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Preference for robot service or human service in hotels? Impacts of the COVID-19 pandemic

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ABSTRACT

Robots and artificial intelligence (AI) technologies are becoming more prominent in the tourism industry. Nowadays, consumers are faced with multiple options involving both human and robot interactions. A series of experimental studies were implemented. Four experiments demonstrated that consumers had a more positive attitude toward robot-staffed (vs. human-staffed) hotels when COVID-19 was salient. The results were different from previous studies, which were conducted before the COVID-19 pandemic. Since the moderating role of perceived threat in consumers' preference for robot-staffed hotels was significant, the respondents' preference was attributed to the global health crisis. This research provides a number of theoretical and managerial implications by improving the understanding of technology acceptance during a health crisis.

1. Introduction

With the rapid development and implementation of robots and artificial intelligence (AI) technology, discussions about how robots will replace human jobs and labor are omnipresent among researchers and practitioners. These automation technologies combine facial recognition technology, robots, wearable technology, and voiceover technology that can be implemented in the manufacture and delivery of products and services (Ivanov, 2020). While some see the progress of these technologies as an important risk factor in regard to jobs and unemployment, others mention the positive changes they can bring in terms of enhancing quality of life, health, and welfare (Brynjolfsson and McAfee, 2014; Choi et al., 2020a; Talwar et al., 2017). However, one common point of view is that artificial intelligence will disrupt the job market, with modified jobs and skills being required (Webster and Ivanov, 2020). According to the BBC, robots could take over 20 million manufacturing jobs worldwide by 2030 (BBC, 2020). Adjustments will continue to take place within the tourism and hospitality industry, as robots and artificial intelligence are a foreseeable avenue for innovation, and improved efficiency and profitability (Ivanov and Webster, 2019a).

When making travel decisions, consumers are commonly presented with several hotel options with different attributes to choose from. The innovations caused by automation technologies are modifying consumers' consideration sets and experiences. Deeper knowledge about the acceptance of these technologies is key for marketers, travel agencies, and hotels, as it determines their adoption and usage by individuals (Ukpabi and Karjaluoto, 2017). In this work, we focus on the current COVID-19 pandemic, asking travelers to compare robot- and human-serviced hotels. The extant literature suggests contradictory findings with regard to consumers' reactions to robotic hotel service. Some research has encountered skepticism and potential issues regarding customers' acceptance of robots (Io and Lee, 2020; Mori et al., 2012), while other studies have demonstrated positive reactions and visiting intentions relating to robot-serviced hotels (Ivanov et al., 2018; Qiu et al., 2020).

Although studies on preferences regarding robots and new technology in the tourism and hospitality industry have recently emerged (Chan and Tung, 2019; Choi et al., 2020b; Ho et al., 2020; Kuo et al., 2017; Park, 2020; Shin and Jeong, 2020; Tussyadiah and Park, 2018; Lu et al., 2019; Yu, 2020), empirical research on related industrial trends has not actively been conducted. Previous studies have examined aspects that pertain to customers' attitudes towards the use of robots (Ivanov et al.,

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2018), evaluation of service robots in hotels (Tussyadiah and Park, 2018), service quality perceptions of service robots in hotels (Choi et al., 2019), and customers' experiences with service robots (Tung and Au, 2018).

However, customers' preference for human service or robot service in the context of a health crisis (such as COVID-19) is yet to be adequately examined in the literature. Previous studies have documented the influence of situational factors in moderating consumer choice in different contexts (Xie and Wang, 2003). Knowledge of this can provide a holistic understanding of customer preferences and acceptance of novel technologies during a global health crisis. At present, businesses are dealing with the unexpected global COVID-19 health crisis, which has resulted in rigorous social distancing measures and fear of human contact (Kim et al., in press).

Thus, this study attempts to empirically test whether travelers prefer robot-serviced or human-serviced hotels when COVID-19 is salient. Since this inclination can be attributed to concerns regarding safety and social distancing, as well as individuals' reactions to uncertainty, it is believed that the perceived threat of COVID-19 will moderate the relative preference for robot and human hotels.

This empirical study is important because the findings can provide insights for new technology literature in general by extending our understanding of consumers' acceptance of these technologies. The limited existing research on the subject of robots and AI indicates that certain factors, such as anthropomorphization, may enhance perceptions of trust and responsibility with regard to robots (Murphy et al., 2019). Since this current research examines the impacts of the ongoing health crisis and uncertainty regarding the adoption of new technology, it may help to enhance the comprehensiveness of knowledge about attitudes and intentions toward AI technologies and robots.

In addition, this research is important because it improves our understanding of how robots impact the hospitality industry and how customers will continue to evaluate their experiences and interactions with robots in hotels. Finally, since the results of this study provide insights for the consumer behavior literature by proposing perceived threat as an essential factor in understanding consumers' preferences and behaviors in times of health crises and disruptive events, there was a strong rationale for implementing this study.

2. Literature review and main predictions

2.1. Characteristics and preference for human service

As hospitality is shared between a host and a guest, hospitality service provision is based on "hospitableness", which refers to the positive attitudes of service providers; they make guests feel cared for, welcome, and valued (Kim, Kim et al., 2020). Hospitableness is premised on service offered by humans and it mainly relies on emotional treatment by human staff (Golubovskaya et al., 2017). Hotels are represented as a symbol of hospitality, which manifests as human values or human touch. Customers' hotel experience is determined by a variety of factors, some of which are associated with the attitudes of service staff, such as showing politeness, patience, and emotion, welcoming guests, and providing a serene atmosphere of comfort and relaxation (Hwang et al., 2015; Lashley and Morrison, 2000).

Hotel guests' preference for human staff stresses the importance of face-to-face communication, which provides them with the opportunity to express their commendations and concerns. The need to interact with hotel staff also signifies guests' desire to experience quality and personalized service (e.g. eye contact and genuine smiles) (Ariffin, 2013). For example, a human staff member calling hotel guests by their names and offering an authentic smile communicates sincerity. As far as service encounters are concerned, human interaction is important when evaluating a service. Parasuraman, Zeithaml, and Berry's (1988) SERVQUAL, Cronin and Taylor's (1992) SERVPERF, and Brady and Cronin's (2001) three-factor service quality model have been widely used to assess human service delivery. For instance, Choi et al.'s (2019) study adopted Brady and Cronin's (2001) three factor service quality dimensions to compare the service quality perceptions of human employees, service robots, and a combination of human service and robot service. Their study found that human employees were preferred and performed better in both interaction quality and physical service environment dimensions.

A similar trend was identified by Chan and Tung (2019) when they compared the service delivery of human staff and service robots in the hotel brand experience. They found that irrespective of the hotel classification, human staff were better than service robots in making guests feel emotionally attached to the hotel brand and providing them with an enriching experience. Previously, Dabholkar (1992) examined customers' attitudes toward technology-based services and found negative perceptions of non-human services. In the same vein, Kim et al. (2012) found that customers who had a high desire for human service in a hotel had a lower likelihood of using a technology-based service.

Using human services provides several benefits to hospitality facilities. First, customers develop trust and interpersonal relations through their interactions with a hotel's human staff (Chao et al., 2007). The facilitation of communication and interactions between guests and hotel employees through interpersonal relationships consolidates trust and affection, which can enhance competitive advantages. Previous studies have found that interpersonal relationships between hotel guests and front office staff are important in promoting customer loyalty and repurchase behaviors (Ariffin, 2013; Guenzi and Pelloni, 2004). Second, since close engagement between hotel guests and human staff determines customer satisfaction (Ariffin and Maghzi, 2012), the absence of human staff can result in the loss of customers who prefer human service in hotels.

As a third benefit, interactions between guests and front office employees can reinforce guests' commitment and loyalty (Choi and Chu, 2001; Beatson et al., 2006). Since hotel guests expect personalized services and want to be valued by hotel employees, kind gestures, such as smiles, greetings, and pleasant eye contact can elicit positive emotions among guests, which can indirectly enhance guests' hotel experiences and loyalty to a hotel (Chen, 2011). In a similar manner, Bove and Johnson (2006) found that guests were loyal to organizations whose service employees exhibited positive attitudes.

Notwithstanding the benefits accrued by human services and engagements, they pose certain challenges. First, interpersonal interactions between service employees and guests can lead to negative outcomes. For example, the use of improper language or negative attitudes among hotel staff can negatively affect hotel guests, so that guests may become dissatisfied and their experiences may be marred (Chen, 2011; Kim et al., 2019, 2015). Second, human service is vulnerable to quality variation because service-providing humans are emotional animals (Kattara and El-Said, 2013). In addition, the fallible nature of humans can affect service provision; mistakes can be made, resulting in customer inconvenience or litigation, financial damage, and the degradation of a hotel's image (Barth, 2002).

2.2. Characteristics and preference for robot service

The advent-cum-proliferation of artificial intelligence (AI), as well as its pertinent technology, is not only redefining the way in which consumers interact with service providers, but is also stimulating significant research interest in service robot adoption, especially in the hotel subsector. Scholars have acknowledged the importance of technology (i.e., robots) in the service delivery process, resulting in empirical inquiries into consumers' perceptions of the use of robots in hotels (e.g., Choi et al., 2019; Lu et al., 2019; Shin and Jeong, 2020; Tussyadiah and Park, 2018). Robot service can be adopted as a form of service that is performed and delivered by robots to hotel guests (Murphy et al., 2019; Tung and Law, 2017). It can also be viewed as a robot-featured technological innovation that allows hotel guests to receive services without

the direct involvement of human employees (Wirtz et al., 2018).

Various researchers have discussed some drivers that necessitate the use of service robots in hotels. For instance, some note the influence of recent technological advancements on digitalized consumers' expectations of novel experiences, the quick adoption of new technology, and showing off their experience to others (Ivanov and Webster, 2019a; Qiu et al., 2020). Another reason is the demands incurred due to recently emerging social and technological changes, such as the rapid digitalization and introduction of state-of-the-art technology products, immersion in these devices, individualization due to digitalization, and the reduction of high labor costs (Choi et al., 2020b; Lu et al., 2019; Rodriguez-Lizundia et al., 2015). The perceived usefulness and ease of use of robots have also been integral in influencing customers' preference for service robots (Shin and Jeong, 2020).

The technology acceptance model (TAM) has been useful in examining individuals' acceptance and adoption of novel technologies (Venkatesh and Davis, 2000). Within the robotics literature, authors have found customers accept and have a positive disposition towards robots because of the functionality (perceived usefulness), efficiency and ease of use of robots in hotels and other hospitality facilities (Heerink et al., 2009; tom Dieck and Jung, 2018). Shin and Jeong (2020) found guests to have a positive attitude toward using a robot concierge and a subsequent influence on their intention to adopt a robot concierge. Tavitiyaman et al. (2020) also found the perceived usefulness of robot technologies to have a significant impact on hotel customers' preferences.

Aside from these factors, the morphology of robots can influence customers' preferences in the hotel context (Shin and Jeong, 2020; Tussyadiah and Park, 2018). Anthropomorphism, which involves an attribution of human characteristics to non-human objects, is key in this regard. For instance, previous studies identified anthropomorphic robots to induce positive attitudes, perceptions and a sense of efficacy among customers (Kiesler and Goetz, 2002; Nowak and Biocca, 2003; Tussyadiah and Park, 2018; Yu and Ngan, 2019). However, recent studies applying the uncanny valley theory find customers to have a preference for caricatured robots or "non-human-like" robots over anthropomorphic ones (Shin and Jeong, 2020; Mori et al., 2012).

Currently, service robots are used to deliver a wide range of services, including check-in and check-out, greeting, cooking, cleaning, escorting, butler services, and in-room delivery in hotels (Choi et al., 2019; Ivanov and Webster, 2017, 2019b; Lu et al., 2019; Shin and Jeong, 2020; Tussyadiah, 2020; Ziemke and Thill, 2014). In addition to performing service tasks, van Doorn et al. (2017) assert that robots can create new types of automated social interactions that can make guests feel accompanied by another social entity. In their study on hotel guests' experiences with service robots, hotel guests responded that they gained new and memorable experiences when they received services provided by robots.

The adoption of service robots brings several benefits to both hotels and consumers, such as enhanced and efficient service delivery, customization of the service delivery process (Pinillos et al., 2016), reduced labor costs (Mende et al., 2019; Wirtz et al., 2018), increased productivity through fewer staff (Dirican, 2015; Zhong et al., 2020b), improved competitiveness (Ivanov and Webster, 2017), and differentiation as a result of technological reputation (Choi et al., 2019; Ivanov and Webster, 2017). Importantly, using robots in a hotel has the potential advantage of controlling heterogeneity and standardization (Belias, 2020; Curran et al., 2003; Lu et al., 2019; Shimmura et al., 2020). Robots overcome the challenge of perishability, which is often associated with human service delivery, because robots, unlike human staff, can be activated by human staff's operation according to the order in a queue (Chiang and Trimi, 2020; Huang and Rust, 2020).

Apart from the advantages the use of service robots offer to a hotel, hotel guests can also save time and money through swift service delivery and sometimes lower service costs (Ivanov and Webster, 2017). Further, hotel guests can enjoy a higher level of personalized service, reduced waiting times for service delivery, fun, enjoyment, and flexibility from using robot technology, enhanced safety, satisfaction, and a unique experience (Pinillos et al., 2016; Kuo et al., 2017).

Notwithstanding these advantages, the loss of interpersonal contact as a result of using robots can be associated with the loss of social relationships, difficulties in setting up service recovery tactics in the event of service failure, the loss of upselling opportunities, and human staff resenting the technology, as it may be perceived as job-threatening (Bitner, 2001; Curran et al., 2003). Some hotel guests have reported that they perceive service robots negatively because of their lack of humanization or their limited ability to show emotions (Choi et al., 2019; Qiu et al., 2020). Hotel guests who are not conversant with technology may be fearful of robot technologies and have difficulty with service recovery issues in the event of a defect in service delivery (Curran et al., 2003). Customers might also worry about the potential loss of interpersonal contact between themselves and service staff (Zeithaml and Gilly, 1987).

3. Conceptual model and hypothesis development

3.1. Conceptual model

In psychology and the behavioral sciences, the concept of preference emanates from the rational choice theory, which posits consumer choice behaviours based on value maximization and identification of options with high utility (Blume and Easley, 2016). Further, the theory assumes the rationality of individuals, who carefully examine the costs and benefits of options and behave according to self-determined choices (Kahneman and Tversky, 1986). Preference connotes consumers' higher favor for one of the available options. Previous studies have shown that preference is linked to outcomes such as willingness to pay or purchase intention (Bagozzi, 1992). In contrast, Tversky and Thaler (1990) postulate that preference is context-dependent and can be influenced by certain external factors. Based on this, we argue that customers' evaluation of a human-staffed hotel or a robot-staffed hotel can be influenced by an environmental factor such as the recent COVID-19 outbreak, given its lethal and highly contagious nature.

This study was designed to identify customers' preference for human-staffed and robot-staffed service in the COVID-19 situation. Most traditional studies in service marketing have unveiled diverse benefits sought from human-staffed hotels because of high interaction and experiential quality (Choi and Chu, 2001; Tang and Tang, 2012). Although service robots serving functions such as cleaner, carter, information guide, front clerk, barista and cook have been recently introduced in the hotel field, there have been limited studies until now.

Among those that did not consider the effect of the COVID-19 pandemic, there are a few studies that compare preferences between human and robot service and the results show that human service was preferred (Chan and Tung, 2019; Choi et al., 2019; Kattara and El-Said, 2013; Ivanov et al., 2020; Stock and Merkle, 2018). For instance, in Choi et al.'s (2019) study, a combined human- and robot-staffed service was most preferred, followed by human-staffed and robot-staffed. Stock and Merkle (2018) used an experimental method to identify a strong positive customer preference for human employees over humanoid service robots in the hotel context. Chan and Tung (2019) also identified a preference for human staff (vs service robots) in terms of emotional attachment to a hotel's brand experience. Recently, Ivanov et al. (2020) revealed hotel managers' positive perceptions and preference for human employees rather than service robots. They emphasized that human employees are better at tasks that require social skills and emotional intelligence, although service robots were useful for the repetitive and more dangerous tasks in a hotel.

However, the COVID-19 pandemic has had an influence in determining customers' decisions in choosing digital or virtual technologies and platforms including virtual reality, virtual meetings, delivery Apps, visual games, virtual tourism, and virtual health care, among others

(Jiang and Wen, 2020; Sheth, 2020; Shin and Kang, 2020). For example, Shin and Kang (2020) found technology innovation (such as robots) to be important in consumer decisions, and essential in reducing perceived health risks based on expected levels of interaction in hotels. Similarly, Zeng et al. (2020) documented how COVID-19 has influenced the choice of robots in hotels, while Seyitoglu and Ivanov (2020) noted hotel managers' decisions to use service robots to enhance sanitation and physical distancing from the supply perspective.

The trends are for forceful social distancing measures, caused by the fear and threat of contracting COVID-19, and these form the basis of the conceptual model of this study, as shown in Fig. 1. Hypotheses 1a and 1b manifest the relationship between the perceived level of threat of COVID-19 and evaluation of preference for robot-staffed hotels, while hypothesis 2 indicates the relationship between the perceived threat of COVID-19 and concerns about safety and social distancing. Hypothesis 3 was designed to examine the mediating relationship between the perceived level of COVID-19 and concerns about safety and social distancing.

3.2. Effect of the risk of COVID-19 on evaluation of robot-staffed hotels

Perceived risk plays an important role in consumers' decision-making processes vis-à-vis their choice of tourism products. In the hospitality field, there is a range of risks related to customers, including personal health, social, financial, and performance risks (Chang and Hsiao, 2008; Sun, 2014). The perceived risk concerns a subjective belief about the uncertainty related to a purchasing activity (Bauer, 1960; Rehman et al., 2020) or a predisposition to a potential hazard or loss (An et al., 2010; Mitchell, 1998). Researchers have identified the salience of a risk as having an influence on consumers' emotions, attitudes, and choice behaviors (Galoni et al., 2020; Han et al., 2012; Lerner et al., 2004). Galoni et al. (2020), for instance, identified that the perceived risk of an influenza outbreak resulted in fear and disgust, such that individuals avoided contagion by choosing a less risky option. Individuals also held favorable attitudes toward an option when the salience of an event was high (Murray and Schaller, 2012). Customers' perceptions of the salience of an influenza outbreak, coupled with perceived contagion anxiety, can influence their attitudes toward and evaluations of a product.

With the introduction of service robots to alleviate concerns about personal risk and provide convenience to customers, researchers have recently identified a growing interest in adopting the use of service robots in hotels (Choi et al., 2019; Ivanov et al., 2017; Qiu et al., 2020; Tung and Law, 2017). Among other things, robots are being used to provide a range of benefits to hotels and hotel guests (Bartneck et al., 2009; Tung and Au, 2018). However, the psychological mechanism that underpins how customers evaluate their experience of a robot-serviced hotel during a health crisis is underexplored.

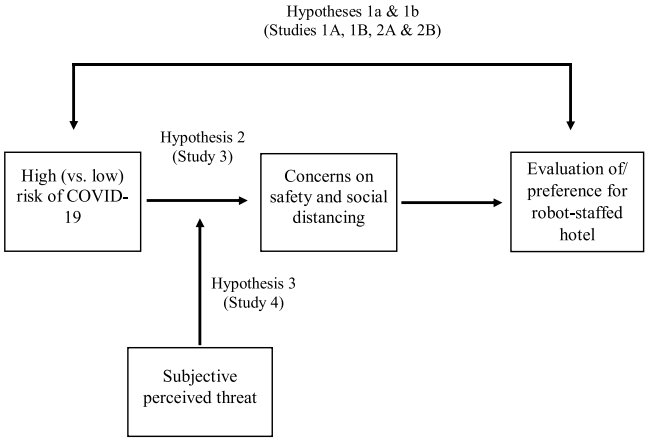


Fig. 1. Theoretical Framework and Empirical Studies.

In particular, the salience of the COVID-19 risk can affect customers' attitudes toward and/or evaluation of a robot-staffed hotel (Galoni et al., 2020). Recent studies, conducted in the context of the pandemic, have predicted a growing demand for the introduction of service robots in hotels (Jiang and Wen, 2019; Seyitoğlu and Ivanov, 2020; Shin and Kang, 2020; Zeng et al., 2020). The highly contagious nature of COVID-19 can create anxiety and uncertainty, and subsequently influence customers' decisions about staying in robot-staffed hotels. Given that robots are perceived to pose less risk of contagion, travelers will be more likely to show favorable attitudes toward robot-staffed hotels. Thus, it is hypothesized that the evaluation of a robot hotel will be more favorable when the COVID-19 pandemic is salient, compared to when it is less salient. We further expect that this difference in evaluation will occur regardless of any pre-existing attitudes toward robot-staffed hotels (e.g. Shin and Jeong, 2020).

H1a. *Under the COVID-19 pandemic situation, the evaluation of a robot-staffed hotel will be higher (*vs. *lower) when the risk of COVID-19 is high (*vs. *low).*

3.3. Effect of the risk of COVID-19 on the preference for robot- vs human-staffed hotels

In the hotel context, previous studies have identified hotel guests' preference for human-staffed hotels because of their perceived "hospitableness" and empathy (Kattara and El-Said, 2013; Hartline et al., 2000). Human staff services have been found to solidify trust and customer loyalty (Chao et al., 2007). However, human staff services are also characterized by inconsistency, which sometimes leads to customer dissatisfaction. Recent studies point to a gradually increasing preference for robot staff services, which typically ensure efficient, consistent, and personalized guest services (Ivanov et al., 2018).

Some studies have explained how situational factors and/or perceived risks influence consumer choices in different contexts (Xie and Wang, 2003). Researchers posit that the salience of an event can lead to risk-averse choices or a preference for a "safe" option (Xie and Wang, 2003). The nature of COVID-19 can pose significant uncertainty and heighten the fear of infection among travelers (Slovic et al., 1980; Lerner and Keltner, 2000). Thus, the anxiety caused by human contact and the perception of possible contagion can influence travelers to undertake risk-averse behaviors, such as avoiding human-staffed hotels. Travelers' mental structures will thus lead to a greater preference for robot-staffed (vs. human-staffed) hotels, because they are perceived to pose less exposure to the virus. Based on this assertion, we expect that when the COVID-19 pandemic is salient, travelers will have higher preferences for robot-staffed (vs. human-staffed) hotels. In other words, the preference for robot-staffed (vs. human-staffed) hotels will be higher (vs. lower) when the risk of COVID-19 pandemic is salient (vs. less salient). Hence, we propose the following hypothesis:

H1b. *In the COVID-19 pandemic situation, the preference for a robot-staffed (*vs. *human-staffed) hotel will be higher when the risk of COVID-19 is high (*vs. *low).*

3.4. The mediating role of concerns about safety and social distancing

Several factors and protocols have been found to be effective in alleviating the risk of disease transmission. These factors include good hygiene practices, safety measures, and social distancing. Zhong et al. (2020a), for instance, discovered that enhanced sanitary conditions and distancing protocols were necessary to control certain contagious diseases. In particular, social distancing has been noticed to be effective in curbing influenza transmission (Lewnard and Lo, 2020). Individuals' concerns about hygiene and safety can indirectly influence their preferences. For instance, concerns about the (in)effectiveness of hygiene, safety measures and social distancing protocols can influence an

individual, especially when choosing between human-staffed and robot-staffed hotels.

With particular reference to COVID-19, travelers are concerned about the risk of contagion, given the high levels of interpersonal contact in human-serviced hotels and the (in)effectiveness of safety and social distancing protocols. Consequently, travelers may show a preference for a less risky alternative, such as a robot-staffed hotel. Researchers have identified safety as a key attribute of robots (Bartneck et al., 2009), with a robot-staffed hotel perceived to pose lower infection risks than a human-staffed hotel. Given the salience of the COVID-19 pandemic, it is expected that travelers' concerns regarding safety and social distancing will indirectly influence their preference for a robot-staffed hotel. In particular, it is predicted that concerns regarding safety and social distancing will mediate the relationship between the salience of the COVID-19 pandemic and individuals' preference for a robot-staffed (vs. human-staffed) hotel. As a result, the following hypothesis is proposed:

H2. *Concerns about safety and social distancing will mediate the impact of the risk of COVID-19 pandemic on the preference for a robot-staffed (*vs. *human-staffed) hotel.*

3.5. The moderating role of the perceived threat of COVID-19

Since the above prediction is based on the key assumption that travelers have a high perceived threat of COVID-19, differences in individuals' perceived threat will affect their preferences. Specifically, when travelers have a relatively high perceived threat, it is expected that the prediction made above (that the salience of COVID-19 will increase the preference for a robot-staffed (vs. human-staffed) hotel) will hold. Those with a high perceived threat would want to avoid person-to-person encounters in a human-staffed hotel (for fear of contagion) by opting for a robot-staffed hotel (which is perceived to pose a lower risk of contagion). Hence, under a high perceived threat from COVID-19, it is anticipated that travelers will choose a "safer" alternative in favor of a robot-staffed (vs. human staffed) hotel. On the other hand, when travelers have a relatively low perceived threat, they will not feel the need to proactively mitigate the threat of COVID-19; thus, their preference for a robot-staffed hotel will not be influenced by the salience of the pandemic. The above discussion leads to the following hypothesis:

H3. *The perceived threat of COVID-19 will moderate the impact of the risk of COVID-19 on the preference for a robot-staffed (*vs. *human-staffed) hotel. Specifically, a strong preference for a robot-staffed (*vs. *human-staffed) hotel will be more frequent when the perceived threat of COVID-19 is high (*vs. *low).*

All studies were conducted in the US in order to control the country-specific effect of the COVID-19 pandemic. Studies 1A and 2A were conducted in mid-September 2020, whereas all other studies were conducted in late May and early June, 2020. The majority of participants were involved in only one study.

4. Empirical studies

4.1. Study 1A and 1B: showing a main prediction (H1a)

Study 1A investigated the main prediction regarding the impact of high (vs. low) perceived risk of COVID-19 on the evaluation of robot-staffed hotels in order to test H1a.

4.1.1. Study 1A - Method and results

The participants in this study were 134 U.S. adults (45.5% female, average age = 36.39 years, *SD* = 11.59) recruited from an online panel (Amazon MTurk) for a nominal payment. At the beginning of the study, participants were informed that this study consisted of multiple unrelated tasks. Participants were then given a short piece of information (e.g., definition of the disease) about COVID-19 from WHO (World Health Organization). Following this, participants were asked to rate their perceived risk of COVID-19 using two items (i.e., What are the chances of you getting infected with the coronavirus?; and What are the chances of an average person getting infected with the coronavirus?) based on a 7-point scale (1 = extremely low, 7 = extremely high, Cronbach's $\alpha = .851$) based on recent COVID-19 literature (e.g., Kim, 2020; Kim and Lee, 2020).

Participants were next asked to imagine that they planned to visit a city soon. They were further asked to imagine that they found one hotel option after browsing online. Then, the "robot-staffed hotel" was presented to them, with four pictures illustrating the services provided by robots, as shown in Fig. 2. All participants were then asked to evaluate their overall attitude toward the robot-staffed hotel, using three items on a seven-point scale (i.e., 1 = very bad/negative/unfavorable, to 7 = very good/positive/favorable; Cronbach's $\alpha = .945$). Finally, all participants were asked to report the realism of this study (1 = highly unrealistic, 7 = highly realistic) and provide demographic information.

The realism of the robot-staffed hotel was rated higher than the neutral value ($M = 4.81$, SD = 1.79 vs. '4', $t\,(133) = 5.26$, $p < .001$). To test H1a, we conducted a regression analysis (IV = perceived risk, DV = evaluation of robot-staffed hotel). The results indicated a significant effect of perceived risk ($R^2 = .041$, $F\,(1, 132) = 5.70$, $\beta = .20$, $t = 2.39$, $p = .018$) in that a higher level of perceived risk of COVID-19 increased the positive evaluation of the robot-staffed hotel. The robot-staffed hotel is based on new technology. Adaptation to new technology is significantly influenced by age (e.g., Laguna and Babcock, 1997). To exclude this effect, we conducted a regression analysis with age as an additional IV. The results indicated that the impact of age was not significant ($\beta = -.13$, $t = -1.53$, $p = .128$), whereas the effect of the risk of COVID-19 was still significant ($\beta = .21$, $t = 2.42$, $p = .017$).

In summary, this result supported H1a in that a high perceived risk of COVID-19 increased the positive evaluation of a robot-staffed hotel.

4.1.2. Study 1B – Method and results

In this study, we used a slightly different way of manipulating the risk threat of COVID-19. The participants in this study were 134 US adults (45.5% female, average age = 36.39 years, *SD* = 11.59) recruited from an online panel (Amazon MTurk) for a nominal payment. Participants in this study were randomly assigned to one of two (risk salience of COVID-19: high risk salience [during the COVID-19 pandemic, n = 67] vs. low risk salience [no mention, n = 66]) experimental conditions in a between-subjects design.

Similar to Study 1A, participants were asked to imagine that they planned to visit a city. The salience of COVID-19 was manipulated so that participants in the risk salient condition were informed that they planned to travel during the COVID-19 pandemic, whereas participants in the risk absent condition were only informed that they planned to travel to a city, with no mention of the COVID-19 pandemic. Then, they were further asked to imagine that they found the "robot-staffed hotel" (same as study 1A) and asked to state their attitude using the same scale of Study 1A, Cronbach's $\alpha = .974$).

The results of ANOVA (IV: risk salience of COVID-19, DV: evaluation of robot-staffed hotel) indicated a significant main effect of the risk salience of COVID-19 ($F\,(1, 131) = 5.46$, $p = .021$, $\eta^2 = .040$). Specifically, the evaluation of the robot-staffed hotel was higher under the salience of the COVID-19 pandemic condition ($M_{\text{COVID-19 high risk salience}} = 5.06$, SD = 1.64) than under the low risk salience ($M_{\text{COVID-19 low risk salience}} = 4.38$, SD = 1.79). This effect was still significant ($F\,(1, 130) = 5.33$, $p = .022$, $\eta^2 = .039$) with age as a covariate ($F\,(1, 130) = .84$, $p = .363$, $\eta^2 = .006$).

In summary, both Studies 1A and 1B provide initial evidence of the impact of a high perceived risk of COVID-19 on the evaluation of a robot-staffed hotel. In the next study, we focus on the relative preference between a robot-staffed hotel and a human-staffed hotel.

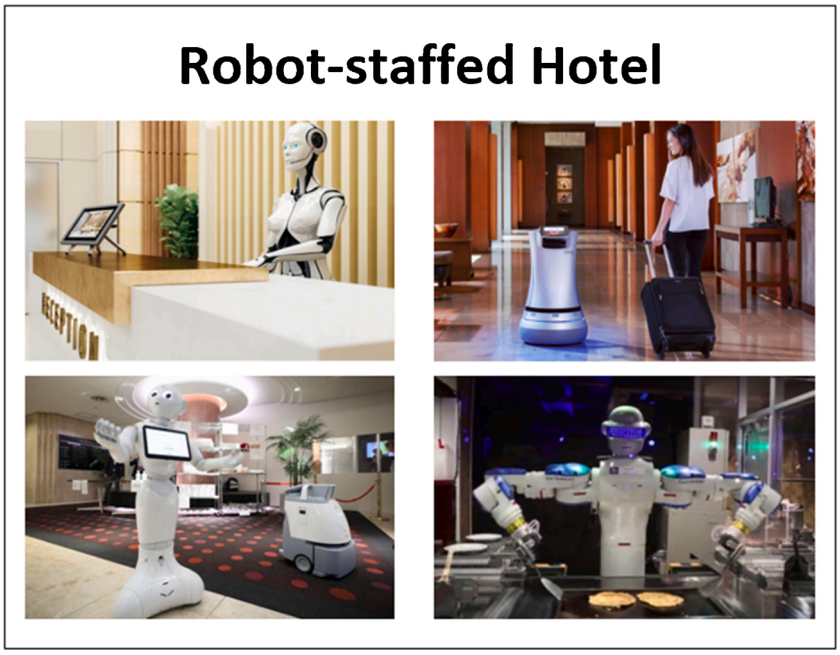


Fig. 2. Stimuli for Study 1A and 1B.

4.2. Studies 2A and 2B: showing a main prediction (H1b)

Studies 2A and 2B investigated the main prediction regarding the impact of the salience of COVID-19 on the preference for a robot-staffed (vs. human-staffed) hotel in order to test H1b.

4.2.1. Study 2A – Method and results

The participants in this study were 162 US adults (47.5% female, average age = 37.22 years, *SD* = 12.08) recruited from an online panel (Amazon MTurk) in exchange for a small monetary payment. Participants were exposed to one of two conditions (COVID-19 threat: high risk salience [n = 81] vs. control [n = 81]) using a between-subjects design.

First, participants were informed that the study consisted of multiple unrelated tasks. Then, they were requested to read a newspaper article regarding either COVID-19 (i.e. high COVID-19 risk salience condition) or sport (i.e., control condition). Specifically, participants in the high risk salience condition were asked to read a news article regarding the dangers of COVID-19 (e.g. title of '*Study finds 1 in 5 people worldwide at risk of severe COVID*-19'), while those in the control condition read an article about a golf tournament, based on a study by Huang and Rust (2020). The two articles were of similar length, as shown in Fig. 3. After reading the news articles, participants were asked to recall the topic they had read about, and five participants were excluded because they failed to recall correctly.

Participants were then asked to imagine that they planned to visit a city soon and to choose one hotel from two options (i.e., a robot-staffed vs. a human-staffed hotel), as shown in Fig. 4. All participants were asked to provide their demographic information, as well as their hotel booking and usage experience within the past two years.

First, we conducted a chi-square test (IV: risk salience of COVID-19, DV = hotel choice) for the main analysis. The results indicated a significant main effect of the risk salience of COVID-19 ($\chi^2(1) = 3.83$, $p = .050$). Specifically, the preference for the robot-staffed (vs. human-staffed) hotel was higher in the high risk salience condition ($M_{\_high\ salience} = 33.3\%$ [27/81]) than in the control condition ($M_{\_control} = 19.8\%$ [16/81]).

4.2.2. Study 2B – Method and results

In Study 2B, we used a different way of manipulating the risk salience of the COVID-19 threat. Specifically, participants were asked to make a choice either "during the COVID-19 pandemic" or "after the COVID-19 pandemic is fully controlled". Finally, we considered participants' hotel usage experience. The participants in this study were 171 US adults (51.5% female, average age = 38.33 years, *SD* = 13.01) recruited from an online panel (Amazon MTurk) in exchange for a small monetary payment. Participants in this study were randomly assigned to one of two experimental conditions (risk salience of COVID-19: risk salient [during the COVID-19 pandemic, n = 86] vs. risk less salient [after the COVID-19 pandemic, n = 85]) in a between-subjects design.

As in study 2A, participants were requested to imagine that they planned to visit a city. The salience of the COVID-19 risk was manipulated so that participants in the salient condition were informed that they planned to travel "during the COVID-19 pandemic", whereas participants in the risk absent condition were informed that they planned to travel to a city "after the COVID-19 pandemic is fully controlled". Participants were then asked to choose one hotel from the two options, as in Study 2A. All participants were also asked for their demographic information, as well as their hotel booking and usage experience within the past two years.

The results of a chi-square test indicated a significant main effect of the risk salience of COVID-19 ($\chi^2(1) = 11.01$, $p = .001$). Specifically, the preference for the robot-staffed (vs. human-staffed) hotel was higher in the "during COVID-19" situation ($M_{\_during\ COVID\text{-}19} = 57.0\%$ [49/86]) than in the "after COVID-19" situation ($M_{\_after\ COVID\text{-}19} = 31.8\%$ [27/85]). Second, we re-analyzed the above for (i) participants who had both booking and usage experience (n = 132) and (ii) others (n = 39). The results were quite similar to the overall results, as shown in Fig. 5.

4.3. Study 3: showing evidence of mediation (H2)

Study 3 replicated Study 2 with different images and provided mediation evidence for "concerns on safety and social distancing". In addition, this study excluded one alternative explanation for the preference for innovative technology since robot-staffed hotels are strongly associated with innovation in the hospitality setting (Yu, 2020). We expect that the impact of the perceived risk of COVID-19 on preference for a robot-staffed hotel would be mediated by concerns about safety and social distancing (i.e., H2) rather than preference for innovative

New article for high salience condition

The New York Times

Study Finds 1 in 5 People Worldwide at Risk of Severe Covid-19

Roughly 1.7 billion people have at least one of the underlying health conditions that can worsen cases of the coronavirus, a new analysis shows.

June 15, 2020

In just six months, nearly 8 million people worldwide have been stricken with confirmed cases of Covid-19, and at least 434,000 have died. But those deaths have not been distributed evenly; among the most vulnerable are people with underlying health conditions, such as diabetes and diseases that affect the heart and lungs. According to a new modeling study, roughly 1.7 billion people around the world — 22 percent of the global population — fall into that category.

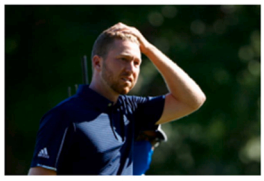
That estimate, published today in The Lancet Global Health, excluded healthy older individuals without underlying health conditions, a group also known to be at risk because of their age. It also did not take into account risk factors like poverty and obesity, which can influence a person's susceptibility to disease and access to treatment.

New article for control condition

The New York Times

A Nerve-Racking Final Round Adds Drama to Golf's Fan-Free Return

Daniel Berger forced a playoff with Collin Morikawa by sinking a birdie putt on the 18th hole, then went on to victory at Colonial Country Club.



June 15, 2020

The Charles Schwab Challenge at Colonial Country Club in Fort Worth began with the 148 players in the field successfully passing tests for the coronavirus. The best players in golf made a run at the tournament title on Sunday.

In the end, a one-hole playoff on Colonial's 17th hole ended with a rising star on the tour, Collin Morikawa, 23, missing a short par putt that handed the championship to Daniel Berger, another surging young player who has had to overcome serious, career-threatening injury. Berger clinched his berth in the playoff with a twisting birdie putt on the 72nd hole of the event. Morikawa could have clinched victory on the same 18th green, but missed a 3-foot putt. Berger, 27, whose playoff record before Sunday was 0-2, commiserated with Morikawa.

Fig. 3. Stimuli for Study 2A.
New article for high salience condition
New article for control condition

technology.

4.3.1. Method: subjects, design, and procedure

Participants in this study were 113 US adults (45.1% female, average age = 39.41 years, *SD* = 14.01) recruited from an online panel (Amazon MTurk) for a nominal payment. Participants were randomly assigned to one of two experimental conditions (risk salience of COVID-19: salient [during the COVID-19 pandemic, n = 58] vs. less salient [after the COVID-19 pandemic, n = 55]) in a between-subjects design.

The overall procedure for this study was quite similar to that of Study 2, with a few modifications. First, participants were asked to imagine that they planned to visit a city and were presented with two hotel options, as shown in Fig. 3. The salience of COVID-19 was manipulated in the same way as in Study 2. Then, participants were asked to rate their preference using a seven-point scale (1 = I will definitely choose option A [robot-staffed hotel], to 7 = I will definitely choose option B [human-staffed hotel], reverse-coded for the main analysis [a higher value represents a preference for the robot-staffed hotel]). After that, all participants were asked to rate their perceptions of their previous decisions regarding "concerns regarding safety and social distancing", across two items (i.e., "keeping social distance from others" and "safety from COVID-19") on a five-point scale (i.e., 1 = not at all important, to 5 = extremely important; Cronbach's $\alpha = .874$), and for "perception regarding innovative technology" across two items (i.e., "innovative staff service" and "service with modern technology") on the same scale (Cronbach's $\alpha = .852$).

4.3.2. Results

First, we conducted an ANOVA (IV: risk salience of COVID-19, DV = relative preference for the robot-staffed (vs. human-staffed) hotel) as the main analysis of the relative preference for robot-staffed and human-staffed hotels. The results indicated a significant main effect of the risk salience of COVID-19 (F (1, 111) = 15.05, $p < .001$, $\eta^2 = .119$). Specifically, the preference for the robot-staffed hotel was higher in the "during COVID-19" situation ($M_{during\ COVID\text{-}19} = 3.90$, SD = 2.28) than in the "after COVID-19" situation ($M_{after\ COVID\text{-}19} = 2.45$, SD = 1.58), as shown in Fig. 6.

Second, we found similar results for concerns regarding safety and social distancing. The overall result was significant (F (1, 111) = 6.50, $p = .012$, $\eta^2 = .055$) in that concerns regarding safety and social distancing were much more important in the "during COVID-19" condition ($M_{during\ COVID\text{-}19} = 4.16$, SD = 1.14) than in the "after COVID-19" condition ($M_{after\ COVID\text{-}19} = 3.62$, SD = 1.10).

Finally, the main effect of the risk salience of COVID-19 was not significant for perceptions regarding innovative technology (F (1, 111) = 1.03, $p = .313$, $\eta^2 = .009$). Specifically, the two means were quite similar ($M_{during\ COVID\text{-}19} = 3.42$, SD = 1.28 vs. $M_{after\ COVID\text{-}19} = 3.20$, SD = 1.04).

We also conducted a mediation test using Hayes' (2017) process analysis and Model #4 (with two mediators). The results indicate that the overall mediation model was significant, in that the indirect effect was significant (95% CI: [−0.608, −.040]). Specifically, the mediation (IV: risk salience of COVID → mediator: concerns regarding safety and social distancing → DV: preference for robot-staffed hotel) was significant (95% CI: [−0.676, −.065]). On the other hand, the alternative mediation (IV: risk salience of COVID → mediator: perceptions regarding innovative technology → DV: preference for robot-staffed hotel) was not significant (95% CI: [−0.078, .209]). In summary, the results support H2.

4.4. Study 4: showing evidence of a moderating effect (H3)

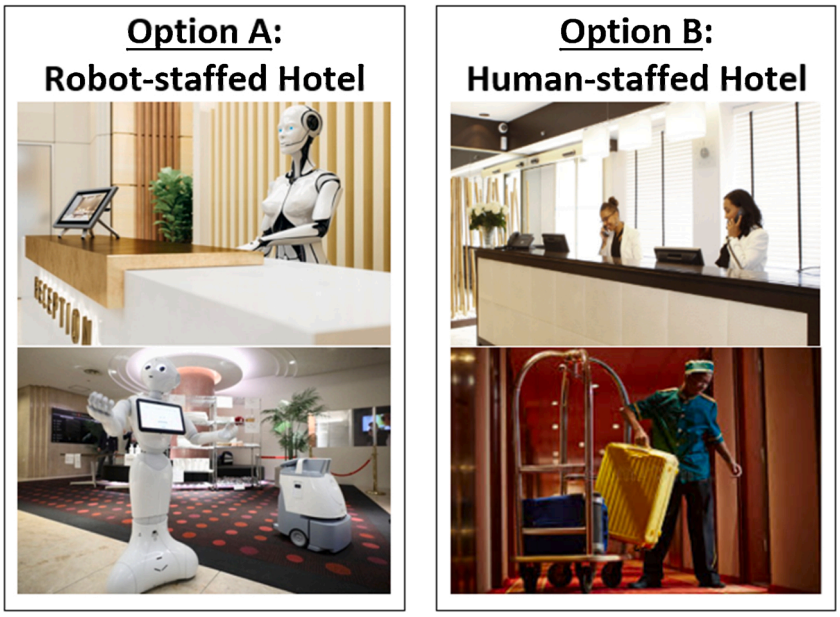
Study 4 replicated the previous studies by showing the moderating role of perceived threat in order to test H3. We expected a significant moderating effect of the perceived threat on the previous findings of H1b.

4.4.1. Method: subjects, design, and procedure

Participants in this study were 150 US adults (40.7% female, average age = 40.40, *SD* = 12.97) recruited from an online panel (Amazon MTurk) for a nominal payment. Participants were randomly assigned to one of three experimental conditions (risk salience of COVID-19: risk salient [during the COVID-19 pandemic, n = 50] vs. risk less salient I [after the COVID-19 pandemic, n = 51] vs. risk less salient II [control - no mention, n = 49]) in a between-subjects design.

First, participants were informed that this survey consisted of different tasks. The overall procedure for this study was quite similar to that of Study 2, with a few modifications. Participants were asked to imagine that they planned to visit a city and were presented with two

Stimuli for Studies 2A, 2B, and 4



Stimuli for Study 3

Fig. 4. Stimuli for Studies 2A, 2B, 3, and 4.
Stimuli for Studies 2A, 2B, and 4
Stimuli for Study 3

hotel options, as shown in Fig. 3. The salience of COVID-19 was manipulated in three different ways. Specifically, participants in the salient condition were informed that they planned to travel "during the COVID-19 pandemic". In contrast, participants in the less salient I condition were informed that they planned to travel to a city "after the COVID-19 pandemic is fully controlled", whereas participants in the less salient II condition were not given any information regarding COVID-19. Participants were then asked to rate their preference using a seven-point scale (1 = I will definitely choose option A [robot-staffed hotel], to 7 = I will definitely choose option B [human-staffed hotel], reverse-coded for the main analysis [a higher value represents a preference for the robot-staffed hotel]).

After the hotel selection task, participants were asked to participate in different tasks. Specifically, they were given basic information regarding COVID-19 and were asked to rate their perceptions regarding the threat it posed in regard to two items ("In your opinion, is the coronavirus a serious threat?" and "How life-threatening is the coronavirus?") based on Böhm and Pfister (2005), using a seven-point scale (1 = not at all serious/life-threatening, to 7 = very serious/life-threatening; Cronbach's α = .784).

4.4.2. Results

First, we conducted an ANOVA (IV: risk salience of COVID-19- 3 conditions, DV = relative reference) for the main effect of the salience of COVID-19 on the relative preference for the robot-staffed and human-staffed hotels. The results indicated a significant main effect of the salience of COVID-19 (F (2, 147) = 7.19, p = .001, η^2 = .089), as shown in Fig. 7. Specifically, the preference for the robot-staffed hotel was higher in the salient condition ($M_{during\ COVID\text{-}19}$ = 4.44, SD = 2.22) than in the less salient I condition ($M_{after\ COVID\text{-}19}$ = 3.41, SD = 2.26; post hoc

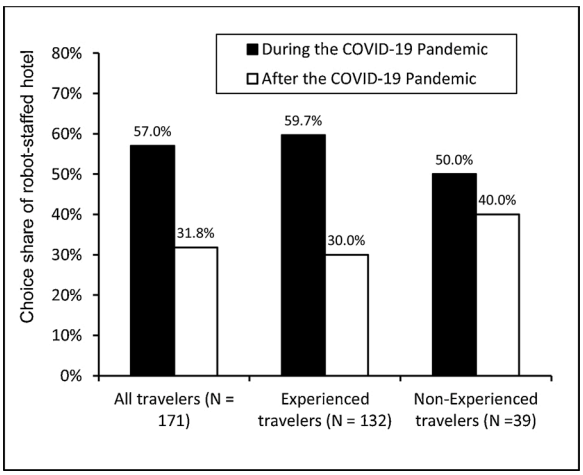


Fig. 5. Results of Study 2.

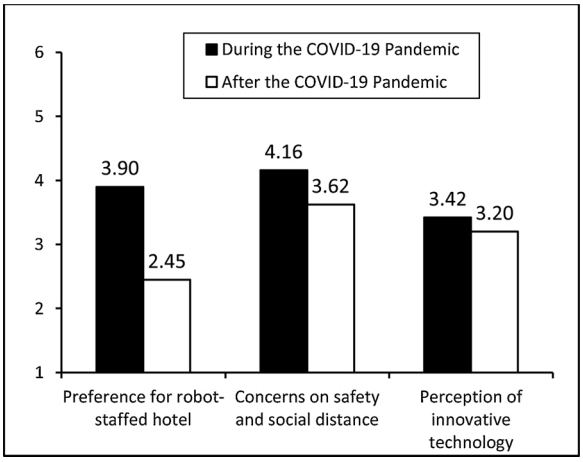


Fig. 6. Results of Study 3.

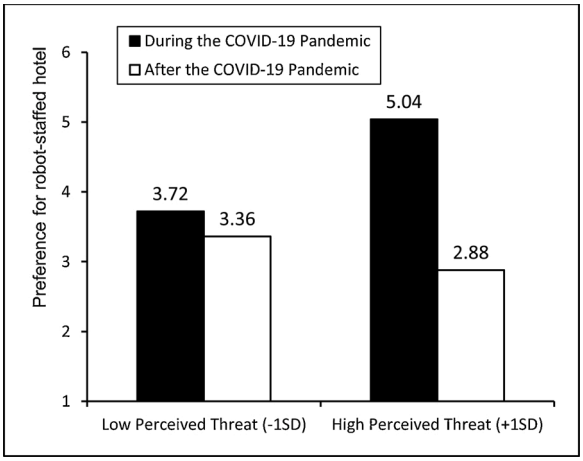


Fig. 7. Results of Study 4.

$p = .044$) and the less salient II condition ($M_{\_control} = 2.84$, SD = 1.90; post hoc $p = .001$). There was no difference between the less salient I and II conditions (post hoc $p = .372$).

We conducted a further ANOVA (IV: risk salience of COVID-19- 2 conditions, DV = relative reference) after combining the less salient I and II conditions into one condition. The results were significant (F (1, 148) = 12.49, $p = .001$, $\eta^2 = .078$) in that the preference for the robot-staffed hotel was higher in the salient condition ($M_{\_during\ COVID\text{-}19} = 4.44$, SD = 2.22) than in the less salient I and II conditions ($M_{\_after\ COVID\text{-}19\ +\ control} = 3.13$, SD = 2.10).

We also conducted a moderation test for the perceived threat of COVID-19 using Hayes (2017) process analysis and Model #1 (i.e., IV: salience of COVID-19 [salient vs. less salient], moderator: perceived threat, DV: preference for robot-staffed hotel). The results indicated that the overall moderation was significant (effect = −1.04, $t = -2.42$, 95% CI: [−1.890, −.191]). Specifically, when the perceived COVID-19 threat was relatively low (-1SD in measurement), the preference for the robot-staffed hotel was similar ($t = -.690$, $p = .492$) between the salient condition (estimated $M_{\_during\ COVID\text{-}19} = 3.72$) and the less salient I + II condition (estimated $M_{\_after\ COVID\text{-}19\ +\ control} = 3.36$). However, when the perceived COVID-19 threat was relatively high (+1SD in measurement), the preference for the robot-staffed hotel was much higher in the salient condition (estimated $M_{\_during\ COVID\text{-}19} = 5.04$) than in the less salient I and II conditions (estimated $M_{\_after\ COVID\text{-}19\ +\ control} = 2.88$; $t = -4.24$, $p < .001$).

5. Overall discussion and conclusion

With the rapid development of robotics and AI, scholars foresee the rise of service robots as the future workforce of the tourism industry (Choi et al., 2019; Ivanov, 2020; Shin and Kang, 2020). In this initial attempt to investigate the impact of COVID-19 on customers' reactions to robot services, we conducted a series of four experiments in late May and mid-September of 2020. The results of this study, which showed a preference for robot service compared to human service, are different from most previous studies conducted before the COVID-19 pandemic, which indicated a preference for human service rather than robot service in hotels (Chan and Tung, 2019; Choi et al., 2019; Kattara and El-Said, 2013; Ivanov et al., 2020; Stock and Merkle, 2018). Thus, the current COVID-19 pandemic may accelerate acceptance of service robots providing contactless services, which are beneficial for maintaining social distancing and reducing anxiety regarding contagion through human interaction.

When faced with a crisis, there are individual differences in how seriously people perceive or appraise risks and threats (Kim, Giroux et al., 2020; Reisinger and Mavondo, 2005). In a similar vein, this work revealed that the level of perceived threat substantially influences customers' preference for a robot-staffed hotel. Hence, after the pandemic, customers' preferences may return to human service over robot service because human service is characterized as involving emotion, warrantees and communicability. However, the introduction of high-level technologies in hotels is an industrial trend. Therefore, there is a consistent examination of customers' reactions to adoption of these technologies under both expected risk situations or riskless situations.

In conclusion, despite the rapid evolution of new technologies in the tourism and hospitality field, including robots and AI, research is still fairly limited in terms of consumers' acceptance of these automated technologies. This paper facilitates our understanding of how robot-serviced hotels can be seen as more attractive and trustworthy options during a critical health crisis. Furthermore, as perceived threat is crucial in the assessment of risk, we specifically suggest a requirement for monitoring and controlling the level of perceived threat at robot-staffed and human-staffed hotels to increase consumer preferences. The findings lead to straightforward suggestions for tourism and hospitality businesses with regard to successfully managing their communications and promotions strategies to ensure customers continue to use their services.

5.1. Academic implications

This study provides meaningful contributions, particularly to the literature on robotics and AI, tourism, and consumer behavior. First, this

work provides empirical evidence that users' perceptions of service robots can be changed by situational factors. In line with previous studies (Galoni et al., 2020; Han et al., 2012), this work's findings support the view that a particular event or crisis can change customers' mindsets and attitudes toward new technology. Particularly in the context of a health-related crisis, such as COVID-19, customers' preference for robot services increases because the use of service robots can reduce the chance of disease transmission. We also found that concerns regarding safety and social distancing play an important mediating role. That is, the salience of COVID-19 increased customers' concerns for safety and social distancing, which in turn influenced their preference for a robot-staffed hotel. This work illustrates customers' psychological mechanisms relating to how the pandemic evokes certain feelings or perceptions that make customers prefer service robots over human staff. This work will serve as a good exemplar for developing a set of experiments to investigate the impact of situational factors on users' acceptance of robot and AI technologies.

Second, by comparing customers' preferences for service robots and human staff in a hotel setting, this work expands the scope of the existing tourism literature to rethink the traditionally accepted importance of "hospitableness" (Ariffin and Maghzi, 2012) and "human touch" (Golubovskaya et al., 2017; Lasheley and Morrison, 2000). Given that service quality has been treated as a multidimensional concept (Brady and Cronin, 2001; Parasuraman et al., 1988), humans are highly regarded in terms of emotional service quality dimensions, which appeal to the qualities of emotional connection, sophistication, and sincere care. On the other hand, robot services were highly evaluated in terms of the qualities of reliability, efficiency, and novelty. Building upon the "computers are social actors" paradigm (Reeves and Nass, 1996), Choi et al. (2019) argue that the concept of service quality for human-human interaction is applicable to that for human-robot interaction. Moreover, the findings of this study revealed that robot service during an international pandemic situation can enhance service quality dimensions related to cleanliness, health and safety because customers are likely to prioritize health and safety over the human touch and feel more comfortable with high-tech services that provide automated and contactless interactions through service robots (van Doorn et al., 2017).

5.2. Practical implications

Given that the COVID-19 pandemic has been dramatically changing many aspects of tourism and hospitality businesses (Franck, 2020), the current study's findings provide useful practical implications. At the moment, it is uncertain how long the pandemic will last and how severely it will affect the industry. The longer the current situation continues, the stronger people will perceive the threat to be, which will be imprinted in customers' memories even after the COVID-19 crisis ends. Many researchers and practitioners cautiously predict encountering a "new normal", in which service providers need to enhance safety measures and hygiene practices. As a way to provide contactless services and allay customers' concerns regarding safety, service robots equipped with AI could be widely adopted in diverse service delivery environments, such as hotels, airports, restaurants, and event settings. As observed in the case of self-service technologies (e.g., self-check-in kiosks at airports and payment kiosks at grocery stores), it is important to provide clear instructions and guidelines to lower barriers to first-time users, in order to successfully implement and commercialize service robots. Our findings also show that service robots are preferred by customers who have a high perceived risk of the pandemic. Targeting those customers would be efficient in terms of promoting the health and safety aspects of service robots. Thus, marketers are recommended to develop a strategic approach to identifying customers' key characteristics and attributes (e.g., age, occupation, and residence) associated with their risk perceptions.

The current crisis provides a good opportunity for pioneers to act in regard to adopting service robots. In recent years, several hotels have started using service robots to replace or assist human staff. Despite their important role as a sounding board for introducing new types of service robots, robot-staffed hotels have faced operational and financial difficulties. For instance, HIS Hotel Holdings, the first robot-staffed hotel chain company in Japan, has decided to replace more than half of its service robots with human staff (Choi et al., 2019; Newman, 2019). However, as discovered in our experiments, the current health crisis has increased the potential demand for service robots. Pioneers in adopting service robots may get a chance to step ahead and use their accumulated knowledge, acquired from previous experiences of success and failure. Based on this study's findings, we recommend highlighting the usefulness of service robots in maintaining social distancing and preventing the spread of infectious diseases during the COVID-19 health crisis.

5.3. Limitations and suggestions for future studies

This study has some limitations. First, more kinds of service robots with diverse functions need to be presented, because the questionnaire for this study showcased only a few functional robots, such as those working at front desks, handling luggage, searching for information, and cooking. Second, from the perspective of anthropomorphization, customers' perceptions of service robots are different in terms of attractiveness, preference, trust, and credulity, according to the robots' design, function, and color (Murphy et al., 2019). Therefore, future research needs to identify whether or not preferences for a robot-staffed hotel are different according to robots' different functions, designs, or colors.

Across different experimental studies, we used different manipulations or stimuli as well as different situational or individual difference variables as the control variables. A future study may need to investigate the effect of other influential mediators on perceived preference. Finally, since this study explored only individuals' preferences for human-serviced or robot-serviced hotels, a future study needs to adopt more dependent variables, such as attractiveness, trustworthiness, service quality, and intentions, because respondents may show different reactions to variables that manifest in different psychological mechanisms. It would be interesting to compare results to identify whether or not responses fluctuate across psychological variables.

Acknowledgement

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