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The Internet of Things in upscale hotels: Its impact on guests' sensory experiences and behavior

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Abstract

Purpose

This research bridges the gap between sensory marketing and the use of the Internet of Things (IoT) in upscale hotels. We investigated how stimulating guests' senses through IoT devices influenced their emotions, affective experiences, eudaimonism (well-being), and, ultimately, guest behavior. We examined potential moderating effects of gender.

Design/methodology/approach

Research conducted comprised an exploratory study, which consisted of interviews with hotel managers (Study 1) and an online confirmatory survey (n= 357) among hotel guests (Study 2).

Findings

The results showed that while the senses of smell, hearing, and sight had an impact on guests' emotions, the senses of touch, hearing, and sight impacted guests' affective experiences. The senses of smell and taste influenced guests' eudaimonism. The sense of smell had a greater effect on eudaimonism and behavioral intentions among women compared to men.

Originality

IoT can be applied in creating customized multi-sensory hotel experiences. For example, hotels may offer unique and diverse ambiances in their rooms and suites to improve guest experiences.

Research limitations/implications

This study concentrated on upscale hotels located in Europe. Further research may explore the generalizability of the findings (e.g., in other cultures, comparison between high-end and low-end hotels).

Practical implications

Managers of upscale hotels should apply congruent sensory stimuli from all the five senses. Stimuli may be customized ('SoCoIoT' marketing). IoT in hotels may be useful in the aftermath of the COVID pandemic since voice commands help guests avoid touching surfaces.

Keywords: IoT; hospitality industry; sensory marketing; emotional value; affective experience; eudaimonism

Introduction

The international hotel industry has been revolutionized due to the development and adoption of new technologies and the influence of Information Communication Technology (ICT). For example, the growing guest demand for online interactions, through digital touchpoints, has considerably changed guest experiences (Nadkarni *et al.*, 2020). State-of-the-art and high-tech services have become an important prerequisite for customer satisfaction and have been found to increase the performance of hotels (Melián-González and Bulchand-Gidumal, 2016). This trend will considerably rise in importance in the future (Gonzalez *et al.*, 2019; Sigala, 2020).

Recently, the Internet of Things (IoT) and smart devices have been rapidly gaining ground, e.g., in the healthcare industry, smart cities, and smart homes (for a review see Stankov *et al.*, 2019). The global smart home market is expected to attain revenues of more than 141 billion U.S. dollars by 2023 (Statista, 2020). IoT is shaping marketing actions by enabling firms to acquire a holistic understanding of their customers' needs and behaviors across platforms and devices, as well as across different products and services (Gupta *et al.*, 2020). The real stake for businesses in the service industry is to anticipate tomorrow's new trends and to incorporate indispensable smart objects in their offerings. Their goal is to both prepare for future interactions consumers may have with IoT and to gain a competitive edge.

Ives *et al.* (2016, p. 281) argued that “the IoT is firmly rooted in tangible objects with their ‘mind’ in the cloud.” Hence, IoT enables real time object-to-object and object-to-actor interactions. The challenge for marketers is not only to comprehend the functioning of individual devices or their uses, but also to be aware of the experiences which can emerge from customer interactions with IoT devices (Hoffman and Novak, 2017). Technology plays a critical role in providing memorable customer experiences. For example, gamification mechanics (Xu *et al.*, 2017) may lead to enhanced customer engagement (Gupta *et al.*, 2020). Radde (2017, p. 29) defined the digital guest experience as “the personal perception and the

interaction with the digital service provided which a guest experiences while staying in the hotel,” i.e., referring to any direct or indirect digital touchpoint guests are exposed to during their hotel stays.

Digitally-supported experiences may be linked to the same sensory modalities of vision, hearing, olfaction, touch, and gustation that have been shown to be important in the design of physical retail or hospitality operations. The strategic creation of multi-sensory experiences in retail environments (atmospherics) and their impact on consumer behavior was initially explored by Kotler (1973). Expanding on the term “atmospherics”, Bitner (1992) developed the concept of “servicescape”, which described the impact the built environment may exert on consumers in service organizations. Sensory marketing of retail environments took on considerable momentum at the beginning of the new millennium (Spence *et al.*, 2014).

According to Obrist *et al.* (2017), there is still need for research to comprehend what multisensory experiences IoT, and, more generally, Human-Computer Interaction (HCI), can generate. IoT enables guests to experience their stay in a hotel in unique ways using a variety of stimuli (Buhalis and Leung, 2018). In our study, we sought to bridge the gap between traditional sensory marketing and the use of new digital technologies in the hotel industry. Firstly, we investigated how IoT devices in upscale hotels draw upon the five senses to impact guest emotions, affective experience, eudaimonism (well-being), and, ultimately, guest behavior. Secondly, we examined the role of gender: how the effects of IoT-driven sensory stimuli on emotions, affective experience, and eudaimonism varied between gender groups and how gender moderated the effects of emotions, affective experience, and eudaimonism on behavioral intentions. Our results should help managers of upscale hotels in their pursuit of multi-sensory marketing strategies for their hotels.

We chose to study upscale hotels since these are more likely to possess the necessary budgets for integrating IoT devices in their hotels. The likelihood of adopting IoT devices is

heightened in the case of dominant global upscale hotel chains. According to Pantano and Vannucci (2019), larger retail store companies invested more in digital technologies than did their smaller counterparts.

Our article is organized as follows. First, we provide an overview of the potential use of ICT, and, in particular, IoT, in the hotel industry. Then we point out the logical connections between sensory marketing and HCI, i.e., Sensory-Enabling Technologies (SETs). After that, we introduce our research model and hypotheses and present the findings of our Study 1 (exploratory) and Study 2 (confirmatory). Subsequently, we discuss our results and clarify theoretical and managerial implications. Finally, we outline the limitations of our paper and give directions for future research. Refer to Figure 1 for our procedure.

Figure 1 illustrates our rationale and research design.

Insert Figure 1 about here

The Use of Information Communication Technology (ICT) in Hotels

One can differentiate between two types of ICT used in hotels: first, support-centered technologies, which have a back-stage role and ensure the efficiency of hotel processes, e.g., property management systems, and, second, customer-centered technologies, which the customer encounters as part of the service experience, e.g., in-room entertainment (Murphy and Rottet, 2009). Concerning the latter, one heavily researched area is the adoption of ICT in information search (per Law *et al.*, 2020). Table 1 gives an overview of additional studies on ICT and customer experiences. For example, Jeong and Shin (2020) examined the relationship between smart tourism destinations and tourists' overall experience and revisit intentions.

One of the newer ICT applications is the Internet of Things (IoT), which has revolutionized and reengineered tourism and hospitality industry services by incorporating connected devices and platforms into the hospitality product (Hoffman and Novak, 2017; Porter and Heppelmann,

2014). IoT devices have been utilized in the hotel industry to create multi-sensory experiences and influence guest emotions and outcomes (Lemon and Verhoef, 2016).

Pieroni *et al.* (2015, p. 2) developed the idea of the Affective Internet of Things (AIoT) where “smart devices are empowered with artificial ‘feeling’ and personality; while also able to share their emotion within a networked domain.” This new paradigm assumes that interconnected smart devices allow emotional object-to-object and object-to-human exchanges. An example would be beacon technology which recognizes consumer activity in networked hotel spaces and registers consumer responses, e.g., consumers who have pursued promotional offers (special spa treatments or restaurant meals) sent in the form of push messages to guests as they passed through the lobby. Moreover, the hotel manager’s connected smartphone app may summarize the overall affective state of the hotel and signal the need to take action in order to increase the well-being of the hotel.

IoT can match services to mood states of guests as well. Smart wearables that can check a guest’s body signs may be connected to a concierge tablet in the hotel room. A high pulse rate of the guest is transmitted via the wearable, and, consequently, the concierge tablet would suggest a list of songs to help relax the guest. Wearable and environmental IoT sensors can monitor guests’ emotional states and promote the use of personalized service strategies (Grewal *et al.*, 2020).

Insert Table 1 about here

Experiential Offerings in Hotels: Sensory-Enabling Technologies (SETs)

The creation of multi-sensory experiences in “servicescapes” has been the foundation of “sensory marketing” (Hultén, 2015; Krishna, 2013). Krishna (2013, p. 5) defined sensory marketing as “marketing that engages the consumers’ senses and affects their perception, judgment, and behavior.” Lee *et al.* (2019) confirmed both the general importance of

multisensory experiences in hotels and their moderating role in relations among customers' cognitive and affective evaluations and customer satisfaction. Lo (2007) distinguished between three levels of hotel services: actual, augmented, and experiential ones. She claimed that there are interdependencies between service level, the design focus of hotels, and resultant guest emotions. On the first level, the design of actual services focuses on functionalities. On the second level, the design of augmented services provides added value by exceeding guest expectations, owing to the provision of both functional and sensorial benefits for the guest.

On the third level, the design of experiential services requires an optimal mix of functional, sensorial, and meaning-oriented (theme-based) offerings (tangible elements and intangible processes). Foster and McLelland (2015) confirmed that themed servicescapes were more effective in generating shopping enjoyment, positive brand attitudes, and brand loyalty, compared to similar non-themed servicescapes. In general, the higher the level of the offering, the higher the influence on guest perceptions and emotions, positing a critical role for IoT-supported multisensory services.

The connection between sensory marketing and HCI has been furthered through the development of SETs, which facilitate the presentation of augmented sensory stimuli to hotel guests and, ideally, should advance guest exposure to multisensory experiences (Obrist *et al.*, 2017). SETs include devices which can be found nearly ubiquitously, like smartphones and touch screens, but also new technologies not yet widely adopted, e.g., virtual reality, augmented reality, and even digital interfaces generating taste and smell stimuli (see for a review Petit *et al.*, 2019). For instance, hotels may provide virtual reality headsets to allow guests to virtually visit the hotel golf course. The primarily visual and tactile experiences produced by the headset may be enhanced with olfactory, thermal, auditory, and wind stimuli to simulate real-world conditions (Ranasinghe *et al.*, 2018). Upscale hotels are logical settings for the creation of SET-enabled guest experiences using IoT devices.

Theoretical Framework and Hypotheses

Sensory-driven experiences

Research has conceptualized the hotel guest experience as a mix of stimulated senses that energizes arousal of their affective responses and cognition (Kim and Perdue, 2013). Kim and Perdue (2013) found that sensory attributes such as music and lighting may be combined to create atmospherics (ambience) that greatly influence customer evaluations and hotel choice. Customers usually have a holistic impression of the environment before paying attention to specific details. This principle refers to ‘Gestalt psychology’ (Alderson, 1952; Hultén, 2015). Due to customers’ holistic perception of servicescapes, sensory perceptions across the multiple senses are required to be congruent to ensure customers’ positive evaluations of the environment (Helmefalk and Hultén, 2017; Spence *et al.*, 2014). Lin (2010) showed that hotel guests’ affective responses depended on the level of congruence between the sensory attributes of color and music in specific environmental settings, such as the hotel bar and guest room.

Hence, in our study, guest experiences in upscale hotels are defined as emotional and affective responses resulting from the stimulation of the five senses through IoT devices. In our study, the measure of emotional value reflects enjoyment, playfulness, and pleasure of staying in upscale hotels equipped with IoT devices. The affective experience towards hotels equipped with IoT devices encompasses emotional and hedonic feelings, according to Hoffman and Novak (2017).

Thus, we suggest the following hypotheses:

H1. (a) Touch, (b) smell, (c) hearing, (d) sight, and (e) taste stimulated by IoT devices in hotels will positively influence emotional value.

H2. (a) Touch, (b) smell, (c) hearing, (d) sight, and (e) taste stimulated by IoT devices in hotels will positively influence affective experience.

Eudaimonic experiences

Ryan and Deci (2001) differentiated between hedonism and eudaimonism, with both referring to an individual's perceived well-being. Hedonism is related to happiness, satisfaction in life, and positive mood, while eudaimonism refers to people's tendencies to engage in activities that help them realize their potentials and find meaning in life. While hedonic approaches see happiness (hedonia) as one's goal, eudaimonic approaches consider feelings of personal expressiveness (eudaimonia) as the process through which individuals enact the pursuit of excellence, virtue and self-realization (Waterman *et al.*, 2010). Eudaimonia has received much attention in social psychology, where it is defined as the orientations, behaviors, experiences, or functioning that allow individuals to fulfill their intrinsic motives (Huta and Waterman, 2014). Rahmani *et al.* (2018) argued that eudaimonia invariably leads to hedonia.

Hotels may help guests to satisfy their intrinsic motives by means of IoT devices. For example, hotels might enable their guests to modify the atmosphere of their bedroom to align with their physical or mental state measured via their body functions (degree of sweating, body temperature, and heart rate). In-room sensor-equipped devices or fixtures could track these body signals. We chose to examine eudaimonism as a separate construct from hedonism, since we believe the former covers an important range of intrinsic goals applicable to upscale hotel guests.

Thus, we hypothesize the following:

H3. (a) Touch, (b) smell, (c) hearing, (d) sight, and (e) taste stimulated by IoT devices in hotels will positively influence eudaimonism.

There is increasing evidence that emotions and affective states in service encounters are important for the prediction of behavioral intentions (Loureiro *et al.*, 2013). In hospitality and tourism research, behavioral intention is generally characterized as the intention to repurchase, the willingness to speak favorably about a service, and the intention to recommend a service to others (Loureiro *et al.*, 2013). The experience of positive emotions in service encounters increases customer satisfaction and, in turn, enhances customer loyalty and the likeliness of producing positive word of mouth (Jang and Namkung, 2009).

Therefore, we assume the following hypotheses:

H4. Emotional value has a positive impact on behavioral intentions.

H5. Affective experience has a positive impact on behavioral intentions.

H6. Eudaimonism has a positive impact on behavioral intentions.

Gender differences in the hotel industry

In the hotel industry, there are specific gender-based differences in consumer behavior. For example, considering the application of fingerprint technology in allowing access to guest rooms, men reported the convenience of such technology, while women were more concerned with issues of data security (Kim and Bernhard, 2014). DeFrank *et al.* (2000) claim that hotels that offer fitness equipment need to consider preferences based on gender to enhance their brand's reputation for wellness. Likewise, there exist gender differences in the emotional response to the tasting of different wines. According to Mora *et al.* (2018), men rate wines higher in terms of their emotional response in comparison to women.

Response to sensory stimuli can also be influenced by gender. Bogicevic *et al.* (2018) found that men preferred hotel rooms featuring masculine colors (e.g. blue, gray, and brown) as opposed to feminine colors (e.g. orange, pink, and purple), while women appreciated both

masculine and feminine colors equally. According to Brand and Millot (2001), women are more sensitive towards scents, i.e., they discriminated between scents better than men do and were more expert at categorizing them. Citrin *et al.* (2003) ascertained that women required more tactile inputs than men when assessing products. Andersson *et al.* (2012) revealed that the influence of music in retail stores on consumer behavior (money and time spent) was moderated by gender. Women were positively influenced by no music or slow-tempo music, while men were positively influenced by music and fast-tempo music. Although the hospitality and tourism literature has established the importance of emotional and affective reactions in defining customers' behavioral intentions, few studies have examined gender differences with respect to hotel experiences.

Hence, we propose the following hypotheses:

H7. The five senses have a greater effect on (a) emotional value, (b) affective experience, and (c) eudaimonism among women compared to men.

H8. The effects of (a) emotional value, (b) affective experience and (c) eudaimonism on behavioral intentions are greater for women than for men.

Based on the S-O-R paradigm (Mehrabian and Russell, 1974), Krishna (2012) argued that cues from the five senses (Stimuli) are perceived by customers (Organism) and exert an impact on their attitude and behavior (Response). Drawing on the S-O-R model, we developed our research model, whereby sensory cues deriving from IoT devices (Stimuli) are deemed to affect guest emotions, affective experience, and eudaimonism (Organism) and impact their behavioral intentions (Response). Refer to Figure 2 for our research model.

Insert Figure 2 about here

Methodology

Prior research in tourism and hospitality has recommended using a mixed method approach to better understand the phenomenon under study and to provide stronger evidence of findings (Lee and Hallak, 2020). This study adopted a mixed method approach, combining qualitative research (semi-structured interviews) to explore hotel managers' perspectives on the potential use of IoT in upscale hotels and quantitative research (surveying hotel guests) to empirically test the research model and the related hypotheses developed above.

Qualitative research

Sampling and data collection

We selected respondents according to two sequential criteria: 1) hotel managers who had at least five years of experience in managing upscale hotels and 2) who had an interest in sharing their thoughts about the use of new technologies and IoT. We drew up a list of upscale hotels located in Paris and then we contacted their managers. Although it was difficult initially to find managers who fulfilled our sampling criteria and were available for an interview, we extended our sample using the managers' professional networks, until the saturation point was achieved. Final sample size was 14 interviews, with interview times ranging from 20 to 30 minutes. The sample included 9 women and 5 men, with 14% younger than 34 years and 86% between 35 and 54 years. Over half of the interviewees (57%) had more than 7 years of experience as hotel managers.

Interview guide and content analysis

The interview guide was designed to gain insights into the hotel managers' perspectives on the use of IoT in the hotel industry as well as their perception of the strengths, weaknesses,

opportunities and threats of digitalization in upscale hotels through IoT devices. The interview guide was pre-tested with two hotel managers, resulting in the reformulation of some questions to enhance their clarity. The interviews were transcribed for analysis.

Subsequently, we conducted content analysis using selective thematic codes (Arsel, 2017). Firstly, the findings showed that the majority of hotel managers believed that the use of IoTs may improve guest experiences: *"Today, the customer experience is a challenge for hoteliers; you have to be able to differentiate yourself, surprise customers"; "Thanks to the connected watches, customers are generally quite happy that the staff arrive so quickly."* Managers perceived IoT devices as an opportunity to differentiate their hotel from those of their competitors and to attract customers and retain them.

Secondly, managers were convinced that guests' technological skills would affect the implementation of IoT devices in hotels, deeming it necessary to test the various connected objects carefully before putting them at the guests' disposal. Indeed, the perceived ease of use of IoT devices has influenced guest experience (Libai *et al.*, 2020). Nevertheless, managers believed that the use of IoT devices creates considerable convenience and has great time-saving potential for both hoteliers and guests: *"For example, the connected tablets (...) it's really convenient, it saves time for the customer and for us... overall it works well"*.

However, managers said customers still require human contact. *"Staff need to explain the functions of such devices to the guests at the reception desk, for example"; "It's still very important to include physical and human aspects in the customer experience."* Therefore, welcoming employees at the reception should not be replaced by robots at present; issues range from customer and employee acceptance of service robots to government policy and prevailing technological advancements (McCartney and McCartney, 2020). At a minimum, customers should be given the opportunity to decide whether to check in themselves at a terminal or with the help of a live receptionist.

Finally, managers believed hotel room equipment of the future will be “smart”, i.e., bulbs, speakers, or other intelligent objects. Such connected devices could be used to control room atmospherics, access information/news, order room service, or check guests out: *"It's the future anyway; these are the rooms of the future for sure! It's a real trend in 4- and 5 star hotels now."* *"For example, we provide a connected TV where they can also book a table in the restaurant as well as consult the menu of the restaurant and the bar as well as our offers at the spa; all this from the IPTV [1]."* *"Television, we could develop a lot of things... we could make phone calls as well as request the concierge to make a reservation or arrange for an anticipated departure."* Therefore, connected devices were seen to enable upscale hotels to cater to customer needs and create memorable experiences.

Quantitative research

Data collection instrument

Data were collected through an online questionnaire. To screen respondents, we used the following filtering question: “Have you stayed in a 4-5* hotel over the last two years?” A “No” answer redirected respondents to the socio-demographic questions and ended the questionnaire. We also asked our respondents whether they owned any IoT devices in order to consider only respondents who were familiar with this technology. Existing multi-item scales relevant to the variables of the model were adapted to our study. Emotional value (EV) was measured with six items adapted from Choe and Kim (2018). Four items from Pijls *et al.* (2011) were used to measure affective experience (AE) and six items from Jani and Han (2011) were applied to measure behavioral intentions (BI). Eudaimonism was evaluated with 12 items from Waterman *et al.* (2010). The five senses were evaluated using scales adapted from Peck and Wiggins (2006) as well as Webb and Peck (2015): touch (4 items), taste (3 items), smell (4 items), hearing (4 items), and sight (3 items). All items were measured on a five-point Likert scale ranging from “1 = Strongly disagree” to “5 = Strongly agree.”

Sampling profile

A total of 357 questionnaires, which represented 47% of the total sample of respondents (n= 757), were retained for data analyses, after applying the two filters mentioned above. Among the respondents, 47% had stayed in 4-5* hotels at least once a year and, at the same time, were users of IoT and smart devices. The average age was 35 years; 53% of respondents were females and 47% males.

Assessment of measurement model

The coefficients in the correlation matrix were less than 0.8 (see Table 2), thus multicollinearity was not a problem (Field, 2009). The composite reliability coefficients exceeded .80, as shown in Table 2, indicating a high level of construct reliability for all the measurements. The average variance extracted (AVE) of the scales were over .50, and in no case was the AVE lower than its squared correlation. This demonstrated a satisfactory convergent and discriminant validity for all constructs (per Hair *et al.*, 2017). Lastly, Hair *et al.* (2017) suggested that a satisfactory model should have comparative fit index (CFI) scores above .90, root mean square error of approximation (RMSEA) scores below .05 and normed chi-square less than 3.0. In this study, the fit indices were satisfactory, with $\chi^2/df = 2.74$ ($p < .001$), CFI = .93, and RMSEA = .04, indicating an acceptable overall fit of the measurement model to the data.

Insert Table 2 about here

Results of hypothesis tests

Structural equation modelling using AMOS Version 24 was employed to test the hypotheses in this study. Results (RMSEA = .04, TLI = .91, CFI = .93; $\chi^2/df = 2.88$, $p < .001$) demonstrated a good fit of the proposed model to the data. The results of hypothesis tests are

summarized in Table 3. The parameter estimates and the associated t values obtained from the structural model analysis showed that smell positively influenced emotional value ($\beta = .38, t = 7.61, p < .01$) and eudaimonism ($\beta = .07, t = 2.33, p < .05$). Hence, H1b and H3b received statistical support. Smell had no effect on affective experience ($\beta = -.05, t = -.14, p > .05$). H2b was not supported. Hearing and sight had non-significant effects on eudaimonism (respectively $\beta = -.07, t = -.42, p > .05$; $\beta = .07, t = .45, p > .05$), but a significant effect on emotional value (respectively $\beta = .13, t = 2.46, p < .05$; $\beta = .50, t = 8.29, p < .01$) and affective experience (respectively $\beta = .12, t = 3.81, p < .01$; $\beta = .11, t = 2.66, p < .05$). Therefore, H1c, H2c, H1d and H2d were statistically supported, but H3c and H3d were not supported. Touch had a significant effect on affective experience ($\beta = .12, t = 3.28, p < .05$), but a non-significant effect on emotional value and eudaimonism (respectively $\beta = .09, t = 1.58, p > .05$; $\beta = .05, t = 1.86, p > .05$). Hence, H2a was supported. H1a and H3a were not supported. Taste had a positive influence on eudaimonism ($\beta = .06, t = 2.04, p < .05$), but a non-significant effect on emotional value and affective experience (respectively $\beta = .09, t = 1.76, p > .05$; $\beta = -.03, t = -.95, p > .05$). H3e was supported, but H1e and H2e were not supported. The results also demonstrated a non-significant effect of emotional value on behavioral intentions ($\beta = .06, t = .43, p > .05$). Thus, H4 was not supported. Affective experience and eudaimonism had positive influences on behavioral intentions (respectively $\beta = .83, t = 4.53, p < .01$; $\beta = .43, t = 2.00, p < .05$). H5 and H6 were supported.

Insert Table 3 about here

A multi-group analysis was employed to test the moderating effect of gender on the significant paths of the model. Following Kline (2005), an equality constraint was imposed on

the structural paths between men and women. Then, the moderator effect was tested by examining the difference in the two Chi-square values between the constrained and unconstrained models.

The multi-group analysis is presented in Table 4. Relationships between eudaimonism and both sense of smell and behavioral intentions were significant for women (respectively $t = 2.63$, $p < .01$; $t = 2.34$, $p < .01$) and non-significant for men ($t = .56$, $p > .05$; $t = .52$, $p > .05$), as supported by Chi-square difference tests, $p < .01$. Hence, H7c received partial support and H8c was not supported. However, gender did not moderate the relationships between the following paths: smell and emotional value ($\chi^2\Delta = 2.07$, $p > .05$), hearing and emotional value ($\chi^2\Delta = .04$, $p > .05$), sight and emotional value ($\chi^2\Delta = .01$, $p > .05$), touch and affective experience ($\chi^2\Delta = .02$, $p > .05$), hearing and affective experience ($\chi^2\Delta = .04$, $p > .05$), sight and affective experience ($\chi^2\Delta = .01$, $p > .05$), taste and eudaimonism ($\chi^2\Delta = .13$, $p > .05$), as well as affective experience and behavioral intentions ($\chi^2\Delta = .02$, $p > .05$). Thus, H7a, H7b, H8a, and H8b were not supported.

Insert Table 4 about here

Discussion and Conclusions

The goal was to reveal how IoT in upscale hotels might stimulate the five senses and exert influence on guests' emotions, affective experiences, eudaimonism, and, ultimately, impact their behavior. Moreover, we examined the moderating effects of gender on these relationships. The results of the confirmatory study showed that the senses of smell, hearing, and sight had positive impacts on guest emotions. This finding has affirmed Lo's (2007) conclusion that an increase in experiential offerings results in an increase in guest emotions, which, in turn, may enhance customer satisfaction, loyalty, and positive word of mouth (Jang and Namkung, 2009).

Our findings also established that the senses of touch, hearing, and sight positively influenced guests' affective experiences. This may lead to an increase in customer satisfaction, given that Lee *et al.* (2019) found that multisensory experiences in hotels moderated the relation between customers' affective evaluations and their satisfaction. Our results support Lemon and Verhoef's (2016) finding that, through the creation of multisensory experiences, IoT devices influenced not only hotel guests' emotions, but also their affective states.

We also concluded from the results that smell and taste impacted guests' perceptions of eudaimonism. These two senses are chemical senses, which are much more complex to study than the physical senses of sight, touch, and hearing (Obrist *et al.*, 2017). Spence *et al.* (2017) gave an overview of state-of-the-art technologies which exploit the digitization of smell and taste. For example, virtual reality experiences may be amplified with the emission of meaningful scents. Our findings are in line with research in neuroscience, which has shown that smell, taste, and memory are very much connected to each other in the human brain (Plailly *et al.*, 2012), and, thus, these senses prove more effective in influencing guests' mood and memories compared to the other senses (Obrist *et al.*, 2017).

Results demonstrated that both guests' affective experience and eudaimonism influenced guest behavior. This corroborates work by Kim and Perdue (2013), who found that affective attributes of hotels, like friendliness and security, impact customers' hotel choice. Furthermore, results showed that whereas affective experiences are positively influenced by touch, hearing, and sight, eudaimonism is positively impacted by smell and taste. This confirms the significance of the Gestalt principle (Helmefalk and Hultén, 2017) which suggests that all five senses need to be stimulated to ensure the full effectiveness of a sensory marketing strategy.

Finally, the results of our study suggested that the sense of smell had a greater effect on eudaimonism and behavioral intentions among women than among men. This supports Brand

and Millot (2001) who found evidence that women were more sensitive towards scents and could better distinguish and categorize scents and odors.

Theoretical implications

The S-O-R paradigm (Mehrabian and Russell, 1974) was used to frame a theoretical association between the usage of IoTs and multisensory guest experiences in upscale hotels. In line with Krishna (2012), we have shown how sensory cues originating from IoT devices (S) affect hotel guests' emotions, affective experience, eudaimonism (O), and ultimately, their behavioral intentions (R).

Furthermore, Buhalis and Foerste (2015) introduced "SoCoMo" (SOcial media, COntext-based marketing, MObile devices) as "an advanced systematic method of context marketing on smart mobile devices that integrates social media to empower co-creation of value" (Buhalis and Foerste, 2015, p.155). Their concept of context-based marketing considered both internal context (guest preferences, cultural background, needs) and external context (weather conditions, traffic, time, location, as detected by built-in sensors in mobile devices). We did not confine our analysis to mobile devices. Instead, we recommend extending the "SoCoMo" model based on our findings. We propose substituting the term 'SoCoIoT' to broaden the narrower mobile component (Mo) into the Internet of Things (IoT).

Practical implications

Managers of upscale hotels are advised to deploy cues from all the five sensory modalities to engage their guests more fully. Operators should monitor the congruence of diverse sensory cues signalled to guests and strive to achieve a sense of perceptual harmony in hotel spaces (Helmefalk and Hultén, 2017). There should be also sensory congruence across the virtual world and the physical world (Lin, 2010). Managers need to define the optimal degree of sensory stimulation, i.e., the most pleasant one for guests (Gu *et al.*, 2016), to exert a positive

influence on experiential value (Chen *et al.* 2020). “Sensory overload” should be avoided (Richard and Chebat, 2016).

Brands can also develop service designs based on sensory appeals that meet varied guest interests or needs. For example, IoT devices may emit different scents, music, and visual stimuli in the lobby or restaurant compared to the guest room. Hotels may create different rooms and suites based on “sensory-informed themes” (Agapito *et al.*, 2014). It is also important for upscale hotels to ensure seamless connections across their pre-stay, stay, and post-stay phases (García *et al.*, 2018). For instance, in the pre-stay phase, hotels may ask guests about their sensory preferences: surfaces, like wood, metal, glass, and, especially, the floor covering, such as parquet, carpet, etc. (touch); perfume categories, like floral, woody, etc. (smell); Internet playlists, radio stations, sounds of nature, etc. (hearing); color hues, saturation, and lightness (sight); type of water, which is automatically poured into a jug, once the guest has served themselves from the jug (taste).

For Mercan *et al.* (2021), context awareness and hyper-personalization, through intensive and continuous data collection (hyper-connectivity) and real time processing, are key trends in the service industry. Therefore, big data plays a crucial role in the collection of information, since it allows hoteliers to retrieve, analyze, and visualize data to provide personalized services in real time (Mariani, 2019; Stylos *et al.*, 2021). Together with their guests, hotels may co-create customized sensory experiences. For instance, if the hotel knows about the guest’s music preferences based on social media as well as their age and gender, etc. (internal context) and considers the temperature and size (standard, suite, etc.) of the guest room (external context), this may determine the playlist of the concierge-tablet made available in the guest room. Furthermore, one may record the guest’s voice in order to use it for voice command purposes, once the guest arrives at the hotel. Based on our finding that the sense of smell has a greater impact on eudaimonism and behavioral intentions among women than men, hotels may deploy

subtler scents with lower intensities, or even different scents, for female guests in comparison to male guests.

The use of IoT in hotels represents an opportunity for hotels to attract customers in the aftermath of the COVID-19 crisis. According to Zenker and Kock (2020), this pandemic will lead to a paradigm shift in tourism with considerable changes in tourist behavior. Hotels may substitute voice-enabled services to make guests feel more secure since they can avoid touching surfaces. This will lead to tourists' positive emotional experiences (Rahmani *et al.*, 2019). Similarly, hotels may use scent strategically to give their guests the impression of staying in a clean and healthy environment. Mechanical Artificial Intelligence may be applied to clean and sanitize hotels, i.e., where robots monitor the level of cleanliness of the lobby area, corridors, or elevators and alert the cleaning staff if certain areas of the hotel need their attention (Jiang and Wen, 2020). Table 5 expands on findings from Study 1 and Study 2. It exemplifies strengths, weaknesses, opportunities, and threats (SWOT) and managerial implications of IoT for each of the five sensory modalities addressed in this study.

Insert Table 5 about here

Limitations and future research

One limitation is that we concentrated on upscale hotels located in Europe. This study could be replicated in upscale hotels in countries like Japan, China, and the US, where cutting-edge digital tools, such as check-in robots, have been used (Tung and Law, 2017). Cultural influences on guests' perceptions of multisensory experiences may be investigated as well.

We focused on the stay phase of the 'digital customer journey' (Radde, 2017) with respect to hotels. However, the application of IoT in the pre-stay phase (e.g., facilitating booking, asking guests for their sensorial preferences and offering online check-in before

arrival) and post-stay phase (e.g., asking for feedback or encouraging guests to return to the hotel) and their influence on guests' sensory experiences may be explored in future.

The use of IoT requires hotels to incur considerable investments in both their technology and the training of their staff. Although we focused on upscale hotels, hotels at lower levels might readily adopt IoT to create customized multisensory experiences while reducing operational costs through digital applications. Many such hotels are part of large international hotel chains that can capitalize on economies of scale when investing in technology. Beldona *et al.* (2018) concluded that new technologies have a greater influence on guest satisfaction in mid-scale and economy hotels compared to upscale and luxury hotels.

We only considered respondents who had stayed in 4-5* hotels. A comparison among high-end, medium range, and low-end hotel customers might increase the validity of our model. We did not distinguish between different target groups and their different consumer behaviors in relation to IoT. For example, differences between leisure and business travelers could be investigated. Future research can also focus on the use of IoT with older hotel guests and persons with disabilities, who might require more assistance in accessing hotel, food, security, and medical services (Tuominen and Ascenção, 2016).

Finally, future research should validate our model *in-situ*, i.e., to determine its ecological validity. One method is to conduct an experiment comparing actual guest behavior in controlled settings, e.g., comparing the use of a hotel room equipped with IoT against one without IoT. Such an experiment may be replicated as a longitudinal study to assess guests' learning curves or familiarization with IoT devices over time.

Endnotes

[1] IPTV stands for Internet Protocol Television and refers to the delivery of television content over Internet Protocol networks.

[2] Responsive architecture is an evolving field of architectural practice and research. Responsive architectures measure actual environmental conditions (via sensors) to enable buildings to adapt their form, shape, color or character responsively (via actuators).

[3] GDPR seeks to give control to individuals over their personal data, to help businesses govern data, and to harmonize the regulations within the EU. It came into force on 25 May, 2018.

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Table 1. ICT and customer experiences

	Setting/Industry	Findings
Mercan <i>et al.</i> (2021)	IoT, hospitality industry	IoT offers many opportunities for the hospitality industry to create innovative services. Its potential applications will continue to alter the servicescape.
Jeong and Shin (2020)	Smart tourism technologies (STTs)	Informativeness, interactivity, and personalization are the main attributes of STTs that affect tourist experiences and revisit intentions.
Grewal <i>et al.</i> (2020)	Human enhancement technology, retail and service	Emotion detection technologies may be especially relevant in the hospitality industry; they suggest specific offers that match the emotional state of a customer.
Ranasinghe <i>et al.</i> (2018)	Virtual reality (VR) technologies, sensory stimuli	VR technologies could enhance sensory engagement (olfactory and haptic stimuli) within interactive experiences.
Spence <i>et al.</i> (2017)	HCI, chemical senses	The technological solutions enabling the stimulation of olfactory and gustatory senses may enhance consumer experiences.
Hoffman and Novak (2017)	IoT, smart home	IoT devices have the potential to revolutionize consumer experiences through object-to-object and object-to-human interactions.
Obrist <i>et al.</i> (2017)	HCI, multisensory experiences	Interactive technologies can generate cross-sensory effects to create different affective reactions.
Lemon and Verhoef (2016)	Information Technology (IT), customer experience	IT plays a crucial role in optimizing the service ecosystem and delivering a customized experience.
Buhalis and Foerste (2015)	SoCoMo paradigm, travel and tourism	SoCoMo combines social media (So) and context-aware marketing strategies (Co) on mobile devices (Mo). It co-creates value for tourist experiences.

Table 2. Mean, standardized deviations, and correlation matrix

Variable	Mean	Std Dev	CR ^a	EV	AE	BI	EUD	Touch	Smell	Sight	Hearing
Emotional value (EV)	3.61	.97	.94	1							
Affective experience (AE)	3.55	.91	.89	.72**	1						
Behavioral intentions (BI)	3.40	.95	.94	.72**	.72**	1					
Eudaimonism (EUD)	3.57	.56	.85	.49**	.51**	.54**	1				
Touch	3.69	.80	.80	.59**	.61**	.56**	.42**	1			
Smell	3.67	.86	.80	.68**	.65**	.64**	.42**	.68**	1		
Sight	3.81	.89	.88	.72**	.69**	.64**	.40**	.69**	.69**	1	
Hearing	3.83	.88	.90	.61**	.62**	.58**	.37**	.59**	.57**	.72**	1
Taste	3.83	.85	.80	.54**	.51**	.49**	.36**	.59**	.57**	.63**	.52**

Note: ^aComposite reliability; **Correlation is significant at the 0.01 level (2-tailed).

Table 3. Results of hypothesis tests

	Estimate	S.E.	t-value	p-value	Hypothesis
H1a. Touch → EV	.09	.06	1.58	.11	Rejected
H1b. Smell → EV	.38	.05	7.61	***	Supported
H1c. Hearing → EV	.13	.05	2.46	.01	Supported
H1d. Sight → EV	.50	.06	8.29	***	Supported
H1e. Taste → EV	.09	.05	1.76	.07	Rejected
H2a. Touch → AE	.12	.03	3.28	.01	Supported
H2b. Smell → AE	-.05	.03	-.14	.88	Rejected
H2c. Hearing → AE	.12	.03	3.81	***	Supported
H2d. Sight → AE	.11	.04	2.66	.01	Supported
H2e. Taste → AE	-.03	.03	-.95	.34	Rejected
H3a. Touch → Eudaimo	.05	.02	1.86	.06	Rejected
H3b. Smell → Eudaimo	.07	.03	2.33	.02	Supported
H3c. Hearing → Eudaimo	-.07	.01	-.42	.67	Rejected
H3d. Sight → Eudaimo	.07	.01	.45	.64	Rejected
H3e. Taste → Eudaimo	.06	.03	2.04	.04	Supported
H4. EV → BI	.06	.14	.43	.66	Rejected
H5. AE → BI	.83	.18	4.53	***	Supported
H6. Eudaimo → BI	.43	.21	2.00	.04	Supported

Table 4. Moderating effect of gender

	Male (N = 167)		Female (N = 190)		Chi Square Difference Δ
	β <i>std.</i>	<i>t-value</i>	β <i>std.</i>	<i>t-value</i>	
Smell → EV	.31	5.04**	.53	6.78**	2.07
Hearing → EV	.15	2.20*	.12	2.27*	.04
Sight → EV	.43	5.84**	.58	6.10**	.01
Touch → AE	.24	2.35*	.11	2.28*	.02
Hearing → AE	.13	2.72**	.25	2.56**	.04
Sight → AE	.26	2.81**	.17	2.25*	.01
Smell → Eudaimo	.01	.56	.20	2.63**	7.58**
Taste → Eudaimo	.13	2.55*	.28	2.35*	.13
AE → BI	.13	2.29*	.17	2.33*	.02
Eudaimo → BI	.05	.52	.59	2.34*	7.41**

** *Sig. at $p < .01$* ; * *Sig. at $p < .05$*

Table 5. Managerial implications for the use of IoT in upscale hotels

	SWOT	Managerial implications
Sight	<p>Strengths Responsive [2] hotels may adjust lights through IoT. Voice commands may replace switches to turn the light on/off or open/close shutters. Visual footprints may open the safe-deposit box.</p>	<p>Guest rooms may be equipped with both voice command technology and switches for guests who are not familiar with this new technology.</p> <p>Through a concierge tablet connected to a screen mounted on the wall, guests may choose a specific landscape (e.g., beach or mountain scenery). The resulting ambiance may be enhanced through congruent auditory cues (e.g., the sound of sea waves). IoT devices may automatically detect the guest’s mood and propose an appropriate ambient scenery selection.</p>
	<p>Weaknesses Guests may become confused because of the absence of switches.</p>	
	<p>Opportunities Voice commands may reassure guests who want to avoid touching surfaces due to COVID-19.</p>	
	<p>Threats Voice command technology is not useful for guests who have hearing/speaking challenges.</p>	
Hearing	<p>Strengths Guest voices are recorded for automatic voice recognition purposes during their stay at the hotel. Speakers in the guest room, like <i>OK Google</i>, may be used when contacting the hotel staff.</p>	<p>IoT may automatically recognize the guest’s mood and propose, accordingly, a playlist of music titles on the concierge tablet.</p>
	<p>Weaknesses If there is more than one guest in the room, the speaker may encounter difficulties in differentiating between different voices.</p>	
	<p>Opportunities Guests may use speakers to purchase products sold exclusively in the country where the hotel is located.</p>	
	<p>Threats Speakers may raise concerns about the protection of guests’ private data.</p>	
Smell	<p>Strengths Carpets, towels, and bed linen may emit fragrances, which are changed automatically with each new guest. Guests can choose a perfume category (e.g., floral or citrus). Personalized scents may be created, whose diffusion is triggered through face recognition. In the ballroom, depending on the number of people present, IoT may adjust the temperature and air conditioning.</p>	<p>Different mood scents may emanate from diffusers in different areas of the hotel. Such diffusers may adjust scent type and intensity in real time through IoT, according to detected changes in ambient conditions, e.g., temperature or climate.</p>
	<p>Weaknesses The presence of a large variety of odors may prevent guests from distinguishing different scents. In public spaces (the lobby, hallways, etc.) the presence of different personalized scents may produce an olfactory overload.</p>	
	<p>Opportunities Hotels may pursue a co-branding strategy with luxury perfumers.</p>	
	<p>Threats</p>	

	Guests with allergies may react negatively to olfactory stimuli.	
Touch	<p>Strengths Switches with a surface that give a pleasant feeling when switching on the light, opening/closing the curtains, etc., may be used. One may use the same material on remote controls to create a coherent tactile experience.</p>	Tactile/haptic experiences may be personalized through IoT. Guests may be identified through face recognition and surfaces (e.g., floors, handrails, and chairs) may be adapted to their tactile preferences.
	<p>Weaknesses Surfaces need to be regularly disinfected due to the COVID-19 pandemic.</p>	
	<p>Opportunities Mobile integration provides data which helps hotels remember guests' tactile preferences.</p> <p>Hotels may choose speakers, or any other Bluetooth system, that allows guests to pair their private phone to these devices to ensure their privacy. Guests do not need to touch the speakers (Hoyer <i>et al.</i> 2020).</p>	
	<p>Threats Due to the GDPR¹[3] (General Data Protection Regulation), guests may be reluctant to access any data from any system since they may judge their privacy to be in jeopardy (Ziegeldorf <i>et al.</i> 2014).</p>	
Taste	<p>Strengths Hotels may offer tastings of local food specialties (cheese, truffles, etc.) and wines. They may give guests directions of how to get to producers in the proximity of the hotel through maps or beacon aerals.</p>	Equipment may allow guests to experience virtual reality or augmented reality visits to the restaurant as part of information searching. Information on the ingredients, nutritional values, or allergens of meals may augment their virtual experience.
	<p>Weaknesses Virtual experience may not provide the type of information required by the guest prior to visiting the restaurant.</p>	
	<p>Opportunities Hotels may cooperate with local vendors near the hotel to expand guest tourism activity.</p>	
	<p>Threats Virtual and subsequent physical experiences at partner restaurants may not be consistent, or level of partner is not consistent with upscale hotel quality.</p>	

Figures

Figure 1: Rationale and Research Design

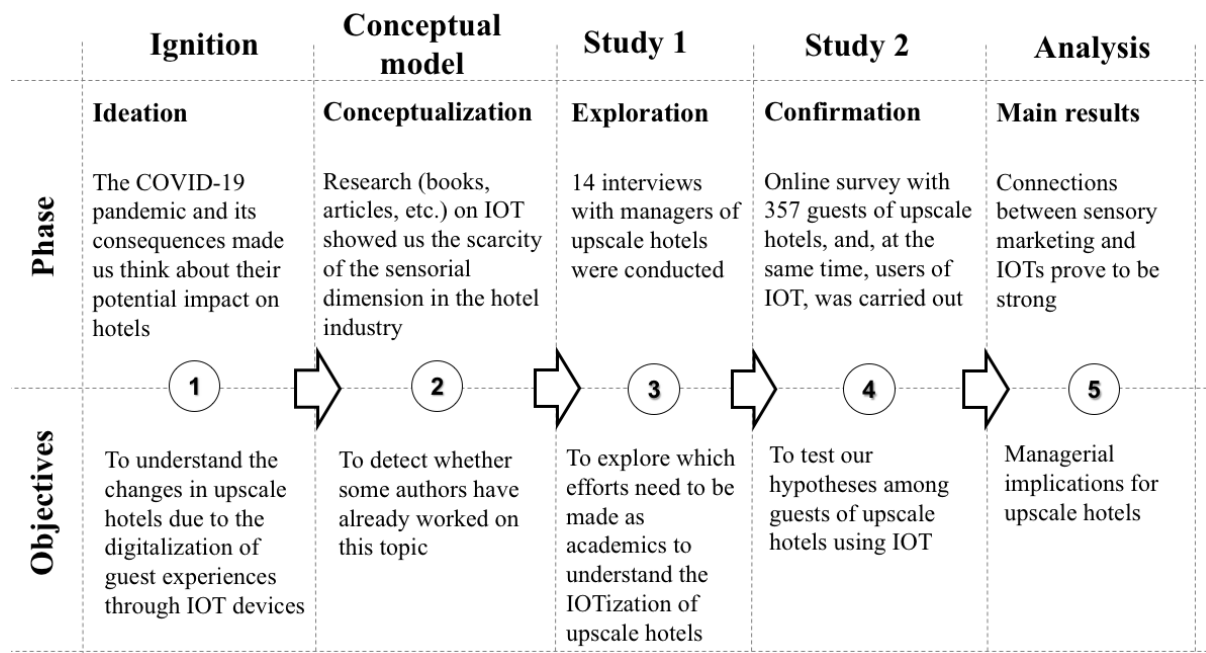


Figure 2: Conceptual Model

