Robotic service quality, authenticity, and revisit intention to restaurants in China:

Extending cognitive appraisal theory

Abstract

Purpose – Using cognitive appraisal theory, this study proposes and tests an integrated framework – comprising robotic service quality, robotic service authenticity, customer existential authenticity, and customer revisit intention – on diners with experience using robotic technology in restaurants. The moderating role of robotic appearance is in the hypothesised relationship.

Design/methodology/approach – Data were gathered through a web-based survey delivered to 428 diners who had experience using robotic services in restaurants in China. The hypotheses were analysed using a structural equation model and multi-group analysis was used to analyse the moderating effect.

Findings – The findings indicate that functional service quality positively influences robotic service authenticity and existential authenticity. However, technical service quality only affects existential authenticity, which leads to revisit intention. Robotic appearance moderated the relationship between functional service quality and service authenticity.

Research implications – Restaurateurs should enhance robotic service authenticity, existential authenticity, and revisit intention by improving robotic technical service, collaborating with robot manufacturers and operators.

Originality – Focusing on cognitive appraisal theory, the findings serve as a starting point for investigating robotic service quality and authenticity in robotic service settings theoretically and empirically.

Keywords: Robotic service quality; Robotic service authenticity; Customer existential authenticity; Revisit intention

Paper type: Research paper

1. Introduction

More and more hospitality businesses have been implementing service robots to support or replace human staff to assist and serve customers (Choi *et al*., 2023; Yu *et al*., 2022). This phenomenon is also appeared in hospitality businesses in China (Song *et al*., 2022; X-Zhang *et al*., 2022), including Haidilao Hot Pots, FlyZoo Hotel, Foodom Robot Chinese Restaurant, etc. (Guan *et al*., 2022). Despite the extensive adoption of robotic services in China, however, concerns have arisen regarding technological flaws (Fu *et al*., 2022; Liu *et al.*, 2023), unpleasant robotic services (Hwang *et al*., 2021), and quality experience seeking (Davari *et al*., 2022). To obtain a competitive advantage through the utilisation of service robots (Chen *et al.*, 2023; Cheng *et al*., 2023), it is imperative to investigate the robotic service quality (Shin, 2022), particularly within China's context.

Authenticity drives customers' repurchase/revisit intention (Kim *et al*., 2020). It also conveys customers' quality assessment of the restaurants (Liu *et al*., 2018), such as quality of service (Chen et al., 2020). Additionally, customers seek existential authenticity that emphasises consumers' authentic selves in consumption than objects (Xu *et al*., 2023). In tourism research, most studies examine the authenticity of toured objects, otherness, and the realisation of the true self (existential authenticity) (Le *et al*., 2021). However, in the restaurant context, studies on authenticity have focused mainly on the delivery of otherness through objects (i.e., ethnic culture and cuisines) (Le *et al*., 2019), there has been relatively less exploration of existential authenticity in the restaurant context (Xu *et al*., 2023). Considering the popularity of adopting robotic technology in the restaurant industry, quality automation service and authenticity should be a priority in restaurants (Seyitoğlu, 2021); however, that remains under-researched in the robotic service context.

The uniqueness of robotic service quality is related to the quality of service interacted with robots, and customers evaluate robotic service quality towards authenticity varies

significantly, compared with human employees in restaurants. Understanding the robotic service quality is conducive to improving customer experience, and organisational competitive advantage and profitability (Prentice and Nguyen, 2021). However, the influence of robotic service quality on service authenticity and existential authenticity remains unknown.

Authenticity differs in various restaurant contexts (Song *et al*., 2022; Xu *et al*., 2023). For example, customers view time-honoured and ethnic/themed restaurants differently regarding perceived authenticity and existential authenticity (Xu *et al*., 2023). In the robotic restaurant context, since robot employees differ from human staff, customers view service authenticity as higher when human staff offers the service than robot employees (Song *et al*., 2022). If robots are perceived as less authentic, customers may refrain from using them (Lin and Mattila, 2021). Considering that not every customer may favour the same service context, restauranteurs can benefit from combining robotic service and authenticity, which may help position and differentiate themselves in the market (Seyitoğlu, 2021).

Given the inherent disparities between services provided by robots and human beings, a comprehensive understanding of service quality and authenticity within the robotic service domain is necessary. Nonetheless, the research conducted thus far has made limited efforts to explore the impact of service quality on service and existential authenticity within the robotic service setting. Addressing this research gap is of paramount importance, not only due to the significant influence of authenticity in hospitality services on customers' intention to repurchase or revisit and business success (Xu *et al*., 2023) but also to assuage concerns within the hospitality industry regarding the resistance to implementing robotic service owing to technological flaws or less authentic (Fu *et al*., 2022; Lin and Mattila, 2021), and to comprehend how robots can effectively retain customers through high-quality robotic service (Chen *et al*., 2023).

Service robots with an appropriate appearance can improve customers' perceptions of service quality and authenticity (Strathearn and Ma, 2021; Zhu and Chang, 2020). By appearance, service robots have been categorised into human-like, machine-like, and mascot-like robots (Zhang *et al*., 2021). The mascot-like robot incorporates both zoomorphic (e.g., animal) and caricatured (e.g., cartoon-like or animation) appearances (Zhang *et al*., 2021). In this classification, a machine-like robot has various visible mechanical components without explicitly human-like features. However, it is still difficult to set coherent guidelines to classify those with both mechanical parts and mascot-like features.

In addition, Li *et al*. (2010) argue that the machine-like appearance includes wheels, tracks, robotic arms, no facial features, etc., which is more suitable for low sociability tasks. Since machine-like robots are less life-like, it could be difficult for customers to attribute authenticity to a machine-like robot (Jago *et al*., 2022), and thereby excluded in our study. Therefore, human-like and mascot-like robotic appearances are suitable for studying robotic service authenticity.

Cognitive appraisal theory posits that customers cognitively appraise the environment, influencing their emotional and behavioural responses (Lazarus, 1991). In applying cognitive appraisal theory in this study, the external environment (robotic service quality) is appraised cognitively using robotic service authenticity. Customers' emotions (existential authenticity) contribute to behavioural responses (revisit intention). Few studies have empirically tested authenticity in a restaurant context by adopting cognitive appraisal theory (Foroughi *et al*., 2022), and even fewer have applied it to the robotic service context.

Our study adds new knowledge to three areas. First, robotic service quality has received some attention in the service industry recently, but empirical investigation on its consequences is limited (Wei and Prentice, 2022). To the best of our knowledge, this paper is the first to propose and test an integrated framework comprising robotic service quality, service

authenticity, existential authenticity, and revisit intention among experienced diners. Thus, this study sheds new light on customers' views of robotic service quality and its relevant impacts on robotic service settings.

Second, despite the robotic appearance's important function in human-robot interaction (Onnasch and Roesler, 2021), its moderating effect has not been understood clearly in the existing literature. Our study has bridged this literature gap by empirically testing moderating effects of robotic appearances on the relationships between robotic service quality and authenticity.

Finally, this study extends the classic cognitive appraisal theory. This study also adds additional linkages such as associating the stimulus (robotic service quality) directly to emotions (existential authenticity) and linking the cognitive appraisal (robotic service authenticity) directly to behavioural responses (revisit intention). The study empirically tested a theory-based framework, derived from experienced customers' perspectives and builds on three main literature streams: cognitive appraisal theory; robotic service quality; and authenticity.

In summary, the objectives of this study are 1) to investigate the effects of robotic service quality (i.e., functional and technical) on robotic service authenticity and existential authenticity, 2) to determine whether the constructs of service authenticity and existential authenticity influence revisit intention and 3) to assess the moderating effects of robotic appearance type on the relationship between robotic service quality and service authenticity.

2. Literature review

2.1 Theoretical foundations

Cognitive appraisal theory comprises three main components – cognitive appraisal, emotion, and behavioural response (Lazarus, 1991; Huang *et al*., 2023) – and provides a framework for

explaining how a stimulus contributes to individuals' behavioural responses following appraisals and emotions (Kim *et al.*, 2020). Cognitive appraisal is proposed as the mental mechanisms linking stimuli and emotion, whilst emotion is an inner reaction and coping behaviour (Prayag *et al*., 2022). Service quality can be regarded as a stimulus in the restaurant service (Jang and Namkung, 2009), and perceived authenticity can be assessed based on service quality (Chen *et al*., 2020). As a cognitive appraisal, perceived authenticity may influence customers' emotions in restaurants (Kim *et al*., 2020), in which existential authenticity plays a vital role (Xu *et al*., 2023).

Cognitive appraisal theory has been used to evaluate individuals' appraisals and emotions in various domains, including marketing, tourism, and hospitality (Huang *et al*., 2023; Kim *et al*., 2020). However, cognitive appraisal theory rarely has been applied to study authenticity, aside from a few extant studies (Kim *et al*., 2020; Prayag *et al*., 2022). Kim *et al*. (2020) used cognitive appraisal theory to examine the antecedents (i.e., authenticator, ownership type, and history) and consequences of authenticity (i.e., positive emotions). Prayag *et al*. (2022) tested the antecedents (i.e., neophobia, neophilia, and emotions) and consequences (i.e., existential authenticity) of perceived food authenticity. Considering that both studies examined various types of authenticity – e.g., perceived authenticity, food authenticity, and existential authenticity – no consensus has been reached on how to place these different types of authenticity properly in cognitive appraisal theory.

Since authenticity drives customers' purchase (or repurchase/revisit) decisions (Kim *et al.*, 2020), businesses create a sense of authenticity in various areas, including products, brands, and services (Kim, 2021). In the hospitality context, most studies on authenticity have centred on human-human interactions (Yang *et al.*, 2022). Scholars, however, argued that authenticity needs to be investigated in the human-robot interactions in the robotic service context (Seyitoğlu, 2021; Song *et al*., 2022). Failing to address robotic service quality may limit

understanding of the key trend (Prentice and Nguyen, 2021) and its impacts on customers (Wei and Prentice, 2022). Additionally, service authenticity (Kim, 2021) and existential authenticity (Xu *et al*., 2023) have been rarely studied in hospitality literature. Despite robotic appearances being vital in hospitality (Zhang *et al*., 2021), the literature has not identified its moderating effects between robotic service quality and service authenticity.

2.2 Robotic service quality

It is critical to examine the robotic service quality that customers have experienced (Chiang *et al.*, 2022), as service quality often represents an overall evaluation of services (Hartline and Jones, 1996). Parasuraman *et al*.'s (1988) SERVQUAL is one of the most popular service quality measures. However, it has been criticised for its focus on the functional aspects rather than the technical outcomes of the service encounter (Ladhari, 2009), and for not being universal across service sectors (Buttle, 1996).

The former fails to address technical components that may limit the understanding of accurate evaluation of service quality (Mangold and Babakus, 1991). The latter cannot well explain the rapid technological change in the service area, such as the robotic service (Prentice and Nguyen, 2021). In addition, SERVQUAL does not appear to be an appropriate conceptualisation due to its unnecessary and inefficient adding of customer expectations, because service quality assessment should focus on customers' perceptions via encountering customers, and robotic service is no exception (Prentice and Nguyen, 2021).

Given the aforementioned limitations, Prentice and Nguyen (2021) developed a four-dimensional scale to assess robotic service quality: automation, personalization, precision, and efficiency. However, whether robotic service varies across different service contexts (i.e., restaurant context) and cross-validation in different countries (i.e., China) remains unclear and calls for further empirical investigation. After we validated Prentice and Nguyen's (2021)

robotic service quality measures in this study, the complexities of two-dimensional structures are sorted out, which cannot be fitted appropriately by the above-mentioned four dimensions. After scrutinising these scales and perusing related literature on service quality, the present study has adopted the definitions of technical (outcome) and functional (process) perspectives proposed by Grönroos (2000), which are used predominantly in the technology domain (Su *et al*., 2022).

Technical quality refers to the result of the service action or the outcome of the service process (Grönroos, 2000). For example, whether the robotic service can provide updated information, solve customers' problems and requests, and address customers' needs and demands, which are the outcome of the robotic service process. Functional quality represents a perception of robotic service evaluated during the process of service delivery (Grönroos, 2000). Customers' perceptions toward robotic restaurants are influenced by the functional perspective, including efficient, reliable, and dependable robotic service (Hwang *et al*., 2020). Hence, we use technical (outcome) and functional (process) service quality as the two dimensions in our study.

The restaurant industry currently is characterized by labour shortage and rising cost, which have catalysed the robotic service in restaurants (Morosan and Bowen, 2022). The supplementary material shows the existing literature on robotic service quality. However, possible consequences of robotic service quality, e.g., service authenticity and customer existential authenticity, have not been investigated yet.

2.3 Authenticity

Service authenticity originally was defined as to what extent the service organisation offers its authentic services (Featherman *et al*., 2006), but hospitality researchers have examined service authenticity slightly differently. For example, Chen *et al*. (2020) mainly referred to service

authenticity in the context of service staff members, while Song *et al*. (2022) focussed on the service experience itself. However, Kim (2021) linked service authenticity to seven dimensions of service providers.

In terms of service authenticity antecedents, Song *et al*. (2022) revealed that human staff members, rather than robotic ones, in core and facilitating services develop consumers' perceptions of higher service authenticity. However, their study only focussed on who delivers the service rather than the service quality itself. Considering that Brockhaus *et al*. (2017) found a positive association between service quality and customers' authenticity perceptions of a particular business initiative, service quality and service authenticity might be connected.

Most hospitality literature has adopted a constructive view to examine authenticity, including brand, food, employee service, and environmental authenticity (Chen *et al*., 2020). Some recent articles have confirmed service authenticity's significant position in consumer perception and behaviour (Song *et al*., 2022). Thus, investigating how robotic service quality influences service authenticity and behavioural intention in a restaurant context is compelling.

Constructive authenticity is an external projection of expectations, while existential authenticity emphasises consumers' internal fulfilment (Cook, 2010). Therefore, existential authenticity concerns the existential meanings and experiential outcomes that individuals perceive through participation in relevant activities (Le *et al.*, 2021). More specifically, it is about being true to oneself, being in touch with one's inner being, and asserting one's own will (Prayag *et al.*, 2022).

Service providers and customers sometimes interact with constructive and existential authenticity (Zatori *et al*., 2018). Existing studies have investigated the effect of service authenticity on service quality (Chen *et al*., 2020), and the effect of food authenticity on existential authenticity (Prayag *et al.*, 2022), but few have addressed the nonhuman elements

that influence perceived service authenticity (Kim, 2021) (i.e., service robots). The supplementary material shows the literature on authenticity in the robotic service context.

2.4 Hypotheses development

2.4.1 The effects of robotic functional and technical service quality on robotic service authenticity

Service authenticity is determined by service quality (Chen *et al*., 2020). According to cognitive appraisal theory, stimuli could lead to emotional responses through cognitive appraisal (perceived authenticity) (Kim *et al*., 2020). Service quality, as a stimulus, contributes to customers' perceived authenticity (Brockhaus *et al*., 2017). The technical quality of services is based on perceived authenticity (Aghamolaei *et al*., 2014). Functional service quality such as dependable functioning and reliable operating generates authenticity through the service process (Kim and Kim, 2020). Thus, we suggest:

H1: Functional service quality positively affects robotic service authenticity.

H2: Technical service quality positively influences robotic service authenticity.

2.4.2 The effects of robotic functional and technical service quality on customers' existential authenticity

Existential authenticity focuses on individuals' authentic self in consumption (Le *et al*., 2021). Customers' existential moments (i.e., being yourself) can be triggered by interacting with service staff (Hsu *et al*., 2021). In addition, existential authenticity is more significant because customers perceive authenticity in the service process as reliable, effective, and dependable (Morhart *et al*., 2015) (functional perspective), as well as in the outcome of the service process (technical perspective) (Grönroos, 2000), such as providing updated information, solving customers' problems and requests, and addressing customers' needs and demands.

Empirical study has indicated existential authenticity is associated with service quality (Chen *et al*., 2020). Individuals' emotional responses (e.g., existential authenticity) are a key component of cognitive appraisal theory (Prayag *et al*., 2022). In line with cognitive appraisal theory, robotic technical and functional service quality can influence customers' emotions (i.e., customer existential authenticity). Thus, we propose:

H3: Functional service quality has a positive effect on customers' existential authenticity.

H4: Technical service quality has a positive effect on customers' existential authenticity.

2.4.3 The effect of robotic service authenticity on customers' existential authenticity

The connection between constructive and existential authenticity is explored by scholars, e.g., customers' existential connotations and fulfilment in being themselves can be achieved through heritage sites' constructive authenticity (Yi *et al*., 2018). Service authenticity concerns consumers' authenticity evaluation of the service itself (Song *et al.*, 2022); therefore, service authenticity is formed based on the constructive perspective. Empirical evidence confirms the association between constructive and existential authenticity (Prayag *et al*., 2022), and customers' authenticity perception (from a constructive authenticity perspective) significantly determines their positive emotions (Kim *et al*., 2020). Thus, we propose:

H5: Robotic service authenticity has a positive effect on customers' existential authenticity.

2.4.4 The effect of robotic service authenticity on customers' revisit intention

Customers' revisit intentions are a key measure of post-purchase behaviour (Meng and Choi, 2018), and robotic restaurants must attract customers to revisit. Existing studies have empirically identified the influence of individuals' perceived authenticity on their revisit intention in themed restaurants (Meng and Choi, 2018), and service authenticity affects customers' repurchasing intention in robotic restaurants (Song *et al*. 2022). Thus, we propose:

H6: Robotic service authenticity has a positive effect on customers' revisit intention.

2.4.5 The effect of customers' existential authenticity on revisit intention

Customers' existential authenticity significantly influences their behavioural intention. For example, tourists' self-reflection and self-fulfilment (i.e., existential authenticity) cultivate their intention to visit theme parks (Tan and Huang, 2020). In the spa hotel setting, Chen *et al*. (2023) empirically verified that customers' existential authenticity contributes greatly to their revisit intention. Regarding cognitive appraisal theory, Ma *et al*. (2013) indicated that positive emotions contribute to purchase decisions and post-purchase consequences. Based on the similar logic, we propose:

H7: Customers' existential authenticity has a positive effect on revisit intention.

2.4.6 Moderating effect of robotic appearance

Service robots with properly designed appearances can influence individuals' judgment of service quality (Zhu and Chang, 2020) and authenticity (Coghlan *et al*., 2021; Jago *et al*., 2022). For instance, service robots with human-like appearances are perceived as more capable of producing authenticity (Jago *et al*., 2022) and signaling good quality of service (Chiang *et al*., 2022). Some studies suggest otherwise (Mori, 1970; Coghlan *et al.*, 2021), though. Uncanny

Valley theory (Mori, 1970) indicates that the more human-like the robot's appearance, the less acceptable it is to people.

Service robots with a highly human-like appearance are often perceived as scary and lacking authenticity (Coghlan *et al*., 2021), and negatively influence perceived service quality (Chiang *et al*., 2022). On the other, robotic mascot-like appearances can lead to positive reactions because of their cuteness and sense of humour (Zhang *et al*., 2021). Thus, it is necessary to investigate the effects of robotic appearances (i.e., human-like versus mascot-like) on customer perceptions. Properly designed robotic appearances can be viewed as a moderator (Van Doorn *et al*., 2017) that may affect service quality (Chiang *et al*., 2022) and service authenticity. Thus, we propose:

H8: Robotic appearance moderates the relationship between functional service quality and robotic service authenticity. The relationship is higher when using mascot-like robots than using human-like robots.

H9: Robotic appearance moderates the relationship between technical service quality and robotic service authenticity. The relationship is higher when using mascot-like robots than using human-like robots.

The comprehensive literature on robotic service quality, robotic service authenticity, existential authenticity, and revisit intention, as well as the potential moderating effect of robotic appearance helped to produce the research model in Figure 1.

(Figure 1 should be added here)

3. Methodology

3.1 Measurement and survey design

All measurements were based on a seven-point Likert scale (1=strongly disagree, 7=strongly agree), with each construct selected from existing literature and slightly modified to fit the current study. This study used items adapted from Prentice and Nguyen's (2021) study to assess functional robotic service quality (three items) and technical robotic service quality (six items). Five items of robotic service authenticity were adopted from Featherman *et al.*'s (2006) study. Existential authenticity was assessed using five items derived from Stepchenkova and Belyaeva (2020) and Yi *et al.*'s (2018) studies. Revisit intention (two items) was derived from Kim *et al.*'s (2020) study. Two types of robotic appearance, e.g., human-like or mascot-like appearance, were considered the moderator.

Data on respondents' robotic service experience were collected via yes/no answers. Demographic information (i.e., age, gender, marital status, education level, employment status, and monthly income) also was gathered. English version of the survey was first created, and it was translated into Chinese based on back-translation (Brislin, 1980).

3.2 Sampling and data collection

Wenjuanxing, a mainstream online survey platform (https://www.wjx.cn/), has been confirmed with high validity for data collection (Yang *et al.*, 2022). Thus, we collected data via this platform to target participants who had experiences using robotic services at restaurants in the Chinese Mainland in the previous six months. Considering the risk of infection or quarantine policies during the COVID-19 pandemic, online surveys were used in our study because of advantages that include geographic accessibility, time efficiency, and cost-effectiveness (Zheng *et al.*, 2022). We conducted a pilot test in June 2022 to ensure clarity and then conducted the main survey in July 2022.

3.3 Data analysis

We utilised two software programs (i.e., SPSS and AMOS) to run data analysis. In terms of testing the direct relationships between constructs (H1–H7), we followed the 3-step approach recommended by Gerbing and Hamilton (1996), including EFA, CFA, and SEM. Robotic appearance's moderating effect on the relationship between robotic service quality and robot service authenticity (H8 and H9) was tested via multi-group analysis with AMOS.

4. Results

4.1 Participants' profile

In the pilot study of 126 valid responses, 69.8% of them were female, nearly half (47.6%) were 21–30 years old, 57.9% were single and 52.4% held bachelor's degrees. In terms of the main survey, we collected 428 valid responses comprising 302 females. More than half (52.8%) were single, 42.3% were 21–30 years old and 52.3% held bachelor's degrees. 137 respondents had experience using mascot-like robots, and 291 respondents had experience using human-like robots.

4.2 Exploratory factor analysis

The pilot study aimed to determine the final number of constructs and items for each construct. We implemented EFA using the principal component method with varimax rotation (Anderson and Gerbing, 1988). We deleted items with low loadings below .60, and five factors/constructs were generated. These five constructs were reliable based on Bartlett's $\chi 2$ test, the Kaiser-Meyer-Olkin (KMO) test, and *a* value (above 0.70).

[Table 1 should be added here]

4.3 Measurement model

We conducted a CFA of the five constructs mentioned above. As shown in Table 2, all constructs demonstrated high reliability, e.g., with both *a* (ranging from 0.755 to 0.911) and composite reliability (ranging from 0.757 to 0.907) for all constructs higher than 0.70, demonstrating good internal consistency. Validity can be checked from both convergent and discriminant perspectives. In terms of convergent validity, average variance extracted (AVE) scores were distributed between 0.610 and 0.763, exceeding 0.50 (Fornell and Larcker, 1981) and factor loadings were larger than 0.6. All square roots of AVEs were higher than their paired correlation coefficients, confirming high discriminant validity (Fornell and Larcker, 1981).

Table 3 shows that no extremely high correlations exist among constructs, indicating no common method bias problem (Siahtiri *et al*., 2022). Furthermore, the measurement model indicated a good model fit (goodness-of-fit index: $\chi 2 = 437.355$; degrees of freedom [df] = 175; $\chi 2$ /df = 2.499; comparative fit index [CFI] =.958; Tucker Lewis Index [TLI] = .950; incremental fit index [IFI] = .959; and root mean square error of approximation [RMSEA] = .059).

[Tables 2 and 3 should be added here]

4.4 Model comparison and structural equation model

Based on cognitive appraisal theory, we proposed an alternative model in which both robotic functional and technical quality directly influence service authenticity. Consequently, robotic service authenticity directly affects existential authenticity, and finally, existential authenticity influences revisit intention. Our research model was based on the existing literature review section above. We conducted a model comparison between the research model ($\chi 2 = 441.622$, df = 177, $\chi 2/df = 2.495$, normed fit index [NFI] = .932, IFI = .958, TLI = .950, RMSEA = .059)

and the alternative model ($\chi2$ = 607.756, df = 179, $\chi2$ /df = 3.395, NFI = .907, IFI = .932, TLI = .920, RMSEA = .075). In the alternative model, the paths (two dimensions of robotic service quality → customer existential authenticity and robotic service authenticity → revisit intention) were constrained to zero. As demonstrated in Table 4, the two models were significantly different ($\Delta\chi^2$ = 166.134, $\Delta\chi^2/\Delta df$ = 83.096, $p < .001$), and the research model was better.

[Table 4 should be added here]

We tested seven hypotheses with SEM, which indicated a good model fit (goodness-of-fit index: $\chi2$ = 513.215; df = 196; $\chi2$ /df = 2.618; CFI = .952; TLI = .943; IFI = .952; RMSEA = .062). The results provided support for five out of seven hypotheses, with the remaining two rejected. As shown in Figure 2, robotic functional quality positively influenced robotic service authenticity (β = .404; $p < .001$), thereby supporting H1. Surprisingly, robotic technical service quality did not affect robotic service authenticity (β = -.109; ns), thereby rejecting H2. Applying the cognitive appraisal theory, the results show that only the stimulus event of robotic functional service quality affected the cognitive appraisal of robotic service authenticity.

Furthermore, both robotic functional (β = .169; $p < .05$) and technical (β = .523; $p < .001$) service quality positively contributed to existential authenticity, thereby supporting H3 and H4. Linking to the revised cognitive appraisal theory, we found that the stimulus events of both functional and technical service quality can also directly influence customers' emotions (i.e., existential authenticity). Robotic service authenticity positively affected existential authenticity (β = .114; $p < .05$) therefore, supporting H5. Therefore, such results demonstrated that the relationship between cognitive appraisal and emotion from the cognitive appraisal theory is also supported in the study. Surprisingly, robotic service authenticity did not influence revisit intention (β = .010; ns), and H6 was rejected. Finally, existential authenticity positively influenced revisit intention (β = .779; $p < .001$), thereby supporting H7. This result supports

the argument of customers' emotion influences their behavioural copying in the cognitive appraisal theory.

[Table 5 should be added here]

[Figure 2 should be added here]

4.5 Moderating effect

Table 6 shows the results of moderating effect. Multi-group analysis indicated a significant difference between the two types of robotic appearance (mascot-like and human-like robots) in terms of the paths between functional quality and service authenticity ($\Delta\chi^2 = 5.918$, $\Delta\chi^2 / \Delta df = 5.918$, $p < .05$). Although the path between functional quality and service authenticity is significant for both mascot-like and human-like robots, functional service quality exerts higher impact on service authenticity with the mascot-like robots ($\beta = .514$, $p < .01$) than with the human-like robots ($\beta = .247$, $p < .01$), thereby supporting H8.

Similarly, we observed a significant difference between mascot-like and human-like robots in terms of the path between technical quality and service authenticity ($\Delta\chi2 = 8.925$, $\Delta\chi2 / \Delta df = 8.925$, $p < .05$). Robotic technical service quality was related negatively to robotic service authenticity for the mascot-like robots ($\beta = -.266$, $p < .01$). Yet the relationship between technical quality and service authenticity was not significant for the human-like robots ($\beta = .053$, $p = .462$), thereby rejecting H9.

[Table 6 should be added here]

5. Discussion and conclusions

Being the first study to test how robotic service quality affects customers' authenticity perception, we confirmed that robotic service quality of functions significantly leads to service authenticity and existential authenticity, thereby supporting H1 and H3. Existing studies partly can explain the results, in that generally service quality positively influences perceived authenticity (Lalicic and Weismayer, 2017). Functional service quality emphasizes the process of quality service (Huang and Lin, 2020), and customers may evaluate the process of robotic service delivery effectively, reliably, and dependably. Our study extends knowledge on robotic functional service quality by finding that it affects existential authenticity as well.

Existing studies have confirmed the relationship between intangible and tangible objects and existential authenticity in tourism (Kesgin *et al*., 2021). Robotic service can be viewed as an intangible object contributing to customers' existential authenticity. The results show that robotic technical service quality does not affect service authenticity, but positively influences existential authenticity, thereby rejecting H2 and accepting H4. Technical service quality emphasizes what customers receive from a service experience (Grönroos, 2000). As robotic technology remains less developed in the restaurant industry (Zemke *et al*., 2020), the current service robots cannot solve, adjust or address customers' problems, requests, and demands, and fail to provide updated information (Fu *et al*., 2022).

In this study, the elements of technical service quality, such as problem-solving, requests responding, needs adjusting and demands addressing, etc., are critical in influencing customers' cognitions towards robotic service quality. Given robotic service delivery constraints, customers may not view the robotic technical quality, which could lead to service authenticity. Certain customers, however, prefer robots in terms of imperfect technical service quality (Zemke *et al.*, 2020). This may be because customers perceive robots as more endearing

and desirable, which can generate customers' positive emotional reactions (Van Doorn *et al*., 2017) linked to their existential authenticity.

In our study, existential authenticity (H7 accepted) - not service authenticity (H6 rejected) - significantly impacts revisit intention. This is a novel finding to some extent, suggesting that perceptions of existential authenticity are more important than those of service authenticity for customers in the robotic service context. In addition, service authenticity can influence existential authenticity (H5 supported). The findings corroborate the results of past studies that customers' perceived authenticity significantly contributes to their existential authenticity (Yi *et al*., 2018), and their existential authenticity greatly determines their revisit intention (Chen *et al*., 2023). This result, however, contradicts the previous findings of a positive association between service authenticity and revisit intention (Song *et al*., 2022).

Authenticity is not a "stand-alone" concept that should incorporate with customers' perceptions of quality towards the service provider (Seyitoğlu *et al*., 2021). As not all robotic services can be accomplished with current technological development, robots may be inefficient in restaurant services due to the deficiency of human-level interaction expertise (Roberts and Maier, 2023), not being able to solve service problems, inadequate in emergencies, not addressing customers' needs and demands, etc., which decrease the service quality, threaten the authenticity, and cause negative behaviour (Seyitoğlu *et al*., 2021). Technological flaws and poor robotic service have impeded the intention to adopt technological services (Fu *et al*., 2022; Guan *et al*., 2022). Thus, customers are less likely to view these robots as having high service authenticity, which is less likely to contribute to revisit intention. Thus, H6 is rejected.

Mascot-like service robots have become increasingly popular in recent years (Zhang *et al*., 2021). Because of their cute and adorable appearance, customers have the most favourable attitudes toward mascot-like robots (Shin and Jeong, 2020). Although more service robots are imbued with human-like appearance, users may resist adopting them due to their lack of

authentic anthropomorphous features (Fu *et al*., 2022). Customers have experienced uneasiness and threats when interacting with human-like robots, leading to a negative response (Zhang *et al*., 2021), that technological flaws have prevented consistent service delivery and excellent task completion (Fu *et al*., 2022). Therefore, when a mascot-like robot, rather than a human-like robot, performs comparatively simple functional service tasks (e.g., reliable, effective, and dependable services), customers normally believe this mascot-like robot performs better and offers more authentic service than the human-like robot does.

Service robots can be used for simple and routine tasks and may not be suitable for complex services such as meeting personalised services, handling complaints, and problem-solving (Roberts and Maier, 2023), which align with technical service quality in this study. In this respect, some restaurants have removed robots from their services due to technical difficulties (Drexler and Lapré, 2019). Both mascot-like and human-like robots cannot offer such complex technical service quality to customers in the current restaurant industry (Fu *et al*., 2022). Thus, customers viewed no significant differences between human-like and mascot-like robots regarding the relationship between technical service quality and service authenticity. Hence, the above discussion can be used to explain why H8 is accepted whilst H9 is rejected.

5.1 Theoretical contributions

This study makes three major theoretical contributions. First, this study may serve as a starting point for theoretical investigations of service quality and authenticity in the robotic service context. Authenticity is vital in restaurants, including robotic restaurants (Song *et al*., 2022). Researchers have identified the relationship between service quality and human employees' service authenticity (Chen *et al*., 2020), whilst the relationship remains unaddressed in the robotic service context (Chen *et al*., 2020). Thus, our findings shed new light on the literature on robotic service quality and service authenticity. In addition, this study

expands knowledge relating to existential authenticity in the hospitality literature. Focussing on the robotic service context, our study has proved that robotic service authenticity influences existential authenticity and confirmed that robotic service quality is an antecedent of existential authenticity, and that revisit intention is a consequence.

Second, we have extended the understanding of cognitive appraisal theory by directly linking stimulus to customer emotion and directly associating cognitive appraisal to customer revisit intention. For example, we have compared two models, namely an alternative model based on classic cognitive appraisal theory and a research model based on a comprehensive literature review of the existing literature (see Figure 1). We have found that the research model works better than the alternative model, demonstrating that robotic functional and technical service quality (stimulus) firmly influence existential authenticity (customer emotion). Furthermore, robotic technical service quality does not affect robotic service authenticity, which directly influences revisit intention. This finding could extend the understanding of cognitive appraisal theory in that stimuli (e.g., robotic service quality) can contribute directly to customers' emotions (e.g., existential authenticity) rather than through customers' cognitive appraisal (e.g., robotic service authenticity).

Lastly, we have investigated robotic service from the perspective of real human-robot interactions. Although earlier studies have researched human-robot interaction using qualitative (Jain *et al*., 2021; Wong *et al*., 2022) or quantitative methods (Choi *et al*., 2023), previous qualitative investigations are mainly exploratory or conceptual (Hu, 2021), and quantitative papers are developed based on hypothetical scenarios of human-robot interactions, instead of real interactions (S. Zhang *et al*., 2022). In addition, this study echoes Zhang *et al*. (2021), who called for investigating robotic appearance types and their impact on customer perceptions.

5.2 Practical implications

This study provides managerial implications. First, given that functional robotic service quality positively influences both robot service authenticity and customer existential authenticity, restaurateurs should ensure that the service robots operate reliably and performs their tasks effectively and dependably. Experienced customers and technology providers need to evaluate service robot performance continually. Efforts should be made through various strategies, including designing reliable hardware, software, and user interfaces, implementing maintenance, and ensuring an effective and dependable service delivery process.

Second, due to technological flaws and constraints (Fu *et al*., 2022), not all robotic services lead to service authenticity. Restauranteurs may provide appropriate human assistance in areas with less authenticity; furthermore, they should work closely with manufacturers to optimise the design of service robots to avoid any technical errors by improving the robots' abilities to respond to and address diners' requests and needs, solving problems, providing the most up-to-date information, etc. Knowing perceived service quality and authenticity may be valuable in designing robotic services and retaining customers.

Third, restauranteurs should put extra effort to ensure that service robots can actively interact with customers and provide an extramundane experience during the on-site robotic service experience. For example, service robots should recommend various suitable dishes to satisfy customers' tastes and provide information about food culture and nutrition, including how the restaurants have applied these principles in menu design and food preparation. Such on-site participatory experience involving interaction and focused mental and emotional engagement may enhance customers' existential authenticity and revisit intention, which might enable them to make optimum use of their time while at the restaurants as well as have authentic experiences. This is also supported by the moderating effects of robotic appearance, given the

appropriately designed robotic appearance contributes to service quality (Zhu and Chang, 2020) and customers' perceptions of service quality may improve, whilst having better service authenticity.

5.3 Limitations and future research

We acknowledge several limitations in this study. First, when comparing the moderating effect of two types of robotic appearance, there were more samples of customers using human-like robots (i.e., 291) than those using mascot-like robots (i.e., 137). The imbalanced sample distribution could be a limitation in influencing the results. Future research needs to overcome and mitigate the consequences of the imbalanced sample distribution. Second, given that authenticity is an important aspect of individual well-being (Kifer *et al*., 2013) and experience memorability (Sthapit, 2017), future studies could examine whether customer existential authenticity contributes to subjective well-being and memorable gastronomic experience.

Finally, we did not collect data on the types of restaurants and the level of interaction between customers and robots. In the future, the types of restaurants (e.g., modern vs. heritage restaurants) and the level of interaction between customers and robots (e.g., high, moderate, vs. low) can be served as moderators to influence customers' authenticity perception towards robotic services.

Supplementary material

The supplementary material for this article can be found online.

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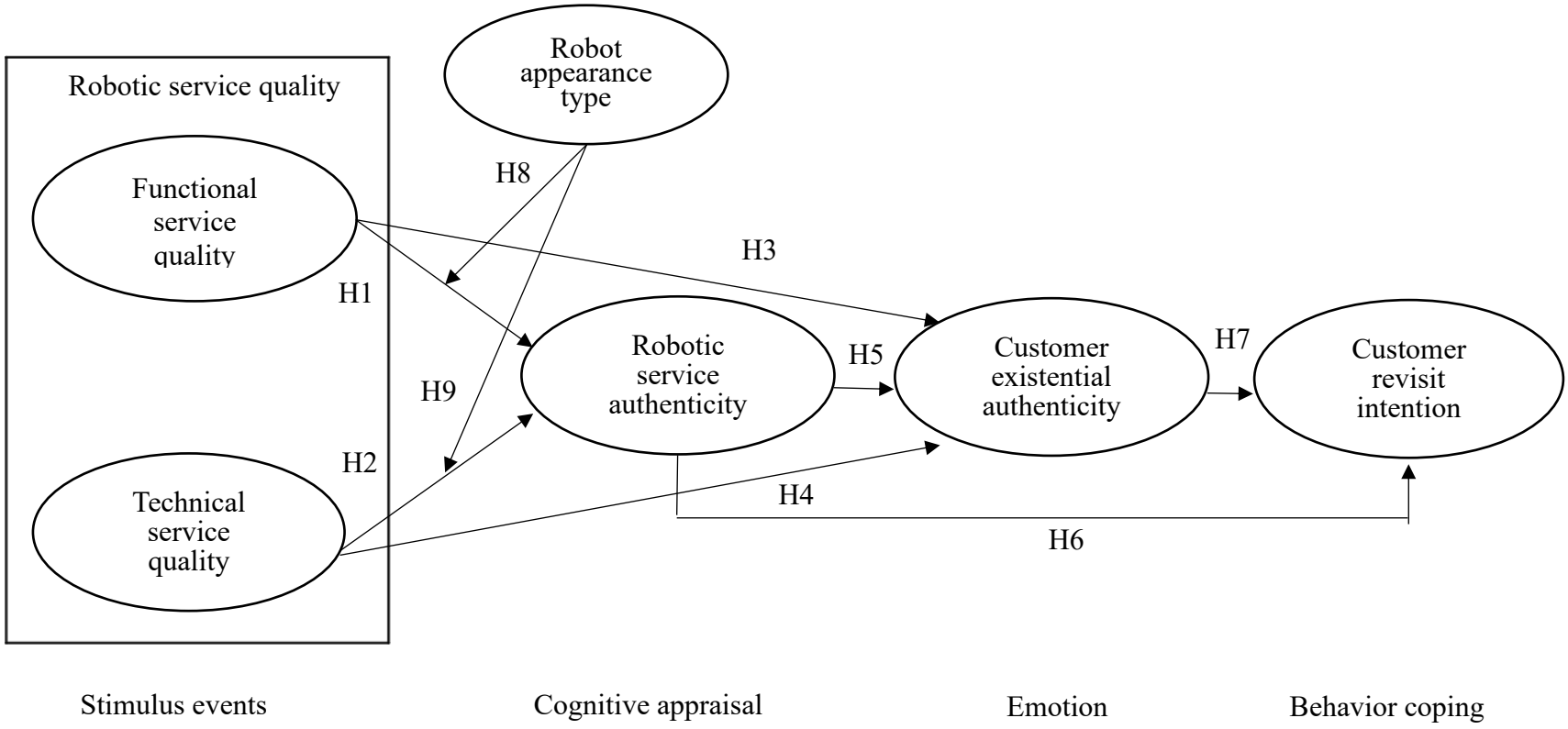
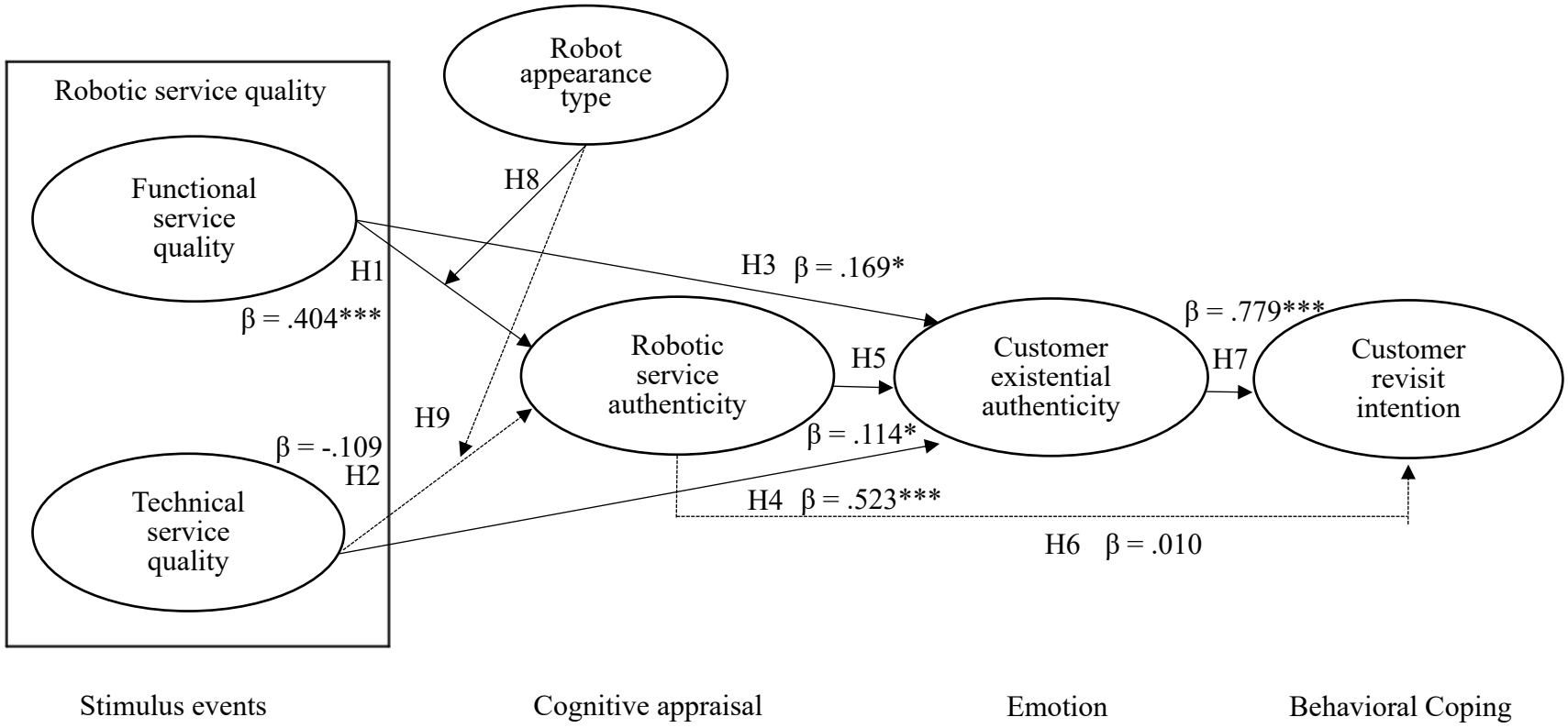


Figure 1. Research framework

Source: Authors own creation



Note: Dotted line indicates hypothesis was not supported. *** p < .001; ** p < .01; *p < .05
H8: mascot-like robots: β = .514**; human-like robots: β = .247**
H9: mascot-like robots: β = -.266**; human-like robots: β = .053

Figure 2. Results of hypotheses testing
Source: Authors own creation

Supplementary material

Appendix

Literature on service quality/authenticity in the robotic service context

Author(s)	Service quality in the robotic service context
Chiang *et al*. (2022)	Anthropomorphism in robots affects customers' perceived service quality.
Prentice and Nguyen (2021)	Scale development and validation of robotic service quality
Söderlund (2022a)	Influences between robotic self-recognition and perceived service quality (low vs. high)
Söderlund (2022b)	Effects of perceived humanness and usefulness on perceived service quality (low vs. high)
C.-S. Song and Kim (2022)	Attitudes toward Human-Robot interaction on anticipated service quality
Wei and Prentice (2022)	Influence of AI service quality on internal and external customer loyalty
Shah *et al.* (2023)	The impact of robotic service quality on customers' engagement
S. Zhang *et al*. (2022)	The difference in SERVQUAL between service robots and human staff
Zhu (2022)	Effect of service quality on interest in robot restaurants and behavioral intentions
Author(s)	Authenticity in the robotic service context
Seyitoğlu (2021)	Evaluation of automation (robots) vs. authenticity in Services
Song *et al*. (2022)	Effects of different product levels on perceived authenticity by robotic and human employees

Source: Authors own creation

Table 1: EFA results

Variable and measurement item	Factor loading	*a*
Robotic functional service quality		.914
I think robots in this restaurant operate reliably.	.783	
I think robots in this restaurant perform effectively.	.812	
I think robots in this restaurant function dependably.	.739	
Robotic technical service quality		.909
I think robots in this restaurant can provide updated information.	.660	
I think robots in this restaurant can provide prompt service	.718	
I think robots in this restaurant can solve customers' problems	.827	
I think robots in this restaurant can respond to customers' requests	.800	
I think robots in this restaurant can adjust to meet customers' new demands.	.759	
I think robots in this restaurant can address customers' needs	.852	
Robotic service authenticity		.835
Robot services received in this restaurant do not seem real to me.	.745	
Robot services received in this restaurant seem like illusions to me.	.687	
Robot services received in this restaurant do not appear to be authentic.	.827	
Robot services received in this restaurant do not feel genuine.	.833	
Robot services received in this restaurant seem artificial.	.767	
Customer existential authenticity		.920
I liked the services provided by robots.	.677	
I felt connected with the service robots in this restaurant.	.813	
I liked the atmosphere created by the service robots in this restaurant.	.763	
In the dining experience with service robots, my body was freed from the self-control or limitation of daily work/routine life and become more self and subjective in its own right.	.868	
In the dining experience with service robots, I tried to seek extramundane or extraordinary experiences to pursue self-realization or get self-satisfaction.	.876	
Customer revisit intentions		.771
This restaurant would be my first choice compared with other restaurants in the future.	.812	
I would like to dine in this restaurant again.	.744	

Note: KMO =.862, χ^2 = 1888.952, $p < .001$, α = Cronbach's α
Source: Authors own creation

Table 2: CFA results

Variable	Factor loading	CR	AVE	*a*
Robotic functional service quality		.906	.763	.906
I think robots in this restaurant operate reliably.	.868			
I think robots in this restaurant perform effectively.	.882			
I think robots in this restaurant function dependably.	.871			
Robotic technical service quality		.907	.619	.911
I think robots in this restaurant can provide updated information.	.712			
I think robots in this restaurant can solve customers' problems	.767			
I think robots in this restaurant can provide prompt service	.819			
I think robots in this restaurant can respond to customers' requests	.825			
I think robots in this restaurant can address customers' needs	.801			
I think robots in this restaurant can adjust to meet customers' new demands.	.791			
Robotic service authenticity		.889	.619	.893
Robot services received in this restaurant do not seem real to me.	.726			
Robot services received in this restaurant seem like illusions to me.	.669			
Robot services received in this restaurant do not appear to be authentic.	.827			
Robot services received in this restaurant do not feel genuine.	.902			
Robot services received in this restaurant seem artificial.	.789			
Customer existential authenticity		.903	.651	.910
In the dining experience with service robots, I tried to seek extramundane or extraordinary experiences to pursue self-realization or get self-satisfaction.	.761			
In the dining experience with service robots, my body was freed from the self-control or limitation of daily work/routine life and became more self and subjective in its own right.	.773			
I liked the atmosphere created by the service robots in this restaurant.	.869			
I felt connected with the service robots in this restaurant.	.809			
I liked the services provided by robots.	.818			
Revisit intentions		.757	.610	.755
This restaurant would be my first choice compared with other restaurants in the future.	.737			
I would like to dine in this restaurant again.	.823			

Source: Authors own creation

Table 3: Construct intercorrelations

	RFSQ	RTSQ	RSA	CEA	RI	Mean	SD
RFSQ	.874					5.32	.97
RTSO	.617	.787				4.81	1.02
RSA	.331	.160	.787			4.54	.96
CEA	.447	.578	.160	.807		4.65	1.01
RI	.391	.485	.078	.675	.781	4.44	.97

Note: RFSQ: robotic functional service quality; RTSQ: robotic technical service quality; RSA: robotic service authenticity; CEA: customer existential authenticity; RI: revisit intention

Source: Authors own creation

Table 4: Model comparison

	χ2	*df*	*χ2 /df*	NFI	IFI	TLI	RMSEA
Research model	441.622	177	2.495	.932	.958	.950	.059
Alternative model	607.756	179	3.395	.907	.932	.920	.075

Source: Authors own creation

Table 5: Results of hypothesis testing

	Estimate	t-value	*p*	Results
H1: Robotic functional service quality positively affects robotic service authenticity	.404	6.006	.000	Accepted
H2: Robotic technical service quality positively affects robotic service authenticity	-.109	-1.604	.109	Rejected
H3: Robotic functional service quality positively affects customer existential authenticity	.169	2.518	.012	Accepted
H4: Robotic technical service quality positively affects customer existential authenticity	.523	7.083	.000	Accepted
H5: Robotic service authenticity positively influences customer existential authenticity	.114	2.076	.038	Accepted
H6: Robotic service authenticity positively influences customer revisit intention	.010	.241	.809	Rejected
H7: Customer existential authenticity positively influences customer revisit intention	.779	13.399	.000	Accepted

Source: Authors own creation

Table 6: Results of moderating effect

	Mascot-like		Human-like			
Hypotheses	β	t-value	β	t-value	$\Delta\chi 2$	Results
H8: Robotic appearance moderates the relationship between functional service quality and robotic service authenticity.	.514	6.662**	.247	3.182**	5.918*	Supported
H9: Robotic appearance moderates the relationship between technical service quality and robotic service authenticity.	-.266	-3.414**	.053	.735	8.925*	Rejected

Note: * $p < .05$; ** $p < .01$

Source: Authors own creation