International Journal of Hospitality Management 95 (2021) 102930

Contents lists available at ScienceDirect

International Journal of Hospitality Management

journal homepage: www.elsevier.com/locate/ijhm

# A systematic review of AI technology-based service encounters: Implications for hospitality and tourism operations

Minglong Li [a,*], Dexiang Yin [a], Hailian Qiu [b], Billy Bai [c]

[a] School of Business Administration, Zhongnan University of Economics and Law, Wuhan, China
[b] Business School, Hubei University, Wuhan, China
[c] William F. Harrah College of Hospitality, University of Nevada Las Vegas (UNLV), Las Vegas, NV, USA

ARTICLE INFO

*Keywords:*
Service encounter
Artificial intelligence (AI)
Service experience
Public health emergency
Systematic review

ABSTRACT

The hospitality and tourism industry faces serious challenges during public health emergencies such as COVID-19. Managers are concerned not only about how to maintain business and provide humanized services but also about social distancing. This study presented artificial intelligence (AI) technology-based service encounters as a possible solution and examined the antecedents and consequences of the encounter triad including customers, employees, and AI. Based on a systematic literature review, the study identified 4 modes of AI technology-based service encounters: AI-supplemented, AI-generated, AI-mediated, and AI-facilitated encounters. In addition, the study developed an integrated model to specify the factors that influence AI technology-infused service encounters in general and the customer service outcomes that result from the encounters. The findings contribute to service management and AI application theoretically and practically.

## 1. Introduction

The occurrence of public health emergencies has accelerated the application of technologies, especially artificial intelligence (AI). Since the end of 2019, COVID-19, a new virus with extremely strong infectivity, has spread all over the world, threatening the livelihoods, health, and living of millions of people (Chakraborty and Maity, 2020). To combat this disease, quarantine and social distancing are considered urgent and effective measures (Lisa and Vineet, 2020). However, it seems almost impossible to ask everyone to stay at home to save lives as people need to go to work to keep the economy going (Gössling et al., 2020). The challenge is how we can maintain social distance while not closing businesses. Requiring no interpersonal contact or a low level of social contact was regarded as a solution for service industries (Elavarasan and Pugazhendhi, 2020). For this purpose, AI technologies were applied. For example, in Wuhan, China, where COVID-19 first started, unmanned aerial vehicles and intelligent robots provided patrol inspection services, and played a significant role in community governance and disease prevention and control systems (Shaw et al., 2020; Nguyen, 2020). Hospitals in Wuhan used AI for medicine delivery, temperature monitoring, and virus forecasting (Allam et al., 2020). Hospitality and tourism firms have also followed this trend, adopting more AI technologies in service processes, such as self-driving luggage trolleys at airports, contactless food services, and intelligent check-in procedures in hotels (Chi et al., 2020; Li et al., 2019).

The past few years have witnessed a growth of AI adoption in hospitality and tourism businesses. Because of their advantages in labor cost reduction and service efficiency improvement (Ruiz-Alba and Martín-Peña, 2020; Zhou et al., 2020), intelligent technologies have been infused into the hospitality and tourism industry, from underlying technologies such as Internet of Things (IoT), big data, cloud computing, speech recognition, and facial recognition to various applications such as social media, virtual reality (VR)/augmented reality (AR), intelligent service desks, and service robots (Chi et al., 2020; Ivanov and Webster, 2019). The use of these technologies has become ubiquitous during the COVID-19 pandemic in an attempt to avoid or reduce social interactions with customers in service industries. As a result, management decision-making has been greatly improved because of the data collected using AI technologies, while some human jobs have been partly replaced (Oravec, 2018; Zhou et al., 2020). For customers, AI application has decreased the level of human-to-human or face-to-face contact and created technology-based service encounters, reshaping service interactions (Ivanov and Webster, 2019), and consequently affecting customers' experiences and behaviors. In an industry where

* Corresponding author.
*E-mail addresses:* minglong.li@connect.polyu.hk (M. Li), dexiang_yin@163.com (D. Yin), 573389302@qq.com (H. Qiu), billy.bai@unlv.edu (B. Bai).

https://doi.org/10.1016/j.ijhm.2021.102930
Received 1 July 2020; Received in revised form 13 November 2020; Accepted 25 March 2021
Available online 6 April 2021

service quality and moments of truth are pursued, hospitality and tourism managers are eager to understand the characteristics of AI technology-based service encounters and how they influence customer service outcomes. However, there have been no reported studies that examine such a critical issue from a systematic perspective (Belanche et al., 2020).

The precondition of this discussion topic is how to understand the new service encounters after AI is applied in frontline services. Previous studies offered useful findings regarding AI application in services. For example, Keyser et al. (2019) categorized the technologies that are applied in customer contact services, and examined the influence of extended reality (XR) on customers, frontline employees, and service organizations separately. XR technologies are not just important manifestations of visual art but methods that connect the virtual and real world (Ivanov and Webster, 2019). Thus, XR with human-robot interaction (HRI) capabilities, can be integrated into service encounters in essence (Kim et al., 2020). Other similar studies (Makridakis, 2017; Larivière et al., 2017) also analyzed the enhancement or substitution role of technologies in productivity, but the infusion of intelligent technologies in service interactions has attracted much less attention, while customers' physical, psychological, and social responses in the global pandemic context have not been fully considered. Against the background of the COVID-19 pandemic, the following research questions remain unresolved: What are the features of technology-based service encounters? How do they meet the requirements of service firms in terms of providing effective services while maintaining social distance between customers and service providers? A thorough review of the literature can help answer these questions.

Another issue to be addressed is the influence mechanism of AI technology-based service encounters on customers' experiences and behaviors. Previous research investigated the effect of technology or human employees alone on service outcomes (Yeh et al., 2017). However, the combined effect of technology and employees through human-robot cooperation on customer service outcomes deserves more investigation (Giebelhausen et al., 2014). Additionally, as AI differs from traditional technologies in terms of high interactivity and ease of use (Gursoy et al., 2019), customers have more access to service value creation in AI-infused service encounters (Keyser et al., 2019), which should also be considered. Thus, it is necessary to evaluate the three-sided service encounter involving AI technologies, human employees and customers and its linkage to service outcomes (Belanche et al., 2020). For this purpose, we conducted a timely, systematic literature review on AI penetration in service encounters and proposed the influence mechanism of technology-based service encounters on customers' experiences and behaviors.

Therefore, this study aims to: a) explicate the nature and characteristics of the service encounter triad after AI technologies are adopted in services, especially during the COVID-19 pandemic, and b) conceptually explain the influence mechanism of technology-based service encounters on customers' experiences and behaviors, through a systematic review, comparison, and analysis of the existing literature. By doing so, the current study could contribute to service encounter and AI application management from theoretical and practical perspectives.

## 2. Literature review

### 2.1. AI technology-based service encounters for service value cocreation

A service encounter is a form of social exchange, which traditionally described the person-to-person interactions between service transactors (Fitzsimmons et al., 2011). This two-sided service encounter view highlighted the role of customers and employees but ignored the nonhuman factors that also shape service interactions, such as the service facilities, atmosphere, and environment (Hoffman and Turley, 2002; Wu and Liang, 2009). Later, a more comprehensive three-sided service encounter involving service organizations was widely accepted (Fitzsimmons et al., 2011; Riley, 2007). The role of technology in service encounters was indirectly reflected by organizations as service providers (Massad et al., 2006). AI technologies differ from other nonhuman factors in terms of anthropomorphism and intelligence to such a degree that they can be regarded as automated social presence (Qiu et al., 2020; Van Doorn et al., 2017). Therefore, there are interactions between AI and customers or employees; the attributes of these interactions are worth investigating (Huang and Rust, 2018).

Service encounters change with the application of AI. In the era of big data, AI quickly penetrated service processes when service firms endeavored to remain competitive. Consequently, an increasing amount of work has become automatized and intellectualized (Marinova et al., 2016). Additionally, customers play an increasing role in services due to AI and engage in service value cocreation (Lundberg, 2011). According to service-dominant (SD) logic, services, as essential bases for exchange, are applications of professional knowledge and skills for benefits (Vargo and Lusch, 2008). AI facilitates service exchanges by providing necessary information and knowledge, and making the knowledge applications user-friendly (Yoon and Lee, 2019). In addition, since service firms cannot deliver value, but only provide resources for the application of competencies, which must be matched with customers in order to create value, AI applications that have advantages of spontaneously connecting with customers are effective resources for value creation (Makridakis, 2017; Vargo and Lusch, 2008). Furthermore, AI technologies are not just resources for service value creation; they reshape service encounters as actors (Larivière et al., 2017). SD logic does not regard actors as dual (producer or consumer), but as broad participants consisting of a network system that creates value with resource integration and interaction (Mathis et al., 2016; Mustelier-Puig et al., 2019). Therefore, AI technology-based service encounters are a trend adaptive to SD logic and service value cocreation.

Successful management of AI-infused service encounters relies on clearly defining the roles of participants in service processes and understanding the attributes of various interactions (Mustelier-Puig et al., 2019; Fitzsimmons et al., 2011). Traditionally, the different levels or roles of technologies in services led to different service encounter modes, including technology-assisted, technology-facilitated, technology-mediated, and technology-generated service encounters (Froehle and Roth, 2004). In contrast, AI is more complicated and interactive than the traditional technologies (Giebelhausen et al., 2014) and thus requires specific investigation. The interactions between humans and AI have been integrated into service encounters, the quality of which depends on the customers, employees, and intelligent technologies (Lundberg, 2011; Fitzsimmons et al., 2011). AI can play the roles of guide, facilitator, substitute, and enhancer in human-robot interactions (Larivière et al., 2017; Marinova et al., 2016; Robinson et al., 2020). With the identification of the various roles of customers, employees and AI, AI technology-based service encounters can be categorized, and their influences on customer experiences and behaviors can be explored specifically (Keyser et al., 2019; Larivière et al., 2017).

### 2.2. AI technology-based service encounters as a solution for businesses during the pandemic

Public health emergencies bring challenges to service-encounter management. The crises caused by infectious viruses (e.g., COVID-19 and MERS) have changed the perceptions of tourists and the methods of service (Ahmed et al., 2020; Sigala, 2020). For instance, health and security are given higher priority in travel decision-making (Batle and Robledo, 2018). Meanwhile, psychological disorders, such as anxiety, frustration, loneliness, and social phobia, may accompany the plagues (Ahmed et al., 2020). As a result, customers become more sentimental and irrational and less tolerant of uncertainty and pressure in communication (Gössling et al., 2020). Correspondingly, service managers should consider customers' demand for health, their psychological characteristics, and their value perceptions to design services with high

efficiency and personalization (Ahmed et al., 2020). Against this background, AI technologies become an option to deliver the needed services to customers.

Service encounters with AI has gained more popularity during the COVID-19 pandemic. To combat COVID-19, service managers have implemented AI because these technologies have advantages in the new business environment (Yoon and Lee, 2019). First, as technology carriers are not hosts of viruses and can be repeatedly disinfected, AI with mechanical functions have been used in transferring objects to decrease face-to-face interactions between humans and in disposing of materials to avoid virus spread (Belanche et al., 2020; Yang et al., 2020). For example, service robots have been adopted to deliver food, beverages and other items in hotels and restaurants and to guide guests in tourism services (Seyitoğlu and Ivanov, 2020; Jiang and Wen, 2020). In addition, some tasks, such as sweeping, cleaning, disinfecting, and food preparation, have been assigned to robots to diminish the exposure of public areas or food to potential virus carriers (Ramalingam et al., 2020; Zeng et al., 2020). Second, AI technologies have been applied to handle data and information, which is another manner of service contact (Elavarasan and Pugazhendhi, 2020). Various robots have provided counseling services, and stored customer information, which is conducive to fighting against the virus and improving service quality (Chi et al., 2020; Khan et al., 2020). Third, intelligent technologies have been used to relieve psychological symptoms due to COVID-19 (Liu et al., 2020). Despite their infancy, service robots, chatbots, and virtual assistants placed in lounges, guestrooms or quarantine units have partly assisted customers' mental health during the global crisis (Dananjayan and Raj, 2020; Zeng et al., 2020). Therefore, synthesizing the research on technology-based service encounters in public health emergencies and their consequences will provide insights into service quality improvement in the COVID-19 pandemic.

## 3. Methods

This study reviews AI technology-based service encounters and their influence on customer service outcomes following the principles suggested by MacInnis (2011), who proposed eight tasks for a conceptual paper based on systematic review: identifying (the status quo and gaps), revising (i.e., viewing the identified issues differently), delineating (the relationships between the constructs), summarizing, differentiating, integrating (the existing information into the new theory), advocating, and refuting. The analytic process and results presentation were guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which provides protocols for review implementation, including steps for analyzing literature and specific checklist items for reporting from the title to funding (Moher et al., 2009). First, the concepts and research focus were clarified (Section 2). Based on this, the target literature was determined as the literature that discusses the domain of "service encounter/contact/interaction" and "AI/artificial intelligence/intelligent technologies." The combination of the two keywords was searched in four influential academic databases: Web of Science, Taylor & Francis, ScienceDirect, and Emerald. A total of 198 articles were obtained. Google Scholar was also searched as a supplement, and 19 more papers were included after removing the repetitive literature. After that, we skimmed each article by title, abstract, and conclusion to ensure the inclusion of the important studies and remove those that were irrelevant in the research domain, based on the following criteria: a) the research context should be the service sectors rather than manufacturing; b) the literature focusing on technologies used backstage where customers have no contact with the technologies was excluded; c) the studies not discussing service encounters, service quality or other service outcomes (customer experiences and behaviors) were removed, even though they included some keywords such as "interactions"; and d) articles discussing AI usage in services during the COVID-19 pandemic were retained. This process eliminated 110 articles. The next step involved full-text reading and note taking. Special attention was given to the application of AI in service encounters and the relationships between the related concepts. The 107 articles, most of which were published in 2020 (n = 38) or the last three years (2017–2019) (n = 41), were analyzed using qualitative synthesis. In the analysis, the conceptualization and concept classification of AI technology-based service encounters were derived from the extant literature. The attributes of the new service encounters were summarized and categorized. Meanwhile, the relationships between the key constructs were analyzed, and then integrated into a meaningful "series of stories" by constructing a "storyline" (MacInnis, 2011).

## 4. Findings

### 4.1. Four modes of AI technology-based service encounters

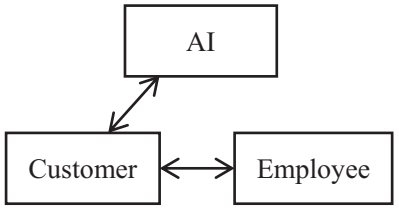
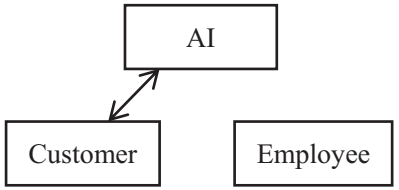
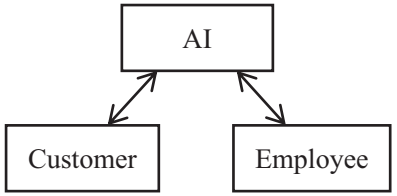
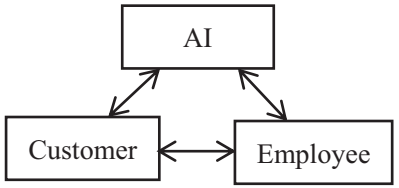
Based on the academic literature and industry practices, all AI applications in service encounters in various service contexts were listed, using the technology-context matrix. Similar applications were combined, and nine typical AI-infused encounters were reached ("Examples" in Table 1). For each encounter, three parties, including customers, employees, and AI technologies, were analyzed in terms of the roles they play and the activities they perform. Meanwhile, the attributes of the possible interactions between the parties were summarized. As the customers and employees in service encounters have received much attention, this research focused more on AI technologies. Based on the characteristics of the encounters and the roles of AI, four modes of technology-based service encounters were identified: AI-supplemented, AI-generated, AI-mediated, and AI-facilitated service encounters. The diagrams, roles, typical examples, and characteristics of the four modes are reported in Table 1 and explained in the following sections.

#### 4.1.1. Mode A: AI-supplemented service encounters

AI-supplemented service encounters generally occur at the initial stage of service transactions. In this mode, customers are served by AI and employees separately, directly, and independently, and the role of AI is to provide guidance and network facilitation (Ruiz-Alba and Martín-Peña, 2020). For example, a hotel guest uses an AI-integrated hotel cellphone application (App) to order a meal, while the employees serve him/her at the table. Through communication technologies integrated with AI, the information search, counseling, and exchange processes take a shorter time, with less human contact, and the customers form more accurate and personalized demand that matches the services (Alzahrani, 2016; Buhalis and Law, 2008). With big data and machine learning technologies, smartphones and wearable devices allow customers flexibility (in time and place) in contacting service providers, and give intelligent recommendations based on the data from customers' searching, browsing, and buying history (Paschen et al., 2019). Some technologies with strong visualization can also facilitate customers' immersive participation and learning (Kim et al., 2020). This mode reduces customers' waiting time, and could also reduce social contact. For example, some hotels provide VR, through which their customers can familiarize themselves with the environment and facilities of the property visually; then, the customers can choose their guestrooms and quickly check in, decreasing discussions with frontline employees and social exposure risks (Ivanov and Webster, 2019).

Social media smart recommendation is one of the applications of AI in Mode A. In social media platforms using AI, service encounters take place through tourist experience-sharing and recommendations (Meehan et al., 2016). Intelligent recommendation relies on an integrated AI that connects various entities and automatically matches customers' needs with services according to the customers' information (Gavalas et al., 2013). From this point of view, social media with AI offers customers much external information and assists their value cocreation (Makridakis, 2017), which is subsequently confirmed by encounters with employees (Ivanov and Webster, 2019). In other words, intelligent recommendation and employees supplement each other in offering

**Table 1**
Four modes of AI technology-based service encounter.

| Modes | Diagrams | Role | Examples | Characteristics | Literature |
|---|---|---|---|---|---|
| Mode A: AI-supplemented | RMl.   | Guidancing/ Network facilitating | • Social media smart recommendations;<br>• Intelligent virtual Reality (VR) technology | Technologies integrated with AI, services previewed, flexible interactions, accurate demand, visualization, immerse learning, interactive participation, experience innovation | Gavalas et al., 2013; Yeh et al., 2017<br>Bogicevic et al., 2019; Tussyadiah et al., 2018; Yung and Khoo-lattimore, 2017 |
| Mode B: AI-generated |   | Substituting | • Mechanical intelligence: self-driving cars, self-service check-in machines, vending machines, smart telephone customer service;<br>• Analytical intelligence: Smart home, smart monitoring;<br>• Intuitive intelligence: AR, chatbot | Convenient, quick, more autonomy (for customers), active participant, task responsive, innovative, offerings or information spontaneously presented, environments as carrier of interactions, user friendly | Cohen and Hopkins, 2020; Kelly et al., 2017; Beatson et al., 2007; Ahn and Seo, 2018<br>Tussyadiah, 2020; Kontogianni and Alepis, 2020; Nguyen, 2020 Hassan et al., 2018; Cranmer et al., 2018; Lu et al., 2019; Choi et al., 2019 |
| Mode C: AI-mediated |   | Intermediary | • Social media online services;<br>• Production/delivery robots | User friendliness, easy accessibility, quick responsiveness, simple function, accurate customization | Froehle, 2006; Massad et al., 2006<br>Ivanov and Webster, 2019; Tung and Au, 2018; Gursoy et al., 2019 |
| Mode D: AI-facilitated |   | Augmenting | • Customer relationship management (CRM) system;<br>• Service robot | Personification, autonomy, deep learning, complex, interactive, people-oriented, aesthetics matter, emotional, innovation | Prentice et al., 2020; Li et al., 2017; Froehle, 2006<br>Choi et al., 2019; Wirtz et al., 2018; Tung and Au, 2018; Belanche et al., 2019; Tung and Law, 2017 |

tourists a complete service with constructive and actual forms, where intelligent recommendations make tourists more familiar with the services and decrease the time for close personal contact, which is important during global health calamities (Hassannia et al., 2019; Shaw et al., 2020). Service interactions with AI-supplemented media provide useful information, stimulate customers' sense of emotion (e.g., novelty, altruism), enhance customers' perceptions of epistemic value, and lead to customer satisfaction, loyalty, and recommendations (Hwang and Hyun, 2013; Liu et al., 2019; Prentice et al., 2020; Wang et al., 2012).

VR is another important AI application used to supplement service encounters by employees. VR greatly enhances tourists' service experiences by creating a simulated world in which they can immerse themselves (Bogicevic et al., 2019). According to cognitive fit theory, tourists will give a high appraisal of services if the services are consistent with their mental imagery (Salazar, 2012). Service encounters with intelligent VR can narrow the gap between customers' service expectations and service performance, increase tourism service accessibility, and add novelty experiences to tourists (Kim et al., 2020; Cranmer et al., 2020; Hoyer et al., 2020). Moreover, this immersed service encounter can easily trigger tourists' emotions, which link AI-customer-employee interactions and customers' perceptions and behaviors (Tussyadiah et al., 2018; Yeh et al., 2017).

#### 4.1.2. Mode B: AI-generated service encounters

Mode B occurs when AI technologies are so powerful that they serve customers independently at service sites, while employees are absent. In this mode, AI is substituted for human labor and decision making and directly interacts with customers in a fast and personalized way (Froehle and Roth, 2004; Keyser et al., 2019). Meanwhile, AI technologies are responsive to customer tasks and deal with routine matters quickly. Thus, they are more convenient and user-friendly (Ivanov and Webster, 2019; Robinson et al., 2020). These technologies in Mode B mainly include self-service devices, smart home systems, and chat robots in hospitality and tourism services (Chi et al., 2020; Keyser et al., 2019), which can be categorized into three types of intelligence: mechanical, analytical, and intuitive intelligence (Huang and Rust, 2018).

First, self-service technologies such as self-check-in and intelligent customer service are adopted to complete relatively simple and standardized tasks. Combined with AI, self-service reduces unnecessary social contact and saves time (Ivanov and Webster, 2019; Li et al., 2017). By autonomous vehicles, customers can reach and leave hotels conveniently (Cohen and Hopkins, 2020). At the front desk, customers can perform self-check-in quickly with recognition systems (Kelly et al., 2017). Intelligent customer service offers help to customers anytime they need it (Lee, 2016). In these service encounters, AI technologies create instant service environments as carrier of interactions. At the same time, customers act as seekers, judges, motivated workers, obligatory workers, and assistance providers, reflecting customers' perceptions of the interactions (Beatson et al., 2007; Ahn and Seo, 2018). The reliability of technologies should be ensured as they affect customer experiences and satisfaction (Lin and Hsieh, 2011; Wei et al., 2016).

Second, smart home and intelligent monitoring systems provide customers with more meticulous and secure services based on machine learning. The IoT relying on big data can record the habits and preferences of a customer for guest rooms (e.g., temperature and brightness) and restaurants (e.g., seat and environment), so that when the customer arrives at the hotel, AI can automatically determine the best service mode to match his/her preferences (Tussyadiah, 2020). The increased flexibility and personalization due to AI can improve service quality (Makridakis, 2017) and positively affect customer satisfaction and loyalty (Kontogianni and Alepis, 2020). Additionally, sensors with AI can monitor the physical health status of elderly and sick customers, which meets customer demand in terms of problem diagnoses and rapid, accurate responses and improves their sense of security in the COVID-19 crisis (Marinova et al., 2016; Nguyen, 2020; Yoon and Lee, 2019).

Third, AI-based technologies such as AR and chatbots, with elementary communicative competence and personalized adaptability, can interact with customers. These technologies usually involve voice, face, and movement recognition systems (Ivanov and Webster, 2019; Wirtz et al., 2018). AR with mobile and wearable devices seamlessly connects customers' real world and digital information (Hassan et al., 2018), and enhances customer participation and their relationships with the service environment, leading to positive service experience (Cranmer et al., 2020). Despite its innovativeness and user friendliness, AR may also cause data overload, resulting in negative customer experiences (Hassan et al., 2018; Kontogianni and Alepis, 2020; Yung and Khoo-Lattimore, 2017). Chatbots with speech recognition focus on answering customers' questions (Robinson et al., 2020). The application of chatbots in service encounters can not only bring novelty to customer experiences, but also quickly target the services they need (Lu et al., 2019). Additionally, the flexible and intelligent service atmosphere provided by chatbots can improve on-site service management (Choi et al., 2019; Makridakis, 2017).

In brief, AI-generated service encounters provide customers with efficient and convenient services, reduce unnecessary human interaction such as forming lines (Choi et al., 2019), create novel experiences (Hoyer et al., 2020), and bring about higher flexibility and customer satisfaction (Wu and Cheng, 2018). Compared with employees, however, AI-generated service encounters may lack the human touch (Choi et al., 2019).

#### 4.1.3. Mode C: AI-mediated service encounters

Mode C describes remote service encounters mediated by technology (Froehle and Roth, 2004; Keyser et al., 2019). In this mode, AI plays an intermediary role and extends employees' abilities in service encounters (Marinova et al., 2016). It leaps over the time and space barriers of services and reduces costs for customers and service providers (Keyser et al., 2019). For instance, customers can book hotels via social media online services (Gretzel and Jamal, 2009). Compared with the traditional face-to-face mode, AI as a mediator may decrease customer satisfaction (Massad et al., 2006), while AI attributes and the personality of the employees may offset this adverse effect (Froehle, 2006; Wu and Cheng, 2018).

AI-mediated service encounters also exist in the context of using robots who perform production or distribution tasks. For example, some hotels use robots to deliver food and beverages (Lu et al., 2019). These robots have the mechanical intelligence to deliver items to guestrooms or produce some goods; however, they cannot communicate with customers but rather act as assistants for employees to connect with customers (Choi et al., 2019). AI service robots in service encounters may cause fear and insecurity, thus weakening customer satisfaction (Wu and Cheng, 2018). They also offer novelty and unique experiences (Choi et al., 2019; Gursoy et al., 2019). The direction of the effect depends on the service robot's attributes (e.g., user-friendliness and accuracy), the improvement of which will bring about trust, comfort, pleasant customer experiences, and experience-sharing behaviors (Tung and Au, 2018; Wu and Cheng, 2018).

#### 4.1.4. Mode D: AI-facilitated service encounter

AI-facilitated service encounters occur when AI technologies and employees jointly provide services to customers. In this mode, all-around interactions occur between customers, employees, and AI. AI can record customer preference information and access internet big data, giving rise to a better customer relationship management (CRM) system and more effective and customized services (Prentice et al., 2020). Service robots in this mode differ from those in Modes B and C in that they have a higher level of autonomy, intelligence, and data storage and retrieval (Prentice et al., 2020). Mode D relies on cooperation among AI, employees, and customers (Lu et al., 2020). For customers to use AI, control of performance and effort expectancy is important during the appraisal stage (Gursoy et al., 2019). Employees should also maintain harmonious relationships with customers so that AI acts as a kind of

interpersonal barrier to reduce unnecessary interactive responses and customer evaluations, but not customer satisfaction (Giebelhausen et al., 2014). Additionally, the communication between employees and service robots is necessary for beneficial relationships (Moshe, 2018; Qiu et al., 2020; Tussyadiah et al., 2020).

AI-facilitated service encounters should be well managed. To create flexible, consistent and standardized service experiences, it is important to consider robot design (e.g., notification and operability), customer characteristics (e.g., culture and personality), and service policies (e.g., participation and complaint handling) because these factors influence customer acceptance, satisfaction, and service experiences (Prentice et al., 2020; Xiang et al., 2015). Customers may be more inclined to accept AI-facilitated encounters if they value innovation and individualism (Lobera et al., 2020; Lin et al., 2019). Additionally, service robots' embodiment, emotion, human-oriented perception, security features, and collaboration capabilities will affect the interaction quality and customer experience (Choi et al., 2019; Lin and Mattila, 2010; Tung and Au, 2018).

### 4.2. Public health emergencies and AI technology-based service encounters

AI technology-based service encounters can be a choice during public health emergencies. Protection motivation theory (PMT) suggests that customers conduct threat and coping appraisals in infectious disease crises (Wang et al., 2019). AI technology-based service encounters solve health problems in two ways: through avoidance and coping. First, AI applications, as technology barriers, can increase physical and psychological distances and divert attention that causes stress and fear (Giebelhausen et al., 2014; Javaid et al., 2020). In addition, as innovative technologies, AI can enhance customers' coping assessments via a personal sense of control and expected efficacy (Luo et al., 2019; Yang and Ma, 2020). From the perspective of service contact, the substitution (Mode B) and intermediary (Mode C) roles of AI avoid direct human contact, preventing the spread of COVID-19 and decreasing customers' threat appraisals (Chakraborty and Maity, 2020; Loureiro et al., 2020; Ruan et al., 2020). When employees are involved, the facilitation (Mode A) and augmentation (Mode D) by AI reduce the duration of unnecessary contact, provide safeguard measures, and make face-to-face contact more secure (De Castries, 2017; Tussyadiah, 2020). In addition, the remote functions of AI can reduce risks after service encounters, by addressing such tasks as comforting, disinfecting, and temperature monitoring (Ramalingam et al., 2020; Zeng et al., 2020). The aforementioned studies were summarized in Table 2, in the framework of PMT.

Service quality is another concern. Compared with employees, applications of AI may result in a lack of humanity, unsociability, and psychological loss, while they could improve the efficiency of routines and add novelty to experiences (Prentice et al., 2020). Thus, the influence of AI service modes on quality is complicated. When taking the contactless or low contact modes, the reliability of AI technologies and the usage of diverse technologies according to their features are important for customized services and shortened psychological distances to customers (Javaid et al., 2020). In the post-COVID era, customers' threat appraisals will decrease. However, because of the long-lasting psychological impact, it is still worth maintaining low contact modes and enhancing customers' coping abilities through the facilitation and augmentation of AI (De Castries, 2017; Ruan et al., 2020). Thus, Mode A and Mode D may be most attractive and effective in the post-pandemic era due to their attributes of high empathy, interaction, and flexibility (Chi et al., 2020; Tung and Law, 2017), especially Mode D in the long term.

**Table 2**
AI technology-based service encounters as a response to COVID-19.

| Threats by COVID-19 pandemic | AI technology-based service encounters | Results |
|---|---|---|
| High rate of spread, aged and low immune people more vulnerable, differential recovery rate, social isolation, economic losses (Chakraborty and Maity, 2020; Nguyen, 2020; Shaw et al., 2020; Zeng et al., 2020) | Clinical care, logistics, reconnaissance, and continuity of work and maintenance of socioeconomic functions ( Yang et al., 2020; Zeng et al., 2020) | Disease prevention, risk reduction, cost-effectiveness, quick and enhanced service, and continued social interactions (Yang et al., 2020) |
| Safety impacts: physical, mental, social, and food (Haghani et al., 2020; He and Harris, 2020) | Medical screening, intelligent monitoring, intelligent forecasting ( Allam et al., 2020; Nguyen, 2020; Shaw et al., 2020; Sigala, 2020); data analysis, text mining, machine learning, natural language processing, and IoT (Dananjayan and Raj, 2020; Nguyen, 2020) | Administrative cost reduction, lowered fatality rate, prevention of infectious disease spreading (Allam et al., 2020; Nguyen, 2020; Shaw et al., 2020) |
| Mental health: loneliness, anxiety, fear, and stress (Ahmed et al., 2020); Fear, intuitive decision making (Zhu et al., 2020); Psychological distress, irrational consumption (He and Harris, 2020; Sigala, 2020) | The sense of security ( Zhao et al., 2020; Zhu et al., 2020); economic benefits: facilitation of virtual interactions, informative and insightful product information (Li et al., 2017; Tussyadiah et al., 2018) | Curb psychological distress (Zhao et al., 2020); trust (Zhu et al., 2020); sustainable consumption (Prentice et al., 2020) |
| Perceived risk (Sigala, 2020; Zhu et al., 2020) | Positivity (Tussyadiah, 2020) | Happiness (Prentice et al., 2020; Yang and Ma, 2020); future intentions (Sigala, 2020) |
| Individual's perception and emotion (Yang and Ma, 2020) | The sense of control (Yang and Ma, 2020) | Emotional well-being ( Yang and Ma, 2020) |
| Self-protection actions ( Zhao and Bacao, 2020), safe and healthy consumption (He and Harris, 2020; Sigala, 2020) | Perceived task-technology fit, performance expectancy, social influence and confirmation (Zhao and Bacao, 2020), performance and effort expectancy (García-milon et al., 2020) | Trust, repurchase intention (Zhao and Bacao, 2020); satisfaction ( García-milon et al., 2020) |
| Safety first, travel restrictions, economic slowdown (Hao et al., 2020; Jiang and Wen, 2020; Sigala, 2020) | Social distancing, prediction and alarm system of infectious diseases, personalized customer service, complicating service interactions, personalized recommendation systems ( Jiang and Wen,2020; Sigala, 2020; Seyitoğlu and Ivanov, 2020); digital, intelligent, and contactless service (Hao et al., 2020) | Service quality (Jiang and Wen, 2020; Zeng et al.,2020); satisfaction, efficient operation, cost reduction (Hao et al., 2020; Seyitoğlu and Ivanov, 2020); loneliness, digital separation, digital inequalities, and increase of travel cost ( Sigala, 2020) |
| Unemployment crisis ( Hao et al., 2020; Jiang and Wen, 2020; Sigala, 2020); security of hotel employees (Hao et al., 2020) | Enabling, mobile computing, telecommuting, and isolation (social distancing), substitution ( Papagiannidis et al., 2020; Seyitoğlu and Ivanov, 2020) | Business continuity plans, and employee well-being ( Papagiannidis et al., 2020; Seyitoğlu and Ivanov, 2020); unemployment crisis ( Jiang and Wen, 2020; Zeng et al.,2020) |

### 4.3. Conceptual model: antecedents and consequences of technology-based service encounters

Hospitality and tourism firms that strive to maintain business are concerned about what factors influence AI technology-based service encounters and how the encounters lead to service outcomes. Following the theory of social interaction, we reached a conceptual model of the influence mechanism of AI technology-based service encounters on service outcomes (Fig. 1). As a solution to deliver services safely in public health emergencies, the four modes of AI technology-based service encounters that we identified in the previous sections lie in the middle. The characteristics of the modes reported in Table 1 forms the basis for their influences. Instead of listing each mode's characteristics, in the integrated model, we summarized the common attributes of AI technology-based service encounters after considering COVID-19 pandemic factors. This involves the attributes or elements of the three parties as customers, employees, and AI, which are reflected in the exposure to the environment (Lin and Mattila, 2010); product and service features (Hassan et al., 2018); form/degree of service technology, subjective norms, perceptual, and behavioral control (Gursoy et al., 2019).

These elements may be affected by customer-based, firm-based, and context-based factors in public health emergencies (Froehle, 2006). The influence of public health emergencies on service encounters varies with customer cognitive assessment and behaviors (Chakraborty and Maity, 2020). Because of the COVID-19 pandemic, customers emphasize health but are less hedonistically motivated (Wang et al., 2019). Additionally, they are eager for communication driven by anxiety and loneliness, while avoiding close contact to reduce infection risks (Wang et al., 2020). In public health emergencies, customers interacting with service providers have accompanying risk appraisals, which with technology readiness, affect AI technology applications (Gursoy et al., 2019; Ruan et al., 2020). In addition, the application of AI in service encounters relies on the innovation strategies of service firms (Makridakis, 2017). The physical servicescapes, psychological climate, and social reputation created by the firms also influence the roles and behaviors of the three parties (Belanche et al., 2020; Ivanov and Webster, 2019). Competitive pressure is another factor driving service interactions with AI. For example, hospitality firms and other platforms (e.g., medical care and e-commerce) have started to jointly overcome difficulties and provide customers with more comprehensive services, which require AI contact systems (Mariani et al., 2019). At the broader level, technological infrastructure (e.g., big data), political ideology, and social norms (e.g., attitudes towards monitoring) are also key factors shaping the forms of AI technology-based service encounters (Rudran and Kumar, 2017; Kim et al., 2013; Novelli et al., 2018; Wen et al., 2020). These factors may interact with each other to produce effects (see double-sided arrows in Fig. 1). For example, firm-related factors can regulate customer factors and adjust the influence of the latter on service encounters, while customer values, risk preferences and social reputation collectively influence the results of the interactions (Lobera et al., 2020).

The consequences of service encounters with AI were categorized into two levels. The characteristics of AI technology-based service encounters may interact with the factors in the COVID pandemic, such as crowding, discrimination, level of risk and availability of health services (Ahmed et al., 2020; Liu et al., 2020), affecting the first level of outcomes as customer experience values, including functional, cognitive, emotional, and social values (Hoyer et al., 2020; Tung and Law, 2017). The value perceptions further lead to the second-level outcomes that firms value, such as trust, adaptability, satisfaction, repurchase, and recommendation (Prajitmutita et al., 2016). The attribute-value-intention relationships for each encounter mode were partly examined (Section 4.1). In contrast, the combination and comparison of various modes generally lack investigations and can be a future research direction (Sampson and Chase, 2020).

## 5. Discussion and conclusions

Against the background of the global COVID-19 pandemic, we systematically reviewed AI technology-based service encounters. One the one hand, public health emergencies result in depression and loneliness, which call for social interaction, but on the other hand, social distance should be kept to stop virus spread (Sigala, 2020). Thus, service contact is the key to service management in public health emergencies, and AI applications could provide solutions (Nguyen, 2020). This study identified four types of service encounters with AI technologies, i.e., AI-supplemented, AI-generated, AI-mediated, and AI-facilitated encounters. In addition, an integrated model including the antecedents (i.e., three types of factors) and consequences (i.e., two levels of outcomes) of AI technology-based service encounters was summarized to further

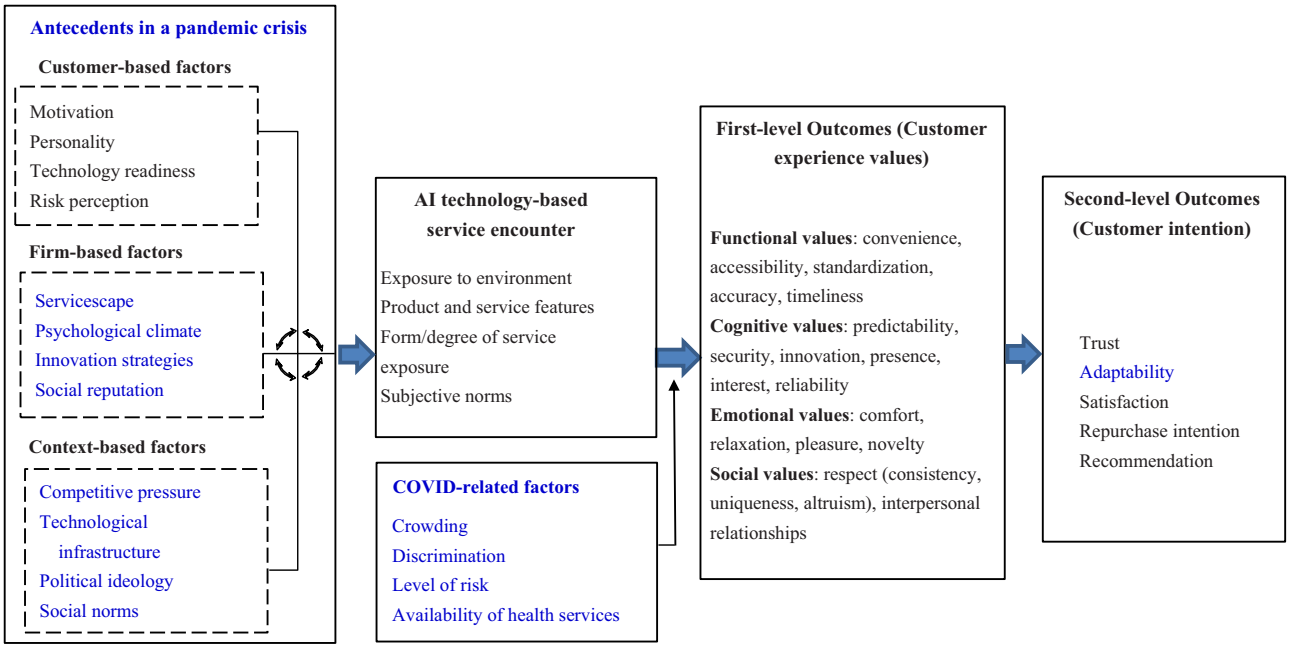



**Fig. 1.** Conceptual model of AI technology-based service encounter.

understand the new service encounters in public health emergencies. The findings have important theoretical and practical implications.

### 5.1. Theoretical contributions

This study makes important contributions to service encounter research. Previous research mainly investigated the service encounters between customers and employees (Riley, 2007; Larivière et al., 2017). Although more recent studies have renewed service contact to the triad model including customers, employees, and service organizations, the analysis of the organization side was general and vague (Fitzsimmons et al., 2011). While the technologies in service encounters have attracted increasing attention, service encounters with AI, a new technology that differs from traditional technologies in terms of intelligence and humanlike qualities, have not been systematically discussed. A systematic review suggested that AI technology-based service encounters mainly show four modes, sharing some similarities to the five archetypes proposed by Froehle and Roth (2004) and eight modes proposed by Keyser et al. (2019). The identification of AI technology-based service encounters could deepen the understanding of this area in many ways. Previous research has generally taken a broad view of technologies and focused on traditional technologies (Buhalis and Law, 2008). This study focused on AI technologies that can independently serve customers in completing a full service (AI-generated), or part of a service by supplementing employees (AI-supplemented, a new archetype add to Froehle and Roth (2004)). "Technology-facilitated customer contact" in previous studies measured unidirectional contact from customers/employees to technologies (Wang et al., 2013). This study enhanced the understanding of the mode by explaining the bi-directional interactions between the customers/employees and technologies. In addition, as the differences between various technologies were unintentionally ignored in previous research, this study specifically examined the different AI technologies that have been adopted in practice and identified their attributes. For example, AI-generated encounters were categorized into three types according to their intelligence, extending the meaning of "technology-generated contact", which was previously restricted to self-service (Froehle, 2006). Moreover, this study updated AI applications in services from the perspective of reducing unnecessary social contact while ensuring service effectiveness, which is a significant issue that has not yet been discussed (Keyser et al., 2019).

This study paves the way for future research on the influence of public health emergencies and AI applications by providing a conceptual model. Public health emergencies bring about challenges and opportunities for service encounters. AI applications are countermeasures, and they further lead to two levels of service outcomes: customer experience value and behavior intentions. Thus, this research provides a framework to analyze the effectiveness of AI adoption in responding to the issues caused by public health emergencies and to research AI penetration in the hospitality and tourism areas.

### 5.2. Practical implications

The results also offer practical implications in terms of AI and service encounter design and management. Hospitality and tourism firms can appropriately adopt AI technologies that fit their services and tasks. For example, many hotels have launched contactless intelligent services. Customers can choose member hotels according to intelligent recommendations or VR, quickly go through self-check-in, locate their guestrooms following service robots, have a casual discussion with chatbots, and obtain information without face-to-face interactions with employees. Additionally, firms should evaluate the relevant AI technologies considering customer-based, firm-based, and context-based factors and transform the threats of public health emergencies into opportunities. For instance, "cloud" tourism as a new form can be explored to follow the transition of tourists' consumption, so that the disadvantage of people staying at home turns into an advantage. Additionally, it is essential to build databases for customized services and service innovations in the post-epidemic era.

### 5.3. Limitations and future research

This paper was conceptual in nature and based on the analysis of existing literature. The lack of empirical research on the proposed model on the COVID-19 pandemic and service encounters involving AI can be a limitation. Future research can collect data to test the relationships proposed in the framework.

Another limitation of the study is the restricted focus on the performance of AI. The social and ethical issues of AI, such as ubiquitous surveillance, privacy, and equality, are important but not considered in the present study. These factors could be the topic for future research. Another direction lies in technology system compatibility, considering the limitation of this study in discussing only value cocreation but not codestruction.

Employees are indispensable for service encounters. However, in the integrated model, employee-based factors were missing because previous studies rarely investigated the influence of employee characteristics on service encounters. Given the critical role of employees, employee-based factors should be included in the model. Future research can explore the influence of employee-related factors on AI-infused service encounters.

## Funding

This work was supported by the National Social Science Fund of China, China (NSSFC), under Grant No. 19CGL031.

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