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A Robotic Concepts: Study of Perceived Brand Reputation and Customers' Perceived Performance in a Restaurant

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ABSTRACT

Purpose: Budget, hygiene factors, and the issue of workforce shortages have accelerated the use of robotics technology in restaurant chains. Even though service robots could operate many functions and roles, further research is required in hotel settings to ascertain how various combinations of robots and humans at different product/service tiers may affect customers' viewpoints and intentions.

Design/methodology/approach: This research study addressed the issue of data collected from 364 customers in Malaysia. This study examines both theoretical and managerial insights.

Findings: The findings of the study on product theory and performance, the use of robots in core and facilitating product levels is far less likely to enhance consumers' perceived performance and brand reputation. The perceived performance of consumers' services influences their brand reputation and repurchase intention. Consumers' repurchase intention is only positively affected by their perceived brand reputation.

Research limitations/implications: This study employs an experimental design approach to investigate the use of robots in the restaurant context. Future research could focus on customers' real-world dining experiences with robot technology. Future research could be used to confirm the findings of this paper. All samples were collected from the Malaysia population, where diners' behavioral intentions toward robots may differ due to cultural differences. Thus, future studies in developed and developing countries are suggested to validate the research findings.

Originality/value: The study adds to the literature on the product-level theory, robots versus human employees, brand and service performance, and behavioral intentions in the restaurant setting. The findings have ramifications for how robotic restaurants can improve restaurant image, expedite performance output, and mitigate the impact of the pandemic.

Keywords: Robot, brand reputation, customers' perceived performance, restaurant

I. Introduction

Robotics in restaurant chains is growingly popular

worldwide, with service robots being used to reduce expenses, enhance service performance (Belanche, Casalo & Flavián, 2021), and add magnificence to customer engagement (Xie & Kim (2022)). The scarcity of workers also drives the prominence of robotic systems issues plaguing the hospitality industry, notably in the restaurant sector, and using robots has

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popped up as an optimal solution (Ivanov, Webster & Berezina, 2022). Customers can be served by robots who can cook, host, order, deliver, and amaze them (Dabral, Rawat, Juyal, Joshi & Pratap, 2022), substituting numerous operations that have been previously conducted by people (Tuomi, Tussyadiah & Stienmetz, 2021; McCartney & McCartney, 2020). Service robots have been increasingly used to reduce contact with humans and enhance hygiene as well as safety requirements during the COVID-19 pandemic (Gaur, Afaq, Singh & Dwivedi, 2021; Pillai, Haldorai, Seo & Kim, 2021). Robots pave the way for new service encounters, workers, and technology (Li, Yin, Qiu & Bai, 2021). Using robots can change the composition and layout of product lines and the design and delivery of services (Akyazi, Goti., Oyarbide, Alberdi & Bayon, 2020). As a result, further research is being done to investigate how the implementation of robots and related technologies may have altered customers' restaurant experiences through the perception of value (Seo & Lee, 2021), perceived distinctiveness (Chuah, Aw & Yee, 2021), and readiness to use robots in service settings and everyday life. (Lin et al., 2020).

In the service industry, robotic and genuine services are desired (Wirtz, 2019). Since service robots have been extensively researched in the hospitality industry, there is a lack of research as to how utilizing robots might (or might not) change the truthfulness of hotel customers (Khaliq, Waqas, Nisar, Haider & Asghar, 2022). Truthfulness has indeed been increasingly studied in the restaurant context as a significant characteristic of the hotel experience (Le, Arcodia, Novais & Kralj, 2022). Nevertheless, there is a gap in the existing literature on the role of robotic performance in restaurants. Focusing on this is vital because restaurant customers want performance in cuisines and food cultures, service delivery (Lee, Liu & Tseng, 2022), and branding (Kwon, Jung, Choi & Kim, 2021; Yoon, 2022). While some consumers believe that robots could make front-of-house transactions more efficient and accurate, others expressed concerns or reservations. Robotic service in restaurants has the potential to improve food consistency, quality control, and cost control in the back of the house, as

well as enhance performance, efficiency, and productivity.

Authenticity encompasses both service authenticity and brand authenticity; the former describes the degree of the authenticity and sincerity that the service provider provides, while the other refers to a subjective evaluation of genuineness ascribed to a brand by consumers (Nunes, Ordanini & Giambastiani, 2021; Song & Kim, 2022). However, limited research has attempted to examine whether customer-perceived service and brand reputation might differ due to robots' involvement. It is critical to close this research gap. Not only because perceived performance in the service experience can significantly influence customers' attitudes (Eren, 2021), but it also fuels the debate about whether robotic systems can substitute human-performed providers in terms of giving hospitality to customers (Song, Wang, Yang & Ma, 2022).

Another gap in the literature on public robots in hospitality settings is the lack of systematic frameworks for how service robots have been adopted from a product/service design standpoint (Ma et al., 2023). We propose that the Product Level Theory be used to investigate how service robots are used in restaurants (Kotler and Keller, 2016). First proposed by Kotler and Levy (1969), this theory suggests that service design should consider satisfying multiple needs of customers. Thus, a product/service should contain a core, facilitating, and augmented layers. Cooking and food preparation are considered core products/services in the context of robotic restaurants; greeting customers, paying bills, and food delivery are considered facilitating products/services, as well as connections among customers and servers (robotic vs. workers) and the dining ambiance are regarded enhanced products/services (Ma, Yang, Wang & Song, 2022; Choi et al., 2022). Despite the good theoretical connection between this theory and the robot service context, practical efforts are rare. It remains unclear whether robot applications at different product/service levels would influence customers' perceived brand and service performance 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 or which are better performed by humans. Achieving such an understanding is essential as hospitality organizations operate with limited resources and must make wise business decisions. Such decisions address the use of service robots 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 (Boyacı-Gündüz, Ibrahim, Wei & Galanakis, 2021).

This study investigates how robot applications at different layers of restaurants' products/services may affect customers' perceived service and brand reputation, as well as behavioral intentions toward using robots in restaurant service, based on the literature of the Product Level Theory and authenticity. First, the study identifies whether the robot applications at different product levels (the core, facilitating, and augmented levels) influence customers' perceptions of brand performance and service performance. Second, it compares the effects of using robotic versus human employees in different product levels on service and brand reputation to see if the effects differ. Third, unlike earlier studies that focused on a single outcome variable, such as customers' intention to use or acceptance of robots, this study focuses on multiple outcome variables (e.g., Blut, Wang, Wunderlich & Brock, 2021). This research examines how brand and service authenticity influence repurchase intention and the use of robots in H. The study adds to the literature on product level theory, robots versus human employees, brand and service performance, and behavioral intentions in the restaurant setting. The findings have ramifications for how robotic restaurants can improve restaurant image, expedite performance output, and mitigate the impact of the pandemic.

II. Literature Review and Hypothesis Development

A. The Correlation between Product Level Theory and the Use of Robots in the Restaurant

Service-oriented manufacturing has emerged as a new business model that unifies the development track of product development and service innovation and constructs a high-quality transformation path based on the service value chain. The platform economy has revolutionized the business model of traditional manufacturing from three aspects: production process, production and sales model. In the hospitality industry, service robots are becoming increasingly popular. In the hotel context, robots can be used to deliver various tasks to customers at various stages, such as Arrival, stay, and departure are all stages of the journey (Lukanova & Ilieva, 2019). Robots are taking on the roles of servers, hosts, and even chefs in restaurants to rise the enjoyment of customers' dining experiences (Seyitoğlu, Ivanov, Atsız & Çifçi, 2021; Zhang, Balaji & Jiang, 2022). The prominence of robotic systems has also piqued the interest of hospitality and tourism researchers (e.g., Liu et al., 2022a; Zhang et al., 2022; Ivanov, Gretzel, Berezina, Sigala & Webster, 2019). 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. humans, despite the solid theoretical correlation between this theory and the context of robot services, empirical efforts are rare. It is unclear whether robot applications at different product/service levels would have a different impact on customers' perceived brand and service performance, and their behavioral intentions employees may influence the brand reputation of robotic restaurants. Ma, Yang, Wang & Song (2022) 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; Fust'e-Forn'e, 2021; S.S. Kim et al., 2021; J.J. Kim et al., 2021; Stumpf et al., 2018), there is a paucity of research that systematically analyzes robots' applications from the product/service design perspective (Ma et al., 2023).

According to the Product Level Theory, one of the classical theories for product design, restaurants offer customers tangible products and intangible service experiences to satisfy their needs at the core, facilitating, supporting, and augmented levels (Ma, Yang, Wang & Song, 2022). Core products satisfy customers' fundamental needs, and in the restaurant context, they mainly include food and beverages that resolve customers' hunger needs (Ma, Yang, Wang & Song, 2022). Facilitating and supporting products enable customers to consume core products necessary for the product/service to function. Restaurants include services such as allocating tables, taking orders, and processing payments (Song, Wang, Yang & Ma, 2022). 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 (Hwang, Abbas, Joo, Choo & Hyun, 2022; Yoon, 2021).

Using robots to replace restaurant employees needs careful consideration from the product/service design perspective because most organizations operate with limited resources, as suggested by the Resource Allocation Model (Tuomi, Tussyadiah & Stienmetz, 2021). Therefore, restaurant operators need to make sound decisions that are not only cost-effective but also can enhance, or at least avoid compromising, customers' service experience. 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 (Song and Kim, 2022). Similarly, restaurants using robot chefs could offer excitement in the overall dining experience, yet, they may fail to offer performance in the taste of the food (e.g., Leo & Huh, 2020). An in-depth understanding of how service robots applied at different layers of the

products/services that restaurants offer could influence customers' perceived service performance, overall dining experience, and future purchase intention is vital for aiding restaurant operators in developing strategic business decisions.

B. Influence of Service Performance on Robots' Application

Performance is vital in contemporary businesses because consumers constantly demand it, and business operators proactively claim to possess it (Goulding and Derbaix, 2019; Kim et al., 2020). Tourism scholars brought the concept of performance from sociology and have researched performance mainly from three angles, namely objective performance, constructive authenticity, and existential performance (Song, Wang, Yang & Ma, 2022). Objective performance refers to the scientific approval of an object's originality (Croes et al., 2013). Constructive performance means individuals' performance towards an object is subjective and socially constructed (Darvishmotevali & Ali, 2020). Rather than focusing on the object, existential performance mainly emphasizes consumers' authentic selves in consumption (Chen, Jiao, Li & Zhang, 2022).

In the restaurant context, food performance, referring to the genuineness of food (Song, Wang, Yang & Ma, 2022), has been well-researched due to the nature that food is the crucial element of restaurants (Mahfud & Lastariwati, 2019). Almost all restaurant scholars adopted the constructive viewpoint to study food performance since individuals often interpret the same food variously based on their beliefs, expectations, and perceptions (Song, Wang, Yang & Ma, 2022). Besides food performance, restaurant scholars have recently started to research brand reputation, which is a well-studied concept in the marketing discipline (Hwang et al., 2022; Song and Kim, 2022), and service performance (Kim, 2021). Different from food performance on food, brand reputation is about the brand, such as the restaurant brand (Song and Kim, 2022), and service performance is about the services provided in the service industry, including the restaurant sector

(Kim, 2021). It should be noted that the meaning of performance can be different in restaurant contexts. For example, consumers may view the food performance of a restaurant differently depending on the restaurant's location (Home, Oehen, Käsmayr, Wiesel & Van der Meulen, 2020). Consumers may view a fine-dining restaurant and a casual restaurant differently regarding brand and service performance due to restaurant differences demonstrating brand image and service procedure (Song, Wang, Yang & Ma, 2022).

Service performance refers to whether the service provider's service is authentic or artificial (Chiang & Trimi, 2020). In non-restaurant contexts, Seo & Lee (2021) suggested that factors such as ease of use, perceived risk of service, and personal innovativeness can influence consumers' perceived service performance. Bae (2021) found that service performance, including authentic, sincere, and considerate services, positively affects service value and satisfaction. In ethnic restaurant contexts, Kim (2021) suggested that service performance should include multiple dimensions such as continuity, consistency, uniqueness, talent, scarcity, honesty, and traditionality, and most dimensions significantly contribute to consumers' positive emotions. However, what contributes to the formation of service authenticity and whether service performance 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 primary service providers in the service industry (Lee, Zhang & Ng, 2019). 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 (S.S. Kim et al., 2021; J.J. Kim et al., 2021), and human appearances demonstrate higher levels of warmth and friendliness (Belanche, Casaló, Schepers & Flavián, 2021). As a result, robot servers in different stages of the service journey are perceived as superficial and less authentic

when providing services than human employees (Lin and Mattila, 2021). Based on the previous literature, we propose:

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

Under the stream of constructive performance, marketing scholars have dominantly researched brand reputation. Brand reputation revolves around whether the brand is viewed as authentic, honest, and genuine (Södergren, 2021). There is a good understanding of what constitutes brand reputation, its antecedents, and consequences from the brand perspective (Jiménez-Barreto, Rubio, Campo & Molinillo, 2020). In addition to being passionate about business, brand reputation is linked to a brand with a history (Chen, You, Lee & Li, 2021), a sense of tradition (Taniyev & Gordon, 2019), or heritage (Song and Kim, 2022). Therefore, a restaurant with cutting-edge technology, such as robots, may be viewed as less traditional and less authentic regarding brand image. Another element of brand reputation is being genuine and sincere (Song, Wang, Yang & Ma, 2022). As human-to-robot interactions are considered less genuine and sincere than 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 reputation. Therefore, we propose:

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

Existing research has shown that services in a service organization positively affect consumers' brand evaluation of the service organization (Chan and Tung, 2019). With a particular focus on restaurants,

DiPietro and Levitt (2019) examined the factors that contribute to restaurant performance. They confirmed that servicescape and food contribute to restaurant performance (DiPietro and Levitt, 2019). Based on similar logic, we hypothesize that authentic service significantly enhances consumers' perceived brand reputation toward the restaurant:

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

C. Service Performance, Brand Reputation, Behavioral Intentions, and Using Robots

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 is critical to a company's growth and profitability (Nguyen, Nguyen & Tan, 2021), and robotic restaurants face challenges in attracting and retaining customers. Previous research has identified the influence of technology in hospitality contexts, such as Facebook messages, information security, and mobile apps, on repurchase intention (Ho and Chung, 2020). However, a comprehensive understanding of the determinants of repurchase intention in the context of robotic restaurants is lacking. The impacts of brand and service performance on repurchase intention are nevertheless largely overlooked, notwithstanding the expected service robot growth in the restaurant context (Chuah et al., 2021).

High service performance is related to the authentic, sincere, and considerate service the servers provide (Bae, 2021), including service robots in robotic restaurants. Service performance also affects service value, satisfaction (Bae, 2021), and positive emotions (Kim, 2021). Whether the performance of robots demonstrates a high level of role congruity is a crucial determinant of service performance that customers perceive. According to the Role Congruity Theory (Anglin, Courtney, & Allison, 2022), individuals' evaluation of role congruity is based on descriptive

norms (i.e., what is expected of a 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 service performance and brand reputation (Hwang et al., 2022). Higher performance reflects higher role congruity, 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 that when customers perceive high service authenticity of a robot in restaurant, they will have a stronger repurchase intention.

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

As one vital factor in attracting customers (Alketbi, Alshurideh & Al Kurdi, 2020), brand reputation positively contributes to trust and loyalty (Portal et al., 2019). Customers are likelier to favor and spread pleasant 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 performance perception of customers can significantly influence their perceived brand equity - a significant predictor for their brand choice intention (Phung, Ly & Nguyen, 2019). Shulga and Busser (2019) have confirmed the positive relationship between brand reputation and purchase intention. In addition, brand reputation inculcates positive feelings in customers and causes their repurchase behavior (Sharma, Kodhati & Sukhavasi, 2021). Thus, brand reputation influences repurchase intention (Park, 2020), leading to the following hypothesis:

H5: Consumers' perceived brand reputation 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 customers in human society (Huang and Rust, 2018, 2021).

Food has always been a necessary part of travel and the culinary experience provided in a destination attracts tourists. Restaurants allow customers to learn about different cultures via food from various regions which enable customers to have authentic and unique experience (Huang and Rust, 2018, 2021). Restaurant dining experience is a multidimensional concept, that has various attributes that are determining the perception of customers (Yrjölä et al., 2019), namely, service staff, cleanliness, location, decor, environment, atmosphere, food taste and menu (Andersson and Mossberg, 2004; Ryu and Jang, 2008; Heung and Gu, 2012). 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, effect, proactivity, manipulability, robot notification, and aesthetics. Meanwhile, from the users' perspective, key customer 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 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 performance through true-to-ideal (i.e., socially constructed performance 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 performance further guides them to consider the performance of service tasks delivered by robots in various aspects. Such consideration goes beyond a restaurant dining experience to the feasibility of using service robots. Similar to the idea that tourists' perceived service performance toward service providers influences their overall tourism experience (Suhartanto, Brien, Primiana, Wibisono & Triyuni, 2020), we believe that in our research setting, customers would base their behavioral intention to use robots on their perceived service performance during a robotic restaurant experience. Therefore, we propose:

H6: Consumers' perceived service performance positively influences their use of robots.

Restaurant customers' perceived brand reputation is based on their subjective evaluation of the genuineness ascribed to the restaurant brand (Le, Arcodia, Novais & Kralj, 2022). Unlike service performance, which focuses on service-related performance evaluations, customers' evaluation of brand reputation covers a broader range of a branded restaurant experience (e.g., brand reliability and 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 the 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 in building trust toward service robots (Chi et al., 2021), allowing customers to gain behavioral intention toward using robots (Ivanov and Webster, 2021; Simon et al., 2020). Therefore, we propose:

H7: Consumers' perceived brand reputation positively influences their use of robots.

The following research framework is proposed for this study in light of the above. Based on product level theory (Ma et al., 2023), we propose that restaurant customers experience service delivered by robots in three levels: core product, facilitating product, and augmented product. The experience of these three product levels would assist customers in perceiving two levels of performance: service performance and brand reputation. Because service experience is a part of the overall brand experience, we further propose that perceived service performance would enhance customers' perceived brand reputation. Further, we propose behavioral intentions regarding the dining and life domains. We predict that customers' perceived performance driven by robotic services would increase their repurchase intention with the restaurant (dining domain) and support their intention to use robots.

III. Research Methodology

In our research, we used a scenario-based experimental design for two reasons. A scenario-based experiment is typically based on hypothetical situations (Kim and Jang, 2014). From a performance viewpoint, subjective and socially constructed constructive performance is the most popular (Cohen, 1988; Kim et al., 2022). Customers may interpret performance in their ways, even if unfamiliar with the objects, according to the constructive perspective of performance (Lu et al., 2015). It means that performance is not necessarily reality and can be relative, depending on the context, which can hardly be objective (Kim and Baker, 2017).

As a result, perceived (constructive) performance has been widely examined by using hypothetical scenarios-based experiments in the restaurant context (Baker and Kim, 2018; Kim et al., 2022; Kim and Baker, 2017; Kim et al., 2017; Wang and Mattila, 2015; Yang et al., 2022; Yu et al., 2020). Second, scenario-based experimental studies have the advantage of effectively controlling multiple independent variables to develop complicated conditions of scenarios (Shulga and Busser, 2020) where such scenarios might not be easily accessible in real life.

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' performance perception toward the service itself and the brand (i.e., service performance and brand reputation). Based on the three independent variables, each with two levels, the research team produced eight dining experience scenarios featuring a mid-priced restaurant in Malaysia.

The casual restaurant in this study is defined as serving 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 *Johnny's Restaurant* and *JBorn Café and Bistro* belong to the 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.

A. Participants

We collected the experimental data in restaurants through a leading 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. 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.

B. Measurement

All constructs were measured using previously validated scales and were measured using a 7-point Likert scale. In particular, service performance, using five items, was adopted from Featherman et al. (2006); brand reputation, using three items, was adopted from Mou-lard et al. (2016); consumers' repurchase intention, using three items, was adopted from Song and Kim (2022); and intention to use robots in restaurants, using three items, was adopted from Chiu et al. (2021). 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.

C. Data Analysis

A three-way analysis of covariance (ANCOVA) was implemented to test the effect of three independent variables on service performance and brand reputation 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 et al., 2017). Following the procedure of model 6, service performance was the independent variable, brand reputation was the mediator, repurchase intention, and the use of robots 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.

IV. Results

A. Check for Manipulation

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 ($M_{\text{Core-Robot}} = 6.81$; $M_{\text{Core-Human}} = 4.37$; $t(362) = 78.591$; $p < .001$). 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

($M_{\text{Facilitating-Robot}} = 6.25$; $M_{\text{Facilitating-Human}} = 4.22$; $t(362) = 108.450$; $p < .001$).

Regarding the augmented product, the subjects in the robot group agreed more on robots delivering an augmented product than those in the human group ($M_{\text{Augmented-Robot}} = 6.23$; $M_{\text{Augmented-Human}} = 4.30$; $t(362) = 35.290$; $p < .001$).

B. The Main Effects of Product Levels on Performance

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 performance and brand reputation. For instance, in terms of the core product, the results show that using robots generated a lower level of service performance than having human beings ($M_{\text{Core-Robot}} = 4.21$; $M_{\text{Core-Human}} = 5.83$; $F[1352] = 7.152$; $p < .01$). In addition, using robots to deliver core products contributed to a lower level of brand reputation than

having human beings ($M_{\text{Core-Robot}} = 4.27$; $M_{\text{Core-Human}} = 5.79$; $F[1352] = 6.523$; $p < .01$). Consequently, H1a and H2a were confirmed. Similarly, the use of robots in the facilitating product generated a lower level of service performance ($M_{\text{Facilitating-Robot}} = 4.12$; $M_{\text{Facilitating-Human}} = 5.73$; $F[1352] = 12.356$; $p < .01$) as well as brand reputation ($M_{\text{Facilitating-Robot}} = 4.03$; $M_{\text{Facilitating-Human}} = 6.12$; $F[1352] = 11.897$; $p < .01$) 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 performance ($M_{\text{Augmented-Robot}} = 4.54$; $M_{\text{Augmented-Human}} = 4.45$; $F[1352] = 0.413$; $p = .598$) and brand reputation ($M_{\text{Augmented-Robot}} = 4.89$; $M_{\text{Augmented-Human}} = 4.67$; $F[1352] = 0.319$; $p = .634$). 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 reputation. However, participants' dining experience with robotic restaurants influenced customers' evaluation of service performance ($F[1352] = 6.473$; $p < .01$).

Table 1. Summary result of ANCOVA analysis

Predictor Variable	Model 1			Model 2		
	Service Performance			Brand Reputation		
	F-statistic	p-value	Effect Size	F-statistic	p-value	Effect Size
Core	7.152**	<0.01	0.241	6.523**	<0.01	0.197
Facilitating	12.356**	<0.01	0.473	11.897**	<0.01	0.406
Augmented	0.413 (ns)	0.598	0.019	0.319 (ns)	0.634	0.008
Core*Facilitating	0.589 (ns)	0.439	0.011	0.621 (ns)	0.386	0.017
Core*Augmented	0.647 (ns)	0.337	0.023	0.593 (ns)	0.403	0.016
Facilitating*Augmented	0.874 (ns)	0.217	0.034	0.753 (ns)	0.257	0.029
Core*Facilitating*Augmented	0.036 (ns)	0.873	0.001	0.024 (ns)	0.906	0.001
Control Variable						
Age	0.932 (ns)	0.134	0.038	0.847 (ns)	0.221	0.030
Gender	0.963 (ns)	0.117	0.042	0.736 (ns)	0.287	0.020
Education	0.867 (ns)	0.236	0.031	0.657 (ns)	0.329	0.024
Experiences of dining in robotic restaurants	6.473**	<0.01	0.189	6.781**	<0.01	0.221

Note: ns = Not significant; **p < 0.01; Effect size = Partial Eta Square.

and brand reputation ($F[1352] = 6.781; p < .001$).

C. The Relationships between Performance 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 performance positively affected brand reputation ($B = 0.274, t = 6.314, p < .01$). Thus, H3 was supported. Furthermore, both service performance ($B=0.316, t = 8.541, p < .01$) and brand reputation ($B=0.478, t=9.788, p < .01$) affected consumer repurchase intention, supporting H4 and H5. However, both service performance ($B=0.081, t=1.036, p=0.563$) and brand reputation ($B=0.093, t=1.066, p =0.599$) did not influence consumers' use of robots. 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 reputation, repurchase intention, and the use of robots. However, participants' dining experience with robotic restaurants influenced customers' evaluation of brand reputation ($B=0.176, t=3.745, p < .05$) and repurchase intention ($B=0.213, t=4.562, p < .01$).

V. Research Discussion

Based on the theoretical support of product level theory (Kotler and Keller, 2009), we first compared the relationship between customers' experienced product variants and performance between robotic employees and human employees at restaurants. Three product levels were tested: core product, facilitating product, and augmented product. Whilst, we analyzed two types of honesty: service performance and brand reputation. Further, we proposed and examined how perceived authenticity at restaurant restaurants would guide customers to develop behavioral intentions in both their dining domain (i.e., repurchase intention toward the restaurant) and life domain. 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 restaurant restaurants. By comparing the effectiveness between robotic employees and human employees regarding customers' perceived performance 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).

Previous studies (e.g., Ayyildiz et al., 2022; Cameron et al., 2018; Zhong et al., 2021) suggested

Table 2. Summary results of relationships between performance and behavioral intentions

Predictor Variable	Model 1		Model 2		Model 3	
	Brand Reputation		Repurchase Intention		Use Robot	
	B	t-statistic	B	t-statistic	B	t-statistic
Service Performance	0.274	6.314**	0.316	8.541**	0.081	1.036 (ns)
Brand Reputation	-	-	0.478	9.788**	0.093	1.066 (ns)
Control Variable						
Age	-0.034	0.734 (ns)	-0.047	0.814 (ns)	-0.021	0.884 (ns)
Gender	-0.027	0.874 (ns)	-0.036	0.793 (ns)	-0.019	0.837 (ns)
Education	0.056	0.634 (ns)	0.068	0.697 (ns)	0.030	0.765 (ns)
Experiences of dining in robotic restaurants	0.176	3.745*	0.213	4.562**	0.097	1.143 (ns)

Note: ns = Not significant; B = Standardized coefficient; **p < .01; *p < .05.

that customers of different gender, age, and education may perceive and respond differently to robots. Our study, however, has not found significant differences in their perceptions and response. It is a fact that we have noted that customers' previous dining experiences at robotic restaurants can serve as a significant control variable. A possible explanation for this is that robotic restaurants, as an innovative and new hospitality concept, account for only a small portion of the catering market in Malaysia. The knowledge and depth of customers' experience at robotic restaurants are yet, limited. Therefore, customers' previous experience counts more than their demographic differences. In particular, customers with more dining experiences at robotic restaurants are more likely to perceive service performance and brand reputation and have a higher future repurchase intention. In addition, the fact that age, education and gender made are not significant control variables has positive practical implications. Contrary to the conventional thought that robotic restaurants might be attractive to certain market segments only, robotic restaurants as an innovative concept may have the potential to attract customers from a broad range of demographic backgrounds (Figure 1).

A. 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 performance and brand reputation. 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 restaurant restaurants, customer service performance would improve brand authenticity. Although both service

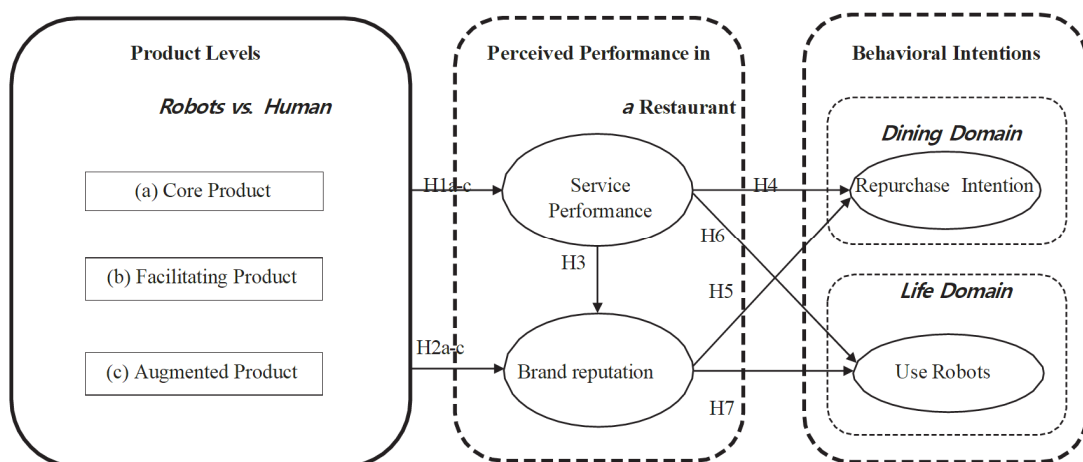


Figure 1. Research framework of this study

performance and brand reputation were found to be significantly improved by core product and facilitating product, the mechanism within perceived performance, specifically regarding the relationship between service performance and brand reputation, has rarely been identified (Davis et al., 2019; Kim, 2021; Matthews and Eilert, 2021). Studying performance 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 performance 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 has proposed and examined both dining (i.e., repurchase intention) and life domains in behavioral intentions as outcomes of performance. We have found that consumers' perceived service performance positively influences their brand reputation 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 reputation only positively affects their repurchase intention, which is consistent with the study of Song and Kim (2022). Interestingly, we have found that neither service performance nor brand reputation influences customers' use of robots. 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. As we mentioned earlier, we postulate that because the adoption of restaurant robots is still in the beginning stage in Malaysia. In the future years when customers get to see robots in nearly every restaurant, the performance formed through robot-assisted restaurant experiences then will be a potential significant predictor to customers' intention to use robots.

B. Practical Implications

The results of this study have huge ramifications for practitioners and managers in the hospitality industry by providing service robots. Service robot marketers and designers must ensure that robot applications at different product levels (facilitating product and core product) incorporate service and brand reputation, which can motivate their customers' behavioral intentions. Prior research on service performance has been limited to human interaction in a service organization (Lechner et al., 2020), so human-robot interaction should be ensured by implementing performance through various product levels. Robotic restaurant managers must distinguish their establishments from the competition. They could, for example, work with robot manufacturers to improve the performance of service robots in more complex tasks such as interacting with and entertaining customers by achieving perceived service and brand reputation.

Robot-friendly hospitality involves the integration of robots into the hospitality industry to provide efficient and personalized services to guests. Designers and operators should provide robot-friendly hospitality facilities for their operation, such as floor surface, corridor width, stairs, lifts, and doorsteps, as well as artificial and natural landmarks, to enable robots to be more effectively and fully implemented (Ivanov and Webster, 2017). When working at different product levels, service robots require different designs in work environments; therefore, managers and designers should consider hospitality interior design, as they differ from human employees working in the restaurant sector. During the pandemic, restaurateurs can emphasize 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 provides useful managerial implications for understanding the perceived performance of robotic and human employees in robotic restaurant settings.

C. Limitations and Future Research

There are several limitations to the current study that provide avenues for future research. First, this study employs an experimental design approach to investigate the use of robots in the restaurant context. Kim and Jang (2014) acknowledged that the results of a field study and an experiment may differ. As a result, future research could focus on customers' real-world dining experiences with robot technology. Future research could be used to confirm the findings of this paper. Second, all samples were collected from the Malaysiapopulation, where diners' behavioural intentions toward robots may differ due to cultural differences. Thus, future studies in both developed and developing countries are suggested to validate the research findings. Future studies in other cultural contexts could be used to validate the findings of this study. Finally, in addition to the service encounter between customers and servers during the dining journey, factors such as restaurant interior and exterior environment may influence diners' performance perception (Wang and Mattila, 2015; Wen et al., 2020), which could be researched in the robotic restaurant context in the future and at the same time looking into the technical way to overcome the limitations of robots.

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