like those appealing to the basic senses, may be a more efficient way to appeal to consumers. Also, these sensory triggers may result in consumers' self-generation of (desirable) brand attributes, rather than those verbally provided by the advertiser. Such deductive engagement may be more persuasive versus deliberate statements (Sengupta & Gorn, 2002).

In the past two decades, some consumer behavior researchers have incorporated elements of vision, touch, audition, smell and taste in their research. Some of this research has explicitly focused on the antecedents and consequences of sensory perception, for example, the effect of verbal and visual ads on ad processing (Houston, Childers, & Heckler, 1987) or the effect of spoken versus written ads on ad recall (Unnava, Agarwal, & Haugtvedt, 1996). Some of this research also used sensory perception for mood manipulation—e.g., food tastes (Kahn & Isen, 1993) or certain types of music (Gardner, 1985). However, despite the focus on sensory perceptions within consumer behavior there lacked cohesiveness within this research stream. In summer 2008, a group of researchers who had been working on individual senses got together and created the umbrella of sensory marketing for their research (see Krishna, 2010: xii).

In a way, sensory marketing is an application of the understanding of sensation and perception to the field of marketing—to consumer perception, cognition, emotion, learning, preference, choice, or evaluation. Fig. 2 provides a conceptual framework for the field of sensory marketing. This review is structured around this conceptual framework. Clearly, one cannot do a comprehensive review covering everything that has been done in the area of sensory marketing. As such, the review discusses parts of this conceptual framework.

I have used two rules to decide what to cover. First, assuming that the purpose of this review is to spark more research in less traveled areas, I have chosen literature useful for generating such additional research. Conversely—I do not expand on research areas which have had decades of research interest, such as the visual/pictorial aspects of advertising which have had (near) exclusive marketing focus, with the other senses receiving scattered attention. Second, when good review articles exist for an area, I point the reader to this article rather than repeat the exercise. I apologize for research that I may have inadvertently missed. I have also built upon previous papers I have written within the domain of sensory marketing, especially borrowing from literatures that I have used there.

Consistent with Fig. 2 and the two rules noted above, I first highlight the difference between sensation and perception using examples from psychology and from marketing. Then, I expound on research on each of the five senses, focusing on key elements that can generate future big-step insights within each of them. I begin with haptics including work on person–product, person–person and person–product haptic interaction and also a discussion of disgust. Smell is discussed next with a concentration on perception and learning. This is followed by work on audition and then on taste, consumption and satiety. Vision receives little attention given the enormous work in advertising in the past. The five senses provide the right scaffold on which to build our discussion of grounded cognition—cognition grounded in the senses. I end the review of sensory marketing with many ideas concerning what is needed for future research.

Sensation versus perception

As one knows, sensation and perception are stages of processing of the senses. Sensation is when the stimulus impinges upon the receptor cells of a sensory organ—it is biochemical (and neurological) in nature. Perception is the awareness or understanding of sensory information. In Latin, *perceptio* or *percipio* means "apprehension with the mind or senses."

An easy way to understand the difference between sensation and perception is by considering visual illusions. One such illusion is given below (see Fig. 3 for the café wall illusion).

In the café wall illusion, the horizontal lines are actually parallel, that is, the biochemical sensation of light hitting the eyes is horizontal; however, the perception is that they are not horizontal—after interpretation of the sensation by the brain, the lines do not appear parallel anymore. We have been trained over time to expect things (like wooden planks) to bend down when a block (like a brick) is placed on top of it. Therefore,

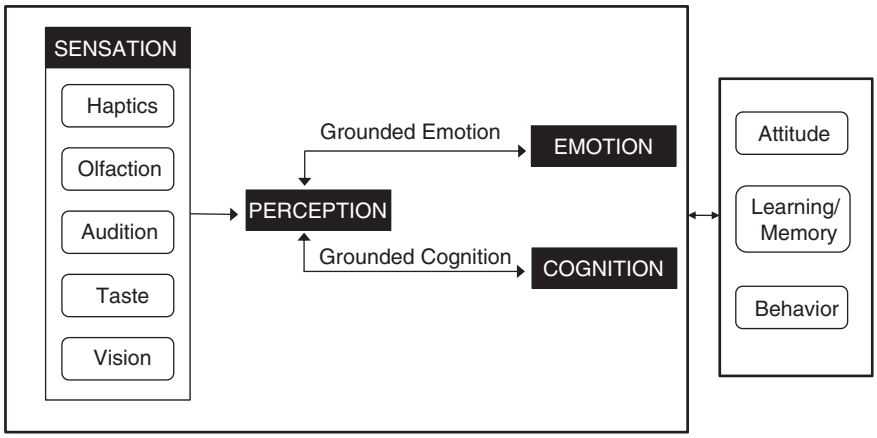


Fig. 2. A conceptual framework of sensory marketing.

the lines with blocks on top do not appear parallel. Hundreds of such visual illusions exist.

Vision is not the only sense for which they can be explicitly recognizable differences between sensation and perception. Speech recognition is another. Newborn Japanese children can tell the difference between "l" and "r", but Japanese adults cannot. Japanese adults have learned (untrained themselves) not to decipher the difference because it does not matter in their language. Even though the auditory signal (sensation) may be carrying an "l" and an "r" sound, the brain will interpret both as "l" (perception)—both sounds will be heard by the Japanese as "l" (Wolfe et al., 2006). Here too, sensation and perception are different and both are largely outside of our control. Japanese adults may train themselves to hear the "l" and "r" as distinct, but it needs pro-active training to hear the difference.

Visual perception biases within consumer contexts

Within the marketing domain, how have researchers studied such explicitly recognizable differences between sensation and perception? One area is that of visual perception biases (Raghubir & Krishna, 1996, 1999; Wansink & Van Ittersum, 2003). Visual perception biases are important within the domain of consumer behavior because they affect judgments of product sizes and of consumption; these judgments in turn can also affect actual consumption (see e.g., Chandon & Wansink, 2007; Chandon & Ordabayeva, 2009; Krider, Raghubir, & Krishna, 2001). Further, visual biases can affect judgments of spaces and distance traveled. One example of this research is Raghubir and Krishna's (1996) "direct distance" bias whereby direct distance between the endpoints of non-straight lines of equal length affects their perceived length—the one with the shorter direct distance between endpoints is perceived to be shorter (see Fig. 4 for the Direct Distance Bias where the path XN' appears to be longer than the path XR' even though the two are equidistant). In Krishna (2006), one can find a summary of visual illusions that are pertinent to marketing researchers.

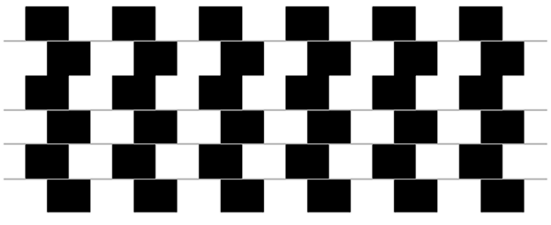


Fig. 3. Café wall illusion.

There is a lot of room for future research examining the differences between sensation and perception focusing on senses other than vision. Speech recognition is clearly one area which can be very important for marketers in the form of spoken advertising, for example, radio, TV, or computer ads, or even spoken ads over cellphones which are inevitable.

With the distinction between sensation and perception fairly clear, we start our review of the five senses.

Haptics

Laura is a warm person; Many rough characters dwell in that neighborhood; She came across as cold as a fish; Cool as a cucumber, that one is; Life has made him as hard as he is.

Personality analogies often dwell on haptic characteristics. In fact, the importance of inter-personal and product touch cannot be stressed enough. As early as the 4th century BC, Aristotle proposed his theory of *aisthesis* or sensation which suggests that our five senses are ordered hierarchically, with "touch" on top, and the other senses increasing the acuity of the touch sensation. Per Aristotle, touch provided a true picture of the intrinsic nature of the object, so that the soft coat of a kitten would be indicative of its innate softness of character. Also, touch and the cosmos were connected since sexual stimulation worked through the sense of touch allowing the human race to continue.

Touch is also the first sense to develop in the womb and the last sense one loses with age. Even before we are born, we start responding to touch and also start touching our own selves. During pregnancy, the senses develop in the following order—

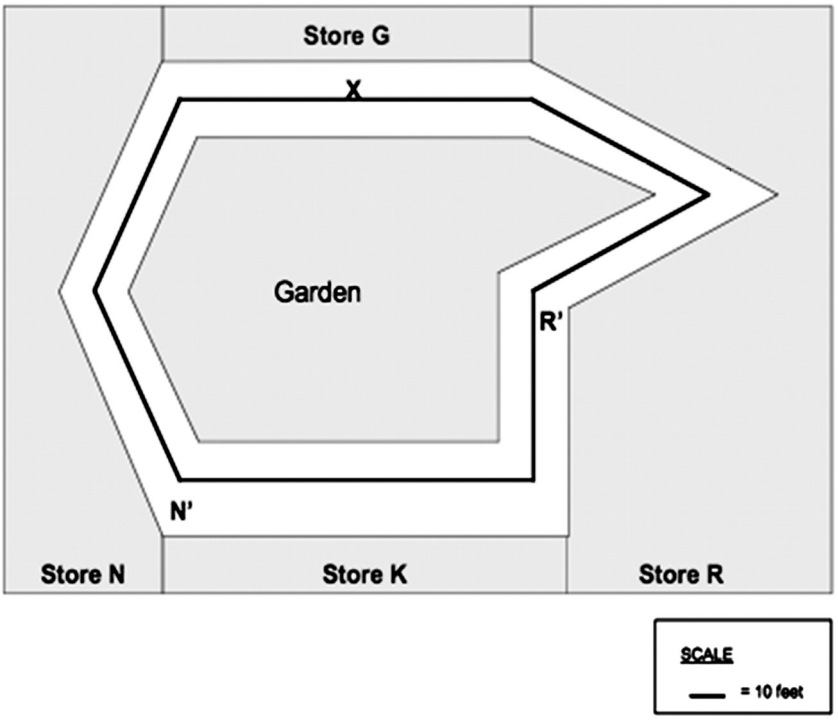


Fig. 4. Direct distance bias.

touch, smell, taste, audition and then vision. Touch lets the human embryo learn its place in the womb and find itself. The touch sensation first develops around the mouth area and then proceeds downwards from head to toe. Mark Lythgoe, a neuroscientist at the Institute of Child Health has used Magnetic Resonance Imaging to show that at 8 weeks of gestation, a human embryo can respond to being touched on the cheek, at 12 weeks, it can begin to suck its thumb and lick, and at 32 weeks of gestation, it can feel and comprehend temperature, pressure and pain. Other research shows that receptor cells on the skin develop at 20 weeks, and that at 24 weeks the embryo has a weak grasp which turns into a firm grasp at 26 weeks so that it will hold anything placed in its palm including the umbilical cord. The reversal, loss of sensory acuity, seems to be faster and earlier for vision, audition, smell, and taste compared to touch.

The importance of touch for humans has been demonstrated in many studies. For instance, research has looked at what an infant desires more—a mother's touch or basic nutrition? Studies with infant macaque monkeys (Harlow, 1958) have found that the monkeys prefer to stay close to a surrogate cloth mother than a wire mother where the cloth mother provides warmth and the wire mother provides nutrition (see Fig. 5). The comforting surrogate cloth mother and the nurturing surrogate wire mothers were created by placing a 100 W light bulb behind the cloth mother and attaching a bottle with milk to the wire mother. The cloth mom provided comfort through contact, and the monkeys chose her over the nutrition mom. Similar comfort through physical contact has been shown in human infants, where holding, caressing, cradling, or massaging the baby, that is, touching the baby, has been shown to enhance parent–infant attachment and also enhance the baby's emotional and physiological health (Montagu, 1986). But, does everyone have the same need for contact or touch?



Fig. 5. Importance of touch. Harry Harlow monkey experiments with wire and cloth mother surrogates.

Need for touch scale

Peck and Childers (2003a) have created the Need-for-Touch scale which picks up individual differences in need-for-touch. The scale is made up of two sub-scales—instrumental and autotelic. The instrumental need for touch, as the name denotes, is for functionality, i.e., for a specific objective, generally to buy a product. A typical question for this scale is "The only way to make sure a product is worth buying is to actually touch it." The autotelic need for touch on the other hand, captures compulsive touch or the emotional component of touch—touch for the sake of touch alone. A typical question for this is "Touching products can be fun." Both the functional and pleasure dimensions have six questions each. The scale has been used widely and has been able to discern differences in judgments based on differences in need-for-touch (e.g., Krishna & Morrin, 2008; Peck & Wiggins, 2006). Such differences also affect the impact of humans touching products, humans touching humans, and products touching products. We look at research done in each of these areas.

Touch and products

Given the large amount of money spent on internet sales (Forrester Research estimates that internet sales overall should exceed $200 billion in 2008), where consumers cannot touch the item, it would make sense to see if low versus high NFT individuals react to products differently when they cannot touch the products.

To test this, 199 subjects were asked to evaluate a sweater and a cellphone (Peck & Childers, 2003b). Half of the study participants were given the chance to touch the product whereas others could only see it through plexiglass and could not touch the products. They found that the high overall NFT people were more confident and less frustrated about their product evaluations when they could feel the product; for low NFTs, touching or not made no difference. Written descriptions of how the product felt if one was able to handle it helped alleviate to some extent high NFTs' frustration. However, this was the case only for the more concrete haptic quality of cellphone weight, but not for the less concrete quality of sweater softness.

Similar results have been obtained for donation appeals. In studies of altruistic behavior, researchers (Peck & Wiggins, 2006) gave people brochures for an Arboretum that either had a "touch" element associated with it (e.g., a tree bark or feather in the front page of the brochure) or did not. They found that people's willingness to donate to the Arboretum increased with a touch element in the brochure for high autotelic NFTs. But, for low autotelic NFTs, there was no difference in donation willingness with and without the touch element.

Touch and generosity: humans touching humans

While the earlier examples are about touching objects, touching people can also have interesting consequences. In an interpersonal touch setting in the U.S., it has been shown that when the waitress physically touches a customer, her tip increases, even though her service is not judged to be any better (Crusco & Wetzel, 1984). Similarly, library service is considered to be better when students checking out books are touched (Fisher, Rytting, & Heslin, 1976); and if touched by the requester, a person is more willing to taste a new snack in the supermarket (Hornik, 1992), or take part in mall intercept interviews (Hornik & Ellis, 1988).

Why does this happen? Is it just because the act of touching is making the relationship more "friendly" or is there a more deep-rooted reason for this? Evolutionary biologists Morhenn and colleagues tried to see if there was a physiological relationship between touch and generosity (Morhenn, Park, & Piper, 2008). In doing so, they studied whether oxytocin levels increase after touch; higher oxytoxin levels have also shown to lead to greater generosity towards strangers, and are also present during childbirth contractions and orgasms. They found that touch did increase oxytocin levels, but only when it was followed by an intentional act of trust.

To get to this result, they divided 96 people into three groups where the first and second got a professional massage but the third did not. Pairs were then made at random from the first and third group and these pairs participated anonymously through a computer in a trust game. Each person in the pair got $10 and could give up a part of this money to the other person, the "trustee." The money given to the trustee was then tripled and the trustee could return some money back to the original "giver." Economic theory indicated that if one is totally rational one should give nothing since there is no rational motive for the trustee to return any money back to the giver. However, in practice, givers generally give and trustees return, since giving money signals trust and evolution dictates that acts of trust need to be reciprocated. They found that group 1 people, that is, the ones who got the massage, gave 243% more, on average, compared to group 3 people, the ones who did not get the massage. To test for a physiological explanation, the research team took blood samples before and after each trust game and looked for changes in oxytocin levels. Remember that there was a second group who was massaged but did not participate in the trust game—no change in oxytocin level was found for this group.

However, they found that oxytocin levels increased in the first group who got a massage and then played the trust game, but did not rise in the third group who did not get the massage and played the trust game. Their results show that touch alone does not increase oxytoxin levels but touch followed by an act of trust does. From an evolutionary perspective, it makes sense that touch followed by trust should lead to more generosity, since touch and trust together imply a community or family situation where one ought to be generous. This is further corroborated by Morhenn and colleagues' finding that women were more susceptible to monetary sacrifice after touch which is consistent with the evolutionary explanation that women need to sacrifice more to look after their young.

Additional credence for haptics and inter-personal behavior comes from an experiment that examines the effect of temperature on social judgment and gift giving (Williams & Bargh, 2008). In this experiment, people who had signed up to do a study were met by an experimenter in the lobby of a building. When they were being taken up to the study room in an elevator, the experiment asked them to please hold his coffee cup while he did something. The coffee was either hot or cold.

The participants were then asked to judge a target person's personality. It was found that people who had held the hot coffee judged the target person as being "warmer," that is, more generous and caring. After holding hot coffee, participants were also more likely to buy a gift for a friend versus themselves. These results show that physical warmth generates interpersonal warmth, the neuro-physiological explanation being that the same part of the brain is activated for physical warmth as for interpersonal warmth.

Products touching products (disgust)

Besides humans touching products and humans touching other humans as we have seen, products touching each other can also affect how consumers react towards products. Products touch each other in the tightly packed supermarket shelves, in our shopping carts, and in our cupboards at home. Does it matter what touches what? Apparently so, if one of the products elicits disgust. While all the earlier touch effects we discussed indeed had positive consequences, here we see that touch can also have negative effects.

Disgust is formally defined as "revulsion at the prospect of (oral) incorporation of an offensive substance" (Rozin & Fallon, 1987). Quite a few supermarket top-seller items are found to be moderately disgusting, among them trash bags, cat litter, diapers, cigarettes, feminine napkins (Morales & Fitzsimons, 2007). Having any of the disgusting items touching normal, non-disgusting items, e.g., placing tampons next to the potato chips in your shopping cart or on the shelf decreases the appeal of the potato chips, but having them close to but not touching them does not. Why? Is it magic? In fact, anthropological researchers would believe that to be the case.

While anthropologists were studying the beliefs of indigenous cultures, they came across the "laws of sympathetic magic" (Mauss, 1972), with the Law of Contagion forming the basis for many of the magical practices and rituals, such as voodoo and strict rules for meal preparation (Meigs, 1984). The law of contagion suggests that when a source object touches a target object, the source will continue to influence the target even after it stops touching it (Rozin & Nemeroff, 1990). This law is similar to the laws of sympathetic magic, with the source magically transferring some of its properties to the target through touch (Nemeroff & Rozin, 1994). Physical contact of a target item with a disgusting source item seems to lead to feelings of disgust towards the contaminated items. Even now, in India, Brahmins, including highly educated ones, will not let non-Brahmins enter their prayer areas or their kitchens for fear of contamination; Brahmin girls too cannot enter these areas of the house during times of menstruation, the laws of contagion being very intertwined here with religious beliefs.

Some early work on disgust and contagion was done by Paul Rozin and his colleagues. They conducted studies where participants were asked to eat dog poo shaped chocolate fudge which they knew that was chocolate fudge. However, more than 40% declined. The researchers also showed that if a drink had been touched by a sterilized cockroach, people did not want to drink it. Interestingly, those who declined to eat the chocolate and consume the drink could not explain their reasons for demurring (Rozin, Millman, & Nemeroff, 1986).

Laws of contagion do not only operate between products but also operate between people and products. Argo, Dahl, and Morales (2006) showed that participants liked a product less and were less likely to purchase it if another shopper had touched it earlier. They instructed study participants to find a particular t-shirt and to try it on. The study was designed so that a third of the participants found the shirt hanging on the shopping rack as usual, another third found it the return rack of the dressing room, and the last third found it inside the dressing room. Contamination was supposed to increase from the shopping rack, to the return rack, to the dressing room, that is, along with increasing proximity to physical contact with the contaminator. As expected, product evaluations and purchase intentions were highest for the t-shirt on the shopping rack and lowest for the one in the dressing room, even though all the actual t-shirts were in perfect condition and untouched by anyone else. Just the mere thought of contamination affected people's evaluations.

Touch, whether between two products, two humans, or a product and a human seems to impact consumer behavior in significant ways. But, is haptics the only sense with such strong ramifications for consumer behavior? We now turn to the sense of smell.

Smell—a focus on how perception affects learning

> *She sent for one of those squat, plump little cakes called "petites madeleines," … I raised to my lips a spoonful of the tea in which I had soaked a morsel of the cake… The taste was that of the little piece of madeleine which… my aunt Léonie used to give me, dipping it first in her own cup of tea …so in that moment all the flowers in our garden…and the water-lilies on the Vivonne and the parish church and the whole of Combray and its surroundings… sprang into being…from my cup of tea.*

The French author, Proust, is recognized for making the connection between scent and autobiographical memories in his book, "In search of lost time," long before neuroscientists connected smell with memory (e.g., Cahill, Babinsky, Markowitsch, & McGaugh, 1995). We focus our discussion of smell on the connection between smell, memory and learning.

Smell and memory

The physiological connection of smell and memory

Research on smell and memory has been done within the basic sciences, psychology, and recently in marketing. This research identifies several biological or anatomical/structural reasons for why scent-encoded information may last for longer stretches of time versus information encoded along with other sensory cues. Primary among these reasons is the physical and neural proximity of the systems associated with olfaction and memory. The limbic system, containing the olfactory

bulb, amygdala, and hippocampus, is characterized by quick synaptic transfers among its members (Herz & Engen, 1996). Specifically, only two synapses lie between the olfactory nerve and the amygdala, which is commonly recognized for its role in emotion, and also plays a large role in determining emotional memory (Cahill et al., 1995). Even more highly involved in memory than the amygdala is the hippocampus (Eichenbaum, 1996). Only three synapses lie between the olfactory nerve and the hippocampus, again making this relationship significantly strong. *The transfer of olfactory information thus differs from that of the other senses, none of which have as direct a connection to memory*.

There are also differences in humans' physiological make-up in terms of the number of receptors devoted to processing incoming olfactory versus visual sensory input. A Nobel prize was granted in 2004 to Buck and Axel (Buck, 2005) for demonstrating how people are able to distinguish among so many different scents. Their work identified scent receptors in humans for the first time, and importantly, showed that humans have a family of some 1000 different genes that encode distinct scent receptors (as a comparison, vision has merely four distinct receptors). Also, since varying combinations of receptors produce distinct smells, humans have the ability to recognize as many as 10,000 different scent combinations (Buck & Axel, 1991). Thus, while humans often have difficulty identifying scents by name (de Wijk, Schab, & Cain, 1995; Lawless & Engen, 1977), their ability to distinguish among different scents and to recognize scents previously smelled, even after long periods of time, is quite robust (Schab & Crowder, 1995).

Memory for scent itself

Odor recognition studies show that people's ability to recognize scents they have encountered previously persists over very long time periods, with minimal reductions in recognition accuracy from seconds (Engen, Kuisma, & Eimas, 1973) to months or years after exposure (Engen & Ross, 1973; Zucco, 2003)—in Engen and Ross's (1973) research, odor recognition reduced from 70% immediately after exposure to 65% after 1 year; in Lawless and Cain's (1975) research, it reduced from 85% immediately after exposure to 75% after 1 month. Memories for other sensory inputs decay at a much faster rate, exhibiting steep forgetting curves (Ebbinghaus, 1913). For instance, recognition accuracy for pictures dropped from 99% when measured immediately after exposure to 58% when measured 4 months later (Shepard, 1967). Memories for scents thus exhibit flatter forgetting curves over time than do memories for information acquired via the other sensory modalities.

Scent and auto-biographical memories

There is considerable research focused on the ability of scent cues, versus cues from other sensory modalities, to evoke autobiographical memories, or memories for events that have taken place long ago. Herz (2004) found that memories triggered by scent retrieval cues were rated as more emotional than those evoked by the other types of cues. Chu and Downes (2002) found that scent cues (versus visual or verbal–scent–label cues) yielded more detailed autobiographical memories; and Willander and Larsson (2006) found that autobiographical memories cued by olfactory information were older than those cued by verbal and visual information.

Ambient scent and memory

There have been mixed findings regarding ambient scent and memory. Morrin and Ratneshwar (2003) showed that ambient scent increased recall and recognition of brands seen. Congruence of the odor with the item recalled had no effect. Herz (1997) found that memory for (recalled) verbal statements was better with an incongruent ambient odor vs. a congruent one only if the odor was present at *both* encoding and retrieval (there was no improvement in recall otherwise). Mitchell, Kahn, and Knasko (1995) suggested that ambient odors result in memories and affect elaboration on product information and choice. They find no effect of smell versus no smell on memory, but that memory with a congruent odor is higher than that with an incongruent odor.

Product scent and memory

Krishna, Lwin, and Morrin did a trilogy of papers exploring product-embedded scent and memory for associated information. In Krishna, Lwin, and Morrin (2010), they demonstrate that product scent increases memory for associated information. In one of their experiments, subjects given a *scented* (pine) branded pencil, along with a 10-point list of its selling points remembered 3.67 points 2 weeks later; however, subjects in the control condition with an *unscented* pencil could only recall 0.87 attributes. Note that the pine scent was *not* provided to jog memory.

What happens to recall of verbal information when an advertisement has verbal information, a picture and a smell, as did the advertisement for the television show "Weeds" which had a marijuana-smell strip embedded (see Fig. 6)? Lwin, Morrin and Krishna (2010) extend the dual coding theory of memory retrieval (Paivio, 1969, 2007) beyond its traditional focus on verbal and pictorial information (Wyer, Hung, & Jiang, 2008) to olfactory information. They manipulate the presence or absence of both olfactory stimuli (smell) and pictorial stimuli, and measure the impact on verbal recall. They find that scent enhances recall of verbal information, and scent-based retrieval cues also increase the facilitative effect of pictures on recall (make it even stronger). These two smell-effects occur after a time delay (i.e., scent is a memory-enhancer after a time delay) and are shown to occur both at encoding and at retrieval.

While scent may help cut through the information clutter and help enhance memory, does this enhanced memory survive interference from future information that the consumer is exposed to? In Morrin, Krishna, & Lwin (2011), it is shown that scent-enhanced memory is indeed prone to retroactive interference (from information obtained later), but that some of the information lost is restored using a scent-based retrieval cue.

Other consumer behavior research on smell

Within the domain of smell, consumer behavior researchers have also looked at how it impacts product/store evaluation and time spent in store. Researchers have found that pleasant scents can enhance evaluations of products and stores (Bosmans,



Fig. 6. Advertisement with verbal, visual and olfactory stimuli.

2006; Laird, 1932; Spangenberg, Crowley, & Henderson, 1996) and increase variety-seeking behavior (Mitchell et al., 1995). Bosmans (2006) demonstrated that ambient scent can result in emotion-based semantic connections with memories (e.g., roses and babies) and improve product evaluation. Spangenberg et al. (1996) show that evaluation of a product increased with ambient scent if evaluations were low to begin with. Mitchell et al. (1995) show that more time is spent searching and there is more variety-seeking with a congruent versus incongruent odor. With more spaces (e.g., hotels, stores) and more products being scented, I expect to see more interest in the effect of scent.

Conclusion for smell, perception and learning

Much other work on the connection between the senses (smell, audition, taste, haptics) and learning (information processing, memory), evaluation, judgment and behavior is needed. While there is much research on smell and memory, there is relatively little research on the connection between other senses and memory. For instance, how do pitch, tone and volume affect recall (if they do so at all)? Can good taste affect recall of other aspects of the eating experience? Is there greater elaboration on auditory information if the speaker speaks louder, slower, or at a higher pitch? This brings us to a discussion of audition.

Audition

"Music is perpetual, and only the hearing is intermittent."
Henry David Thoreau, American philosopher.

Much of marketing communication is auditory in nature—one hears radio and television advertising messages, jingles and songs; one also hears ambient music in retail spaces, hotels, restaurants and airplanes; then, there are signature sounds from products such as the sound for the Intel Pentium chip that one hears each time one starts a computer or the sounds for Motorola or Verizon cellphones. Importantly, even when one *reads* a word, one *hears* the word as well—if the language is phonetic in nature, then the words that one reads enter a phontactic loop before being encoded in the mind, similar to spoken words (Pinker, 1994; see also Yorkston, 2010).

In their excellent overview of audition, Meyers-Levy, Bublitz, and Peracchio (2010) expound on the effects of sound symbolism (the sound of the word affects the perception of the object it represents—Yorkston & Menon, 2004), the language used (first or second language of bilinguals—see Krishna & Ahluwalia, 2008; Luna & Peracchio, 2001, 2005), visual and auditory processing differences among individuals based on pictorial versus phonetic scripts (Schmitt, Pan, & Tavassoli, 1994), language

associations that a brand name may have (Meyers-Levy, 1989), music in ads (Anand & Sternthal, 1990; MacInnis & Park, 1991; Zhu & Meyers-Levy, 2005) and music in the environment (e.g., Yalch & Spangenberg, 2000).

In elaborating on these auditory sub-areas of research, I rely heavily on Meyers-Levy et al.'s (2010) overview as well as Yorkston's (2010) and Dahl's (2010).

Sound symbolism

When we hear the sound of a word, we attach meaning to it, even perceiving physical features for the source of the sound—be it animate (human, dog, cat) or inanimate (box, robot, car, ice cream). For instance, a high frequency bark/yelp is associated with a small dog whereas a deep, low frequency growl with a large, ferocious looking one. Macho men are similarly expected to have deeper voices and luxury cars smoother shutting doors with low frequency sounds. Yorkston and Menon (2004) show that Frosh brand ice cream sounds more creamy than a Frish brand ice cream (see also Klink, 2000). Zampini and Spence (2005) showed that the sound the food makes when bitten plays a key role in taste perceptions for certain food items (e.g., potato chips, celery, crackers), impacting perceived freshness as well as quality. Lowrey and Shrum (2007) showed the role of expectations in sound symbolism. When a brand name sounded congruent with expectations, they found brand evaluations to be positive.

Language

Just like the sound of a brand name can result in certain product perceptions, language too can have its own associations. Krishna and Ahluwalia (2008) state that there are some "generalizable language-related associations in bilingual cultures that use English as the second language. Use of English in ads has come to suggest a social stereotype—a symbol of modernity, progress, sophistication and a cosmopolitan identity (e.g., in Japan, Korea, Germany, India) (Bhatia, 2000; Piller, 2003; Takashi, 1990a, 1990b)…(whereas) the primary (or first) language is likely to have high levels of "belongingness" associations which connote a stronger sense of closeness and in-group associations (e.g., Myers-Scotton, 1999, 2002)." Krishna and Ahluwalia (2008) then demonstrate that the same ad slogan in English or Hindi language has different associations. While the reason for these associations has not been explored, since the lexical meaning of the slogans is the same, one possible reason is the associations the subject holds with the "sound" of the language. Also looking at bilingual consumers, Luna and Peracchio (2005) have focused on the effect of code-switching (switching a few words in a sentence into a second language) on message evaluation.

Other research on language has examined the cognitive structures, memory and organization of information by bilinguals (e.g., Tavassoli & Han, 2001; Zhang & Schmitt, 2004). Schmitt et al. (1994) show that the logographic (pictorial) writing system of Chinese characters enhances recall for brand names for the Chinese when these names are presented visually (versus auditorially); the phonetic (sound-based) writing system of English enhances recall for brand names for Americans when these names are presented auditorially (versus visually). Many other such visual versus auditory processing differences have also been shown in the literature (e.g., Pan & Schmitt, 1996; Tavassoli & Han, 2001).

Music in advertising

Music in advertising has been shown to impact ad persuasion by impacting mood (Park & Young, 1986) as also involvement (MacInnis & Park, 1991). Also, like the sound of brand names, the music itself can also carry a meaning—both embodied (e.g., a faster tempo can evoke more positive feelings—Stout & Leckenby, 1988) and referential (a nursery rhyme takes us back to childhood—Zhu & Meyers-Levy, 2005).

Ambient music

Ambient sound, such as music heard in hotels, restaurants, retail stores, and supermarkets, can influence consumer mood, actual time spent in a location, perception of time spent, and actual spending. For instance, stereotypically French versus German music has been shown to affect the choice of wine—shoppers bought more French (German) wine when French (German) music was played (North, Hargreaves, & McKendrick, 1999); classical music has been shown to enhance pleasure, whereas pop-style music to increase arousal (Kellaris & Kent, 1993). Music in a store also influences shopping pace—slower music produces slower shopping and results in more purchases since customers progress at a slower pace as they move through the store (Milliman, 1982). When consumers enjoy the background music, they feel they have spent less time shopping relative to the actual amount of time they have spent in the store; if they dislike it, despite the short amount of time they have actually spent in the store, they claim to have been there for much longer (Yalch & Spangenberg, 2000; but, see also Kellaris & Kent, 1992).

Voice

Sounds emitted by products are not the only sounds that impact brand perception. The voices of spokespeople for the brand produce the same result. When a viewer turns on CNN, she hears James Earl Jones say, "This is CNN." His deep voice is authoritative and gives the impression that the news broadcast on this channel is accurate, up-to-date and covers all significant world events. French accents and husky-voiced females make the cosmetic or perfume they are selling appear sexier to the consumer. Dahl (2010) suggests that "fundamental frequency (voice pitch) and vocal speech rate are two important influencers of listener response to verbal communication and that they can affect personal perceptions of the speaker…in general, low-pitched voices are evaluated more favorably than high-pitched voices (Brown, Strong, & Rencher, 1973) (and) listeners attribute greater competence and credibility to individuals who speak more quickly (Stewart & Ryan, 1982).

Sound clearly has an impact on many different aspects of consumer behavior from product evaluation (e.g., related to how a product sounds) to advertisement evaluation (e.g., related to the

music in an advertisement) to perception of ambience in a restaurant, hotel, retail store, etc. (e.g., through ambient music). Sound is the perception of one pure sense—audition. We next turn to taste which, as we will see, is an amalgam of all five senses.

Taste, consumption and satiety

> "*…if we let something linger in our mouth, feel its texture, smell its bouquet, roll it around on the tongue, then chew it slowly so that we can hear its echoes, what we're really doing is savoring it, using several senses in a gustatory free-for-all…*".

This statement from Ackerman (1990) resonates with all of us. Yet, we know that humans can merely distinguish between five pure tastes, that is, there are basically five disparate biochemical and cellular interactions in our bodies related to taste, which are sweet, salty, sour, bitter and umami. The last, umami, was discovered by Japanese researchers (Ikeda, 2002) and has an approximate meaning of "deliciousness" or "savory", referring to the taste from monosodium glutonate (MSG) or the taste of pure protein. So, how do humans manage to distinguish between very subtle tastes with great sophistication? In fact, every single taste from milk to chocolate to wine to prosciutto is a combination of all our five senses—from smell (how the food smells), touch (temperature, fattiness and other textures of food, painfulness such as from hot spices), vision (how the food looks—aesthetic appeal including color), and also audition (e.g., the sound of the potato chip cracking when you bite it).

Even though we eat constantly, we are not very good at discerning one taste from another when using only our sense of taste. Thus, when we cannot smell or see the food, it is difficult to tell a potato apart from an apple, or red wine apart from coffee (Herz, 2007: 187). One reason for this limited capability is the few distinct tastes that we can detect—only five as mentioned earlier. As such, what we find "tasty" may have nothing to do with the "taste" sense, but may be largely dependent on the other senses. Think of the penchant Andhraites (from India) have for hot chili peppers in their food causing a thrilling sensation (chilies affect the trigeminal sense which is related to the haptic sense), why we want potato chips or cereal to be fresh enough to retain their crunch (the crunchy sound affects taste), why we crave the prickly feeling in the nose sensation of Coke (again the trigeminal sense), or why top fugu chefs retain just the tiniest bit of poison from the puffer fish to make the lips tingle (trigeminal, yet again).

Hoch and Ha (1986) show that the general ambiguity of product experience leads to a greater susceptibility to outside influences. Consistent with this reasoning, many factors have been shown to affect taste perception. Taste is susceptible to external influences, e.g., physical attributes, brand name, product information (ingredients, nutritional information), product packaging, and advertising. In terms of physical attributes, as early as DuBose, Cardello, and Maller (1980) showed that fruit drink colors determine perceived flavors, and more recently, Hoegg and Alba (2007) demonstrate that the color of juice dominates taste in discrimination tasks (discussed in greater detail under sensory dominance).

Brand names and descriptive product naming have also been shown to affect perceived taste—Leclerc, Schmitt, and Dubé (1994) showed that foreign sounding brand names (French) altered hedonic ratings of yogurt, whereas Allison and Uhl (1964) demonstrated that brand name influence beer perceptions among heavy beer drinkers. In a cleverly designed experiment, Lee, Frederick, and Ariely (2006) try and tease out if knowledge of product ingredients (balsamic vinegar) in beer affects actual experience or just judgment, by providing subjects with this ingredient disclosure either before or after tasting, but prior to evaluation. The authors find that disclosure of ingredients only affected the taste of the beer when disclosed prior to consumption, signifying a change in the experience due to the ingredients. When given the ingredient information after consumption, evaluations matched a control condition. Also looking at product ingredients, Levin and Gaeth (1988) showed that ground beef is evaluated more favorably when it is described as being 75% lean vs. 25% fat with the effects reducing when the consumer has experience with the product. In similar vein, Wansink, Park, Sonka, and Morganosky (2000) show a negative effect of soy ingredient on taste perceptions. Raghunathan, Naylor, and Hoyer (2006) further show that perceived healthiness of food item lowers taste. Interestingly, the authors show that this effect occurs at an automatic level, largely outside of consumer awareness.

In terms of advertising affecting taste, Elder and Krishna (2010) show that an ad emphasizing multiple sensations (e.g., taste, touch and smell) results in better taste perception than one emphasizing taste alone. They show that this effect works through sensory stimulation. Braun (1999) shows that advertising can alter the memories of past product experiences—orange juice was misremembered as tasting better following exposure to a positive advertisement.

Nowlis and Shiv (2005) and Shiv and Nowlis (2004) examine the effect of distracting (musical) input on food choice. They argue that food choice has an affective (taste) and cognitive (health benefits) component. Distracting consumers (imposing cognitive load) while taste testing results in greater focus on the affective versus informational component; this increases the likelihood of choosing a more affective product (e.g., milk chocolate vs. soy chocolate) and also consumption pleasure.

Actual and perceived consumption

Pierre Chandon and Brian Wansink have done dozens of very insightful studies on consumption behavior. Two good summaries are available in Wansink (2006) and in a review done by Chandon (2010). Some of this research related to visual labels/visual salience and consumption is mentioned here. Chandon and Wansink (2007), show that when fast-food restaurants claim to be healthy (e.g., Subway) versus not (e.g., McDonald's), people are more likely to underestimate the calories contained in main dishes and thereby to choose higher-calorie side dishes. In another set of studies (Wansink & Chandon, 2006), they argue that "low-fat" nutrition claims may influence food consumption by increasing

perceptions of the appropriate serving size, and reducing consumption guilt. They also demonstrate the connection between visual salience of food and its consumption (Chandon & Wansink, 2002).

do Vale, Pieters, and Zeelenberg (2008) demonstrate a result seemingly counter to existing findings. Prior research showed that small packages are perceived to be helpful in exerting self-control and lowered consumption (Wansink & Park, 2000). However, they show exactly the opposite. Why does this happen? For self-control to come into play, consumers need to perceive the consumption act as a self-control conflict. When they have a small package, it does not, but for a large package it does. Small packages act as a substitute for internal control of self-regulation. This is similar to work by Scott, Nowlis, Mandel, and Morales (2008) where they show that restrained eaters consume more calories from small food in small packages, whereas unrestrained eaters consume more calories from large food in a large package. However, the reason they suggest for this finding is different—they argue that for restrained eaters, higher consumption of small food in small packages results from a lapse in self-control caused by the stress of perceiving conflicting information—the small food in small packages is perceived as both diet food and high in calories.

Interestingly, a social psychology approach has identified similar social influences on food consumption as cognitive psychology approaches have shown. We have discussed earlier how shape of packages can influence consumption (Raghubir & Krishna, 1999); we have also discussed how self-control regulation kicks in with large packages and is let go with small ones (do Vale et al., 2008). Social psychologists similarly show that the shape of an observed person (and her choices) can influence consumption. McFerran, Dahl, Fitzsimons, and Morales (2010a) demonstrate that consumers' choice of food quantity is affected by what others around them select, but that it also depends on whether the other person is obese or thin—people choose a larger portion following another consumer who does that, but more so if the other is obese than thin, and if the consumers are lower in appearance self-esteem. In McFerran, Dahl, Fitzsimons, and Morales (2010b), they show that the body type of the "server" (rather than another consumer) impacts the quantity and choices made by participants—non-dieters eat more snacks when the server is thin, whereas dieters eat more when the server is heavy. In both papers, they use a professionally constructed obesity prosthesis, so that appearance of the "other" is controlled except for their (supposed) weight. They do not directly test if the size and choice of observed other could result in more or less self-control regulation (as induced by food packages). This is a potential topic for future research.

For a more detailed review of food decision making and dietary restraint, see Bublitz, Peracchio, and Block (2010). For another thought provoking article, see Mandel and Smeesters (2008) where exposure to death-related stimuli is shown to increase purchase quantities and also consumption of food products for low (but not high) self-esteem participants.

Raghubir and Krishna (1999) introduce the notion of perceived (as opposed to actual) consumption when they demonstrate the perceived size–consumption illusion. They first show, similar to the elongation bias (Holmberg, 1975) that people judge tall–thin containers to contain more volume than short–fat ones. But, interestingly, after consuming liquid from these containers, subjects feel that they drank more from the short–fat containers than the tall–thin ones. They explain this reversal based on expectation disconfirmation. People think that the tall–thin containers have much more liquid, but when they drink from it they feel that this is not so, and over-adjust. Wansink and Van Ittersum (2003) build upon this result by showing that bartenders pour more alcohol into short–fat containers compared to tall–thin ones.

Aydinoğlu and Krishna (2011) demonstrate that size labels adopted by food vendors can have a major impact on consumers' size judgments and consumption (actual and perceived), since consumers integrate the actual size information from the stimuli, with the semantic cue from the size label. They can even result in relative perceived size reversals, so that a smaller package appears bigger than a larger one. Further, consumers are more likely to believe a label that professes an item to be smaller (vs. larger) in the size range associated with that item. This asymmetric effect of size labels can result in larger consumption without the consumer even being aware of it, a phenomenon they refer to as "guiltless gluttony."

Satiation

There is a recent surge in research on satiation building upon work in psychology focusing on habituation (Epstein, Temple, Roemmich, & Bouton, 2009) or sensory-specific satiation (Weijzen, Smeets, & de Graaf, 2009). Habituation refers to reduced physiological and behavioral responses after extended or repeated exposure to a stimulus—one typically loves the first bite of a dessert much more than the seventh (Epstein et al., 2009) and is specific to stimuli. Sensor-specific satiation is also stimuli-specific but focuses more on saliva-flow related to food cues. Focusing on habituation, Galak, Redden, and Kruger (2009) show that people can overcome habituation effects (called satiation in their article) merely by mentally recalling various alternatives they have also consumed in the past. Their work also demonstrates that satiation is partly constructed in the moment. More recently, Morewedge, Huh, and Vosgerau (2010) similarly demonstrate that imagining consuming food can result in habituation effects just the same as actually consuming it does.

Interestingly, the link between work in consumer behavior on actual and perceived consumption and this work has not been made, even though it would appear that feelings of satiation would be very connected to perceived consumption. This presents another opportunity for future research.

We end our discussion of the five senses with a very brief mention of vision.

Vision

> "Everyone takes the limits of his own vision for the limits of the world". Arthur Schopenhauer, German philosopher.

While vision is clearly our dominant sense in several contexts, as stated earlier, I do not devote attention to the visual

sense, given the enormous amount of research on visual input within the context of advertising. I have already discussed visual illusions. Additional research in marketing on visual aspects of products and spaces considers the effect of spatial configuration on information processing (Meyers-Levy & Zhu, 2007), the effect of product proportions on aesthetic judgments (Raghubir & Greenleaf, 2006), and the effect of (irrelevant to the task) aesthetic aspects of products on other judgment (Hagtvedt & Patrick, 2008; see also Journal of Consumer Psychology's special issue on aesthetics—Volume 20 (4) of 2010).

We have now looked at the connection between sensation and perception, and at the perception of each of the five senses. But, what about the connection between perception and cognition? Does perception affect thought?

Perception affects cognition—grounded cognition

While no one contests that perception affects attitude and behavior and even memory, there has been debate about whether cognition is modally grounded, that is, are our thoughts stored in the modality in which they were perceived? Standard theories of cognition believe thought to be a-modal, such that cognition happens independent of perception; however, another school of thought suggests that our bodily states, situated actions, and mental simulations are used to generate our cognitive activity (Barsalou, 2008). The school of grounded cognition supporters has been growing, and much recent work in psychology and marketing is building off grounded cognition theories (e.g., Hung & Labroo, 2011; Labroo & Nielsen, 2010; Mazar & Zhong, 2009; Williams & Bargh, 2008). Note that there is also work by marketing researchers that predates the work listed above—this work does not use the "grounded cognition" but it is essentially building upon the theory of grounded cognition, e.g., research by Cacioppo, Priester, and Berntson (1993) and that by Tavassoli and Fitzsimons (2006).

What is grounded cognition?

While Barsalou includes bodily states, situated actions, and mental simulations within his definition of grounded cognition, precise definitions of bodily states and situated action have not been provided by Barsalou or by other researchers.

Bodily state

My understanding of *grounded cognition based on bodily state refers to cognition that is affected by an unmoving physical condition that one is in.* For instance, when the smile muscles (zygomaticus major) are compromised by holding a pen tightly with the lips without touching the teeth, or engaged by holding a pen with the teeth (Strack, Martin, & Stepper, 1988). Or, if one is looking at a hill with a heavy backpack on one's back (Proffitt, Stefanucci, Banton, & Epstein, 2003), or evaluating statements while holding a heavy clipboard (Jostmann, Lakens, & Schubert, 2009). In all these situations, one holds a particular bodily state which results in certain behaviors and thought processes.

In Strack et al.'s (1988) study, subjects' facial activity affected their funniness ratings of cartoons. In Proffitt et al.'s (2003) study, when subjects wore heavy backpacks, they judged hills as being steeper and distances as longer than when they did not. In Jostmann et al.'s (2009) studies, people holding a heavy clipboard gave greater importance to opinions and higher value to foreign currency than those who held less heavy clipboards.

Situated action

My interpretation of *grounded cognition based on situated action refers to cognition impacted by movement that is not locomotive in nature, that is, the whole body is not transported; one's body mass remains in the same coordinates but some parts of the body are moved.*

Wells and Petty (1980) show that overt movements can impact cognitive activity depending on associations built up over time between these movements and their signals. They show that vertical (horizontal) head movements impacted agreement (disagreement) with editorial content of a radio broadcast. In an interesting manipulation, they inform subjects that the head movements are to test headsets.

Additional support for the effect of motor activity on attitudes (likes–dislikes) due to learned non-declarative memory associations (e.g., skill learning, habit forming, muscle memory) is provided by Cacioppo et al. (1993). They proposed that since arm-flexion (arm-extension) is associated with withdrawal (onset) from pain and with acquisition (withdrawal) of desirable material, countless repetitions of these pairs can create attitudinal effects (motor biases) for arm flexion and arm extension in non-declarative memory. In their experiments, subjects liked Chinese ideographs that they viewed "during" arm flexion more than those they viewed during arm extension (like–dislike judgment done during arm flexion/extension).

Mental simulation

As Barsalou (2008) has stated, many researchers use the term "embodied cognition" to refer to "grounded cognition." However, the term "embodied" denotes that bodily states need to be involved for cognition which is not necessarily true since *even mental imagery or mental simulation may be enough to drive cognition*. Mental imagery that Barsalou refers to here, and in the definition of grounded cognition given earlier, is straightforward to understand. It is akin to visual imagery that has been used a lot within consumer behavior research, but may involve more than just the visual sense. Several neuroimaging studies provide evidence for such mental simulation whereby conceptual processing of sensory perceptions leads to neural activation of corresponding regions of the brain. For example, imagining hearing Beethoven played leads to activation of the auditory cortex (Zatorre & Halpern, 2005), reading (but not aloud) words associated with strong smells like "cinnamon" or "garlic" activates the primary olfactory cortex (González et al., 2006), and seeing pictures of chocolate chip cookies activates the taste cortices (Rolls, 2005; Simmons, Martin, & Barsalou, 2005). Recently, Elder and Krishna (2012) show that alternate visual depictions of a product (e.g., in an advertisement) can result

in less or more mental simulation of using the product and consequently affect purchase intention—in Fig. 7, the mug with the handle on the right (versus left) results in greater mental simulation and higher purchase intention for right-handed people.

History of grounded cognition

If one wants to trace the history of grounded cognition theory, early mention of it is found in work by Lotze (1852) and James (1890). The James–Lange theory suggests that "emotional experience is largely due to the experience of bodily changes." Similarly, Darwin (1872/1965) too suggested that a person's emotional experience can be strengthened or attenuated with accompanying appropriate muscular activity. After a long hiatus, mention of grounded cognition resumed in some psychology work, with Zajonc and Markus (1982: 130) stating that "..attitudes…are likely to have multiple representations—and somatic representations are probably among the more significant ones."

So, why has there been a recent resurgence? It could be because of developments in neuroscience. For instance, mirror neurons have been found, such that observed action is internally simulated in monkeys' motor systems (Di Pellegrino, Fadiga, Fogassi, Gallese, & Rizzolatti, 1992). Similarly, Adolphs, Damasio, Tranel, Cooper, and Damasio (2000), working with brain lesion patients and normal subjects, show that motor and somatosensory areas are engaged in purely perceptual tasks, e.g., stimulus (emotional facial) recognition.

Metaphors and grounded cognition

A specific sub area within grounded cognition that has become very popular is that of sensorially-rich metaphors like fishy smells, clean person, warm heart, etc. For instance, as discussed earlier under haptics, Williams and Bargh (2008) show that holding warm/cold cups results in judgments of a person being warmer or colder, and also that holding a warm versus a cold cup leads to a greater likelihood of buying gift for friend vs. self. They explain this using neuroscience evidence that the insula is involved in processing both physical warmth (temperature) and social warmth (trust).

While many studies showing that metaphors denoting sophisticated emotions like these may have a neural underpinning have been run, some are more rigorous than others. I provide an example of one such study and the criteria I use for what makes it more rigorous.

In Lee and Schwarz's (2011) research, they show that fishy smells can arouse suspicion in people. However, they additionally show a bi-directional link between fishy smells and suspicion. When someone is suspicious, they are also more likely to identify a fishy smell as a fishy smell. Further, the researchers walk you through five studies which conceptually build on top of each other to provide a very convincing story. Some other work showing such bidirectional links is research on the link between feeling cold and feeling lonely (Ijzerman & Semin, 2009; Zhong & Leonardelli, 2008).

Two excellent overviews of the metaphor-related research are provided by Isanski and West (2010) and Landau, Meier, and Keefer (2010). There are vast unexplored opportunities for work on grounded cognition—we have just scratched the surface. *Much additional work can be done on how perception affects cognition. But, even more, there exists a need for work on how perception can affect learning, how physical sensation is suggestible (to a-modal information), the extent to which language comprehension is bodily grounded, etc.* Next, we discuss opportunities for research.

Need for research

While a lot of work has been done on sensory marketing in the last two decades as we have seen, there is still need for additional research on many aspects of sensory marketing. Many



Fig. 7. Visual depiction and mental simulation.

of the links in Fig. 1 still remain to be explored; even for the link where some research has been done, more research is still needed and there is ample room for further research. *In terms of links where little research has been conducted so far, we have the interaction of senses, sensory imagery, sensory load, grounded emotion, a-modal information affecting perception, and emotion affecting perception;* there are many others. I briefly address each of the aforementioned links.

Interaction of senses

Some recent studies within consumer behavior have looked at cross-modal interactions, including the effects of smell and sound (Mattila & Wirtz, 2001), sound and vision (Russell, 2002), sound and smell (Spangenberg, Grohmann, & Sprott, 2005), sound and perceived taste (Yorkston & Menon, 2004), touch and taste (Krishna & Morrin, 2008), vision and taste (Hoegg & Alba, 2007), and smell and haptics (Krishna, Elder, & Caldara, 2010).

Non-diagnostic sensory input

Krishna and Morrin (2008) find that even though the haptic quality of the container (bottle/cup) that a drink is consumed from is non-diagnostic for judgment, it alters the taste perceptions of the water—the taste is perceived as higher quality when in a firm versus flimsy container. Interestingly, this is the case only for individuals with low Need-for-Touch (NFT)—they suggest that this is because the high NFTs have a better idea of when haptic input is diagnostic for the task.

Sensory dominance

Many papers in psychology and marketing have exhibited visual dominance over other senses. In like vein, Hoegg and Alba (2007) show that the color of orange juice can be more instrumental in driving taste perceptions than actual taste. Participants rated the perceived differences of three pairs of orange juice, with one of the pairs containing identical juice. The color of the orange juice was manipulated such that two of the four samples had different colored juice. This color difference led participants to perceive the two dissimilar samples as more similar than the two identical samples. That is, participants found the same color–but different taste pair to taste more similar than the different color–but same taste pair.

Sensory congruence

Some papers have examined the effect of congruence between two senses. In a retail setting, Mattila and Wirtz (2001) show that when the arousing qualities of scent and music are congruent, it improves approach behaviors. Similarly, Spangenberg et al. (2005), show that congruence between the scent and music in retail settings in the context of Christmas improves store evaluations. Krishna, Elder and Caldara (2010) examine the effect of the congruence between semantic associations of smell and touch. In two experiments, they show that smell can impact perceived touch. Specifically, they examine two properties of touch—texture and temperature. In study 1, when the smell is more feminine (vs. masculine), then a match with paper being more feminine (vs. masculine) enhances texture evaluations compared to a mismatch. In study 2, when the smell is more cold (vs. hot), then a match with a therapeutic gel-pack paper being for cooling (or heating) enhances its perceived effectiveness compared to a mismatch.

Sensory conflict

Kinney and Luria (1970) demonstrated that when submerged divers matched circular disks in size with remembered coins, objectively undersized disks were picked, even when the divers could feel the disks. Many other studies have also examined vision–touch discrepancy and found strong or complete dominance of vision over touch (e.g., Miller, 1972).

Much research has shown that taller containers appear to be more voluminous than shorter ones of equal volume, the effect being labeled the "centration hypothesis" (Piaget, 1968) or the "elongation effect" (Holmberg, 1975). This effect is visual in nature. However, what happens when one uses haptic input alone (holding the container while blindfolded) to judge the volume of these containers—which appears bigger? And, what happens when one can use both vision and haptics? Krishna (2006) shows that sensory modality will affect the extent (and even direction) of the elongation effect—with visual cues alone, and with bimodal "visual and haptic cues" (seeing and handling the objects) the elongation bias is obtained; however, with haptic cues alone (handling the objects blindfolded) and in bimodal judgments with visual load, a reversal of the elongation bias is obtained.

Little work in marketing has examined sensory-conflict even though many sensory conflicts exist within the consumption domain.

Sensory-overload

Managers seem to argue that products would be better off if made more sensory (e.g., Lindström, 2005). However, just as it is easy to reach information overload (e.g., Miller, 1956), it is also easy to reach sensory overload. Sensory overload can be overpowering so that any niceties of the experience are missed—think of a food where one (or two) ingredient stands out and pleases your palate versus one with dozens of indistinguishable ingredients. Research on sensory overload is lacking.

Sensory imagery

Within consumer behavior, Unnava et al. (1996) did some of the earliest looking at imagery that was other than visual. Arguing that imagery is cognitive and uses the same resources as perception, they show that learning of visual/auditory information is inhibited by reading/listening. While Unnava et al. (1996) focus on multi-sensory imagery and multi-sensory learning, Lwin, Morrin, and Krishna (2010) examine how one sense can affect the imagery of another. They show that smell can increase visual imagery—one can remember better a picture one saw if the object with the picture (for example, an ad with a picture) also had a smell; however, pictures do not increase smell imagery—having a picture in the ad or not does not increase recall for the smell.

Sensory load

Cognitive load refers to an impediment on information processing ability. Sensory load or sensory blocking refers to prevention of a particular sensory perception in a systematic manner; it can also be referred to as perceptual blocking or perceptual load. Much of the literature in grounded cognition concerns engaging a perceptual action—for instance, moving one's hands away from oneself or towards oneself (Cacioppo et al., 1993), smiling (Strack et al., 1988), nodding one's head up and down (Wells & Petty, 1980). However in some of these studies, subjects have also been prevented from engaging in certain perceptual actions; for instance, engaging the zygomaticus major muscles and preventing smiling (Strack et al., 1988), restricting the ability to gesture (Rauscher, Krauss, & Chen, 1996), and even Botox treatments, restricting the ability to furrow one's brow (Havas, Glenberg, Gutowski, Lucarelli, & Davidson, 2010).

In consumer behavior literature, Elder and Krishna (2012) show that holding a clamp in one's dominant hand prevents one from mentally simulating reaching out and picking up objects using the dominant hand. This affects consumers' purchase intention for products by impacting their mental interaction with the product.

Sensory load manipulations have also been used to show a "causal relationship" (rather than a correlational relationship) between the senses and a task, as we discuss below.

Grounded emotion

Some of the work we have discussed under "Perception affects cognition—grounded cognition" examines the effect of sensory perception on perceived emotion—e.g., Strack et al.'s (1988) study on funniness of cartoons. Similar work has also been done by other psychologists, such as Niedenthal, Winkielman, Mondillon, and Vermeulen (2009) who used EMG to assess embodied simulation of emotion, since EMG can distinguish the valence and intensity of an affective reaction (Cacioppo, Petty, Losch, & Kim, 1986), and certain muscles have been shown to become more active when experiencing specific emotions (e.g., corrugators supercilii or brow muscle for anger). Two studies mixed emotion-related (e.g., smile) and neutral words (e.g., pocket) and had subjects indicate whether the word was related to a specific emotion (while using EMG). The studies provide support for a grounded emotion perspective (emotion-relevant muscles come into play), both for concrete highly image-able emotional words (e.g., sun, vomit) and more abstract less image-able emotional words (e.g., happiness); these muscles are not used for perceptual tasks (judging whether the same words are written in upper or lower case). Blocking the emotion-relevant muscles (holding a pen laterally between the lips—sensory load—this should affect recognition of joy, sadness and disgust) decreases accuracy for recognition (whether the word was associated with an emotion) when the word was related to joy, sadness or disgust.

While much work in consumer behavior has focused on emotion, it has not yet started to explore its grounded nature.

A-modal information affecting perception

Some work looking at taste perception has examined how it can be influenced by a-modal information. We focus here on such a-modal information and its impact on sensory perception.

As discussed earlier under "Taste, Consumption and Satiety", brand names and descriptive product naming affect perceived taste (e.g., Allison & Uhl, 1964; Braun, 1999; Hoegg & Alba, 2007; Leclerc et al., 1994; Lee et al., 2006; Raghunathan et al., 2006; Wansink et al., 2000). While food advertising is typically used to spark an interest in the food or an intention to buy it, it is typically not usually for affecting taste perception. However, Elder and Krishna (2010) show that the verbal ad copy can impact taste perception. When the copy focuses on all senses (versus taste alone) perceived taste is enhanced—this occurs because taste is a composite of all senses, and the ad copy can affect consumers' thoughts about the food. Note that all this research is taste-related. Research so far has not examined how a-modal information affects, for instance, smell, haptic, auditory or visual perception. What about the effect of brand name, ingredients, ads on perceptions of smell and haptics? One can imagine that desirable brand names make a perfume smell better (inferential thinking, halo effect), but do they make the bottle more aesthetically appealing? Can a product description make something smell, feel, sound different? *There is enormous need for research exploring the effect of verbal information on sensory perception.*

Along the same lines, how does the physical presence of products differ from the presentation of verbal brand names in affecting preference and behavior? Linking sensory information processing with construal level theory (Trope & Liberman, 2010; Trope, Liberman, & Wakslak, 2007) Kardes, Cronley, and Kim (2006) demonstrated that consumer judgment processes differ markedly when products are physically present as opposed to being represented by a verbal brand name. The physical presence of products encourages concrete, low-level, cognitive representations, whereas the presence of a verbal brand name encourages abstract, high-level, cognitive representations. Peck and Shu (2009) show that mere touch, without any information content being provided, can result in an increase in perceived ownership. Differences between verbal representations, physical presentation and human–product interaction need to be delved into much more.

Final remarks

In this review article, I have tried to present an overview of research on sensory perception that I feel can spark additional research on the subject. I have also attempted to point out areas where it is easier to do more impactful research—areas where little research has been done, so that each additional paper has a greater chance of making a bigger difference and sparking new ideas. It should be fairly clear by now *that there is indeed tremendous need for research within the domain of sensory marketing*. For instance, besides all the relatively unexplored topics I have already mentioned, *we know very little about individual differences in the need for sensory perception or ability*. While a Need-for-Touch scale exists (thanks to Peck

& Childers, 2003a), we still do not have other sensory scales—e.g., a need-for-smell scale, need-to-speak (versus hear), sensory overload, etcetera.

There are also many concepts waiting to be discussed for the first time, for instance, how does one person's sensory reality relate to another's? Gilbert and Gill (2000) argue that people believe that their own senses provide an accurate representation of reality, but other people's senses are biased. Their naïve realism theory is also consistent with research on the bias blind spot (Pronin, 2009), so that for a wide variety of judgmental biases, most people believe that they themselves are objective and unbiased, whereas everyone else is biased. This concept has not been explored within the world of sensory marketing. Another such concept is that of sensory arousal (as opposed to imagery)—do different people get aroused by different senses? Do some people get aroused more easily than others? Is sensory overload the same as sensory arousal—I would argue not, but then that is another paper waiting to be written.

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