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Authors	Song, Hanqun;Wang, Y-C.;Yang, H.;Ma, E.
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Robotic employees vs. human employees: Customers' perceived authenticity at casual dining restaurants

Abstract

Cost-saving and sanitation considerations and the challenge of labor shortages have catalyzed the application of service robots in restaurants. Although service robots can perform multiple roles and functions, more research attention is needed in hospitality contexts on how different combinations of using robots and humans at different product/service layers may influence customers' experiences and behavioral intentions. Building on the literature of product level theory and authenticity, this study empirically investigated this issue with data collected from 364 customers in China. The results show that the use of robots in core and facilitating product levels is less effective in improving consumers' perceived service and brand authenticity. Consumers' perceived service authenticity positively influences their brand authenticity and repurchase intention. Consumers' perceived brand authenticity only positively affects their repurchase intention. Both theoretical and managerial implications are discussed in this paper.

Keywords: Robot; Product Level Theory; Authenticity; Service Robots; Repurchase Intention; Restaurant

1. Introduction

Robotic restaurants nowadays are getting popular all over the world, in which service robots are utilized to save costs, enhance operational efficiency (Chuah et al., 2021), and add a “wow” factor to customer experience (Berezina et al., 2019). The popularity of service robots is also driven by the labor shortage issue facing the hospitality industry, particularly in the food service sector, and using service robots has emerged as an ideal solution (Ma et al., 2021; Miller, 2022). Service robots can perform various roles in restaurants such as cooking, hosting, ordering, delivering, and entertaining customers (Hwang et al., 2020; Ivanov and Webster, 2019), replacing many functions that are traditionally performed by employees (Andreassen et al., 2018). Particularly during the COVID-19 pandemic, service robots have been increasingly used to minimize human contact and strengthen safety and sanitation (Lu et al., 2021). Service robots bring in new forms of interactions among customers, employees, and technology (Qiu et al., 2020), and using robots can change the nature and format of products, service design, and delivery (Mozafari et al., 2021), as well as consequent customer experiences (Kunz et al., 2019). As such, growing research attention has been devoted to studying how adopting robots and related technologies may have altered customers’ dining experiences through value perception (Chuah et al., 2021), perceived innovativeness (Hwang et al., 2020), and acceptance and willingness to use robots in service contexts and day-to-day life (Lin et al., 2020).

Both automated and authentic services are desired in the service industries (Seyitoğlu, 2021). While service robots have been widely studied in the hospitality industry, there is a lack of research on how using robots may (or may not) alter the authenticity of customers’ dining experiences (Seyitoğlu, 2021). As an important characteristic in the overall dining experience (Baldacchino, 2015), authenticity has been increasingly studied in the restaurant context (Kim and Song, 2020; Liu et al., 2018). And yet, there is a gap in the existing

literature on the role of authenticity in robotic restaurants. Focusing on this is important because restaurant customers want authenticity in not only cuisines and food cultures but also service delivery (Kraak and Holmqvist, 2017) and branding (Le et al., 2019).

Authenticity encompasses both service authenticity and brand authenticity, and the former refers to the extent of the authenticity and sincerity that the service provider offers, while the latter refers to a subjective evaluation of genuineness ascribed to a brand by consumers (Price et al., 1995; Napoli et al., 2014). To date, however, limited research has attempted to examine whether customer perceived service and brand authenticity might be differed due to the involvement of robots. To address this research gap is important, not only because perceived authenticity in the service experience can greatly influence customers' attitudes (Lin et al., 2020) but also because it fuels the debate of whether robots can replace human-performed service in terms of providing hospitality to customers (Choi and Wan, 2021).

Another research gap in the study of service robots in hospitality contexts is the lack of systematic frameworks regarding how service robots have been adopted from a product/service design perspective (Ma et al., 2021). We suggest that how service robots were applied in restaurants can be studied using the Product Level Theory (Kotler and Keller, 2016). First proposed by Kotler and Levy (1969), this theory suggests that product/service design should consider satisfying multiple needs of customers. Thus, a product/service should contain core, facilitating, and augmented layers. In the contexts of robotic restaurants, cooking and food preparation are considered core products/services; greeting customers, paying bills, and food delivery are facilitating products/services; and interactions between customers and servers (robotic vs. human employees) and the dining atmosphere are considered augmented products/services (Kotler et al., 2017). Despite the sound theoretical connection between this theory and the robot service context, empirical efforts are rare. It

remains unclear whether robot applications at the different product/service levels would influence customers' perceived brand and service authenticity and their behavioral intentions differently. There is also limited evidence guiding restaurant operators as to which levels of products/services are most suitable to be performed by service robots and which are better performed by humans. Achieving such an understanding is essential as hospitality organizations are operating with limited resources and need to make wise business decisions. Such decisions address not only the use of service robots but also, and more importantly, at which product/service layers they want robots to replace humans. This is particularly true given the current massive labor shortage facing the restaurant industry (Littman, 2021).

Building on the literature of the Product Level Theory and authenticity, this study explores how robot applications at different layers of restaurants' products/services may affect customers' perceived service and brand authenticity as well as behavioral intentions toward using robots in the domains of restaurant service and day-to-day life. First, the study identifies whether the robot applications at different product levels (the core, facilitating, and augmented levels) influence customers' perceptions of brand authenticity and service authenticity. Second, it compares the effects of using robotic versus human employees in different product levels on service and brand authenticity to explore whether the effects vary. Third, unlike previous studies focusing on a single outcome variable such as customers' intention to use or acceptance of robots (e.g., Cha, 2020; Yang et al., 2021), this research examines how brand and service authenticities influence not only repurchase intention but also the use of robots in daily life. The study contributes to the literature on product level theory, robots versus human employees, brand and service authenticity, and behavioral intentions in the Chinese robotic restaurant context. The results have practical implications for how robotic restaurants may enhance restaurant image, advance the production of authenticity, and reduce the impact of the pandemic.

2. Literature Review and Hypothesis Development

2.1. Link between product level theory and using robots in the restaurant industry

Service robots have become increasingly popular in the hospitality industry. In the hotel context, robots can be employed to deliver various tasks in different stages to serve customers, including pre-arrival, arrival, stay, and departure (Luo et al., 2021; Ivanov et al., 2020). In restaurants, robots are playing the roles of servers, hosts, and even chefs (Hwang et al., 2020) to create excitement in customers' dining experiences. The popularity of service robots has also drawn growing research attention from hospitality and tourism researchers (e.g., Liu et al., 2022a; Zhang et al., 2022). For instance, Ivanov and Webster (2022) investigated public preferences for using robots for food and beverage service. Hwang et al. (2022) studied how using service robots vs human employees may influence the brand authenticity of robotic restaurants. Liu et al. (2022b) explored the interactions between robots' appearance (friendly vs competent) and service contexts (hedonic vs utilitarian) and how such interactions may influence customers' trust and willingness to use robotic service. Despite the increasing research attention on robots' applications in hospitality, particularly in restaurants (e.g., Cha, 2020; Fusté-Forné, 2021; Kim et al., 2021), there is a paucity of research that systematically analyzes robots' applications from the product/service design perspective (Ma et al., 2021). According to the Product Level Theory, one of the classical theories for product design, restaurants offer customers both tangible products and intangible service experiences to satisfy their needs at the core, facilitating, supporting, and augmented levels (Kotler and Keller, 2016). Core products satisfy customers' fundamental needs, and in the restaurant context, they mainly include food and beverages that resolve customers' hunger needs (Reid and Bojanic, 2010). Facilitating and supporting products are elements that enable customers to consume core products or are necessary for the product/service to

function, and in restaurants, they include services such as allocating tables, taking orders, and processing payments (Xu and Liu, 2011). Augmented products are extra features that distinguish one product/service provider from another, and in the case of robotic restaurants, these include using service robots to entertain customers (Biyani and Gupta, 2014).

Using robots to replace restaurant employees needs careful consideration from the product/service design perspective because most organizations are operating with limited resources as suggested by the Resource Allocation Model (Bower, 2018). Therefore, restaurant operators need to make sound decisions that are not only cost-effective but also can enhance, or at least avoid compromising, the service experience of customers. For instance, restaurants using robot servers to deliver food enjoy the cost savings and efficiency such technology brings to customers. On the other hand, they also take the risk that robot servers may irritate customers for not being responsive and flexible enough to satisfy individual needs (Kranker, 2021). Similarly, restaurants using robot chefs could offer excitement in the overall dining experience, and yet, they may fail to offer authenticity in the taste of the food (e.g., Fusté-Forné, 2021). An in-depth understanding of how service robots applied at different layers of the products/services that restaurants offer could influence customers' perceived authenticity of service, overall dining experience, and future purchase intention is vital for aiding restaurant operators in coming up with strategic business decisions.

2.2. Robots applied at different levels and their influence on authenticity

Authenticity is a vital competence in contemporary businesses because consumers constantly demand it and business operators proactively claim to possess it (Beverland and Farrelly, 2010; Goulding and Derbaix, 2019; Kim et al., 2020). Tourism scholars brought the concept of authenticity from sociology, and have researched authenticity mainly from three angles,

namely objective authenticity, constructive authenticity, and existential authenticity (Wang, 1999). Objective authenticity refers to the scientific approval of an object's originality (Croes et al, 2013). Constructive authenticity means that individuals' authenticity towards an object is subjective and socially constructed (Cohen, 1988). Rather than focusing on the object, existential authenticity mainly emphasizes consumers' authentic self in consumption (Wang, 1999).

In the restaurant context, food authenticity, referring to the genuine of food (Groves, 2001), has been well-researched due to the nature that food is the key element of restaurants (Robinson and Clifford, 2012). Almost all restaurant scholars adopted the constructive viewpoint to study food authenticity since individuals often interpret the same food variously based on their beliefs, expectations, and perceptions (Kim and Jang, 2016). Besides food authenticity, restaurant scholars have recently started to research brand authenticity which is a well-studied concept in the marketing discipline (Hwang et al., 2022; Song and Kim, 2022), and service authenticity (Kim, 2021). Different from food authenticity on food, brand authenticity is about the brand, such as restaurant brand (Song and Kim, 2022), and service authenticity is about the services provided in the service industry, including the restaurant sector (Kim, 2021). It should be noted that the meaning of authenticity can be different in different restaurant contexts. For example, consumers may view food authenticity of a Chinese restaurant differently depending on the location of the restaurant (Chang et al., 2010). Consumers may view a fine-dining restaurant and a casual restaurant differently in terms of brand and service authenticity due to the differences in restaurants that demonstrate brand image and service procedure (Hwang and Ok, 2013; Ma and Hsiao, 2020).

Service authenticity refers to whether the service provided by the service provider is authentic or artificial (Featherman et al., 2006). In non-restaurant contexts, Featherman et al. (2006) suggested that factors such as ease of use, perceived risk of service, and personal

innovativeness can influence consumers' perceived service authenticity. Bae (2021) found that service authenticity including authentic, sincere and considerate services positively affects service value and service satisfaction. In ethnic restaurant contexts, Kim (2021) suggested that service authenticity should include multiple dimensions such as continuity, consistency, uniqueness, talent, scarcity, honesty and traditionality, and most dimensions significantly contributed to consumers' positive emotions. However, what contributes to the formation of service authenticity and whether service authenticity affects other variables are areas of inquiry that remain under-researched in the restaurant context.

The service industry is a labor-intensive industry, and humans have traditionally been the main service providers in the service industry (Hanzaee and Mirvaisi, 2013). Although there are robot-staffed service organizations, customers have more positive perceptions of human-to-human interactions (e.g., between customers and human staff) than human-to-robot interactions as human-to-human interactions are perceived as sincere and genuine (Shin and Jeong, 2020). In addition, hospitality in the service industry is presented through human values or a human touch (Kim et al., 2021), and human appearances demonstrate higher levels of warmth and friendliness (Van Doorn et al., 2017). As a result, robot servers in different stages of the service journey are perceived as superficial and less authentic in terms of providing services compared with human employees (Lin and Mattila, 2021). Based on the previous literature, we propose:

H1: The use of robots in all three product levels is less effective at improving consumers' perceived service authenticity. Specifically, the three product levels include the core product (H1a), the facilitating product (H1b), and the augmented product (H1c).

Under the stream of constructive authenticity, marketing scholars have dominantly researched brand authenticity. Brand authenticity revolves around whether the brand is viewed as real, honest, and genuine (Guèvremont, 2018). There is a good understanding of what constitutes brand authenticity, its antecedents, and consequences from the brand perspective (Hernandez-Fernandez and Lewis, 2019; Napoli et al., 2014). In addition to being passionate about business (Morhart et al., 2015), brand authenticity is linked to a brand with a history (Morhart et al., 2015), a sense of tradition (Napoli et al., 2014), or heritage (Fritz et al., 2017; Song and Kim, 2022). Therefore, a restaurant with cutting-edge technology such as robots may be viewed as less traditional and less authentic in terms of brand image. Another element of brand authenticity is being genuine and sincere (Beverland, 2005). As human-to-robot interactions are considered less genuine and sincere compared with human-to-human interactions (Shin and Jeong, 2020), consumers perceive a service delivered by robots as less authentic. Consequently, restaurants using robot servers might be viewed as having low levels of brand authenticity. Therefore, we propose:

H2: The use of robots in all three product levels is less effective at improving consumers' perceived brand authenticity. Specifically, the three product levels include the core product (H2a), the facilitating product (H2b), and the augmented product (H2c).

The existing literature has verified that services in a service organization positively affect consumers' brand evaluation of the service organization (Chan and Tung, 2019; Durna et al., 2015; Krystallis and Chrysochou, 2014). With a particular focus on restaurants, DiPietro and Levitt (2019) examined the factors that contribute to restaurant authenticity. They confirmed that factors such as servicescape and food all contribute to overall restaurant authenticity (DiPietro and Levitt, 2019). Based on similar logic, we hypothesize that

authentic service significantly enhances consumers' perceived brand authenticity toward the restaurant:

H3: Consumers' perceived service authenticity positively influences their perceived brand authenticity toward the restaurant.

2.3. Service and brand authenticity, behavioral intentions, and using robots in daily life

Along with the development of service robots, purchase intention has been widely studied in the hospitality literature (e.g., Hwang et al., 2021, Park, 2020; Zhong et al., 2020). Repurchasing plays a crucial role in a company's growth and profitability (Barney, 1991), and robotic restaurants are facing challenges regarding how to attract and retain customers. As for repurchase intention, previous studies have identified the influence of technology in hospitality contexts, such as Facebook messages, information security, and mobile apps (Ho and Chung, 2020). However, a holistic conceptualization of the determinants of repurchase intention in the context of robotic restaurants is scarce. The impacts of brand and service authenticity on repurchase intention are nevertheless largely overlooked, notwithstanding the expected service robot growth in the restaurant context (Chuah et al., 2021).

High service authenticity is related to authentic, sincere, and considerate services provided by the servers (Bae, 2021; Featherman et al., 2006), including service robots in the robotic restaurants. Service authenticity also affects service value, service satisfaction (Bae, 2021), and positive emotions (Kim, 2021). Whether the performance of robots demonstrates a high level of role congruity is a key determinant of service authenticity that customers perceived. According to the Role Congruity Theory (Eagly and Karau, 2002), individuals' evaluation of role congruity is based on descriptive norms (i.e., what is expected service

provider) and injunctive norms (i.e., ideally what should a service provider do). When server or service robots' performance meets or exceeds the descriptive norm level, customers would perceive a high level of service authenticity and brand authenticity (Kim & Baker, 2017). Higher authenticity reflects higher role congruity, which is achieved by meeting customers' expectations at the descriptive norm level or exceeding customers' expectations at the injunctive norms level (Song et al., 2019). When customers' expectations are met or exceeded, customer satisfaction and loyalty such as repurchase would follow. Therefore, we propose when customers perceive high service authenticity in a robot restaurant, they would have a stronger repurchase intention.

H4: Consumers' perceived service authenticity positively influences their repurchase intention.

As one vital factor in attracting customers (Boyle, 2003), brand authenticity positively contributes to trust and loyalty (Portal et al., 2019). Customers are more likely to favor and spread positive feelings about authentic brands (Shulga and Busser, 2019). If such customers have positive impressions of robotic restaurants, they are more likely to return to such restaurants. Previous research suggests that the authenticity perception of customers can significantly influence their perceived brand equity—a significant predictor for their brand choice intention (Lu et al., 2015). Shulga and Busser (2019) have confirmed the positive relationship between brand authenticity and purchase intention. In addition, brand authenticity inculcates positive feelings in customers and is one of the causes for their repurchase behavior (Jang et al., 2012). Thus, brand authenticity influences repurchase intention (Park, 2020), leading to the following hypothesis:

H5: Consumers' perceived brand authenticity positively influences their repurchase intention.

With the development of modern technology, especially Artificial Intelligence (AI), the use of robots is a new trend assisting the service needs of daily life in human society (Huang and Rust, 2018, 2021). Through analyzing AI in service sectors, Huang and Rust (2018) proposed four intelligence types for AI applications: mechanical intelligence (i.e., learn or adapt at the minimum), analytical intelligence (i.e., systematically learn and adapt based on data), intuitive intelligence (i.e., intuitively learn and adapt based on understanding), and empathetic intelligence (i.e., emphatically learn and adapt based on experience). Belanche et al. (2020) summarized that service robot design involves key factors of formality, affect, proactivity, manipulability, robot notification, and aesthetics. Meanwhile, from users' perspective, key customers features in developing robots include age, gender, culture, personality traits, customer tier, and technology readiness (Belanche et al., 2020).

Huang and Rust (2021) further proposed three levels of AI and their service benefits: (1) mechanical intelligence: learn and adapt with only minimal standardization (e.g., payment and delivery), (2) thinking intelligence: learn and adapt with data personalization (e.g., develop new service and personalize service), and (3) feeling intelligence: learn and adapt with relational experiences (e.g., engage customers and customer care). To implement service robots at service encounters, Belanche et al. (2020) pointed out that factors such as information provision, employee replacement versus collaboration, transactional versus relational, product or service, failure and complaint, and involvement levels should all be considered. In addition to the service robots adopted in the hospitality industry (Choi et al., 2019; Lv et al., 2021; Ma et al., 2021), robots have been developed to serve human needs in daily life in various aspects, such as logistics and transportation (Amazon's warehouse

robots) and public service (Volvo's robot-based autonomous refuse collector) (Xiao and Kumar, 2021).

During a restaurant service experience, Kim (2021) conceptualized that customers may evaluate service authenticity through true-to-ideal (i.e., socially constructed authenticity standard; e.g., consistency), true-to-fact (i.e., information communicated about a product or a business to others; e.g., honesty), and true-to-self factors (i.e., an entity being intrinsically motivated versus extrinsically motivated; e.g., uniqueness). Thus, restaurant customers' perceived service authenticity further guides them to consider the authenticity of service tasks delivered by robots in various aspects. Such consideration goes beyond a restaurant dining experience to the feasibility of using service robots in other services in daily life. Similar to the idea that tourists' perceived service authenticity toward service providers influences their overall tourism experience (Zatori et al., 2018), we believe that in our research setting, customers would base their behavioral intention to use robots in daily life on their perceived service authenticity during a robotic restaurant experience. Therefore, we propose:

H6: Consumers' perceived service authenticity positively influences their use of robots in daily life.

Restaurant customers' perceived brand authenticity is based on their subjective evaluation of genuineness ascribed to the restaurant brand (Napoli et al., 2014). Different from service authenticity, which focuses on service-related authenticity evaluations, customers' evaluation of brand authenticity covers a broader range of a branded restaurant experience (e.g., brand reliability and brand credibility). During a robotic dining experience, customers get opportunities to experience and understand how feasible it is to utilize robots replacing human employees in various product levels at restaurants and how the hospitality

business can maintain consistency of its core brand image while utilizing robots to perform tasks as good as (if not better than) human employees (de Kervenoael et al., 2020; Hwang et al., 2021). Such robotic brand experiences at restaurants would assist customers to build trust toward service robots (Chi et al., 2021), allowing customers to gain behavioral intention toward using robots in daily life to deal with other service needs (Ivanov and Webster, 2021; Simon et al., 2020). Therefore, we propose:

H7: Consumers' perceived brand authenticity positively influences their use of robots in daily life.

In light of the above, the following research framework is proposed for this study. Based on product level theory (Kotler and Keller, 2009), we propose that customers at casual dining restaurants would experience service delivered by robots in three product levels: core product, facilitating product, and augmented product. The experience of these three product levels would assist customers in perceiving two levels of authenticity: service authenticity and brand authenticity. Because service experience is a part of the overall brand experience, we further propose that perceived service authenticity would enhance customers' perceived brand authenticity. Further, we propose behavioral intentions regarding the dining and life domains. We predict that customers' perceived authenticity driven by robotic services would not only increase their repurchase intention with the restaurant (dining domain) but also support their intention to use robots in daily life (life domain).

(Insert Fig 1 about here)

3. Method

A between-subjects 2 (core product: human vs. robot) x 2 (facilitating product: human vs. robot) x 2 (augmented product: human vs. robot) experimental design was adopted to explore the effects of three independent variables on consumers' authenticity perception toward the service itself and the brand (i.e., service authenticity and brand authenticity). Based on the three independent variables each with 2 levels, the research team produced eight dining experience scenarios, featuring a mid-priced casual-dining restaurant in China (see Appendix 1).

The casual restaurant in this study is defined as a restaurant that serves moderately priced food in a relaxed atmosphere with table services (Ponnam and Balaji, 2014). There were three reasons why a casual-dining restaurant was featured in the scenarios. First of all, according to previous research findings, casual restaurants are more likely to adopt technologies in services, such as using service robots (Lu et al., 2021). Second, most restaurants already using service robots such as *Spice* and *Haidilao Restaurant* belong to the casual dining restaurant categories. Third, casual-dining restaurants are more commonly seen and accessible to most customers, thus they are easier for participants to relate the scenarios to their own experiences.

3.1 Participants

We collected the experimental data in China through a leading Chinese marketing research firm. The firm sent the questionnaire link to its panel members in the database and invited these members to complete it. By clicking the link, every member was randomly placed in one of the eight dining scenarios (see Appendix 1). For example, in one of the scenarios, customers were told that a robot server greeted, led and took orders, delivered food and processed payments for customers, while in another scenario, the human employee did

all the above-mentioned tasks. There were 6 scenarios where restaurants use both robot server and human server in a customer dining experience. Participants were requested to evaluate their dining experience based on their assigned scenarios. They were also asked to share their demographic information (e.g., age, gender, education) and dining experience (e.g., dining experience with robotic restaurants).

A total of 364 members joined the study, with a cell size ranging from 40 to 50. Among these participants, nearly half were aged 21-30 (44%), more than half were female (55.5%), around three-quarters held an undergraduate degree (75.8%), and 57.7% of participants dined in robotic restaurants 1-5 times.

3.2 Measurement

All constructs were measured using previously validated scales, and were measured using a 7-point Likert scale. In particular, service authenticity, using five items, was adopted from Featherman et al. (2006); brand authenticity, using three items, was adopted from Moulard et al. (2016); consumers' repurchase intention, using three items, was adopted from Song and Kim (2022); and intention to use robots in daily life, using three items, was adopted from Chiu et al. (2021). The factor loadings for each item and the Cronbach's alphas for each construct are shown in Appendix 2.

Based on previous literature (e.g., Zhong et al., 2021; Ayyildiz et al., 2022), age, gender, and educational level are variables related to users' perception and experience with service robots. Therefore, these demographic variables were used as control variables. Considering the study context and the fact that robot restaurant is still in its infancy stage of development, the dining experience with robotic restaurants was used as another control variable in our research.

3.3 Data analysis

A three-way analysis of covariance (ANCOVA) was implemented to test the effect of three independent variables on service authenticity and brand authenticity using participants' age, gender, education and experience with robotic restaurants as control variables. In addition, the model proposed included both direct and indirect relationships, and following the mediation analysis procedure by Hayes (2022), SPSS PROCESS model 6 was adopted to test the proposed relationships. PROCESS is a path analysis modeling tool-based ordinary least squared (OLS) and logistic regressions, which has been popularly used in business and hospitality research (e.g., Chen et al., 2021; Hsiao et al., 2020; Wang et al., 2021). It offers advantages in estimating direct and indirect effects, and conditional indirect effects with a single or multiple mediators or moderators (Hayes, 2022; Hayes, Montoya, & Rockwood, 2017). Following the procedure of model 6, service authenticity was the independent variable, brand authenticity was the mediator, repurchase intention, and the use of robots in daily life were dependent variables. As PROCESS only allows one independent and one dependent variable for each model, model 6 was run twice, when using each dependent variable. We set the confidence interval at 95% and bootstrap samples at 5000.

4. Results

4.1 Manipulation check

Participants were asked to answer three manipulation check questions to ensure participants read the scenarios carefully. All manipulations were effective. In terms of the core product, subjects in the robot chef group agreed more on the robot chefs delivering a core product than those in the human chef group ($M_{\text{Core-Robot}} = 6.81$; $M_{\text{Core-Human}} = 1.37$; $t(362) = 78.591$; $p < .001$). In the facilitating product, subjects in the robot server condition rated higher on the robot delivering a facilitating product than those in the human server

condition ($M_{\text{Facilitating-Robot}} = 6.75$; $M_{\text{Facilitating-Human}} = 1.22$; $t(362) = 108.450$; $p < .001$).

Regarding the augmented product, the subjects in the robot group agreed more on robots delivering an augmented product than those in the human group ($M_{\text{Augmented-Robot}} = 6.79$; $M_{\text{Augmented-Human}} = 1.84$; $t(362) = 35.290$; $p < .001$).

4.2 The main effects of product levels on authenticity

We used demographic variables such as age, gender, education, as well as experience with robotic restaurants as control variables while conducting the ANCOVA. Table 1 shows that both core and facilitating products significantly affect consumers' perceived service authenticity and brand authenticity. For instance, in terms of the core product, the results show that using robots generated a lower level of service authenticity than having human beings ($M_{\text{Core-Robot}} = 5.41$; $M_{\text{Core-Human}} = 5.77$; $F[1, 352] = 6.166$; $p < .05$). In addition, using robots to deliver core products contributed to a lower level of brand authenticity than having human beings ($M_{\text{Core-Robot}} = 5.77$; $M_{\text{Core-Human}} = 5.99$; $F[1, 352] = 5.414$; $p < .05$). Consequently, H1a and H2a were confirmed. Similarly, the use of robots in the facilitating product generated a lower level of service authenticity ($M_{\text{Facilitating-Robot}} = 5.42$; $M_{\text{Facilitating-Human}} = 5.77$; $F[1, 352] = 10.232$; $p < .01$) as well as brand authenticity ($M_{\text{Facilitating-Robot}} = 5.74$; $M_{\text{Facilitating-Human}} = 6.02$; $F[1, 352] = 11.568$; $p < .01$) than the use of human servers. As a result, H1b and H2b were supported.

However, using robots or human servers in the augmented product contributed to a similar score of service authenticity ($M_{\text{Augmented-Robot}} = 5.54$; $M_{\text{Augmented-Human}} = 5.65$; $F[1, 352] = .856$; $p = .356$) and brand authenticity ($M_{\text{Augmented-Robot}} = 5.89$; $M_{\text{Augmented-Human}} = 5.87$; $F[1, 352] = .043$; $p = .836$). Thus, both H1c and H2c were rejected. Surprisingly, no two-way or three-way interaction effects were observed in this study. For control variables, participants' demographic variables (e.g., age, gender and education) were found did not

significantly influence service and brand authenticity. However, participants' dining experience with robotic restaurants influenced customers' evaluation of service authenticity ($F[1, 352] = 9.479; p < .01$) and brand authenticity ($F[1, 352] = 16.097; p < .001$).

(Insert Table 1 about here)

4.3 The relationships between authenticity and behavioral intentions

H3-H7 were tested using PROCESS model 6. We also used demographic and dining-related variables as control variables. The results shown in Table 2 demonstrated that service authenticity positively affected brand authenticity ($p < .001$; 95% CI .314 to .437). Thus, H3 was supported. Furthermore, both service authenticity ($p < .001$; 95% CI .194 to .354) and brand authenticity ($p < .001$; 95% CI .491 to .719) affected consumer repurchase intention, supporting H4 and H5. However, both service authenticity ($p = .493$; 95% CI -.180 to .087) and brand authenticity ($p = .659$; 95% CI -.159 to .250) did not influence consumers' use of robots in daily life. Therefore, H6 and H7 were rejected. For control variables, participants' demographic variables (e.g., age, gender, and education) were found did not significantly influence brand authenticity, repurchase intention, and the use of robots in daily life. However, participants' dining experience with robotic restaurants influenced customers' evaluation of brand authenticity ($p < .01$; 95% CI .046 to .266) and repurchase intention ($p < .01$; 95% CI .048 to .292).

(Insert Table 2 about here)

5. Discussion

Building on the theoretical support of product level theory (Kotler and Keller, 2009), we first compared the relationship between customers' experienced product levels and

authenticity between robotic employees and human employees at casual dining restaurants. Three types of product levels—core product, facilitating product, and augmented product—were tested. Meanwhile, two types of authenticity—service authenticity and brand authenticity—were included in our analysis. Further, we proposed and examined how perceived authenticity at casual dining restaurants would guide customers to develop behavioral intentions in both their dining domain (i.e., repurchase intention toward the restaurant) and life domain (i.e., using robots in daily life). In line with recent robot research in hospitality literature (Cha, 2020; Choi et al., 2019; Ivanov and Webster, 2021; Ma et al., 2021), the findings of this study enrich our understanding of using service robots in the segment of casual dining restaurants. By comparing the effectiveness between robotic employees and human employees regarding customers’ perceived authenticity at restaurants, this study also broadens the scope of knowledge on answering the “robot vs. human” question in hospitality contexts (Byrd et al., 2021; Hwang et al., 2021).

Differs from previous studies (e.g., Ayyildiz et al., 2022; Cameron et al., 2018; Zhong et al., 2021) suggesting that customers with different gender, age, and education may perceive and respond differently to robots, our study didn’t find significant differences on perceptions of customers of different gender, age group or education levels. However, we did note that customers’ previous dining experiences with robotic restaurants served as a significant control variable. A possible explanation for this is robotic restaurants as an innovative and new restaurant concept account only a small portion of the restaurant market in mainland China. The knowledge and depth of experience of customers with robotic restaurants are still limited. Therefore, customers’ previous dining experience with robotic restaurant counts more than customers’ demographic differences. In particular, customers who with more dining experiences in robotic restaurants are more likely to perceived service authenticity and brand authenticity, and have a higher future repurchase intention. In

addition, the fact that age, education and gender made were not significant control variables has positive practical implications, because contrary to conventional thought that robotic restaurants might be attractive to certain market segments only, robotic restaurant as an innovative concept may have the potential to attract customers from a broad range of demographic backgrounds.

For the non-significant effects of service authenticity and brand authenticity on using robots in daily life (i.e., H6 and H7), we think to postulate that it may be because the adoption of robots at restaurants is in the beginning stage and customers mostly with some or limited experiences interacting with robots. Therefore, the limited robotic restaurant brand experience may not be strong enough to support customers to gain a strong intention to use robots in daily life. However, we still predict that once the adoption of robots becomes common and popular in not only hospitality but other sectors, the overall robotic experience will definitely have a strong influence that supports customers to gain significant intention to use robots in daily life. The significant control variable, experiences of dining in robotic restaurants, supports this postulation.

More importantly, different from the above-mentioned hospitality literature on proposing behavioral intention to hospitality business as the outcome, this study is a pioneer for further proposing and examining how robotic restaurants would serve as a learning setting for customers to gain the intention of using robots for other service needs in daily life. Theoretical implications, practical implications, limitations, and future research directions are addressed in the following sections.

5.1. Theoretical implications

The findings of this study offer three major theoretical contributions. First, under the core and facilitating product categories, we found that customers rated robots as significantly weaker than human employees in improving their perceived service authenticity and brand authenticity. Interestingly, in the augmented product, no significant difference between robotic and human employees was found. This finding adds knowledge to the popular discussion of comparing robots versus humans in undertaking hospitality tasks (Byrd et al., 2021; Hwang et al., 2021). It seems that in terms of product-level robotic applications, hospitality tasks under the augmented product category (e.g., interactions with customers, creating a special dining atmosphere by singing birthday songs for customers) would be a more fruitful area than others as the priority for robotic implementations. This may be because the hedonic values of having robots to wow customers in the contemporary hospitality industry (it might be common or dated decades later) “make sense” for customers to feel okay about using robots in place of human employees in augmented product tasks.

Second, we proved that at robotic casual dining restaurants, customers’ perceived service authenticity would improve brand authenticity. Although both service authenticity and brand authenticity were found to be significantly improved by core product and facilitating product, the mechanism within perceived authenticity, specifically regarding the relationship between service authenticity and brand authenticity, has rarely been identified (Davis et al., 2019; Kim, 2021; Matthews and Eilert, 2021). Studying authenticity in robot service experience is in the beginning stage (Deutsch et al., 2019; Kahn et al., 2007), and this study takes one step forward in developing knowledge of the relationships in and among authenticity types. With the adoption of humanoid robots in the hospitality industry (McCartney and McCartney, 2020; Tung and Law, 2017; Tuomi et al., 2021), such examination brings not only theoretical but also practical values. Further investigations will

be needed to enhance our knowledge of how authentic hospitality experiences could be sustained or even be elevated through the adoption of robotic employees.

Third, this study proposed and examined both dining (i.e., repurchase intention) and life (i.e., use robots in daily life) domains in behavioral intentions as outcomes of authenticity. We found that consumers' perceived service authenticity positively influences their brand authenticity and repurchase intention. To the best of our knowledge, our study is one of the first attempts to confirm both positive relationships. Furthermore, consumers' perceived brand authenticity only positively affects their repurchase intention, which is consistent with the study of Song and Kim (2022). Interestingly, we found that neither service authenticity nor brand authenticity influences customers' use of robots in daily life. Conceptually, we think it is because the life domain is broader than the dining domain. Therefore, to change customers' behavioral intentions in the life domain, more technology-assisted experiences should be gained to make such improvement in the intention to use robots in daily life. As we mentioned earlier, we postulate that because the adoption of restaurant robots is still in the beginning stage in 2022. Years later when customers get to see robots in nearly every restaurants, the authenticity formed through robot-assisted restaurant experiences then would be a potential significant predictor to customers' intention to use robots in daily life.

5.2. Practical implications

The findings of this study have significant implications for practitioners and managers by providing service robots in the hospitality industry. Marketers and designers of service robots need to ensure that robot applications at different product levels (facilitating product and core product) should incorporate service and brand authenticity, which can motivate the behavioral intentions of their customers. Prior research on service authenticity is limited to

human interaction in a service organization (Lechner and Mathmann, 2020), hence human-robot interaction should be guaranteed by applying authenticity through different product levels. Robotic restaurant managers must differentiate their businesses from others. For example, they could collaborate with robot manufacturers to improve service robots' performance in completing more complex tasks such as interacting with and entertaining customers by achieving perceived service and brand authenticity.

In order to enable robots to be more effectively and fully implemented, designers and operators should provide robot-friendly hospitality facilities for their operation, such as floor surface, width of the corridors, stairs, lifts, doorsteps, as well as artificial and natural landmarks (Ivanov and Webster, 2017). Service robots need different designs in work environments when working at different product levels, hence, managers and designers should take into account the hospitality interior design, as they are different from human employees working in the restaurant sector. To restore customer confidence in the use of robots in daily life during the pandemic, restaurateurs can highlight the use of service robots to make food preparation more hygienic (core product), socially distanced for greeting, and optimized for ordering and delivering (facilitating products) as well as contactless interaction and entertainment (augmented product). This study offers effective managerial implications to understand the perceived authenticity between robotic employees and human employees in robotic restaurant settings.

5.3 Limitations and future research

The current study has several limitations that offer venues for future research. First, this study focuses on the use of robots in the restaurant context using an experimental design approach. Kim and Jang (2014) acknowledged that there might be different results between a field study and an experiment. Therefore, future studies could research the customers based

on their real dining experiences with robot technology. Future studies could be used to verify the results of this paper. Second, all samples were collected from the Chinese population, where diners' behavioral intentions toward robots may vary due to cultural differences. Thus, future studies are suggested to verify the research results in both developed and developing countries. Future studies conducted in other cultural contexts could be used to verify the results of this study. Finally, in addition to the service encounter between customers and servers in the dining journey, factors such as restaurant interior and exterior environment could affect diners' authenticity perception (Wang and Mattila, 2015; Wen et al., 2020), which could be researched in the robotic restaurant context in the future.

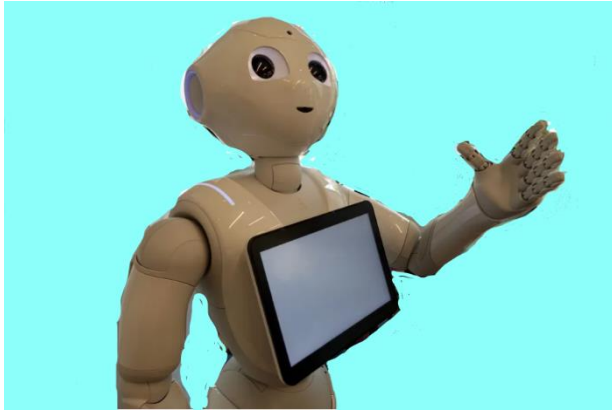
Appendix 1: Scenario Description

Please imagine that you are dining in a local casual restaurant in China. The average cost per person for this restaurant is RMB100-200.

A service robot (see the picture below) greeted you, led you to your table, took your order, processed your payment, and later delivered the food to your table. (A server greeted you, led you to your table, took your order, processed your payment, and later delivered the food to your table).

While waiting for your food, you saw through the open kitchen, and found a number of robot cooks (see the picture below) were cooking food. Everything was fully automatic, from selecting ingredients to cooking. (While waiting for your food, you saw through the open kitchen, and found a number of cooks were cooking food).

While enjoying your food, you also saw a service robot (see the picture below) singing ‘happy birthday song’ to a group of customers near your table. (While enjoying your food, you also saw a server singing ‘happy birthday song’ to a group of customers near your table).



Appendix 2: Measurement Results

Measures	Factor loading	Cronbach's alpha
<i>Service authenticity</i>		.901
Services received in this restaurant do not seem real to me. (reversed)	.825	
Services received in this restaurant seem like illusions to me. (reversed)	.832	
Services received in this restaurant do not appear to be authentic. (reversed)	.774	
Services received in this restaurant do not feel genuine. (reversed)	.773	
Services received in this restaurant seem artificial. (reversed)	.777	
<i>Brand authenticity</i>		.720
This restaurant wants to do its best in providing its product/service	.718	
This restaurant has a true passion for its business	.660	
This restaurant is devoted to what it does	.667	
<i>Repurchase intention</i>		.827
I would like to dine in this restaurant again	.655	
I would choose to go to this restaurant over other restaurants in the future	.788	
This restaurant would be my first choice compared to other restaurants in the future	.778	
<i>Intention to use robots in daily life</i>		.882
Based on this dining experience, I intend to use the robot system in the future if it is possible.	.884	
Based on this dining experience, I expect that I would use the robot system in the future if it is possible.	.901	
Based on this dining experience, I plan to use the robot system in the future if it is possible.	.891	

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