Reducing perceived health risk to attract hotel customers in the COVID-19 pandemic era: Focused on technology innovation for social distancing and cleanliness

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A B S T R A C T

As an essential risk-reduction strategy, technology innovation is likely to play a key role in the hotel industry's recovery from the 2020 coronavirus pandemic. However, its impact on customer decision-making behavior is unknown. Focusing on technology innovation for reducing guest interaction with employees and enhancing cleanliness, the purpose of this research was to examine the impact of expected interaction and expected cleanliness on perceived health risk and hotel booking intention. Three experimental studies were conducted using online consumer samples. The studies found that low levels of expected interaction through technology-mediated systems lead to low levels of perceived health risk. Perceived health risk mediates the relationship between expected interaction and hotel booking intention. In addition, high levels of expected cleanliness through advanced cleaning technologies moderate the impacts of expected interaction on perceived health risk. Importantly, the proposed perceived risk mechanism was effective in post-pandemic scenarios. Theoretical and practical implications are discussed.

1. Introduction

The recent coronavirus pandemic (COVID-19 pandemic) has imposed an unprecedented threat to the global economy. In particular, the hotel industry is proving to be the hardest hit by the COVID-19 pandemic due to the high risk of environmental contamination at hotel properties (AHLA, 2020; Zemke et al., 2015). In 2020, it is projected that nearly 50% of U.S. hotel revenue will be in decline, based on the historic low occupancy rate (38%), the lowest since the Great Depression in 1933 (AHLA, 2020). In addition, it will take approximately five years for the U.S. hotel industry to achieve pre-COVID-19 occupancy, average daily rate (ADR), and revenue (Dobrosielski, 2020). This indicates that the recovery of hotel demand will be very slow.

The travel reluctance during and after the COVID-19 pandemic is resultant from high health risk. While travel and tourism have always involved risks, health risk is the main concern most tourists have when visiting destinations or hospitality properties (Kozak et al., 2007). Importantly, health risk perception is a key factor that influences tourists' decision-making processes; they are less likely to visit a destination

when they perceive high levels of health risk at the destination (Law, 2006; Williams and Baláž, 2013). According to the survey conducted by Longwoods International in April 2020, 48% of U.S. travelers canceled their trips completely, and 43% of them reduced their travel plans because of the COVID-19 pandemic. In addition, 66% of U.S. travelers indicated that the pandemic would greatly impact their decision to travel in the next six months (Longwoods International, 2020). This result shows that reducing health risk is a key strategic point for attracting hotel customers.

In order to attract customers to visit hotels, hotels need to concentrate on improving perceptions of safety and reducing customers' anxiety levels by implementing risk-reduction strategies. Implementing technology innovations for reducing guest interactions with hotel employees and for enhancing hotel cleanliness can be an effective strategy to reduce health risk for hotel customers (Kussmann, 2020). In fact, most branded hotels are already adopting technology systems for social distancing; Marriott, Hilton, and Hyatt hotels have implemented technologies that will reduce staff interaction with hotel customers, such as mobile check-in systems, kiosk check-in machines, and robot cleaning systems. They also recently updated their cleanliness procedures and

began to adopt advanced cleaning technologies for enhanced disinfection (e.g., electrostatic sprayers, ultraviolet-light technology, etc.) (Garcia, 2020). These strategies will be critical for hotels to reduce actual and perceived health risks for hotel customers.

Despite the importance of the impact of hotel technologies on perceived health risk, this link is unknown for a lack of research on this; most existing research has focused on psychological antecedents of perceived risk, such as sensation seeking (e.g., Lepp and Gibson, 2003, 2008), personality (e.g., Carr, 2001; Reisinger and Mavondo, 2005), and motivation (e.g., Lepp and Gibson, 2003; Reisinger and Mavondo, 2005). In particular, consumer information processing has been the focus of risk-reduction strategies (e.g., Meents and Verhagen, 2018; Mitchell and McGoldrick, 1996; Yeung et al., 2010). However, customers' acquisition of further information does not always lead to the reduction of perceived health risk in hospitality and tourism contexts, because of the inherent and unpredictable nature of destination health risks (Bruce, 2002). Further research needs to examine the effectiveness of technology innovation strategies for reducing health risk in customer decision-making processes.

The purpose of this research was to examine the impact of expected interaction with hotel employees and expected cleanliness on perceived health risk and hotel booking intention. To manipulate the expected interaction and cleanliness, this study focused on different scenarios associated with hotel technologies, such as kiosk check-in system, mobile check-in system, and robot cleaning system, and ultraviolet (UV) light cleaning system. Three experimental studies were conducted to achieve the research purpose. This research also sought to enhance the external validity of study results by analyzing the impact of technology innovation on perceived health risk and hotel booking intention in post-COVID-19 pandemic scenarios.

The following sections review the literature on perceived risk and technology innovation as a risk-reduction strategy. In Study 1, the effects of expected interaction with hotel employees on perceived health risk and hotel booking intention were examined. Study 2 analyzed the boundary condition of the proposed process by examining the effects of expected cleanliness on perceived health risk. Study 3 replicated the findings in Studies 1 and 2 in the contexts of the post-pandemic era. Lastly, theoretical and practical implications and future research directions are discussed.

2. Literature review

2.1. Perceived health risk

In consumer research, the theory of perceived risk refers to that consumers perceive risk in their decision-making behaviors because of the uncertainty that can potentially cause negative consequences. Thus, perceived risk equals to the probability of consequences occurring, multiplied by negative consequences of poor brand choice (Mitchell, 1992). Perceived risk is derived from unanticipated and uncertain consequences of an unpleasant nature resulting from product purchases (Bauer, 1960; Rehman et al., 2020). Conceptually, perceived risk is highly associated with perceived uncertainty. A body of research views both concepts as the same construct; perceived risk is a consumer's subjective feeling of uncertainty (Shimp and Bearden, 1982). However, other research focuses on a distinction between them; risk perception is composed of two components, such as uncertainty and adverse consequences of buying a product or service (Mitchell, 1998; Rehman et al., 2020). The present study views uncertainty as the cause of perceived risk; higher degrees of uncertainty about products or services makes customers perceive higher degrees of risk.

Since the 1960s, the theory of perceived risk has been applied to explain consumer decision-making behaviors (Buratti and Allwood, 2019). Since the 1990s, a growing number of hospitality and tourism research has examined how tourists perceive risk, what factors influence tourists' risk perception, and how tourists' risk perception influences travel and decision-making behaviors (e.g., Adam, 2015; Lepp and Gibson, 2003; Lepp et al., 2011). Previous research has been concerned with identifying different types of travel-related risks (Yang and Nair, 2014). Initially, Roehl and Fesenmaier (1992) categorized travel groups in terms of physical-equipment risk, vacation risk, and destination risk. Reisinger and Mavondo (2005) examined the impact of terrorism risk, health financial risk, and socio-cultural risk on travel intention. Most recently, Adam (2015) classified backpackers' perceived risk into environmental risk, political risk, financial risk, socio-psychological risk, physical risk, and expectation risk.

Among several types of perceived risk, health risk indicates tourists' or hospitality customers' perceived risk to their physical health as a result of uncontrolled events associated with terrorism, political situation, natural disasters, and pandemic. Historically, the focus of research on health risk has been to understand how tourists perceive health risk when they engage in risk-taking activities in adventure tourism contexts (e.g. Bentley and Page, 2008; Buckley, 2012). A growing body of research began to emphasize issues associated with health or safety risks especially after a series of events, such as the 9/11 terrorist attacks in 2001, the SARS outbreak in 2003, the Bali bombings in 2002, and the Asian tsunami in 2004 (Williams and Baláž, 2015; Yang and Nair, 2014). Recently, the COVID-19 pandemic has made tourists perceive a high degree of health risk when they visit destinations or hospitality facilities. Even after the pandemic, most tourists will be reluctant to travel, due to health concerns, which makes it critical for hospitality and tourism practitioners to implement risk-reduction strategies.

As mentioned, uncertainty is the cause of perceived risk. Thus, how to successfully reduce the uncertainty is a key point for health risk management. In this regard, two types of uncertainty provide basic knowledge to understand perceived health risk: epistemic uncertainty and aleatory uncertainty. First, epistemic uncertainty, which is also called internal, functional, subjective, or reducible uncertainty, emerges from a lack of knowledge (Yoe, 2011). Acquiring further knowledge on products or services can reduce epistemic uncertainty and perceived risk. Broader marketing research has mainly focused on risks of epistemic uncertainty, such as financial risk (not meeting consumers' financial needs), psychological risk (damaging consumers' self-image), performance risk (failing to deliver benefits to customers), social risk (losing customers' social status), time risk (not performing on time), and satisfaction risk (not being satisfied with the performance of products or services) (Mitchell, 1998; Sönmez and Graefe, 1998).

On the other hand, perceived health risk is highly associated with aleatory uncertainty. Aleatory uncertainty is caused by the inherent and unpredictable variability of the physical world. In the hospitality and tourism industry, aleatory uncertainty is highly associated with unpredictable risks at destination levels, such as perceived health risk (Bruce, 2002). Thus, there are certain limits in reducing aleatory uncertainty by acquiring further information (Yoe, 2011). Previous tourism and hospitality research has identified several tourism risks of aleatory uncertainty, such as functional risk (the possibility of mechanical, equipment, or organizational problems), health risk (the possibility of becoming sick or contracting certain kinds of diseases), physical risk (the possibility of physical danger or injury), political risk (the possibility of being caught up in a political turmoil), and crisis risk (the possibility of natural disasters or terrorist attacks) (Adam, 2015; Sönmez and Graefe, 1998). Among them, perceived health risk is highly based on aleatory uncertainty, which is not reducible by acquiring further information.

2.2. Technology innovation as a risk-reduction strategy

Risk-reduction strategy refers to a process by which consumers seek to reduce the perceived risk and uncertainty involved in the purchase of a product or service (Mitchell et al., 1999). When the level of perceived risk exceeds the levels that consumers find acceptable, they adopt risk-reduction strategies to make a better decision in purchasing (Gemünden, 1985; Pappas, 2016). While various types of risk-reduction

strategies are proposed, such as purchasing branded products or insurance, testing products, using money-back guarantees, and seeking endorsement from trusted sources (Yeung et al., 2010), historically, most consumer research has focused on consumer information seeking from formal, informal, and buyer-oriented sources (e.g., family, friends, buyer sources, etc.) (Meents and Verhagen, 2018). By processing information, consumers can reduce uncertainty of an unsatisfactory decision by evaluating consequences of purchasing a particular product (Mitchell and McGoldrick, 1996). While some travel risks based on epistemic uncertainty can be reduced by acquiring further information during decision-making, it is equally important for hospitality and tourism marketers to concentrate on improving perception of safety and reducing customers' anxiety levels by implementing managerial risk-reduction strategies for health risk (Reisinger and Mavondo, 2005).

How hospitality and tourism firms effectively reduce risks is the key focus for successful risk management (Williams and Baláž, 2015). An important means for reducing risk is technology innovation (Adam, 2015). Technology innovation refers to a combination of innovations associated with technology developments, with the objective of improving existing products or services in an incremental way or creating new ones in a radical way (Zeithaml et al., 2017; Wooder and Baker, 2012). Most previous research focused on innovation in information technology - the relationship between information adoption processes and perceived risk in online environments (e.g., Lepp et al., 2011; Tseng and Wang, 2016). On the other hand, this study focuses on the adoption of hotel operational technologies (e.g., front-office systems and housekeeping systems) for reducing perceived health risks.

According to Bitner (1992), physical settings including technology systems can influence customers' or employees' perception and behaviors. In this sense, the adoption of new technology systems can reduce perceived health risk by transforming hotel service experiences in a way to both reduce social interactions and improve cleanliness. First, technology innovations can minimize the interactions between customers and employees. Bitner et al. (2000) argued that new technologies can transform the traditional "high-touch and low-tech" service experiences into "low-touch and high-tech" service experiences. For example, fully automated hotel check-in systems (e.g., mobile key) or self-service kiosk check-in machines enable customers to have limited interaction with employees (Shin and Perdue, 2019). Given that social distancing is an essential step in preventing the spread of coronavirus, these new technology systems can reduce hotel customers' risk of infection by minimizing physical interactions with hotel employees. Second, technology innovation can be a basis of advanced cleaning tools for hotels. For example, the Best Western hotel chain began to equip its housekeeping crews with UV technology-based equipment to ensure an elevated level of cleaning (Best western, 2012). In response to the pandemic, most hotel chains (e.g., Marriott International, Hilton, and Hyatt) recently announced their new cleanliness guidelines; they plan to use new technologies (e.g., electrostatic sprayers, cleaning robots, etc.) for enhanced disinfection (Garcia, 2020). For example, Xenex robots, which have been commonly used in hospital operating rooms, are deployed in hospitality properties to sanitize and disinfect guest rooms without employee contact (Xenex, 2020). The new technologies for reducing guest interactions and enhancing cleanliness can influence expected interactions and expected cleanliness, resulting in different levels of perceived health risk during customer decision-making processes.

Given together, the main research problem is to understand how hotel technology innovations as a risk reduction strategy influence hotel customers' decision-making behaviors in the COVID-19 pandemic. Specifically, the external environment (COVID-19 pandemic) influences the adoption of hotel technology innovations for reducing health risk via reduced guest interactions and enhanced cleanliness. The risk reduction strategies adopted by hotels influence how hotel customers expect interaction and cleanliness, which influences their perceived health risk and hotel selection behaviors. While customer decision-making processes involve the five processes including need recognition,

information search, evaluation of alternatives, purchase decision, and post purchase behavior (Greenleaf and Lehmann, 1995), this study focuses on the impact of perceived health risk on purchase decision (hotel selection behavior) (Quintal et al., 2010; Sönmez and Graefe, 1998). Fig. 1 represents the customer hotel selection process in the COVID-19 pandemic period.

3. Hypotheses development

Yang and Nair (2014) argued that tourists' risk perception is shaped by both internal and external factors. While most existing research has focused on internal psychological antecedents of risk perception, such as sensation seeking (e.g., Lepp and Gibson, 2003, 2008), personality (e.g., Carr, 2001; Reisinger and Mavondo, 2005), and motivation (e.g., Lepp and Gibson, 2003; Reisinger and Mavondo, 2005). In addition, socio-demographic factors (e.g., income, age, and gender) (e.g., Lepp and Gibson, 2003; Sönmez and Graefe, 1998; Williams and Baláž, 2013; Yang et al., 2017) and cultural factors (e.g., nationality, cultural orientation, etc.) (e.g., Adam, 2015; Kozak et al., 2007) have been the frequently examined internal factors. This research focuses on hotel technology innovation as an external managerial source for reducing perceived health risk.

While hotel technology innovations are associated with multiple technology systems (e.g., front desk system, back office system, meeting and event management system, guest-related interface system, etc.) (Kim et al., 2008), this study focuses on guest check-in and housekeeping systems for their critical role in customer interactions. Hotel customers will perceive different degrees of health risk depending on the expected interactions during check-in and room cleaning processes. While check-ins with front desk employees or room cleaning services by housekeeping employees will increase opportunities for direct interactions with employees, technology-mediated systems, such as mobile check-in systems, kiosk check-in machines, and cleaning robots will decrease the interaction opportunities (Nicholls, 2010). Given that social distancing is important for reducing health risk during the COVID-19 pandemic, high expected interactions with employees are likely to increase perceived health risk by hotel customers whereas low expected interactions with employees (high interactions with technological tools) will decrease the risk (Zeng et al., 2020). The following hypothesis is proposed.

Hypothesis 1. Expected interactions with employees will affect perceived health risk, such that hotel customers will perceive lower levels of health risk when they know that technology-based services, such as mobile or kiosk check-in systems and robot cleaning systems, are provided in the hotel.

Historically, risk perception has been examined as a determinant factor for consumer decision-making behaviors. Initially, Sönmez and Graefe (1998) examined the effects of travel experience, terrorism risks, and perceived safety on individuals' likelihood of engaging in
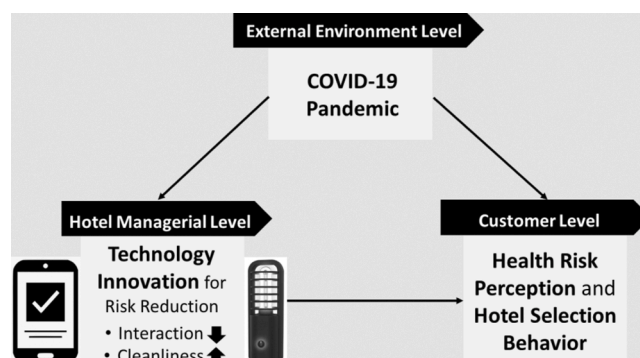

Fig. 1. Hotel Selection Process in the COVID-19 Pandemic.

international travels. Reisinger and Mavondo (2005) found that tourists have low international travel intentions when they have high levels of concern for safety. Quintal et al. (2010) found the impact of perceived risk on individuals' intention to visit destinations is mediated by their attitudes toward the visiting. This research extends previous findings by examining the underlying mechanism of hotel booking intention in terms of perceived health risk. When hotel customers perceive lower degrees of health risk because of lower levels of expected interactions (Zeng et al., 2020), they are more likely to book the hotel (Reisinger and Mavondo, 2005). The following hypothesis is suggested.

Hypothesis 2. Perceived health risk will mediate the relationship between the expected interactions and the hotel booking intention, such that lower levels of expected interaction will lower perceived health risk, which will lead to higher intention to book the hotel.

One further critical factor for health risk perception is cleanliness. The hospitality and tourism industry needs to provide a more extensive level of cleanliness to attract customers. In particular, hotel cleanliness is a critical aspect of hotel firms' success; most hotel customers are highly concerned with the quality of hotel cleaning (Liu and Jang, 2009; Wang and Hung, 2015). Hotel cleanliness has been examined in terms of its impact on customer satisfaction (Liu and Jang, 2009), service quality (Barber et al., 2011), and hotel security (Amblee, 2015). Bitner (1992) argued the perceived servicescape (physical settings) elicits both cognitive and emotion responses. In this regard, how hotel customers expect the cleanliness of hotel physical environments influences their perceived health risk in the COVID-19 pandemic. Technology innovations in hotel cleaning systems can allow tourists to develop a certain level of expected cleanliness (Zemke et al., 2015; Zeng et al., 2020). When prospective customers know that enhanced cleaning technology systems are implemented at hotels, they are likely to have higher levels of expected cleanliness, resulting in lower levels of health risk (Zemke et al., 2015). Thus, the following hypothesis is proposed.

Hypothesis 3. Expected cleanliness about hotel will affect perceived health risk, such that hotel customers will perceive lower levels of health risk when they know that advanced cleaning technology systems are implemented in the hotel.

The effect of expected interaction on perceived health risk will be changed when additional risk-reduction technologies are implemented. Importantly, cleanliness is an essential element considered by hotel customers in their decision-making. A large number of research studies have assessed the significant and positive impact of perceived cleanliness of hotels on hotel selection behaviors (e.g., Barber et al., 2011; Zemke et al., 2015). According to the two-factor theory, cleanliness is regarded as a dissatisfier that has a significant impact on hotel service experiences (Slevitch and Oh, 2010). In a time of pandemic, expected cleanliness will be even more important for hotel customers; hotel customers are likely to think that hotel cleanliness directly affects their health risk since hotel rooms and facilities are shared with other customers. This indicates that there would be replacement effects between expected cleanliness and expected interaction; perceived health risk created by expected interaction can be changed by different levels of expected cleanliness. For example, even if customers have higher levels of expected interaction, they are likely to perceive lower levels of health risk if they have higher levels of expected cleanliness. Thus, expected interaction and expected cleanliness will have a positive interaction effect; expected cleanliness will enhance the negative relationship between expected interaction and perceived risk. Following hypothesis is proposed.

Hypothesis 4. Expected cleanliness will moderate the effect of the expected interactions on the perceived health risk, such that lower levels of expected cleanliness will lead to higher levels of perceived health risk when expected interaction is high. However, higher levels of expected cleanliness will lead to lower levels of perceived health risks even if

expected interaction is high.

4. Study 1

Study 1 examined the effects of expected interaction on perceived health risk and hotel booking intention during hotel check-in processes. A total of three check-in scenarios were developed to test hypothesis 1 and 2.

4.1. Method

One hundred-eighteen Amazon Mechanicl Turk users (42 females) successfully completed this study in exchange for a small monetary compensation at the end of May 2020. Most participants were 30s (42.3%) and 40s (26.6%). The study employed one-way between subject design with three conditions based on online Qualtrics survey. Hypothetical scenarios for all studies were developed based on actual managerial actions taken by major hotel chains. Specifically, we referred to recent press releases from major hotel chains (e.g., Marriott International, Hyatt, Hilton, etc.) on their cleaning and guest interaction strategies using technological tools for dealing with the pandemic published in April 2020 (e.g., "Marriott International Launches Global Cleanliness Council to Promote Even Higher Standards of Cleanliness in the Age of COVID-19" published in 21st April 2020). Participants were instructed to imagine that they are planning to book a hotel for their next vacation in a time of the COVID-19 pandemic. In hypothetical scenarios, they found that different guest check-in systems are available. In the lower levels of interaction scenarios, participants read that either mobile key check-in or kiosk check-in services are available. In the higher levels of interaction scenario, they read that only employee check-in services are available. The developed scenarios were pre-tested using the same data source (n = 90). Significant manipulation effects were found: mobile check-in ($M = 2.65$), kiosk check-in ($M = 2.59$), and employee check-in ($M = 4.87$).

In the main study, participants answered manipulation check questions for expected interaction, perceived health risk questions, hotel booking intention questions, and realism check questions after reading the scenario. After that, they answered a few demographic questions (i.e., age, gender, and frequency of using a hotel). There were no effects of demographic variables on the results reported in Study 1 and any of findings in the subsequent studies. To enhance the validity of responses for all studies, we only collected responses from those who used a hotel in the past 6 months. In addition, several attention check questions were included (e.g., which hotel was introduced in the scenario?).

Measurement items were drawn from existing items in previous research and were further modified to fit the research purpose. 7-point Likert-type response formats were used for all scales (i.e., 1: strongly disagree and 7: strongly agree). Two items were used to check expected interaction manipulations. Perceived health risk was measured by four items adopted from existing research (Quintal et al., 2010; Wong and Yeh, 2009). To measure hotel booking intention, four items were developed based on existing items (Chan et al., 2017; Wang et al., 2015). All items of each construct were reliable (expected interaction: $\alpha = 0.96$, perceived health risk: $\alpha = 0.93$, hotel booking intention: $\alpha = 0.95$). All measurement descriptions are provided in Appendix A.

4.2. Results

The realism of the proposed scenarios was measured by computing a mean score of two realism items. According to the results of one-sample t-test, the provided scenarios were realistic; the realism mean score ($M = 5.60$, $SD = 1.02$) was significantly greater than the neutral scale point 4: $t(117) = 49.52$, $p < 0.01$. Also, there was no significant difference between the three scenarios: $F(2, 115) = 0.26$, $p = 0.78$.

A significant effect of expected interaction manipulations was found: mobile check-in ($M = 2.74$, $SD = 1.58$), kiosk check-in ($M = 2.58$, $SD =$

1.56), and employee check-in ($M = 4.80$, $SD = 0.94$); $F(2, 115) = 30.94$, $p < 0.01$, $n_p^2 = 0.35$. One-way analysis of variance (ANOVA) results indicated a significant effect of expected interaction on perceived health risk: mobile check-in ($M = 3.51$, $SD = 1.40$), kiosk check-in ($M = 3.31$, $SD = 1.57$), and employee check-in ($M = 5.16$, $SD = 1.07$); $F(2, 115) = 19.33$, $p < 0.01$, $n_p^2 = 0.25$. Using PROCESS model 4 (bootstrapping of 5000 samples; Hayes, 2013), mediation analysis was conducted to test the proposed underlying process; perceived health risk was kept as the mediator in the relationship between expected interaction and hotel booking intention. The effect of expected interaction on perceived health risk was positive and significant: $b = 0.66$, $t = 11.28$, $p < 0.01$. Perceived health risk led to a lower of hotel booking intention: $b = -0.57$, $t = -5.73$, $p < 0.01$. While there was no significant direct effect of expected interaction on hotel booking intention ($b = 0.13$, $t = 1.44$, $p = 0.15$), a significant and negative indirect effect was found (indirect effect = -0.38, bootstrap 95% confidence interval [CI]: -0.53, -0.23). Hypothesis 1 and 2 were supported.

4.3. Discussion

The results of Study 1 indicate that hotel customers perceive lower levels of expected interaction when technology-mediated check-in services are available. Lower levels of expected interaction lead to lower levels of perceived health risk, resulting in higher levels of hotel booking intention; perceived health risk mediates the relationship between expected interaction and hotel booking intention. The next study analyzes the effects of expected cleanliness on perceived health risk.

5. Study 2

Study 2 was conducted to examine how hotel customers perceive health risk when they have different levels of expected cleanliness. The study utilized a 2 (expected interaction: high vs. low) × 2 (expected cleanliness: high vs. low) between-subjects design. Hypothesis 3 and 4 were tested.

5.1. Method

One hundred sixty Amazon Mechanical Turk users (63 females) participated in the study in exchange for a small monetary reward at the beginning of June 2020. Most participants were 30s (38.8%) and 40s (28.5%). Unlike Study 1, Study 2 developed hotel housekeeping scenarios to manipulate expected interaction. Participants found that some different housekeeping options are available for room cleaning services. In the low levels of interaction scenario, they read cleaning robots are provided for guest room cleaning. In the high levels of interaction scenario, they read that housekeeping employees are in charge of the guest room cleaning.

According to the Center for Disease Control and Prevention (CDC), the term of cleanliness consists of several key elements, such as cleaning (the removal of observable soil from a surface), decontamination (the removal of disease-causing microorganism from surfaces), disinfection (the removal of most pathogenic microorganisms from surfaces) and sterilization (the removal of microbial life including bacterial spores) (Zemke et al., 2015). Given the critical role of disinfection in preventing the spread of virus during the COVID-19 pandemic, this study focused on advanced Ozone and UV xenon disinfection technology systems to manipulate expected cleanliness. In the high cleanliness scenario, participants read the hotel implements advanced Ozone and UV xenon disinfection systems, which can effectively clean the air in the hotel room. In the control condition, they read that normal room cleaning services are provided without an advanced disinfection system. All scenario descriptions are provided in Appendix B.

After reading the scenarios, they answered manipulation check questions for expected interaction and expected cleanliness, perceived

health risk questions, hotel booking intention questions, and realism check questions. After that, they answered a few demographic questions (i.e., age, gender, and frequency of using a hotel).

Same measures of expected interaction, perceived health risk, and hotel booking intention were used again. To measure expected cleanliness, two items were used. All items of each construct were reliable (expected interaction: α = 0.95, expected cleanliness: α = 0.97, perceived health risk: α = 0.94, and hotel booking intention: α = 0.96,).

5.2. Results

The scenarios were highly realistic: $M = 5.50$, $SD = 0.92$, $t(159) = 20.63$, $p < 0.01$. No significant variation was found across scenarios: $F(3,156) = 0.59$, $p = 0.62$. The manipulation of expected interaction was significant: robot cleaning ($M = 2.53$, $SD = 1.74$), housekeeping employee cleaning ($M = 4.74$, $SD = 1.04$); $F(1, 158) = 94.19$, $p < 0.01$, $n_p^2 = 0.37$. No interaction with expected cleanliness was found: $F(1,156) = 0.93$, $p = 0.76$, $n_p^2 = 0.001$. The manipulation of expected cleanliness was effective: advanced disinfection system ($M = 5.80$, $SD = 1.01$), no advanced disinfection system ($M = 3.53$, $SD = 1.45$); $F(1,158) = 131.85$, $p < 0.01$, $n_p^2 = 0.46$. No interaction with expected interaction was found: $F(1,156) = .35$, $p = 0.65$, $n_p^2 = 0.002$. Collectively, both manipulations were effective.

A significant effect of expected interaction on perceived health risk was found: robot cleaning ($M = 3.88$, $SD = 1.27$), housekeeping employee cleaning ($M = 4.73$, $SD = 1.56$); $F(1, 156) = 16.94$, $p < 0.01$, $n_p^2 = 0.10$. Following the same approach in Study 1, mediation analysis was conducted to test the mediating effect of perceived health risk on the relationship between expected interaction and hotel booking intention. A significant and negative indirect effect was found (indirect effect = -0.23, bootstrap 95% confidence interval [CI]: -0.35, -0.12). Hypothesis 1 and 2 were supported again.

The main and moderating effects of expected cleanliness on perceived health risk were analyzed. A significant effect of expected cleanliness on perceived health risk was found: advanced disinfection system ($M = 3.68$, $SD = 1.51$), no advanced disinfection system ($M = 4.94$, $SD = 1.16$); $F(1, 156) = 38.12$, $p < 0.01$, $n_p^2 = 0.20$. A significant interaction effect of expected cleanliness and expected interaction on perceived health risk was found: $F(1,156) = 5.06$, $p < 0.05$, $n_p^2 = 0.03$. To decompose the interaction effects, simple effects were analyzed. As shown in Fig. 2, when an advanced disinfection system was provided, there was no significant difference in perceived health risk across the interaction situations (Mean difference = 0.37, $F(1, 156) = 1.74$, $p = 0.19$). Conversely, when the advanced disinfection system was not provided, perceived health risk was higher in the high levels of expected interaction scenario (employee cleaning) than in the low levels of
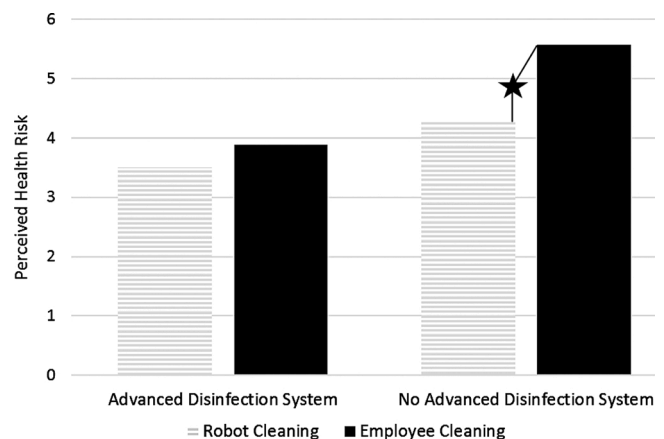
Fig. 2. Interaction Plot.

expected interaction scenario (robot cleaning) (Mean difference = 1.29, $F(1, 156) = 20.25$, $p < 0.01$). Thus, hypothesis 3 and 4 were accepted.

5.3. Discussion

The Study 2 results reconfirm the significant effects of expected interaction on perceived health risk. In addition, the underlying perceived health risk mechanism was found again. Importantly, Study 2 identified that expected cleanliness not only directly affects perceived health risk but also moderates the impact of expected interaction on perceived health risk. The next study analyzes the proposed perceived health risk mechanism in post COVID-19 pandemic scenarios.

6. Study 3

Study 3 replicates the findings of Study 1 and 2 in the context of the post-pandemic era. Sajadi et al. (2020) found that the distribution pattern of COVID-19 virus is similar to the behavior of a seasonal respiratory virus. Importantly, the virus is likely to circulate as a seasonal, endemic flu; it could retreat in summer and return in the fall and winter each year (Bursztynsky, 2020). Considering this prediction, Study 3 tested the hypotheses in post-pandemic scenarios to enhance external validity of study findings. Same as Study 2, 2 (expected interaction: high vs. low) × 2 (expected cleanliness: high vs. low) between-subjects design was utilized.

6.1. Method

One hundred fifty-nine Amazon Mechanical Turk users (74 female) participated in the study in exchange for a small monetary reward at the beginning of June 2020. Most participants were 30s (40.2%) and 40s (25.8%). Participants read that they are planning to book a hotel for their next winter vacation after the COVID-19 pandemic. They also read that the pandemic is over but still the COVID-19 virus exists similar to the seasonal respiratory virus when they book the hotel. To manipulate expected interaction, similar with Study 1, kiosk check-in and employee check-in scenarios were used. In terms of expected cleanliness, participants read that the hotel implements advanced Ozone and UV xenon disinfection systems which can effectively clean the air in the lobby and sanitize surfaces of the kiosk machines or the front desk areas during check-in. Participants in the control condition read that normal cleaning services are provided in front-desk areas without an advanced disinfection system.

After reading the scenario, they answered the same questions as Study 2. All items of each construct were reliable (expected interaction: $\alpha = 0.95$, expected cleanliness: $\alpha = 0.97$, perceived health risk: $\alpha = 0.94$, and hotel booking intention: $\alpha = 0.96$,).

6.2. Results

The scenarios were highly realistic: $M = 5.17$, $SD = 1.19$, $t(158) = 12.32$, $p < 0.01$. No significant variation was found across scenarios: $F(3,155) = 0.85$, $p = 0.47$. The manipulation of expected interaction was significant: kiosk check-in ($M = 2.30$, $SD = 1.27$), employee check-in ($M = 4.75$, $SD = 1.01$); $F(1, 157) = 178.17$, $p < 0.01$, $n_p^2 = 0.53$. No interaction with expected cleanliness was found: $F(1,155) = 1.18$, $p = 0.28$, $n_p^2 = 0.008$. The manipulation of expected cleanliness was effective: advanced disinfection system ($M = 5.90$, $SD = 0.93$), no advanced disinfection system ($M = 3.14$, $SD = 1.41$); $F(1,157) = 248.52$, $p < 0.01$, $n_p^2 = 0.61$. No interaction with expected interaction was found: $F(1,156) = .09$, $p = 0.77$, $n_p^2 = 0.001$. Collectively, both manipulations were effective.

A significant effect of expected interaction on perceived health risk was found: kiosk check-in ($M = 3.65$, $SD = 1.33$), employee check-in ($M = 4.63$, $SD = 1.64$); $F(1, 157) = 17.04$, $p < 0.01$, $n_p^2 = 0.10$. It was found

that perceived health risk fully mediates the relationship between expected interaction and hotel booking intention (indirect effect = −0.27, bootstrap 95% confidence interval [CI]: −0.38, −0.17). Thus, hypothesis 1 and 2 were supported again.

The main and moderating effects of expected cleanliness on perceived health risk were analyzed. A significant effect of expected cleanliness on perceived health risk was found: advanced disinfection system ($M = 3.45$, $SD = 1.53$), no advanced disinfection system ($M = 4.80$, $SD = 1.29$); $F(1, 157) = 35.87$, $p < 0.01$, $n_p^2 = 0.19$. A significant interaction effect of expected cleanliness and expected interaction on perceived health risk was found: $F(1,155) = 8.02$, $p < 0.01$, $n_p^2 = 0.05$. As shown in Fig. 3, when an advanced disinfection system was provided, there was no difference in perceived health risk across the interaction situations (Mean difference = 0.39, $F(1, 155) = 1.83$, $p = 0.18$). Conversely, when the advanced disinfection system was not provided, perceived health risk was higher in the high levels of expected interaction scenario (employee check-in) than in the low levels of expected interaction scenario (kiosk check-in) (Mean difference = 1.57, $F(1, 155) = 49.41$, $p < 0.01$). Thus, hypothesis 3 and 4 were accepted again.

Additionally, a significant effect of expected cleanliness on hotel booking intention was found: advanced disinfection system ($M = 5.01$, $SD = 1.17$), no advanced disinfection system ($M = 3.39$, $SD = 1.47$); $F(1, 157) = 57.71$, $p < 0.01$, $n_p^2 = 0.27$. Furthermore, expected cleanliness moderated the impact of expected interaction on hotel booking intention: $F(1,155) = 18.52$, $p < 0.01$, $n_p^2 = 0.11$. Specifically, when an advanced disinfection system was provided, there was no difference in hotel booking intention across the interaction scenarios (Mean difference = 0.01, $F(1, 155) = 0.03$, $p = 0.96$). However, when the advanced disinfection system was not provided, hotel booking intention was higher in the low levels of expected interaction scenario (kiosk check-in) than in the high levels of expected interaction scenario (employee check-in) (Mean difference = 1.64, $F(1, 155) = 36.69$, $p < 0.01$).

6.3. Discussion

Study 3 results show that the impacts of technology innovation for reducing employee interactions and enhancing cleanliness on hotel customers' perceived health risk and booking intention are significant in the contexts of post-pandemic.

7. General discussion

Given the growing perception of destination and hospitality properties as riskier places to travel during the COVID-19 pandemic, the concerns of health risk within the hospitality and tourism industry justify attention and research. This study sought to understand how risk-reduction strategies via technology innovation at hotels influence
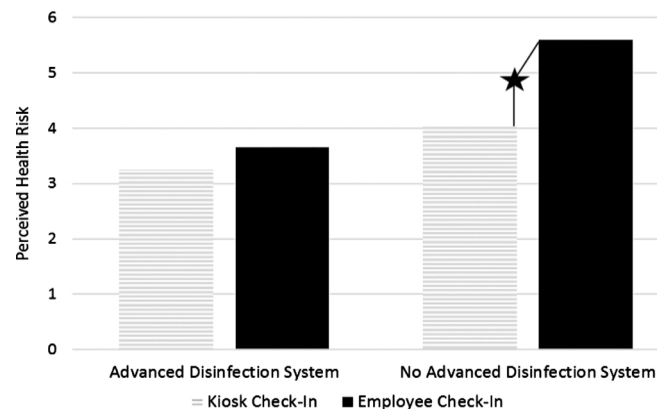
Fig. 3. Interaction Plot.

customer health risk perception and decision-making behaviors in both pandemic and post-pandemic scenarios. The following will discuss theoretical and practical implications, and propose future research directions.

7.1. Theoretical implications

This study has several theoretical implications. First, this study contributed to developing perceived-risk theory by identifying the significant role of perceived health risk in customer decision-making processes. While perceived risk and uncertainty in customer decision-making have been of major interest for researchers (e.g., Meents and Verhagen, 2018; Mitchell, 1999; Williams and Noyes, 2007), there is still a need for a systematic understanding of how hospitality customers perceive health risk and how this influences their decisions to visit hotels (Williams and Baláž, 2015). This study filled this research gap by identifying the significant impact of perceived health risk on hotel booking intention. Importantly, the study results propose that perceived health risk could be a non-compensatory factor for hotel customers when they select a hotel. Thus, the non-compensatory decision rule can be a theoretical framework to understand tourists' or hospitality customers' decision-making behaviors in a time of the COVID-19 pandemic.

Second, this research shows that technology innovation can be a critical means for hotel risk management to alleviate customers' perceived health risks. Importantly, this study expanded the context of technology innovation research. While the historical focus of existing research has been on managerial or employee adoption processes of technology innovation (e.g., Lam et al., 2007; Shin et al., 2019), this study focused on the role of technology innovation in reducing perceived health risk. In addition, the theoretical focus of previous research was the association between the adoption of information technologies and perceived risk (Lepp et al., 2011; Tseng and Wang, 2016). This study expanded the contexts of existing research by exclusively focusing on how the adoption of hotel operational technologies influences perceived health risk. While Bitner et al. (2000) initially conceptualized the service encounter model as "high-touch and low-tech," the study results show that the hospitality service experiences via technology innovation can be "low-touch and high-tech" for reducing perceived health risk. This service nature would be a new normal for attracting hotel customers in the pandemic era and technology can promote this change.

Following previous research (e.g., Liu and Jang, 2009; Lockyer, 2003), this study quantitatively analyzed the significant impact of hotel cleanliness on hotel booking intention. More specifically, potential hotel customers who know that a particular hotel adopts enhanced cleaning practices are likely to have less concern about potential health risk (Zemke et al., 2015). In addition, even if the expected interaction level is high at a hotel, hotel customers are likely to perceive low health risk when the hotel adopts advanced cleanliness practices. The interaction effect is in line with the two-factor theory; hotel cleanliness is a core factor which can replace the impact of existing decision-making factors (Slevitch and Oh, 2010). Importantly, this result indicates that the impact of expected cleanliness can override the impact of expected interaction on perceived health risk. While this study exploratively analyzed a positive interaction effect between expected cleanliness and expected interaction on perceived health risk, further theoretical examinations are necessary to better explain the impact of overriding factors in reducing perceived health risk.

Lastly, this study examined the perceived health risk mechanism in both pandemic and post-pandemic scenarios to enhance the external validity of the study findings. Importantly, the significant effects of perceived health risk on hotel booking intention in post-pandemic scenarios empirically supported the prediction that it could be years before the hospitality business fully recovers; most hospitality customers will be reluctant to visit hotels and restaurants for safety reasons (Bartash, 2020). This is an important insight into hospitality customers'

decision-making processes; hospitality customers' concern pertaining to health risk is not likely to disappear, even after the pandemic. This indicates that health risk and safety issues are likely to be the most critical elements explaining customer decision-making processes in hospitality and tourism research. Further scholarly attention needs to be paid to these issues.

7.2. Practical implications

The COVID-19 pandemic forces hotels - indeed, the entire hospitality and tourism industry - to adopt new working practices to provide customers with an immediate sense of safety. Importantly, technology innovation will be the front-runner in the changes that the hospitality industry will go through the years after the pandemic. In this regard, this study suggests useful practical implications.

First, hotels need to prove they are safe by integrating innovative automated and robotic technologies for social distancing. It is important to reduce interaction with employees and other customers though technology systems, such as contactless check-in and check-out systems, digital key systems, face recognition systems, and cleaning robot systems. In terms of cleaning procedures, the implementation of advanced cleaning technologies (e.g., electrostatic sprayers, ultraviolet light, germ-zapping robots, advanced HVAC [heating, ventilation, and air conditioning systems], etc.) will be critical for reducing actual and perceived health risk. Since other customers share hotel facilities, disinfecting not only rooms but also other high-touch areas and surfaces is important.

While providing technology-mediated service experiences will be a key hotel strategy in the pandemic era, it may also pose challenges, such as high costs, loss of employment, and low-touch service experiences. Although adopting new technologies will incur extra costs for hotel owners, the study results indicate the important role of technologies in attracting hotel customers, even after the pandemic. Thus, investments in technologies should be long-term oriented. The study results show that adopting advanced cleaning technologies can be effective in reducing perceived health risk without the adoption of technologies for social distancing. This is an important strategy considering the costs associated with technology adoptions; hotels can focus on the adoption of cleaning technologies when the adoption of automation technologies incurs large costs. In addition, hotel practitioners need to ensure that the adoption of automation and robotics does not necessarily result in the elimination of human roles, but rather, the creation of new roles in other areas to counteract the displacement. These practices will also help hotels maintain high service quality with employees who play roles that are more creative.

Third, this study reconfirmed that providing hotel customers with appropriate information on risk-reduction strategies can lower their perceived health risk during decision-making processes (Meents and Verhagen, 2018). In terms of signaling theory (Spence, 1974), information provided by a company has a significant impact on consumer decision-making behaviors. Thus, hotels need to facilitate effective communications about their strategies for protecting against coronavirus transmission for potential hotel customers.

7.3. Limitations and future research directions

Several limitations should be acknowledged to provide future research directions. First, while this study focused on the impact of technology innovation on perceived health risk, future research needs to examine the impact of other critical factors, such as anxiety, motivation, and personality (Lepp and Gibson, 2003; Reisinger and Mavondo, 2005). It would be meaningful to examine the proposed framework in the contexts of individual or branded hotels, leisure or business travelers, and different cultural backgrounds of hotel customers. In addition, as found in the additional analysis of Study 3, further research needs to examine the potential impact of expected cleanliness on hotel booking

behaviors in COVID-19 pandemic contexts.

Second, further research needs to examine the hospitality customer's non-compensatory decision-making process in the pandemic era. Contrary to previous research (e.g., Lepp and Gibson, 2003; Yang et al., 2017), this study found there were insignificant impacts of demographic factors (e.g., gender, age, etc.) on perceived health risk. This result might indicate that perceived health risk is likely to act as one cue of a non-compensatory heuristic and is not traded off with other considerations (Hilbig, 2014). Thus, traditional strategies for attracting hotel customers, such as providing room discounts or coupons and mileage benefits, can have limited impact on perceived health risk and hotel booking intention. This issue deserves further scholarly attention.

Lastly, future research needs to improve manipulated scenarios. In the current study, manipulations for expected interaction and expected cleanliness are explicitly stated by following real cases; most hotels clearly communicate their actions for interactions and cleanliness taken to deal with the COVID-19 pandemic. However, in experimental studies, indirectly manipulating situations instead of explicitly stating the manipulations is preferred to enhance the validity of responses. In addition, while this study focused on check-in and room cleaning situations to manipulate expected interaction and expected cleanliness, future research needs to focus on broader contexts. In fact, implementing technologies for reducing health risk is a company-wide process; multiple technologies can be adopted across hotel facilities, such as hotel rooms, lobbies, front desks, restaurants, swimming pools, and so forth. Future research needs to examine the impact of broader technology adoptions at multiple touch points on perceived health risk and hotel booking intention.

Declaration of Competing Interest

The authors report no declarations of interest.

Appendix A. Measurement items (Study 1 and 3 check-in contexts)

Manipulation check (expected interaction)

- What level of interaction do you expect with hotel employees when you check-in to the "3JH Hotel"?
- When checking-in to the "3JH Hotel", how many interactions do you expect to have with hotel employees?

Manipulation check (expected cleanliness)

- What level of cleanliness do you expect of the "3JH Hotel" when you check-in?
- When checking-in to the "3JH Hotel", what level of cleanliness do you expect?

Perceived health risk

- I feel nervous about visiting 3JH hotel because of health concerns.
- Visiting 3JH hotel is a risky decision for my health.
- I feel uncomfortable visiting 3JH hotel because of my health safety.
- There is high probability that visiting 3JH hotel would lead to a health problem.

Hotel booking intention

After reading the scenario,

- It is likely that I would book a room at "3JH Hotel."
- I am willing to book a room at "3JH Hotel."
- It is possible that I would book a room at "3JH Hotel."
- I would intend to book a room at "3JH Hotel."

Appendix B. Study Scenarios (Study 2)

Scenario 1 - Robot cleaning and advanced cleaning system

Imagine that you're planning on booking a hotel room for your next vacation, during the COVID-19 pandemic. As you search for an appropriate hotel, you find that "3JH Hotel" provides cleaning robots that perform housekeeping tasks. These robots will allow you to have a contactless service experience since you don't have to interact with housekeeping staff for your housekeeping needs. In addition, the robot has advanced Ozone and UV xenon disinfection systems that can effectively clean the air in the hotel room without any toxins or adverse side effects.

Scenario 2 - Employee cleaning and advanced cleaning system

Imagine that you're planning on booking a hotel room for your next vacation, during the COVID-19 pandemic. As you search for an appropriate hotel, you find that "3JH Hotel" only provides normal housekeeping services. This means that you will need to meet and interact with housekeeping staff for your housekeeping needs. However, the housekeeping staff will use advanced Ozone and UV xenon disinfection systems that can effectively clean the air in the hotel room without any toxins or adverse side effects.

Scenario 3 - Robot cleaning and no advanced cleaning system

Imagine that you're planning on booking a hotel room for your next vacation, during the COVID-19 pandemic. As you search for an appropriate hotel, you find that "3JH Hotel" provides cleaning robots that perform housekeeping tasks. These robots will allow you to have a contactless service experience since you don't have to interact with housekeeping staff for your housekeeping needs. The hotel provides normal room cleaning services; there is NO advanced disinfection service provided in the room cleaning.

Scenario 4 - Employee cleaning and no advanced cleaning system

Imagine that you're planning on booking a hotel room for your next vacation, during the COVID-19 pandemic. As you search for an appropriate hotel, you find that "3JH Hotel" only provides normal housekeeping services. This means that you will need to meet and interact with housekeeping staff for your housekeeping needs. The hotel provides normal room cleaning services; there is NO advanced disinfection service provided in the room cleaning.

References

Adam, I., 2015. Backpackers' risk perceptions and risk reduction strategies in Ghana. Tour. Manag. 49, 99–108.

AHLA, 2020. Leisure and Hospitality Industry Proves Hardest Hit by COVID-19. Retrieved from. https://www.ahla.com/covid-19s-impact-hotel-industry.

Amblee, N., 2015. The impact of cleanliness on customer perceptions of security in hostels: a WOM-based approach. Int. J. Hosp. Manag. 49, 37–39.

Barber, N., Goodman, R.J., Goh, B.K., 2011. Restaurant consumers repeat patronage: a service quality concern. Int. J. Hosp. Manag. 30 (2), 329–336.

Bartash, J., 2020. Restaurants and Hotels, Devastated by Coronavirus, Face Long and Painful Recovery. Retrieved from. https://www.marketwatch.com/story/restaurants-and-hotels-devastated-by-coronavirus-face-long-and-painful-recovery-2020-04-15.

Bauer, R.A., 1960. Consumer behavior as risk taking. In: Hancock, R.L. (Ed.), Dynamic Marketing for a Changing World. American Marketing Association, Chicago, IL.

Bentley, T.A., Page, S.J., 2008. A decade of injury monitoring in the New Zealand adventure tourism sector: a summary risk analysis. Tour. Manag. 29 (5), 857–869.

Best western, 2012. Best Western Introduces New Cleaning Technologies for Hotels. Retrieved from. https://www.prnewswire.com/news-releases/best-western-introduces-new-cleaning-technologies-for-hotels-155945325.html.

Bitner, M.J., 1992. Servicescapes: the impact of physical surroundings on customers and employees. J. Mark. 56 (2), 57–71.

Bitner, M.J., Brown, S.W., Meuter, M.L., 2000. Technology infusion in service encounters. J. Acad. Mark. Sci. 28 (1), 138–149.

Bruce, M.L., 2002. Psychosocial risk factors for depressive disorders in late life. Biol. Psychiatry 52 (3), 175–184.

Buckley, R., 2012. Rush as a key motivation in skilled adventure tourism: resolving the risk recreation paradox. Tour. Manag. 33 (4), 961–970.

Buratti, S., Allwood, C.M., 2019. The effect of knowledge and ignorance assessments on perceived risk. J. Risk Res. 22 (6), 735–748.

Bursztynsky, J., 2020. Johns Hopkins Doctor Says New Coronavirus is Here to Stay, Expects 'Seasonal' Outbreaks. Retrieved from. https://www.cnbc.com/2020/02/04/johns-hopkins-dr-amesh-adalja-says-new-coronavirus-is-here-to-stay.html.

Carr, N., 2001. An exploratory study of gendered differences in young tourists perception of danger within London. Tour. Manag. 22 (5), 565–570.

Chan, I.C.C., Lam, L.W., Chow, C.W., Fong, L.H.N., Law, R., 2017. The effect of online reviews on hotel booking intention: the role of reader-reviewer similarity. Int. J. Hosp. Manag. 66, 54–65.

Dobrosielski, C., 2020. HotelAVE Projects 5-year Recovery for Hotels After COVID-19. Retrieved from. https://www.hotelmanagement.net/asset-management/hotelave-projects-5-year-recovery-for-hotels-after-covid-19.

Garcia, I., 2020. Hilton, Hyatt, and Marriott Will Introduce New Cleaning Protocols. Retrieved from. https://www.housebeautiful.com/lifestyle/a32367701/hilton-hyatt-and-marriott-new-cleaning-protocols-coronavirus/.

Gemünden, H.G., 1985. Perceived risk and information search. A systematic meta-analysis of the empirical evidence. Int. J. Res. Mark. 2 (2), 79–100.

Greenleaf, E.A., Lehmann, D.R., 1995. Reasons for substantial delay in consumer decision making. J. Consum. Res. 22 (2), 186–199.

Hayes, Andrew F., 2013. Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. Guilford, New York.

Hilbig, B.E., 2014. On the role of recognition in consumer choice: a model comparison. Judgm. Decis. Mak. 9 (1), 51–57.

Kim, T.G., Lee, J.H., Law, R., 2008. An empirical examination of the acceptance behaviour of hotel front office systems: an extended technology acceptance model. Tour. Manag. 29 (3), 500–513.

Kozak, M., Crotts, J.C., Law, R., 2007. The impact of the perception of risk on international travellers. Int. J. Tour. Res. 9 (4), 233–242.

Kussmann, H., 2020. Will the Coronavirus Crisis Force Hoteliers to Implement New Technologies Faster? Retrieved from. https://www.hotel-online.com/press_releases/release/will-the-coronavirus-crisis-force-hoteliers-to-implement-new-technologies-faster/.

Lam, T., Cho, V., Qu, H., 2007. A study of hotel employee behavioral intentions towards adoption of information technology. Int. J. Hosp. Manag. 26 (1), 49–65.

Law, R., 2006. The perceived impact of risks on travel decisions. Int. J. Tour. Res. 8 (4), 289–300.

Lepp, A., Gibson, H., 2003. Tourist roles, perceived risk and international tourism. Ann. Tour. Res. 30 (3), 606–624.

Lepp, A., Gibson, H., 2008. Sensation seeking and tourism: tourist role, perception of risk and destination choice. Tour. Manag. 29 (4), 740–750.

Lepp, A., Gibson, H., Lane, C., 2011. Image and perceived risk: a study of Uganda and its official tourism website. Tour. Manag. 32 (3), 675–684.

Liu, Y., Jang, S.S., 2009. Perceptions of Chinese restaurants in the US: what affects customer satisfaction and behavioral intentions? Int. J. Hosp. Manag. 28 (3), 338–348.

Lockyer, T., 2003. Hotel cleanliness—how do guests view it? Let us get specific. A New Zealand study. Int. J. Hosp. Manag. 22 (3), 297–305.

Longwoods International, 2020. COVID-19 Travel Sentiment Study-Wave 5. Retrieved from. https://longwoods-intl.com/news-press-release/covid-19-travel-sentiment-study-wave-5.

Meents, S., Verhagen, T., 2018. Reducing consumer risk in electronic marketplaces: the signaling role of product and seller information. Comput. Hum. Behav. 86, 205–217.

Mitchell, V.W., 1992. Understanding consumers' behavior: can perceived risk theory help. Manage. Decis. 30 (3), 26–31.

Mitchell, V.W., 1998. A role for consumer risk perceptions in grocery retailing. Br. Food J. 100 (4), 171–183.

Mitchell, V.W., 1999. Consumer perceived risk: conceptualizations and models. Eur. J. Mark. 33 (1/2), 163–195.

Mitchell, V.W., McGoldrick, P.J., 1996. Consumer's risk-reduction strategies: a review and synthesis. Int. Rev. Retail. Distrib. Consum. Res. 6 (1), 1–33.

Mitchell, V.W., Davies, F., Moutinho, L., Vassos, V., 1999. Using neural networks to understand service risk in the holiday product. J. Bus. Res. 46 (2), 167–181.

Nicholls, R., 2010. New directions for customer-to-customer interaction research. J. Serv. Mark. 24 (1), 87–97.

Pappas, N., 2016. Marketing strategies, perceived risks, and consumer trust in online buying behaviour. J. Retail. Consum. Serv. 29, 92-10.

Quintal, V.A., Lee, J.A., Soutar, G.N., 2010. Risk, uncertainty and the theory of planned behavior: a tourism example. Tour. Manag. 31 (6), 797–805.

Rehman, Z.U., Baharun, R., Salleh, N.Z.M., 2020. Antecedents, consequences, and reducers of perceived risk in social media: a systematic literature review and directions for further research. Psychol. Mark. 37 (1), 74–86.

Reisinger, Y., Mavondo, F., 2005. Travel anxiety and intentions to travel internationally: implications of travel risk perception. J. Travel. Res. 43 (3), 212–225.

Roehl, W.S., Fesenmaier, D.R., 1992. Risk perceptions and pleasure travel: an exploratory analysis. J. Travel. Res. 30 (4), 17–26.

Sajadi, M.M., Habibzadeh, P., Vintzileos, A., Shokouhi, S., Miralles-Wilhelm, F., Amoroso, A., 2020. Temperature and Latitude Analysis to Predict Potential Spread and Seasonality for COVID-19. Available at SSRN 3550308.

Shimp, T.A., Bearden, W.O., 1982. Warranty and other extrinsic cue effects on consumers' risk perceptions. J. Consum. Res. 9 (1), 38–46.

Shin, H., Perdue, R.R., 2019. Self-Service Technology Research: a bibliometric co-citation visualization analysis. Int. J. Hosp. Manag. 80, 101–112.

Shin, H., Perdue, R.R., Kang, J., 2019. Front desk technology innovation in hotels: a managerial perspective. Tour. Manag. 74, 310–318.

Slevitch, L., Oh, H., 2010. Asymmetric relationship between attribute performance and customer satisfaction: a new perspective. Int. J. Hosp. Manag. 29 (4), 559–569.

Sönmez, S.F., Graefe, A.R., 1998. Influence of terrorism risk on foreign tourism decisions. Ann. Tour. Res. 25 (1), 112–144.

Spence, Michael, 1974. Market-Signaling. Harvard University Press, Cambridge, MA.

Tseng, S.Y., Wang, C.N., 2016. Perceived risk influence on dual-route information adoption processes on travel websites. J. Bus. Res. 69 (6), 2289–2296.

Wang, S., Hung, K., 2015. Customer perceptions of critical success factors for guest houses. Int. J. Hosp. Manag. 48, 92–101.

Wang, L., Law, R., Guillet, B.D., Hung, K., Fong, D.K.C., 2015. Impact of hotel website quality on online booking intentions: eTrust as a mediator. Int. J. Hosp. Manag. 47, 108–115.

Williams, A.M., Baláž, V., 2013. Tourism, risk tolerance and competences: travel organization and tourism hazards. Tour. Manag. 35, 209–221.

Williams, A.M., Baláž, V., 2015. Tourism risk and uncertainty: theoretical reflections. J. Travel. Res. 54 (3), 271–287.

Williams, D.J., Noyes, J.M., 2007. How does our perception of risk influence decision-making? Implications for the design of risk information. Theor. Issues Ergon. Sci. 8 (1), 1–35.

Wong, J.Y., Yeh, C., 2009. Tourist hesitation in destination decision making. Ann. Tour. Res. 36 (1), 6–23.

Wooder, S., Baker, S., 2012. Extracting key lessons in service innovation. J. Prod. Innov. Manage. 29 (1), 13–20.

Xenex, 2020. First Hotel in Country to Deploy Virus Killing Robots. Retrieved from. https://www.xenex.com/resources/news/first-hotel-in-country-to-deploy-virus-killing-robots/.

Yang, E.C.L., Nair, V., 2014. Tourism at risk: a review of risk and perceived risk in tourism. Asia-Pac. J. Innov. Hosp. Tour. 3 (2), 1–21.

Yang, E.C.L., Khoo-Lattimore, C., Arcodia, C., 2017. A systematic literature review of risk and gender research in tourism. Tour. Manag. 58, 89–100.

Yeung, R., Yee, W., Morris, J., 2010. The effects of risk-reducing strategies on consumer perceived risk and on purchase likelihood. Br. Food J. 112 (3), 306–322.

Yoe, C., 2011. Principles of Risk Analysis: Decision Making Under Uncertainty. CRC Press, NY.

Zeithaml, V.A., Bitner, M.J., Gremler, D.D., 2017. Services Marketing: Integrating Customer Focus Across the Firm, 7th ed. McGraw Hill, New York.

Zemke, D.M.V., Neal, J., Shoemaker, S., Kirsch, K., 2015. Hotel cleanliness: will guests pay for enhanced disinfection? Int. J. Contemp. Hosp. Manage. 27 (4), 697–710.

Zeng, Z., Chen, P.J., Lew, A.A., 2020. From high-touch to high-tech: COVID-19 drives robotics adoption. Tour. Geogr. 1–11.