

Multisensory Consumer-Computer Interaction

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Introduction

Given the recent advances in digital sensory-enabling technologies, it would seem likely that the digital environments will likely engage more of the senses and become more interconnected with the real world in the years to come (e.g., Internet of Things). Indeed, over the past decade or so, there has been much development of digital sensory-enabling technologies in HCI (Human-Computer Interaction) (Velasco & Obrist, 2020). These technologies include those already commercialized such as virtual reality (VR) and augmented reality (AR), whose use is still at early stages in the world of marketing (e.g., Flavian, Ibanes-Sanches, & Orus, 2019; Hopf et al., 2020). Importantly, they also include many other new technologies, which in most cases are still prototypes (Cornelio, Velasco, & Obrist, in press; Kim & Forsythe, 2008). These technological developments can revolutionize the field of digital sensory marketing (Petit, Velasco, & Spence, 2019) and, in turn, offer commercialization opportunities for the relevant technologies (Velasco, Obrist, Petit, & Spence, 2018).

Research on multisensory consumer-computer interaction

Importantly, digital environments can frustrate consumers by the limited sensory inputs that they provide (Petit, Javornik, & Velasco, in press). For example, in online environments consumers are currently not able to feel the texture of a sweater, or to smell the hot bread and cheese on the pizza before ordering online. However, it is a fact that consumers' everyday offline experiences are multisensory in nature (Davis, Kojman, & Ward, 2003; Krishna, 2012; Motoki, Saito, Nouchi, Kawashima, & Sugiura, 2019; Spence & Gallace, 2011; Sunaga, Park, & Spence, 2016). For this reason, online, offline, and mixed reality (which combines both online and offline) environments may be extended beyond the visual and auditory modalities. For instance, allowing people to touch a product with high haptic quality (e.g., a jacket) has been shown to make them more confident and less frustrated in their product evaluations (Peck & Childers, 2003; see also Sheldon & Arens, 1932). On the other hand, the absence of haptic contact online might be expected to reduce the consumer's confidence (Spence & Gallace, 2011; something which might be category-dependent, just think of books and clothes, for example). Despite this, only a relatively small amount of research has been carried out to discuss the ways in which it might be possible to improve the multisensory online experience of consumers beyond the audiovisual domain (Petit, Cheok, Spence, Velasco, & Karunanayaka, 2015). Whilst marketers have already been thinking about research on consumer-computer

interaction (Pantano & Gandini, 2017), we believe it is now time to consider a multisensory perspective on this interaction to develop more natural digital consumer experiences.

Today, multisensory technologies that have been developed by researchers in HCI might offer the opportunity for marketers to create a hyper-real world, providing unexpected, and even extraordinary experiences to their customers. Researchers in HCI are designing new technologies to facilitate such multisensory interactive experiences to the users. For example, Sakurai et al. (2013) developed an AR system to modify the size of a projected image around the food (see Figure 1). This system targets the portion size effect, whereby participants perceive a portion of food as larger when the dish is smaller and as smaller when it is presented on a larger plate (cf. Petit, Velasco, & Spence, 2018). More recently, Suzuki et al. (2021) used projection mapping to change the texture and apparent temperature of foods and showed that it can influence consumers' willingness to order a given food. Meanwhile, Ueda, Spence, and Okajima (2020) demonstrated that manipulating the luminance distribution of foods exerted a significant effect on taste in a series of laboratory studies. These kinds of technology might well be interesting as far as nudging consumers toward healthy food behaviour is concerned (Spence, Okajima, Cheok, Petit, & Michel, 2016; Wang, Meyer, Waters, & Zendle, 2020).

Marketers might also be interested in those technologies that are not limited to the visual modality. Researchers in HCI have also worked on the possibility of communicating haptic, olfactory, and even gustatory information digitally (Obrist, Seah, & Subramanian, 2013; Ranasinghe et al., 2017; though see Spence, Ranasinghe, Velasco, & Obrist, 2017). For example, Ablart, Velasco, and Obrist (2017) integrated touchless feedback (i.e. mid-air haptic stimulation) into short movie experiences (i.e., one-minute movie format) to enhance their experience (see also Velasco, Tu, & Obrist, 2018). Such a system might be integrated into a VR environment to facilitate the evaluation of product with high haptic properties during online shopping (Ho, Jones, King, Murray, & Spence, 2013) and/or communicate emotion to improve the closeness and exchanges between people over the Internet (Obrist, Subramanian, Gatti, Long, & Carter, 2015). However, if HCI researchers are beginning to think about the integration of multisensory devices into multimedia systems, the current focus tends to be very much on the technological challenge (Covaci, Zou, Tal, Muntean, & Ghinea, 2018) more than on the consumer experience. By working with researchers in marketing, they could develop technologies that facilitate consumer product and service experience and acceptance. This, of course, comes with certain challenges.

In parallel, although marketers do not know all the available existing multisensory technologies, many of them have started to consider how new interactive technologies might affect consumer experiences. For example, Choi and Taylor (2014) highlighted that 3D advertising for a watch can create more vivid mental images of product interaction with a positive effect on attitude toward the brand, purchase intentions, and intention to revisit the website as compared to the 2D advertising. However, using 3D advertising for a jacket, a product with high haptic qualities, did not facilitate its evaluation, for people with a high Need for Touch (NFT, Peck & Childers, 2003). More recently, Cano, Perry, Ashman, and Waite (2017) demonstrated that pinching and scrunching a section of a clothing fabric with the fingertips on a tablet increase user engagement for clothes, regardless of their NFT. These studies therefore suggest that by improving the communication of tactile/haptic inputs during online shopping experience, product evaluation and decision making might be facilitated.

Multisensory consumer-computer interaction in the marketing industry

Companies are also starting to integrate multisensory technologies in their marketing campaigns. For example, in 2012 Dunkin Donuts developed a campaign that capitalized on the senses of vision, smell, and audition, and integrated the latter two with the latest in technology. During “Flavor radio” campaign based in Seoul, South Korea, coffee smell dispensers that integrated audio sensors were placed on public buses and were activated whenever the jingle of Dunkin Donuts was played on the radio (Garber, 2012). Another example comes from Finnair. Based on the idea that airplane cabin noise can influence taste perception (Spence, 2017), they developed a series of soundscapes for the dishes served in their long-haul flights to enhance the diner’s experience. This mirroring an earlier campaign by British Airways who introduced a sonic seasoning menu (Victor, 2014). Recently, Finnair also created a sound-based food-experience-enhancing app that runs on WeChat (a Chinese messaging app), which aims to allow customers to take pictures of their food and obtain soundscape that will help to enhance their experience (see <https://www.finnair.com/cn/gb/stevenliu/en> to find out more about their ‘Hear the taste’ campaign). Another example comes from QReal, an AR firm. Based on AR, the QReal app allowed the users to visualize in 3D, before them, the dishes they would like to eat at the restaurant or to order online (<https://www.qreal.io/use-cases/augmented-reality-food-use-cases>). Here, it is worth mentioning that marketing not only targets for profit exchange relationships but also not for profit. In that sense, technologies such as VR (in some cases also involving inputs that go beyond audiovisual cues) are now being used to reach donors, for

example, to increase their empathy with a given cause (e.g., Samit, 2017; see also Amnesty International's virtual reality-themed #360Syria project, <https://www.amnesty.org.uk/press-releases/amnestys-virtual-reality-themed-360syria-project-wins-prestigious-third-sector-award>).

Based on these various examples, it would appear that there is much innovation in multisensory technology underway. Marketers increasingly understand and show interest in integrating them into the sensorial experience of the consumer, whether it be online, in the physical world, or in mixed reality. However, examples of research and campaigns in marketing based on multisensory technology are still very limited (see Spence, 2019, for a review). In addition, the technologies developed by researchers working in HCI are often not adapted for use by the consumer. Therefore, the challenge for researchers working in HCI, psychology, and marketing is to work together to identify the digital sensorial needs of consumers, to find ways to fill them, by developing adapted technologies, and by considering the key variables of the consumer experience (flow, control, enjoyment, Need for Touch) on which these technologies might act (e.g., Petit, Velasco, & Spence, 2019). Looking into the future, the way in which the different senses are stimulated during consumer experiences will likely be transformed by the integration of multisensory technologies. Therefore, one can imagine that similar to advertising on social networks and on retailers' websites, multisensory inputs might be personalized (the colour, the smell, the thermal sensation, etc.) and controlled with a computer for different kinds of customer journeys (Lemon & Verhoef, 2016), which, in turn, also opens up an ethical issues that needs to be addressed (Velasco & Obrist, 2020).

Special issue on multisensory consumer-computer interaction

In this Special Issue, we brought together an international and interdisciplinary group of researchers working in HCI, psychology, and marketing to collaborate and explore the opportunities around Multisensory Consumer-Computer Interaction. One of the key aims in proposing this special issue was to help bridge the gap between researchers and practitioners in these fields. Marketing, for example, may benefit from the different multisensory technologies that are developed in HCI to deliver comprehensive multisensory consumer experiences. HCI, in turn, may benefit from fine-tuning experiences and their understanding, but also from the potential uses that their technologies have. Researchers and developers may be able to rethink the design of digital interfaces by considering the (multi-) sensory needs, and wants, of consumer's as well as ways of delivering new sensory experiences that satisfy them. A key

issue is that very little research, though currently growing, has been conducted between these disciplines in the context of multisensory experience design (Velasco & Obrist, 2020). Careful reflection is needed to provide both users and consumers with engaging, immersive, informative, enjoyable, and ultimately comprehensive multisensory experiences in the future.

In total, we received 18 submissions, from which **six** were eventually accepted for publication. The **accepted** submissions address questions including: How multisensory technologies and sensory inputs affect the consumer's perception, judgment, and behaviour in digital environments? How to bridge the gap between technology development and consumer acceptance? What can multisensory consumer experiences be designed for? What ethical questions does the creation of a multisensory digital environment raise? How to find a good balance between financial profit and responsible design (sensory marketing, nudging)? How realistic should the digital multisensory experience be? How can multisensory design and technology be used to nudge consumers toward healthier behaviours? What are the limitations and scope associated with Multisensory Consumer-Computer Interaction? Below, we present a summary of the submissions.

Reinoso-Carvalho and colleagues assessed the role of 'sonic seasoning' in multisensory tasting experiences. Specifically, the effects of emotional and crossmodally-corresponding music were compared. In the cross-cultural study, Latin-American (Colombian) and Asian (Japanese) participants tasted chocolates while listening to positive music, negative music, 'soft/smooth' music, or 'hard/rough' music. The crossmodal effects of the emotional music were found to be more prominent than those of 'sonic seasoning'. Across cultures, the chocolate was liked more and rated as sweeter while listening to positive music as compared to negative music. As such, these latest results from the growing literature on sonic seasoning in multisensory marketing suggest that music should primarily be chosen to elicit positive emotions, and thereafter to optimize sonic seasoning.

According to regulatory focus theory (Higgins, 1997), there are two types of self-regulations during people's goal pursuit; prevention focus and promotion focus. Individuals with a prevention focus have an orientation toward the absence of negative outcomes while those with a promotion focus have an orientation toward positive outcomes. Sunaga and colleagues presented a study in which they demonstrated that the timbre of the piano fits the listeners' prevention focus, when compared to the timbre of the violin/flute. Given the familiarity of piano timbre to individuals and the feelings of security that it induces it links more strongly with

prevention orientation. In particular, when consumers were exposed to a piano (vs. violin/flute) in an advertisement, consumers assessed the ad and the product it presented more positively when they were prevention (vs. promotion) focused or when the ad message was framed in a preventive (vs. promotional) way.

Flavián et al. indicated that semantic congruency can play an important role in determining the efficacy of the scents in virtual reality. These researchers found that congruent/pleasant ambient scent influenced people's affective and behavioural reactions. In their VR simulation, the smell of coffee was used as the congruent pleasant smell for the city of Venice, while the smell of fresh grass was used to match the Cliffs of Moher (in Ireland), with both scents being rated as equally pleasant). Elsewhere, Hopf et al. demonstrated that the addition of both olfactory (the typical smell of the ocean and the rainforest) and tactile inputs (wind, rain, etc.) to the destination-based VR experience resulted in a significant increase in the user's intention to recommend the destination to others (Hopf et al., 2020).

Using VR in the context of retail, Cowan and colleagues investigated when and how digital retail environments (i.e., 360-VR) influence brand perceptions. 360-VR (vs. low presence media) elicits more favourable evaluations in online retail environments. In contrast, 360-VR (vs. low presence media) might lead to less favourable evaluations of in-store retail environments. The findings depend on product category knowledge, mental imagery, and haptic input. Specifically, consumers with high product category knowledge decrease their brand attitudes in online retail environments presented in 360-VR due to dampened mental imagery. However, these negative effects can be attenuated with haptic imagery instructions presented in 360-VR. Haptic imagery might override the deficiencies of low mental imagery in online retail environments presented in 360-VR, even when consumers have high product category knowledge.

Capitalizing on another mixed reality technology, Javornik and colleagues studied augmented reality (AR) mirrors, which depict augmented looks that are virtually modifying one's face in the mirror. Although AR mirrors are becoming a popular marketing tool that allow virtual try-on of products, little is known about how consumers respond to this form of digital augmentation. Javornik et al. investigated how such sensory experiences affect consumer perception of the self and identified key moderators. Specifically, they demonstrated that viewing oneself in an AR mirror (as opposed to a regular mirror) widened the gap between actual and ideal attractiveness for high appearance self-esteem individuals and that this occurred

when they were explicitly asked to focus on their appearance. Furthermore, these researchers unveiled that ideal self-congruence mediated this process. Their additional survey-based study showed downstream effects of ideal self-congruence and ideal-actual gap on product choice and psychological well-being.

Finally, Manshada and Brannon demonstrated how the provision of vibrotactile feedback might be used to reduce overspending when paying via a mobile device. Indeed, providing tactile feedback and haptic interaction has recently been shown to convey a number of intriguing effects, such as enhancing the sense of ownership of those things that we simply touch (see Gallace & Spence, 2014). In the present study, the research shows that provision of vibrotactile feedback can provide a useful cue to help control one's spending (at least in the laboratory). Such results hint at the fact that the senses are not interchangeable in terms of the kind of feedback they provide. Certain modalities of feedback may afford particular behaviours, and the efficient design of future interfaces will likely build on our growing awareness of what each sense is 'good for'.

Conclusions

In conclusion, this special issue highlights the richness of current research at the interface of human-computer interaction, sensory marketing, and consumer behaviour. It demonstrates the interest of researchers in enhancing consumer's sensory experiences in online environments. The solutions are diverse and stimulate different senses: Sight through the AR Mirror or 360-VR, touch through haptic interfaces and vibrotactile feedback, hearing with sonic seasoning, and even smell with ambient scent in VR environment. These solutions can impact all sensory touch points of the customer journey, with different effects on consumer behaviour. For example, during the awareness step, by improving attitude towards the brand, during product selection, by showing the effect of an AR mirror on self-perception, and during purchase by avoiding overspending when paying via mobile device. Some research has also shown effects of sensory-enabling technologies on the consumption experience and an individual's intention to recommend an experience to others.

This special issue thus highlights the many possible applications of sensory-enabling technologies in multisensory consumer-computer interaction research and paves the way for new studies by identifying certain variables (e.g., emotion, crossmodal correspondences, knowledge, self-congruence) that are likely to affect the impact of these technologies on consumer behaviour. It is our hope the papers in this special issue would make researchers in

marketing, psychology, human computer-interaction and connected disciplines want to develop new collaborative projects in this still relatively unexplored, innovative and promising field.

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