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Robot vs. human in restaurants roles and branding: A role theory perspective with stereotypes as the moderators

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Abstract

Taking a role theory perspective to investigate robot roles in branding is still in its infancy. This study aims to examine the differences between robots and humans in performing restaurant roles (i.e., chef, host, and server) based on customers evaluations of brand warmth and competence. Further, this study proposes stereotypes of warmth and competence toward robots as moderators. In study 1, we examined the main effects from restaurant roles to brand relationship building with a scenario of customers at casual-dining restaurants. In study 2, we added the moderators with a scenario of customers at robot-themed restaurants at theme parks. This study contributes novel theoretical insights on robot roles in branding and provides managers with implications for adopting robots.

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1. Introduction

Due to the advancement of robotic technologies, labor shortage in the post-pandemic era and increasing labor costs (Kwok, 2022; Tussyadiah, 2020), restaurants and destinations around the world are adopting robots to replace human employees (Ivanov et al., 2019). Such a global trend attracts a series of studies on service robots in hospitality and tourism literature and can be categorized into research topics of robotics-customer relationship, robotics-management relationship, robotics-society relationship, and robotics-employee relationship (Shin, 2022). While the growing interest in integrating robots into various service roles is seen as a top research priority, empirical studies on assessing different roles that robots can play and how customers stereotype the robots are still in their infancy (Blaurock et al., 2022; Song et al., 2024; Teng et al., 2024).

In hospitality research, several studies have identified the roles of service robots and interactions in service encounters, including service actors (Ho et al., 2020; Shin & Jeong, 2020) and partners or servants (Teng et al., 2024). Recently, scholars have identified chef (e.g., cooking food), host (e.g., greeting customers and guiding them to a table), and server (e.g., delivering food to the table) as the three typical roles at restaurants that robots can replace (Ho et al., 2020; Ma et al., 2023; Song et al., 2022). Given the inherent disparities among various roles robots provide, a comprehensive understanding of the three roles within the robotic service domain is necessary. Nonetheless, the research conducted thus far has made limited efforts to explore the impact of different roles on brand warmth and competence within brand relationship building (Blaurock et al., 2022; Choi et al., 2022; Teng et al., 2024).

Role theory is defined by Biddle (1979) as "a science concerned with the study of behaviors that are characteristic of persons within contexts and with processes that produce, explain, or are

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affected by these behaviors" (p. 11). Koenig and Eagly (2014) explained a role in role theory as "a set of expectations associated with a particular social position in a specific type of setting" (p. 372). Both Solomon et al. (1985) and Broderick (1999) are the early advocators pointing out the appropriateness of utilizing role theory to explain employee behaviors at service encounters and highlighting the usefulness of role theory in explaining customers' expectations of and evaluations of service employees.

Role theory explains service interactions between social actors (humans) and some scholars now apply it across settings and role performers, integrating multidisciplinary to explain service interactions between human and robotic social actors (Blaurock et al., 2022). However, although hospitality service encounters are environments for role performances (Solomon et al., 1985), limited studies have used a role theory perspective to investigate and explain the roles robots play in hospitality settings (Blaurock et al., 2022). In addition, considering restaurant environments as stages for robot roles to perform, much understanding has been clarified via a series of studies focusing on robots at independent and chain restaurants (Shin, 2022; Wang & Papastathopoulos, 2023). However, theme park restaurant, a different setting where restaurant robots can be used to match themes and branding, are seldom examined (Milman & Tasci, 2022). Hence, this study takes a role theory perspective to examine the robotic roles of chef, host, and server in different restaurant settings.

Warmth and competence are the two major dimensions of social cognition, coming from the two-dimensional configuration among human traits as (1) good-intellectual (e.g., scientific, persistent, determined) versus bad-intellectual (e.g., foolish, irresponsible, clumsy) and (2) good-social (e.g., popular, honest, warm) versus bad-social (e.g., unpopular, unsociable, unhappy) (Fiske et al., 2007; Rosenberg et al., 1968). The current paper investigates warmth and competence from

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two perspectives. The first perspective is the stereotype of warmth and competence towards robots, and the second perspective is brand warmth and brand competence towards restaurant brands. In terms of the stereotype of warmth and competence towards robots, Liu et al. (2022) focused on the service context, and pointed out that stereotypes of human-robot interactions in both warmth and competence aspects are highly associated with customers' emotional responses and behavioral intentions toward robots. Customers' perception of warmth and competence between robots and humans in restaurants is based on customers' stereotypes of how restaurant roles used to be performed in societies (Koenig & Eagly, 2014), and may exist stereotype differences among the restaurant roles as chef, host, or server (Ma et al., 2023). In terms of the brand warmth and competence, the topic has been well researched. Previous scholars have explored a list of antecedents (e.g., brand heritage, brand globalness, and brand localness) (Kolbl et al., 2020; Meyer et al., 2024) and consequences (e.g., perceived values, judgement, and purchase intentions) (Kervyn et al., 2012; Kolbl et al., 2020; Meyer et al., 2024). Customers may develop various level of brand warmth and competence based on the attributes of the brands (Kolbl et al., 2020), in this study, such as different roles in the restaurant. Combining the two streams of research on warmth and competence, we argue that roles in restaurants influence brand warmth and competence, and stereotype of warmth and competence towards robots moderate the relationship between roles in restaurants and brand warmth and competence.

Under such comparisons, customers' perceived stereotypes toward robots' warmth and competence can also leverage their expectations of restaurant roles played by robots, in which

customers may perceive little difference between robots and humans in delivering warmth when their stereotypes toward robots' warmth are high (Belanche et al., 2021; Liu & Xie, 2023). Furthermore, Choi et al. (2022) proposed the concept of robot-brand fit, revealing the importance of comparing robots and humans performing restaurant roles to support restaurant branding. Therefore, to clarify the unknown complexity of the mechanisms among (1) effects from robots versus humans in restaurant roles and (2) stereotypes of warmth and competence toward robots in restaurant branding, restaurant brand warmth and competence are proposed and examined as the outcome of the restaurant roles and stereotypes.

Taken together, to enrich the knowledge of robot roles across restaurant segments, based on the theoretical support of role theory (Biddle, 1979; Blaurock et al., 2022), this study has three major research purposes. First, based on customers' evaluations on restaurant brands' warmth and competence, this study aims to examine the differences between robots and humans playing three major restaurant roles (i.e., chef, host, and server) (Ma et al., 2023; Song et al., 2022). Second, building upon the main effects of robotic restaurant roles on increasing restaurant brands' warmth and competence, this study aims to further examine the moderating effects of customers' stereotypes of warmth and competence toward robots. Based on Liu et al. (2022) regarding the effects of stereotypes of warmth and competence toward robots, we propose that such stereotypes of warmth and competence toward robots may leverage the formation of customers' perceived restaurant brands' warmth and competence.

Third, this study aims to examine that under experiences with robotic restaurant roles, customers' perceived restaurant brands' warmth and competence can significantly increase their revisit intention to the restaurants. These three purposes will be achieved via two studies. Study 1 is a setting with a scenario of customers at casual-dining restaurants, and will focus on the main

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effects of restaurant roles on building brand relationships. Study 2 is a different setting with a scenario of customers at robot-themed restaurants at theme parks and will be added with tests of stereotypes toward robots.

This study has valuable theoretical and practical contributions. First, by adopting a role theory perspective, this research aims to provide innovative insights by exploring different roles (i.e., chef, host, and server) in restaurants between robots and humans and their effects on brand warmth, competence, and revisit intention. This endeavor is crucial not only to enrich the theoretical underpinnings of role theory in human-robot interactions (Blaurock et al., 2022), but also to shed new light on the comparison of roles between robots and humans in hospitality literature (e.g., Ho et al., 2020; Hwang et al., 2021; Song et al., 2022; Xiao et al., 2022). It also advances our knowledge by understanding how robots in different roles can effectively enhance customer retention through brand warmth and competence (Teng et al., 2024).

Second, for cross-setting validation, this study will examine robot roles in different restaurant settings. Although restaurant robots have been empirically examined in recent years (Ivanov et al., 2019; Shin, 2022), most of the empirical studies only focus on one restaurant setting (e.g., independent or chain restaurants) (Ma et al., 2023; Wang & Papastathopoulos, 2023). Restaurant robots in different settings, such as robot-themed restaurants at theme parks, have not yet been fully examined (Tussyadiah, 2020).

Third, the complex mechanisms among robotic restaurant roles and stereotypes of warmth and competence toward robots in hospitality settings can be clarified in this study, resulting in deep practical insights for practitioners to adopt robots. Although the importance of robot stereotypes in human-robot interaction has been noted (Liu et al., 2022; Song et al., 2024), their moderating effect on robot roles has yet to be understood clearly in the existing literature. Our

study fills this gap in the literature by empirically testing the moderating effects of robot stereotypes on the relationships between different robot roles and brand warmth and competence.

Fourth, this study can enrich the human-robot interactions literature by demonstrating the effects of robotic restaurant roles on supporting restaurant branding, which is a knowledge gap pointed out by Choi et al. (2022). Under scenarios of robotic restaurant roles, this study will examine customers' perceived restaurant brand warmth, restaurant brand competence, and revisit intention to the restaurant.

2. Literature Review

2.1. Role Theory and Customer Expectations of Roles of Robots

Growing research attention has been devoted to exploring how to apply robots in service production and delivery process to enhance customers experience (Ma et al., 2023), and the effect of warmth and competence of service rbots on customers' value and loyalty (Belanche et al., 2021). As an industry traditionally labeled as labor-intensive (e.g., Tracey & Hinkin, 1994), hospitality customers are accustomed to receiving service performed by employees who are friendly and display positive emotions in service encounters (e.g., Pizam, 2004; Lee & Madera, 2019). On the other hand, the use of service robots has become increasingly popular in the hospitality and tourism industry particularly in restaurants and hotels, as a means of impressing customers, saving costs, and improving the efficiency of service operations (e.g., Chuah et al., 2022).

Although in practice, robots are performing various roles in hospitality organizations (Mitchell, 2018), there is still a scarcity of literature indicating whether robotic servers, chefs, entertainers, receptionists, etc. would provide the same level of service, social interactions, and warmth to customers as humans. Further, it is still not clear whether customers can accept these

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roles traditionally performed by humans to be performed by robots. As these issues are highly relevant to people's perceptions and expectations of service roles and their performers, we suggest examining such issues using role theory (Biddle, 1979; Solomon et al., 1985).

According to Ogata and Sugang (2000), a role is defined as a cluster of social cues directing and guiding behaviors in given settings. Building on this, role theory suggests that individuals should act according to socially defined role expectations (Solomon et al., 1985). Applied in hospitality contexts, customers would expect servers to perform up to their duties and role expectations, which is also consistent with the expectancy-disconfirmation model of customer satisfaction (Oliver, 1980). According to Oliver (1980), when service providers' performance is consistent with customers' expectations, customers could feel satisfied, and when service providers fail to meet customers' expectations of their role, service failures are likely to occur. People tend to be influenced by stereotypes, or their beliefs about the characteristics, attributes, and behaviors of certain members of groups (Gardner, 1994).

Recent literature also suggests that stereotypes could also happen to robots. For instance, Tay et al. (2013)' study on gender stereotypes and robots found that consumers would accept security robots more when they have matching gender stereotypes and would perceive them as more useful. Tay et al. (2014) also suggested that consumers respond to social robots based on their personality and gender stereotypes, and personality-occupational role stereotypes had a stronger impact on consumers than gender-occupational stereotypes. Despite these pioneer research findings, research in hospitality focusing on robots' role and stereotypes-related issues is rare. It is still unknown whether customers' expectations and perceptions change when service robots perform different roles in hospitality service encounters (e.g., chef vs. server).

Understanding the above issues will not only help better address customers' needs, but it will also contribute to literature on role theory.

2.2. Roles of Robots and Brand Warmth

Brand warmth emphasizes a brand's friendliness, genuineness, and helpfulness (Judd et al., 2005). Warmth is a universal trait dimension of interpersonal and intergroup perception (Fiske, 2018). Current studies on service robots regarding warmth and competence mainly focus on anthropomorphism and robot appearance in tourism and hospitality (Chang et al., 2024; Liu et al., 2022; Yang & Xu, 2024; Zhu & Chang, 2020). Notably, Lv et al. (2024) investigated the effect of colleague type (service robot vs. human) on service warmth in business settings. However, limited research has explored the influence of restaurant roles on brand warmth in the robotic service setting. Further research is warranted to understand the dynamics of warmth in the context of human-robot collaboration (Lv et al., 2024).

The role theory indicates that people are expected to behave according to their socially defined roles (Solomon et al., 1985). Such roles are dependent on their particular social identities and the nature of the situation they are in (Biddle, 1986; Davis, 2014). Applied to human-robot interaction, a service robot in restaurant contexts, when they perform various service roles such as server, chef, or host, are also expected to act according to the expectations of these roles. When customers perceive service robots performing consistently with role expectations of each job, customers are more likely to perceive the service experience and outcomes as positive.

On the other hand, expectations on different roles at restaurants also differ, particularly, jobs that involve frequent customer-contact need to display appropriate emotion and warmth (Chiengkul et al., 2023). Whether robots could convey the same kind of brand warmth to customers

is questionable. In addition, previous literature on stereotypes with robots also suggests that customers have gender and personality stereotypes about service robots and consider that robots are more suitable for certain roles than others (Liu et al., 2022; Tay et al., 2014). Compared to humans, however, robots are perceived as more efficient more productive, but generally less warm. Although technological developments imbue robots with increasing automated social presence and humanness (Jin & Youn, 2023), robots are still perceived only as partial social actors and less warm than humans (Belanche et al., 2021).

For example, robotic chefs (chef roles) may influence the warmth feeling of customers' perception of the robots (Zhu & Chang, 2019), and due to the lack of warmth in service robots, customers' perceptions towards hosting and delivering (host roles) can be different (Seyitoğlu et al., 2021). On the other hand, service robots may be better at entertaining customers (server roles), and conveying stronger warmth to customers (Qiu et al., 2020). Robot service is different from human service, which is generally associated with warmth (Choi et al., 2021). Based on this discussion, we propose the following hypothesis:

H1: Restaurant customers would perceive brand warmth differently between robot chefs and human chefs.

H2: Restaurant customers would perceive brand warmth differently between robot hosts and human hosts.

H3: Restaurant customers would perceive brand warmth differently between robot servers and human servers.

2.3. Roles of Robots and Brand Competence

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Brands may be seen as competent, which is fundamental to social perception (Fiske et al. 2002), and competence perception captures perceived capability, efficiency, and skill (Aaker et al., 2010). In the context of robotic service, research has largely concentrated on the appearance and anthropomorphic features of robots as determinants of competence (Liu et al., 2022; Yang & Xu, 2024). Hwang et al. (2022) examined how perceived innovation affects brand competence in robot restaurants. The influence of restaurant roles in the context of human-robot collaboration on brand competence, however, remains underexplored. Scholars argue that further research on brand competence is needed, as its neglect may hinder a comprehensive understanding of robot restaurant environments (Hwang et al., 2022).

The application of service robots may assume an emerging service role in the service encounter following the role theory, which is composed of a series of mutually dependent service roles and their coordinated actions (Solomon et al., 1985). Go et al. (2020) indicate that robots are capable of enriching customers' dining experiences by performing restaurant roles, including chef, deliverer, and entertainer. Following such a perspective, involving robots in a restaurant as a service provider leads to relevant service roles. For example, some robots are programmed to take restaurant roles that provide quick services directly to customers, such as hosting, entertaining, and cooking (Zemke et al., 2020), which are consistent with the roles of host, server, and chef in our study. Human beings can be projected onto robots by orienting expectations about their competencies and roles (Eagly & Steffen, 1984), for example, they assess the service robot associated with the brand competence and the different roles of the robots in restaurants (Chang & Kim, 2022).

Brand competence emphasizes the level of competitiveness and intelligence of the brand, which is the inherent feature of robotic service judged by customers (Hwang et al., 2022). In the

context of robotic chefs (chef roles), Zhu et al. (2020) disclose that the robotic chef has a positive effect on competence perception. In addition, robotic receptionists (host roles) and singing robots (server roles) positively affect customers' perceived competence (Kim et al., 2019; Harding & Williams, 2016). Robots and humans have different characteristics which lead to varying customer perceptions of service roles based on whether the service is provided by a robot or a human. Additionally, customers' perceptions of brand competence may differ depending on whether the restaurant service provider is a robot or a human (Hwang et al., 2022). Taken together, we propose:

H4: Restaurant customers would perceive brand competence differently between robot chefs and human chefs.

H5: Restaurant customers would perceive brand competence differently between robot hosts and human hosts.

H6: Restaurant customers would perceive brand competence differently between robot servers and human servers.

2.4. Stereotype of Warmth and Competence toward Robots as Moderators

Customers' stereotype of warmth toward robots refers to their impressions of socially desired traits (e.g., warm, sociable, helpful, sincere, and happy) toward robots (Eyssel & Hegel, 2012; Fiske et al., 2007). In restaurant roles, warmth is a desired employee trait that can make customers feel welcomed, gain positive emotions, and be willing to spend time and energy for building relationships with the employee, the service team, or even the restaurant brand (Baker & Kim, 2018; Min & Hu, 2022; Smith et al., 2016).

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Chefs can showcase warmth by warmly saying hi to customers and seeking their feedback on food before they leave, hosts can deliver warmth while greeting customers when they enter the restaurant, and servers can display warmth when interacting with customers with sincere smiles (Baker & Kim, 2018; Min & Hu, 2022; Smith et al., 2016). Hence, when robots are adopted to play human roles in restaurants, warmth is an expected professional trait in restaurant roles (Blaurock et al., 2022).

The stereotype of warmth encompasses the sincerity, friendliness, and caring displayed by chefs, hosts, and servers in a restaurant (Yang et al., 2024a). Signaling warmth can reduce negative reactions to the adoption of robots by a warmth brand (Choi et al., 2022), but robots are generally perceived as less warm compared to humans (Belanche et al., 2021; Choi et al., 2020). Thus, we predict that when customers' stereotype of warmth toward robots is low, they don't possess high expectations on how warm robots would be, and therefore they can easily be amazed and perceive high brand warmth when being served by warm robots. In contrast, when their stereotype of warmth toward robots is high, they would expect robots to display warmth the same as humans, resulting in disappointments and perceived low brand warmth when experiencing robots showing warmth lower than humans. Based on the above, we propose:

H7: Stereotype of warmth toward robots moderates the positive relationship between robot as chef and brand warmth, which becomes weaker when the stereotype of warmth toward robots is high.

H8: Stereotype of warmth toward robots moderates the positive relationship between robot as host and brand warmth, which becomes weaker when the stereotype of warmth toward robots is high.

H9: Stereotype of warmth toward robots moderates the positive relationship between robot as server and brand warmth, which becomes weaker when the stereotype of warmth toward robots is high.

Customers' stereotype of competence toward robots refers to their impressions of intellectually desired traits (e.g., intelligent, skillful, determined, persistent, and scientific) toward robots (Eyssel & Hegel, 2012; Fiske et al., 2007). Competent restaurant employees are important to maintain standardized service operations for the business, ensure consistent food and service qualities, make customers feel the restaurant is reliable and capable of serving their needs, and win customer loyalty (Belanche et al., 2021; Hwang et al., 2022; Kolbl et al., 2020). Chefs present competence by cooking quality food items, hosts can perform competence via speaking a foreign language to greet foreign customers, and servers can showcase competence by suggesting menu items that would match customers' preferences (Genc & Akoglan Kozak, 2020; Hwang et al., 2022; Min & Hu, 2022).

Robots have been recognized as more competent than humans in some service functions such as carrying heavy items and frying chicken wings following standardized steps (Hwang et al., 2022; Xiao & Zhao, 2022). We argue that the higher the customers' stereotype of competence toward robots, the more expectations they would hope to receive when being served by robots, causing potential disappointments and perceived low brand competence when they notice robots are not as perfect as what they have imagined. On the contrary, when their stereotype of competence toward robots is low, they would easily perceive the restaurant's brand competence when being served by competent robots. Therefore, we propose:

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H10: Stereotype of competence toward robots moderates the positive relationship between robot as chef and brand competence, which becomes weaker when the stereotype of competence toward robots is high.

H11: Stereotype of competence toward robots moderates the positive relationship between robot as host and brand competence, which becomes weaker when the stereotype of competence toward robots is high.

H12: Stereotype of competence toward robots moderates the positive relationship between robot as server and brand competence, which becomes weaker when the stereotype of competence toward robots is high.

2.5. Brand Warmth, Brand Competence, and Revisit Intention

Restaurant brand warmth represents a restaurant as socially desirable, where customers have the tendency to like the restaurant for its helpfulness, friendliness, and chances to experience positive emotions (Fiske et al., 2007; Shin & Hwang, 2023). On the other hand, restaurants with high brand competence are intellectually desirable, where customers believe the restaurant has the capability to offer quality food and services, stay reliable on business operations, and hire employees who are skillful and persistent (Fiske et al., 2007; Hwang et al., 2022). Brand warmth allows customers to perceive the emotional and social values of a restaurant, while brand competence offers functional value (Kolbl et al., 2020). Customers therefore have the intention to revisit a restaurant with high brand warmth and brand competence so that they can continue enjoying the values caused by warmth and competence. Lin et al. (2024) state that brand warmth and competence influence revisit intention. Based on the above, we propose:

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H13: Brand warmth is positively related to revisit intention.

H14: Brand competence is positively related to revisit intention.

Based on the above, in line with the recent advocates on investigating the roles of robots at service encounters (Blaurock et al., 2022; Ho et al., 2020; Ma et al., 2023; Song et al., 2022; Tang et al., 2022), this study utilizes a role theory perspective (Biddle, 1986; Solomon et al., 1985) in restaurant settings to examine customers' restaurant brand relationship building. Figure 1 shows the research framework of this study. We propose chef, host, and server as the three major human roles at restaurants that can be replaced by robots (Ho et al., 2020; Ma et al., 2023; Song et al., 2022). Customers may perceive the differences between the roles performed by robots and humans when evaluating their brand warmth and brand competence at restaurants.

Further, considering the aspect of stereotypes in role theory (Koenig & Eagly, 2014) and restaurant customers' stereotypes toward robots (Hu et al., 2022; Liu & Xie, 2023; Seo, 2022), this study proposes two moderators, stereotype of warmth toward robots and stereotype of competence toward robots, for the positive effects of experiencing robotic roles on brand warmth and brand competence. In the end, we propose both brand warmth and brand competence would cause revisit intention. The proposed framework will be examined via two studies. Our study 1 will focus on testing the main effects of the proposed framework with a scenario of casual-dining restaurants (i.e., H1-6 & H13-14). In study 2, we will add the moderating effects together with a scenario of robot-themed restaurants at theme parks (i.e., H1-14).

(Insert Figure 1 here)

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3. Method

3.1. Study design and sample

We conducted two online experiments to verify the hypotheses. Both experiments are a 2 (host role performed by human vs. robot) x 2 (chef role performed by human vs. robot) x 2 (server role performed by human vs. robot) between-subjects design. The first experiment (Study 1) aimed to test the effect of the role of host, chef, and server on brand warmth and brand competence. In addition to replicating the results of Study 1, the second experiment (Study 2) also investigated the potential moderating effect of stereotypes towards robots on the causal effect of role on brand warmth and competence.

A total of 656 Chinese adult diners (N=348 in Study 1, and N=308 in Study 2), recruited via a leading online marketing research firm of Wenjuanxing in China (Zheng et al., 2020), participated in two online experiments. In Study 1, 56.3% were female, 45.1% were in the age group of 21-30, 75% were married, 76.4% held an undergraduate degree, 46% were white-collar workers, and 32.2% earned CNY 7000-9999 (US$ 1092-1560) per month. The cell size for Study 1 ranged from 40 to 48. In Study 2, 63.3% were female, 48.4% were in the age group of 21-30, 83.4% were married, 83.4% held an undergraduate degree, 53.2% were white-collar workers, and 39% earned CNY 10000 and above (US$ 1561 and above) per month. The cell size for Study 2 was between 36 and 41.

3.2. Procedure and stimuli

Wenjuanxing distributed the e-link to qualified members who are adult diners in China in the database. Once participants clicked the e-link, they were randomly allocated into one of the eight experimental scenarios. The experimental scenarios were developed based on three roles

(either performed by human or robot) in restaurants (see Appendix 1). To ensure cross-context equivalence in hypothesis testing and examine variations in hospitality settings, researchers highlight the need to further investigate service robots across different restaurant segments, such as casual dining and theme park restaurants (Yang et al., 2024; Wang & Papastathopoulos, 2023; Ma et al., 2022). To replicate the results, we adopted two various robot pictures and two different contexts (e.g., a casual restaurant in Study 1 and a restaurant in a theme park in Study 2) in both online experiments. To minimize the confounding effect, a middle-priced restaurant, rather than a cheap or expensive restaurant, was described in the scenario descriptions.

3.3. Measure

We used the existing 7-point Likert scale (1 = strongly disagree, 7 = strongly agree) from the previous literature to measure the constructs (see Appendix 2). For example, three items measuring brand warmth and three items measuring brand competence were adapted from Aaker et al. (2010). Consumers' revisit intention was assessed by three items from Kim et al. (2020). We used the scale from Gidaković and Zabkar (2021) to measure robot warmth and competence stereotypes.

3.4. Data analysis

We used Statistical Package for the Social Sciences (SPSS) to test all hypotheses. For both studies, the effects of three independent variables on brand warmth and brand competence (H1-H6) were tested using a three-way analysis of covariance (ANCOVA). The relationships between brand warmth, brand competence, and consumers' revisit intention (H13-H14) were tested by

PROCESS. For Study 2, the moderating effect of stereotypes towards robots (H7-H12) was also tested by PROCESS.

4. Results

4.1. Manipulation check

All manipulations of the experimental treatment were successful. Participants in the robot chef condition rated higher on 'the cooking was produced by robots' than those in the human chef condition (Study 1: $M_{Robot\ Chef}$ = 6.83 > $M_{Human\ Chef}$ = 1.38; t (346) = 76.162; $p < .001$; Study 2: $M_{Robot\ Chef}$ = 6.84 > $M_{Human\ Chef}$ = 1.29; t (306) = 108.010; $p < .001$). In addition, participants in the robot host condition agreed more on 'the host was a robot' than those in the human host condition (Study 1: $M_{Robot\ Host}$ = 6.75 > $M_{Human\ Host}$= 1.23; t (346) = 104.645; $p < .001$; Study 2: $M_{Robot\ Host}$ = 6.79 > $M_{Human\ Host}$= 1.27; t (306) = 92.506; $p < .001$;). Furthermore, participants in the robot server condition agreed more on 'the server was a robot' than those in the human server condition (Study 1: $M_{Robot\ Server}$ = 6.79 > $M_{Human\ Server}$= 1.89; t (346) = 33.597; $p < .001$; Study 2: $M_{Robot\ Server}$ = 6.73 > $M_{Human\ Server}$= 1.23; t (306) = 106.366; $p < .001$;).

4.2. Effect of role on brand warmth and brand competence

According to Table 1, both experiments revealed different results in terms of H1. In Study 1, participants in the human chef condition ($M_{Human\ Chef}$ = 5.58) perceived a higher level of brand warmth than those in the robot chef condition ($M_{Robot\ Chef}$ = 5.24; F [1, 334] = 9.927; $p < .01$), supporting H1. However, both human chef and robot chef generated a similar level of brand warmth ($M_{Human\ Chef}$ = 5.63; $M_{Robot\ Chef}$ = 5.62; F [1, 294] = .080; ns) in Study 2, rejecting H1. Similarly, subjects in the human host condition (Study 1: $M_{Human\ Host}$ = 5.59; Study 2: $M_{Human\ Host}$

= 5.80) perceived a higher level of brand warmth than those in the robot host condition (Study 1: M $_{Robot\ Host}$ = 5.24; F [1, 334] = 10.367; $p < .01$; Study 2: M $_{Robot\ Host}$ = 5.45; F [1, 294] = 13.355; $p < .01$), confirming H2 in both studies. Furthermore, participants in the human server condition (Study 1: M $_{Human\ Server}$ = 5.54; Study 2: M $_{Human\ Server}$ = 5.75) perceived a higher level of brand warmth than those in the augmented-robot condition (Study 1: M $_{Robot\ Server}$ = 5.28; F (1, 334) = 6.011; p < .05; Study 2: M $_{Robot\ Server}$ = 5.50; F (1, 294) = 8.152; p < .01). Thus, H3 was supported. No significant two-way and three-way interaction effects were identified. In terms of control variables, income in both Studies 1 and 2, and education in Study 2 affected brand warmth.

(Insert Table 1 here)

As shown in Table 2, H4, H5, and H6 were all surprisingly rejected. For instance, no significant difference was observed between the human chef and robot chef in terms of brand competence (Study 1: M $_{Human\ Chef}$ = 5.91; M $_{Robot\ Chef}$ = 5.76; F [1, 334] = 3.280; ns; Study 2: M $_{Human\ Chef}$ = 5.92; M $_{Robot\ Chef}$ = 6.05; F [1, 294] = 3.246; ns). Similarly, subjects in both human host and robot host conditions had similar level of brand competence (Study 1: M $_{Human\ Host}$ = 5.86; M $_{Robot\ Host}$ = 5.81; F [1, 334] = .314; ns; Study 2: M $_{Human\ Host}$ = 6.04; M $_{Robot\ Host}$ = 5.92; F [1, 294] = 2.351; ns). Therefore, H5 was declined. Likewise, participants in both human and robot server conditions perceived similar level of brand competence (Study 1: M $_{Human\ Server}$ = 5.82; M $_{Robot\ Server}$ = 5.85; F [1, 334] = .085; ns; Study 2: M $_{Human\ Sever}$ = 5.99; M $_{Robot\ Sever}$ = 5.97; F [1, 294] = .575; ns), rejecting H6.

As shown in Figure 2, we observed a significant two-way interaction effect of host and server on brand competence (F [1, 294] = 6.992; $p < .01$) in Study 2. More specifically, the simple

effect results show that when a human server is used (F [1, 294] = 8.279, $p < .01$), there is a significant difference in brand competence between using a human host or using a robot host (M Human Server – Robot Host = 5.85; M Human Server – Human Host = 6.13). However, the simple effect results show that when a robot server is used (F [1, 294] = .211, ns), there is no difference in brand competence between using a human host or using a robot host (M Robot Server – Robot Host = 5.99; M Robot server – Human Host = 5.95). In terms of control variables, we observed that participants' marital status and education in Study 1 and gender and income in Study 2 affected brand competence.

(Insert Table 2 here)

(Insert Figure 2 here)

4.3. The moderating effect of stereotypes towards robots on brand warmth and brand competence

The moderating effect of the stereotype of warmth towards robots was conducted via PROCESS. The results show that the warmth stereotype of robots doesn't moderate the relationship between chef role and brand warmth ($p = 0.90$, 95%CI -.158 to .180), thus, H7 was rejected. The warmth stereotype of robots moderates the relationship between host role and brand warmth ($p < .001$, 95%CI -.489 to -.177) and between server role and brand warmth ($p < .001$, 95%CI -.496 to -.182), partly supporting H8 and H9. Table 3 shows that for low and medium level of warmth stereotype, the effect size of low level is greater than that of medium level. High stereotype of warmth doesn't affect the relationship between role (e.g., host and server) and brand warmth.

(Insert Table 3 here)

Similarly, the PROCESS results show that the competence stereotype of robots doesn't moderate the relationship between chef role and brand competence ($p = .12$, 95%CI -.033 to .271), thus, H10 was rejected. Competence stereotype of robots moderates the relationship between host role and brand warmth ($p < .05$, 95%CI -.297 to -.001), partly supporting H11. As shown in Table 4, high stereotype of competence doesn't affect the relationship between host role and brand competence. Low and medium level of competence stereotype influence the relationship, and the higher of competence stereotype, the lower level of effect size. The competence stereotype of robots also moderates the relationship between server and brand warmth ($p < .05$, 95%CI -.324 to -.026), partly confirming H12. Only the low level of competence stereotype, neither medium nor high level, influences the relationship.

(Insert Table 4 here)

4.4. The relationships between brand warmth, brand competence, and consumers' revisit intention

We used PROCESS in SPSS to test the relationships between brand warmth, brand competence, and revisit intention. In Study 1, brand warmth ($p < .001$, 95%CI .350 to .523) and brand competence ($p < .001$, 95%CI .315 to .554) positively affected revisit intention. Similarly, in Study 2, brand warmth ($p < .001$, 95%CI .377 to .592) and brand competence ($p < .001$, 95%CI .286 to .588) also positively influenced revisit intention. Therefore, both H13 and H14 were supported. Overall, Table 5 presents the summary of results for studies 1 and 2.

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(Insert Table 5 here)

5. Discussion and conclusion

Using role theory as our theoretical support, this study compared restaurant roles performed by robots and humans in customers' brand relationship building with restaurants. This study recalls the traditional suggestions of Solomon et al. (1985) and Broderick (1999) on the application of the role theory perspective on explaining human employee roles at service encounters, as well as the recent suggestion of Blaurock et al. (2022) on utilizing role theory to explain how robotic roles are replacing humans in the service industry. Regarding brand warmth, it is mostly consistent that customers consider humans to be better than robots to allow them to feel brand warmth, thereby *H1* and *H3* are accepted in Studies 1 and 2. An exception was found for hosts in Study 2, in which customers at robot-themed restaurants within theme parks perceived no difference in brand warmth between robot and human hosts, rejecting *H2*. One possible explanation for the rejected *H2* in Study 2 would be attributed to the contextual match of robot hosts with the theme of robot-themed restaurants at theme parks (Choi et al., 2022). Additionally, robot hosts or online systems have been used to assist customers with reservations and orders at theme parks. Therefore, *H2* is accepted in Study 1 and rejected in Study 2.

Meanwhile, limited differences were found in the scores of brand competence, indicating that brand warmth and brand competence are different concepts in restaurant branding and in determining the effectiveness of robotic roles (Belanche et al., 2021; Liu et al., 2022). With empirical results from hospitality settings, it's interesting that customers did not perceive any difference in brand competence between robots and humans in the roles of chef, host, and server, rejecting *H4*, *H5*, and *H6*. These results contradict previous findings from Hwang et al. (2022) that

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brand competence differs depending on whether the service provider is a robot or a human, implying that the robotic chef/host/server can be as competent as humans (Kim et al., 2019; Zhu et al., 2020). We think the inconsistency among the existing literature would be due to the extent of smartness in robots used for empirical investigations. Different levels of smartness in robots contribute to different levels of quality in functions that robots can play, and this is reflected in a vast range of prices among service robots (Yang et al., 2024b). This issue about robots' smartness should be noted in future research.

With the moderating effects of stereotypes added into study 2 with the scenario of robot-themed restaurants at theme parks, the results bring some new insights into the differences among restaurant roles. We found that customers' stereotypes of warmth and competence toward robots can significantly weaken their perceived brand warmth and brand competence in the roles of hosts and servers, while no difference was found with stereotypes on the role of chefs. Therefore, *H8, H9, H11*, and *H12* are supported, while *H7* and *H10* are rejected. We interpret the findings for the following reasons. First, in robot-themed restaurants at theme parks, customers would consider robot roles at service encounters as a great brand match (Hwang et al., 2021) and value roles played at the front of the house (e.g., host and server) higher than at the back of the house (e.g., chef). Second, although human employees are normally evaluated as better at supporting customers perceive brand warmth than robots (Choi et al., 2021), in some settings where techy atmospheres are socially desirable (e.g., robot-themed restaurants at theme parks) (Hwang et al., 2021), customers may feel robotic roles provide similar levels of brand warmth as humans. On the other hand, consistent with recent literature (Belanche et al., 2021; Kolbl et al., 2020; Liu et al., 2022), this study confirmed that brand warmth and competence created by robotic restaurant experience

could increase customers' revisit intention, thereby supporting *H13* and *H14*. Implications and suggestions for future research are reported in the following sections.

5.1. Theoretical Implications

First, this is one of the first empirical studies taking a role theory perspective to examine and interpret robots in restaurant roles in hospitality settings (Blaurock et al., 2022; Tang et al., 2022). The application of role theory (Biddle, 1979) supports us in planning the tests for each of the key restaurant roles (i.e., chef, host, and server) played by robots and humans on building brand warmth and brand competence, and proposes stereotypes toward robots as the moderators in restaurant brand relationship building. It seems that because roles in the front of the house are more visible, customers gain more stereotypes of hosts and servers than chefs, resulting in significant results for *H8-9* and *H11-12*. Besides, by testing *H2* in Studies 1 and 2, we found that warm human hosts are expected in casual-dining restaurants while it can be replaced by robots to deliver the same level of warmth at theme park restaurants. Via testing these three roles, differences among the roles were found and explained because of (1) whether the roles are in front of the house (e.g., host and server) or back of the house (e.g., chef), and (2) the setting as a casual-dining restaurant or a theme park restaurant.

Second, this study highlights the importance of taking a deeper look into role differences in the comparisons between robots and humans. Simply considering all robot types as one unit to compare robots' warmth and competence with humans would miss meaningful interpretations of the features and uniqueness among restaurant roles. For example, in existing occupational gender stereotypes (Eyssel & Hegel, 2012; Hu et al., 2022; Koenig & Eagly, 2014), people possess impressions that most chefs are male, most servers are female, servers should perform more

warmth in their job roles than chefs, and the trait of competence is more important than warmth to be a professional chef. The role expectations formed through stereotypes make us reconsider the need to analyze each robot's role differently, rather than a simple comparison between robots and humans.

5.2 Practical Implications

We encourage theme park restaurant owners and managers to invest in robots for the roles of chef, host, and server. Specifically, chefs and servers are the roles that owners and managers can plan to mix robots with humans in work teams because customers still believe humans as superior to robots in delivering warmth. If all chefs and servers are played by robots, the reduced level of warmth may undermine customers' brand evaluations on the restaurants. Therefore, strategically, when implementing robots as chefs and servers to save labor costs, owners and managers still need to hire human employees in work teams to collaborate with robots.

For hosts in theme park restaurants, owners and managers may use all robots as hosts because customers reported no difference in robot hosts' warmth and competence with human hosts. Besides, when adopting restaurant robots, owners and managers should communicate with robot designers to ensure the restaurant brand image and the theme park image are integrated into robot design, making restaurant robots as effective supporters to enhance branding and revisit intention in theme parks. To strategically build customers' stereotypes toward restaurant robots in theme parks, restaurant marketing teams can promote the warmth and competence more on their robot chefs in theme parks, while revealing less about the warmth and competence of their robot hosts and robot servers. By doing so, customers can be amazed when actually meeting with robot

hosts and robot servers in the theme park and perceive positive brand warmth and competence toward the restaurants.

On the other hand, casual-dining restaurants' human resource managers should plan training programs on building employees' warmth in job roles. Human resource managers should highlight the importance of employee warmth in restaurant service interactions with customers, and make sure their human employees are capable of supporting customers to perceive warmth via their work roles in a restaurant experience. Through customer surveys, warmth can also be added to human employees' regular work performance evaluation for managers to monitor the quality of warmth played by human employees in their job roles. Moreover, for robot designers, since nowadays customers still perceive humans are better than robots in performing warmth at restaurant roles, the future direction of robot improvement should be on robots' social and emotional functions. Advanced techniques, such as emotion artificial intelligence that can detect and interpret customers' emotions (Lu et al., 2023), can be added to restaurant robots to improve customers' evaluations of the warmth of robots.

5.3 Limitations and Future Research

This study analyzed the robot roles in the restaurant context; however, this study has some limitations that need to be considered when developing future research. First, this paper tested restaurants in two settings in studies 1 and 2 (e.g., one is a general restaurant, and another one is a restaurant in a theme park). It would be worth verifying the results of this study in other restaurant contexts. For example, Wang and Papastathopoulos (2023) examined service robots at luxury, fine-dining, casual, and quick-service restaurants in the U.S. Although a theme park restaurant retains the basic characteristics of general restaurants, it may provide a unique experience. Future

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studies could compare the service robot roles in a local/authentic restaurant and a fine-dining restaurant, or different theme park restaurants.

Second, participants of the two studies were recruited only in China. Since cultural differences have been found in global hospitality services (Guan et al., 2022; Mariani et al., 2020), customers from different cultural backgrounds may possess different stereotypes and expectations toward restaurant roles. Therefore, future studies should implement cross-cultural studies to validate such cultural differences. Third, both studies 1 and 2 are scenario-based research. Although most robot studies in hospitality and tourism literature are scenario-based (Liu et al., 2022; Ma et al., 2023; Song et al., 2022; Wang & Papastathopoulos, 2023), to capture customers' first-hand responses to real robots, we recommend future research to collaborate with restaurant companies and theme parks for on-site data collections.
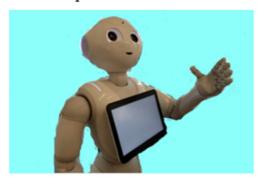
Appendix 1: Scenarios

(In Study 1: Please imagine that you are dining in a local casual restaurant in China. In Study 2: Please imagine that you are visiting a theme park in a city in China, and having your lunch in this theme park). The average cost per person for this restaurant is RMB 100-200.

From the open kitchen, you 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*).

In this restaurant, a robot host (see the picture below) greeted you, led you to your table, took your order … and finally processed your payment. (*A host greeted you, led you to your table, took your order … and finally processed your payment*).

A robot server delivered the food to your table, and the robot server (see the picture below) sang a 'happy birthday song' to customers. (*A server delivered the food to your table, and the server sang a 'happy birthday song' to customers*).

The below picture is shown in relevant Study 1 scenarios:

The below picture is shown in relevant Study 2 scenarios:

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