

HAPTICS AND ITS EFFECT ON CONSUMERS' INTENTIONS USING NEUROSCIENTIFIC METHODS: LITERATURE REVIEW

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Abstract

The haptic properties of a product have mostly been underestimated with most studies focusing on visual aspects of objects. Nonetheless, in the last years, it has been found that tactile stimuli are in some cases even more important than the visual ones. However, the traditional paper-based surveys cannot fully and objectively examine their effects on consumers. Therefore, neuroscientific methods, which overcome these obstacles, are becoming more used but there is still only a small number of studies focusing on the effect of haptics in marketing. Using the keywords haptics, tactile input, EEG, fMRI and tactile, seven relevant studies have been found and used in this literature review, out of which four have used EEG and three fMRI. Thus, the main objective of this paper is to review the research that has been already conducted and to identify the areas in which further research should be made and the neuroscientific methods which could be used.

Keywords: haptics, tactile, tactile input, electroencephalography (EEG), fMRI

INTRODUCTION

Our senses are crucial in experiencing and understanding the world we live in. Human cognition is based on information we gain through the sensory channels of sight, hearing, taste, touch and smell (Neisser, 1976). The traditional forms of media such as the Internet or television use the verbal and visual channel to deliver information to viewers. The human consumption, however, is a complicated multisensory process (Hirschman and Holbrook, 1982; Holbrook, 1982, 1983) and is not limited only to these two senses. In order to fully understand all the aspects of product evaluation we need to explore how it is influenced and shaped by all of the senses (Citrin *et al.*, 2003).

Sensory marketing is an emerging research field (Kampfer *et al.*, 2017) which is focused on just that, it is based on the concept that we are more

likely to memorize and then retrieve the memory when all the senses are involved (sight, hearing, smell, taste and touch) (Roopchund *et al.*, 2016). The importance and the role of different sensory modalities was examined by Schifferstein (2006), during this study 45 different products were used. Vision was determined to be the most important sense in evaluating a product and it was followed by touch, smell, hearing and taste (Workman, 2009).

The skin, the organ through which we experience touch sensations, is the largest body and sensory organ and the tactile sense (or the sense of touch) is the first sense to develop in infants (Gallace *et al.*, 2010; Atkinson and Braddick, 1982; Miodownik, 2005). From the moment we are born we use our hands to explore the world and acquire information about our surroundings (for example, Piaget 1952; Bushnell and Boudreau, 1991). Adults do this also, but considerably less. The theory is that experiences

gained through interacting physically with one's surroundings (such as haptic interaction) will later on subconsciously influence actions and opinions in life (Williams and Bargh, 2010). These early sensory experiences form a foundation which is then used for the development of knowledge which can be used at a later point in one's life (Mandler, 1992). Furthermore, the tactile sense is considered to be the most intimate one with the need for physical contact with the skin. This contact can be facilitated by different parts of our bodies; however, the hands play a vital role as an input to the touch perceptual system (Peck and Childers, 2003a) and this process specifically is being called "haptics" (Gibson, 1966).

The vision has been traditionally considered to be the most important sense in product evaluation (for example, Ernst and Banks, 2002; Warren and Rossano, 1991), although it has been known that all kinds of sensory information are being gathered by consumers in order to judge and evaluate a product (Jansson-Boyd, 2011). Vision of course plays an important role in this process, although touch can be as much important as the visual sense (Jansson-Boyd, 2011). Despite having this information, touch has scarcely been used as a communication tool, however, as a recent development, marketers are attempting to use tactile stimuli increasingly more. This review attempts to summarize the studies which have been conducted.

Effects of Haptics on Consumer

Brands can be differentiated from their competitors by the products' haptic properties and customers do often touch the products before making a final decision (Peck and Childers, 2003b). Therefore, if brands want to have a positive impact on a consumer's decision making, customer must be allowed to touch the products (Peck and Wiggins, 2006). As for the cases, in which the haptic properties of a product are important (e.g., a blanket or a jumper), customers prefer to shop for these products in an offline setting, rather than online (McCabe and Nowlis, 2003). For these products tactile input is essential for deciding. Furthermore, objects that are easily grasped are preferred by customers, e.g., a firm cup would provide a better drinking experience than an unstable one. Meaning that the consumer perception of a product can be influenced by its haptic properties (Krishna and Morrin, 2008).

The texture, hardness, temperature and weight of a product are properties that can be explored only through haptic manipulation. These four attributes were named "material properties" (Klatzky and Lederman, 1992, 1993; Klatzky *et al.*, 1993;) and people can obtain a detailed impression of a product and in some cases even more comprehensive information than through different sensory channels by simply touching an object (Peck and Childers, 2003a, 2003b). As a result, customers can be more confident and sure in their decision to purchase

(Citrin *et al.*, 2003), are more likely to impulsively shop (Peck and Childers, 2006) and are more willing to pay (WTP) (e.g., Peck and Shu, 2009; Peck, Barger and Webb, 2013). It has also been discovered that once a consumer's focus is on haptic properties of a product, it is difficult to shift their attention away and it is less likely that they will focus on a product by a competing brand (for example, Spence, Nicholls and Driver, 2001; Spence, Shore and Klein, 2001; Turatto *et al.*, 2004). However, it has been determined that some people are influenced by touch and haptic properties of products more than others (Peck and Childers, 2003a).

On the other hand, when consumers are deprived of touching the products, their decisions are also affected (Peck, 1999; Peck and Childers, 2003b). This is probably caused by touch being a crucial part of product expectations (Schifferstein and Spence, 2008) and these are at least partially formed by previous experiences (Jansson-Boyd and Marlow, 2007). Therefore, if a customer expects to be able to physically hold a product and this expectation is not met, it can lead to frustration, especially if a customer has a need for some sort of tactile information (Peck, 1999; Peck and Childers, 2003b). Such customers tend to have less confidence in their decisions, this is caused by the fact that they cannot use their tactile experiences (Peck, 1999). On the other hand, in environments where tactile input is not a possible option (such as when shopping online), only a verbal description of material properties of a product can compensate for a lack of touch (Peck and Childers, 2003b).

The information gained through tactile input can influence persuasion in different ways. Firstly, products possessing tactile attributes which can be determined only by touch (such as softness of a blanket) are more positively viewed and customers are more likely to purchase them when they are able to touch them (Grohmann, Spangenberg and Sprott, 2007; Peck and Childers, 2003a, 2003b). Furthermore, certain products with the material properties that can be determined only by touch, cannot be successfully sold online due to the inability to fully explore their material properties (Citrin *et al.*, 2003; McCabe and Nowlis, 2003).

Touch can be divided into two forms, one is instrumental, a consumer touches the product to ascertain certain product qualities or characteristics with a typical purchase goal. The other form is a hedonic touch, often with no product purchase goal, the goal is to enjoy the experience itself (Peck, 2009).

Need for Neuroimaging Studies

Haptic properties of a product can influence consumers' preferences and those can in turn affect purchasing intentions. That is why there is an apparent need for understanding how exactly haptic preference for products is formed (Oliver and Linda, 1981).

The research focused on this issue has been traditionally conducted via paper-based evaluation methods. This approach has, however, several downsides (Morin, 2011). Firstly, the results are environment dependent (i.e., dependent on the person asking the questions, the way the survey is conducted, etc.). Secondly, the said traditional survey is always conducted post-event (i.e., after particular haptic experience), so there is not an option to investigate the participants' responses in real time during the experience (Ariely and Berns, 2010). Considering that the human memory often exaggerates or is skewed (Loftus and Pickrell, 1995; Hyman and Pentland, 1996) even more so if more time has passed since the haptic experience, these kinds of surveys do not tend to be the most reliable (Morin, 2011). As a solution to these issues, more objective indirect evaluations with the use of neuroimaging methods have been emerging in the last years (e.g., EEG or fMRI) (Wang and Minor, 2008).

MATERIALS AND METHODS

This literature review of neuroimaging studies is based on articles concerning the effect of haptic properties on purchase intentions and human brain in general. The studies used for this article were collected via metasearch engine EBSCO Discovery Service containing documents available within Mendel University (and also Masaryk University). Initially 54 articles were found using the keywords: haptics, tactile, touch, consumer behavior, decision making, EEG, fMRI. The original articles were then studied and the amount was then reduced to 16 based on their contents. Eventually, after detailed

analysis, only 7 of them were used for this review. However other studies are also quoted in other parts of this study because of their general nature.

Literature Review of Neuroimaging Studies

The field of marketing which uses neuroscientific methods to analyse and understand human behaviour is called neuromarketing. The specific methods applied in neuromarketing research use powerful brain imaging tools gathering information on brain activity (Vecchiato *et al.*, 2011).

There are many studies focused on the tactile properties of objects and their effect on human brain. However, only a small amount of these studies is dealing with haptics in context of marketing. A vast majority of studies are designed to explore the brain areas which deal with haptics in general or the difference between pleasant touch, neutral touch and painful touch.

This literature review focuses primarily on the marketing-oriented experiments, i.e., how material properties of a product can influence product evaluation or purchase intention. As that may be, the non-marketing-oriented studies are mentioned also, as they may obtain important findings which are needed in order to fully understand how haptics can be used in marketing.

The studies included in this literature review use primarily functional Magnetic Resonance Imaging (fMRI) and electroencephalogram (EEG). The information gathered with the use of these neuroscientific methods are generally more objective and reliable than those collected via traditional paper-based surveys, largely because

I: *Comprehensive summary of haptic research on the usage of neuroimaging tools*

Author	Country	Method	Statistic method	Sample size	Key findings
Francis <i>et al.</i> (1999)	United Kingdom	fMRI	Gaussian random field theory	4	Different aspects of touch are represented in different brain regions
Rolls <i>et al.</i> (2003)	United Kingdom	fMRI	ANOVA	7 (originally 9, but 2 were discarded)	Different aspects of touch are represented in different brain regions
Deshpande <i>et al.</i> (2008)	USA	fMRI	Multivariate analysis of Granger causality	6	Cooperation of different brain regions during haptic perception
Park <i>et al.</i> (2015)	South Korea	EEG	Pearson's linear correlation	unknown	Correlation of haptic satisfaction with EEG activity
Park <i>et al.</i> (2018)	United Arab Emirates South Korea	EEG	ANOVA Linear regression Random permutation test Pearson's linear correlation Wilcoxon rank sum test	18	Development of a novel EEG based haptic measurement technique Haptic preference correlates with gamma band oscillations
Modica <i>et al.</i> (2018)	Italy China	EEG	ANOVA Paired t-test Fisher's exact test	32	Visual and tactile exploration correlates with cerebral approach
Valenza <i>et al.</i> (2018)	Italy	EEG	Spearman's correlation Wilcoxon rank sum test	32	Unpleasant haptic stimulus leads to decreased brain activity

Source: authors' results

these surveys are conducted post-event and human memory often distorts reality (Ariely and Berns, 2010). Furthermore, human emotions and intentions are difficult to explain to other persons, resulting in these methods becoming more frequent in marketing research (Vecchiato *et al.*, 2011).

Tab. I summarises the studies used in this review, their important characteristics and key findings. Only studies using neuroscientific methods such as EEG and fMRI were included, as this review focuses mainly on the use of these neuroscientific methods in investigating haptics, its representation in the brain and the use of haptic properties in marketing. The table includes information on the authors; the country, where the studies originated; the type of scientific method the study used (EEG or fMRI) and the statistical methods used. Furthermore, the number of participants and key findings are also included.

Studies Using EEG

Most of the selected studies used EEG as a method of recording neural responses. The main advantage of this non invasive method lies in the possibility to record neural responses while the participants are interacting with the product, therefore there is no delay between the experience itself and the response recording as it is with traditional surveys (Park *et al.*, 2018).

The material (or haptic) properties of a product such as texture, softness, temperature and weight are often as important as the visual profile of a product. If consumers develop strong haptic preference toward a product, the likelihood of the purchase is higher (Park *et al.*, 2018). Therefore, understanding the overall process of receiving haptic input and its effect on consumers is crucial in order to fully explore the possibilities in marketing.

Two of the studies included investigated correlation between haptic properties of a product and consumer preference and satisfaction (Park *et al.*, 2018, 2015). Both focused on the haptic interface of a dial knob of a commercial washing machine. During the manipulation of the knob, EEG signals were recorded. The results of these two studies revealed significant correlation between the level of haptic preferences and the gamma oscillations. The higher the haptic preference was, the stronger were the gamma oscillations. Both studies also revealed that in the early period of the

task (turning the knob) was the correlation highest. This means that the haptic properties of a product influence our preferences most in the beginning of the interaction (Park *et al.*, 2018, 2015).

The remaining two studies focused on different kinds of haptic interaction. The first one examined how is evaluation of a food product influenced by its sensory properties (visual and tactile) (Modica *et al.*, 2018). The results showed significantly higher EEG activity during visual and tactile exploration phases. This study also focused on the difference between the comfort food and daily food groups, major and private brands and foreign and local brands. Higher cognitive and emotional activity was recorded when participants were freely handling and touching comfort and foreign foods (Modica *et al.*, 2018).

The last study using EEG examined oscillations during caress-like touches. Participants were examined when being caressed on their forearms. A correlation was discovered between the oscillations and caressing force. The more unpleasant the stimulus on the skin is, the more the brain activity decreases all over the head (Valenza *et al.*, 2018).

Studies Using fMRI

The studies employing fMRI as a scientific method were focused more on different brain regions involved in tactile interactions with different products. The first two studies examined what regions of brain are activated by pleasant and painful touch (Rolls *et al.*, 2003). There have been many studies focusing on representation of pain in the human brain, whereas pleasant touch has not been investigated often. These two experiments show that different kinds of touch (a pleasant, neutral and a painful one) is represented in different brain regions. Furthermore, the aspect causing these differences is not the intensity, however, it is the pleasantness of the touch (Francis *et al.*, 1999). These finding are important in understanding how human emotions work and how they can be affected (Francis *et al.*, 1999).

The third fMRI study focused on perceived separation of brain regions. During haptic interaction with products, fMRI data were recorded, and areas generally considered to work separately were found to cooperate with different brain regions in a process called "effective connectivity" (Deshpande *et al.*, 2008).

CONCLUSION

This review's aim was to review the research that has been made on the topic of neuroscientific methods used in examination of tactile input and its effect on the consumers' behavior. The review shows that research into haptics in general and the use of haptics in marketing is a valuable and perhaps underestimated field. In investigating interaction with products, the focus has mostly been on the visual properties of objects. In the last years however, the focus has been on haptic properties increasingly more as it has been found that the haptic properties of a product are in some cases even more important than the visual aspects. However, the research of the effect of tactile stimuli

on consumers via traditional paper-based surveys have been proven to be difficult and that is why neuroscientific methods are used increasingly more. The importance of haptics in marketing has, however, not been fully examined yet and there is only a small amount of experiments using neuroscientific methods, many of them have been included in this literature review. The reasons as to why there are not more studies using these methods are multiple; the purchase price of the machines needed is much higher than with traditional paper-based surveys and the logistics of such research are also more complicated (especially with fMRI). However, there are other neuroscientific methods, which are perhaps more accessible with lower purchase costs (e.g. Functional near infrared spectroscopy or Magnetoencephalography). Also, the Facial Expression Analysis could be utilized in examination of emotion expressed while manipulating and object). To summarize, there are many methods with lower price point which can be utilized in this research field. Another aim of this article was to highlight the areas with potential for further research and these methods could be used for fulfilling this potential.

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