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# Service quality of online food delivery mobile application: An examination of the spillover effect of mobile app satisfaction on food satisfaction and repurchase intention


## Abstract

**Purpose:** Given the complicated service delivery process of online food delivery service, this study drew on the mSERVQUAL model and spillover theory to examine the mechanism through which food-ordering mobile app service quality influences users' mobile app satisfaction, food satisfaction, and repurchase intentions.

**Design/methodology/approach:** Online surveys were completed by 1,000 customers who used a food-ordering mobile app to order fast food on the day they completed the online survey. Structural equation modelling was then used to examine the proposed mechanism.

**Findings:** Results showed that the effects of food-ordering mobile app service quality on customer satisfaction (i.e., mobile app satisfaction and food satisfaction) and repurchase intention varied widely across service quality dimensions. Mobile app service quality had significant spillover effects on food satisfaction and repurchase intention.

**Originality/value:** Rather than examining online food delivery service quality based on the service delivery process in the during-consumption stage or the service outcomes in the post-consumption stage, this study focused on the service quality in the pre-consumption stage to highlight the important role of online food delivery mobile apps. From a longitudinal perspective, this study drew on the Associate Network Theory to explain the spillover effect of mobile app satisfaction in the pre-consumption stage on food satisfaction in the during-consumption stage and repurchase intention in the post-consumption stage.

**Practical implications:** Online food-delivery platforms should find the results insightful to better design their food-ordering mobile app. The findings can also assist restaurateurs and mobile payment companies with supporting the whole online food delivery process.


**Keywords:** online food delivery, mobile app, service quality, satisfaction, repurchase intention, spillover theory

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## 1. Introduction

A recent article from Food Navigator titled "Online food delivery 'one of the only winners' in coronavirus outbreak" captures how the COVID-19 pandemic has boosted the online food delivery sector in terms of both revenue and user numbers (Southey, 2020). For example, Deliveroo reported that sales had doubled and that the company's number of catering service co-operators jumped by 25% in the first quarter of 2020. Despite the online food delivery sector's exponential growth during the pandemic, scholars have contemplated whether its success will endure in a post-pandemic world (Zhao & Bacao, 2020). Some researchers have suggested that customers might 'binge' on outside dining to (over-)compensate for having been unable to do so during the height of the pandemic (Miao et al., 2021). With an uncertain future (Shroff et al., 2022), online food delivery has generated intense academic interest with respect to service quality (e.g., Cheng et al., 2021; Suhartanto et al., 2019; Zhao & Bacao, 2020), because service quality has long been paramount to competitive advantages in the crowded catering market (Cheng et al., 2018; Kim et al., 2009). Following the research path in other delivery service sectors, most studies in the online food delivery sector have assessed service quality based on service outcomes and the service delivery process.

Different from traditional food delivery services that restaurants operate themselves, the online food delivery sector has represented a popular online-to-offline mobile technology by combining an online ordering system with offline delivery services (Southey, 2020). In addition to the two common stakeholders (i.e., service providers and consumers) in the service industry, there are third-party intermediary platforms developing mobile applications that display menu items, supply delivery persons, and receive payments. Consumers can filter available options by parameters such as the restaurant, cuisine type, and rating. They can also track their orders online while waiting for a worker to deliver their food—all without actually interacting with the restaurant. Hence, understating the roles of mobile apps in the online food delivery sector has failed to fully capture the multi-service characteristics of online food delivery industry (Cheng et al., 2021; Ray et al., 2019), because the online food delivery service begins once customers log in to the mobile app and search for restaurant-related information (Suhartanto et al., 2019). In other words, consumers are unlikely to evaluate the service performance of the online food delivery sector based exclusively on the food delivery process and the food items themselves, but also on the mobile app.

The mobile app environment in the pre-consumption stage is influential to the physical environment in the consumption stage (Sabiote Oritz, et al., 2017), because the pre-consumption stage forms consumers' expectations over the overall dining experiences to determine their satisfaction (e.g., food satisfaction) in the during-consumption stage and behavioural intentions (e.g., repurchase intention) in the post-consumption stage (Wijaya et al., 2013). This argument also supported by the Associative Network Theory that recognizes an individual's attitudes as formations of nodes (e.g., pre-, during-, and post-consumption stage) and links between nodes (Collins & Loftus, 1975). The link between pre-consumption stage and post-consumption stage could therefore be recognized as the spillover effect under which consumers' attitudes towards their consumptions in the during- and post-consumption stage (e.g., food satisfaction and behavioural intention)

are influenced by their interaction with the channel they used to purchase the products in the pre-consumption stage (e.g., mobile app satisfaction) (Simonin & Ruth, 1998).

However, the existing studies on food satisfaction and behavioural intention have been dominated by the investigations of factors, such as food image and food novelty, in the during-consumption stage, overlooking the spillover effects of factors in the pre-consumption stage on diners' evaluations in the post-consumption stage. To bridge the aforementioned research gaps, this study proposes an integrated model grounded in Huang et al.'s (2015) mSERVQUAL model to achieve a pair of objectives: 1) to examine the mobile app quality of the online food delivery sector and (2) to investigate the spillover effects of mobile app quality in the pre-consumption stage on food satisfaction in the during-consumption stage and repurchase intention in the post-consumption stage. This work provides an in-depth understanding of food-ordering mobile app service quality, enriching the literature on technological and catering service quality. Results also benefit online food delivery service providers, restaurateurs, and mobile payment companies in terms of service development.

## 2. Literature review

### *2.1. Online food delivery service quality*

Investigations of service quality in the catering context are not new. Stevens et al. (1995) initially referred to the SERVQUAL model in establishing a measure of restaurant service quality, the DINESERV model. Liu and Jang (2009) later adopted the DINESERV model to perform an importance-performance analysis of service quality in Chinese restaurants. In light of diverse service quality viewpoints, some scholars have endeavored to construct a stronger theoretical background by integrating several models (Luoh & Tsaur, 2011). This standpoint stems from Marković et al.'s (2010) belief that service quality in catering activities includes assessments of service outcomes and service delivery processes.

The formation of service quality in catering activities has become complicated when online food delivery flourished in the global catering market since the pandemic, because consumers and catering service providers are physically separated by a mobile app in the pre-consumption stage (Ahn & Kwon, 2021). Collier and Bienstock (2006) asserted that this separation has a significant impact on the criteria used to determine consumers' perceptions of overall service quality in the during-consumption stage and to evaluate service outcomes in the post-consumption stage. While there have been several attempts to measuring food delivery service quality, they mainly framed mobile app as a service product to determine overall service quality by incorporating it with other service outcomes or processes (e.g., Chan & Gao, 2021; Cheng et al., 2021) but overlooked the separable role of the mobile app in the service delivery process.

Compared to the quality of food items and food delivery service providers, the quality of mobile app has consistently been proven to have relatively low factor loadings on overall food delivery service quality, because the construal level theory, a socio-psychological theory common in the study field of marketing,

suggests that individual attitudes (e.g., perceptions of food delivery service quality) are more influenced by events close to them (Markus & Kitayama, 1991). While the construal level theory explains why the quality of mobile app constituted a relatively small part of overall food delivery service quality, it did not challenge its important role in determining one's positive psychological and behavioral responses. Specifically, many scholars have recognized food service consumption as a three-stage experience in which consumers' perceptions in the pre-consumption stage spillovers to form their perceptions in the during-consumption stage and then in the post-consumption stage (Lin et al., 2022; Wijaya & King, 2013).

This spillover effect of the pre-consumption stage on the during-consumption stage and the post-consumption stage was observed in the online food delivery context by Zhuang et al. (2021) who discovered that the technical aspects of a food delivery mobile app significantly influenced diners' perceptions of overall food delivery service quality and their satisfaction. While Ray et al. (2019) focused on the service quality of mobile apps and discovered its significant effect on consumer's intentions to use online food delivery services, they overlooked the possible mediating role of the service aspects in the during-consumption stage as discovered in other e-marketing contexts, such as hotel booking (Sabiote Oritz et al., 2017) and social media marketing (Pop et al., 2022). In other words, much insight remains to be uncovered in this respect.

### *2.2. Mobile app service quality*

Advances in mobile telecommunications have supported the rapid development of mobile commerce by encouraging businesses to sell products or services via mobile devices. Scholars have generally suggested that mobile services are distinct from traditional physical services and online services (Choi et al., 2008). As a popular form of mobile commerce, the online food delivery sector relies on a mobile app to start the whole service delivery process (Southey, 2020; Suhartanto et al., 2019). Since the pre-consumption stage has been recognized to play an important role in determining consumers' attitudes in the during-consumption stage and the post-consumption stage (Ha & Jang, 2010), how the service quality of the online food delivery mobile app in the pre-consumption stage induces spillover effects on diners' attitudes (i.e., food satisfaction and repurchase intention) in the during- and post-consumption stage must be better understood.

Many conceptualizations of service quality stem from Parasuraman et al.'s (1988) SERVQUAL model to recognize its multi-dimensional nature. Given the rapid growth of e-commerce, Parasuraman et al. (2005) advanced their original framework to develop an electronic service quality measurement scale (E-S-QUAL). While mobile commerce is frequently characterized as an extension of e-commerce, Balasubraman et al. (2002) suggested viewing it as a distinct marketing concept that constitutes a major revolution in what we expect of an e-commerce platform, thus calling for new measurements of its service quality. Initial attempts had focused on addressing the technical quality of mobile apps rather than service quality (e.g., Choi et al., 2008) until Lu et al. (2009) proposed three mobile service quality factors: interaction quality, environment quality, and outcome quality to capture the service orientation of mobile commerce. However, as agreed by the authors,

Lu et al.'s (2009) scale was limited to the mobile brokerage context that was classified as a person-interactive experiential mobile service process by Nysveen et al. (2005).

Since Nysveen et al. (2005) proposed a mobile service classification framework along two axes: interactivity (person interactive versus machine interactive) and process (goal-directed process versus experiential process), Huang et al. (2015) criticized Lu et al.'s (2009) scale for its limited generalizability to capture the machine-interactive goal-oriented service process (e.g., online food delivery) and thus extended the SERVQUAL and eSERVQUAL models by creating mSERVQUAL, a model containing nine dimensions of mobile app service quality—efficiency, system availability, content, privacy, fulfilment, responsiveness, compensation, contact, and billing. The mSERVQUAL model has been broadly applied to online-to-offline mobile services, because it captures customers' consumption experiences in online and offline settings, providing a strong theoretical foundation to explore food-ordering mobile app service quality (Table 1).

Table 1. Mobile app service quality of online food delivery businesses (Huang et al., 2015, p. 140)

| mSERVQUAL dimensions | Definition for food-ordering mobile apps |
|---|---|
| 1. Efficiency | • Whether the app responds quickly and is easy to use |
| 2. System availability | • Whether the required technical functions are readily available and food delivery service promises are accurate |
| 3. Content | • Whether the restaurant and food information on the app is appropriate and correct |
| 4. Privacy | • Whether customers trust the app to protect their personal information |
| 5. Fulfilment | • Whether customers perceive the app as fulfilling its promises in terms of order delivery and item availability |
| 6. Responsiveness | • Whether customers perceive the app as being effective in tackling ad-hoc problems |
| 7. Compensation | • Whether customers perceive the app as responsibly rectifying problems |
| 8. Contact | • Whether customers perceive the app as providing accurate telephone or online assistance |
| 9. Billing | • Whether the ordering process is smooth and economically reasonable |

### *2.3. Research model development*

#### *2.3.1. Relationship between mobile app service quality and satisfaction*

As suggested by Parasuraman et al. (1988), service quality represents the gap between customers' expectations and actual outcomes; that is, it encapsulates the constant evaluation of one's consumption experience (Grönroos, 1984). As a similar concept with satisfaction to reflect the differences between expectations and perceptions, service quality has sometimes been used interchangeably with satisfaction in the marketing study field, while Kim et al. (2021) criticized this interchangeable perspective for its ignorance of their time sequence. This time sequence was also reflected by Parasuraman et al. (1985) who proposed the gap model to argue that consumers will be more satisfied in the post-consumption stage when service quality exceeds their expectations in the during-consumption stage.

Mobile app satisfaction has widely been studied in the mobile commerce context. While many existing studies have consistently discovered that the impacts of mobile app quality on mobile app satisfaction were weaker than the impacts of staff's service quality (e.g., Sharma & Sharma, 2019), Jun and Palacios (2015) drew on the causal asymmetry principle of satisfaction/dissatisfaction to conclude that mobile application quality served more a satisfier inducing satisfaction, but staff's service quality was more likely basic requirements generating limited satisfaction. One of the possible explanations of this inconsistent finding is that scholars mainly focused on the technical aspects, such as perceived ease of use and perceived playfulness, of a mobile app (Rejman Petrović et al., 2022) to determine mobile app quality but overlooked the service orientation of the mobile commerce as emphasized by Huang et al. (2015). Hence, drawing on the mSERVQUAL model, we hypothesize that:

H1. Mobile app service quality positively influences consumers' mobile app satisfaction.

*2.3.2. Relationship between mobile app satisfaction and food satisfaction*

Mobile app satisfaction and product satisfaction (i.e., food satisfaction in this study) were independent constructs (e.g., Su et al., 2022) until Collins and Loftus (1975) proposed the Associate Network Theory to recognize individual's attitudes as a combination of nodes and links between nodes. Specifically, the Associate Network Theory highlights the spillover effect between two mentally associated entities (e.g., mobile app satisfaction and product satisfaction). Ahluwalia et al. (2001) defined spillover effect as any change in perceptions of one entity (e.g., food satisfaction) due to an evaluation of another mentally associated entity (e.g., mobile app satisfaction) that does not necessarily feature a causal link. In a service setting, a consumption experience in one stage of the consumption process (e.g., mobile app service satisfaction in the pre-consumption stage) can influence experiences in later stages (e.g., food satisfaction in the during-consumption stage).

While Mittal et al. (1999) highlighted that it is difficult to determine whether service quality has a spillover effect on product quality or vice versa for their possible correlation, studies have adopted a longitudinal point of view to recognize the consumption process of a service setting as an appropriate indicator for the direction of the spillover effect. In the mobile commerce context, Slotegraaf and Inman (2004) suggested that pre-consumption satisfaction can translate to product satisfaction in the during-consumption stage and the post-consumption stage, although this effect weakens over time. Similarly, Oh et al. (2008) indicated that a web-based store with beautiful design features could evoke satisfaction with store merchandise. Sabiote Ortiz et al. (2017) demonstrated that tourists' satisfaction with the online hotel booking website in the pre-consumption stage ultimately led to their satisfaction in the during-consumption stage at hotels.

Since Herhausen et al. (2020) called for more investigations on how different technological distribution channels (e.g., online food delivery mobile app) execute spillover effects on experiences in the during-consumption stage, we propose that mobile app satisfaction in the pre-consumption stage (i.e., service quality)

demonstrates a spillover effect on food satisfaction in the during-consumption stage (i.e., product quality), while the mobile app satisfaction is not causally linked to actual food satisfaction. Stated formally:

H2. Consumers' mobile app service satisfaction positively influences their food satisfaction.

H2a. Mobile app service satisfaction mediates the relationship between mobile app service quality and food satisfaction.

*2.3.3. Relationship between satisfaction and repurchase intention*

Satisfaction has been identified as a key predictor of customers' repurchase intentions in hospitality contexts; prior purchase experiences shape one's subsequent decisions (Oh, 1999). Drawing on expectancy-disconfirmation theory, Chiu et al. (2013) reported a significant positive impact of satisfaction on online repurchase intention. While online reservation involves various transaction, studies have reported that once customers are satisfied with one transaction in the pre-consumption stage, there is a high probability to develop a repurchase intention (Sun et al., 2022). The direct effect of mobile app service satisfaction on repurchase intention was also revealed by Yeo et al. (2021) who proposed the concept of mobile app servitization to argue that consumers who are satisfied with four different aspects (i.e., effort expectancy, perceived usefulness, information quality, and security) of an online food delivery mobile app are more likely to develop a repurchase intention. Given the apparent positive association between satisfaction and repurchase intention (Ladhari et al., 2017; Wang et al., 2019), we propose the following hypothesis:

H3. Consumers' mobile app service satisfaction positively influences their repurchase intentions.

Food has always been a key factor in any dining activities, not only because it represents a physiological need, but also because food consumption is driven by a complex interplay of motivations to satisfy diners' emotional needs (Tikkanen, 2007). In other words, the role of foods must not be neglected when examining consumers' psychological and behavioral responses towards online food delivery services. Similar in peer-to-peer context, Liang et al. (2018) argued that there are two different types of satisfaction: 1) transaction-based satisfaction and 2) product-based satisfaction driving individual's repurchase intention of booking peer-to-peer accommodations online. In the same perspective in the online food delivery context, transaction-based satisfaction may refer to mobile app satisfaction in the pre-consumption stage, whereas product-based satisfaction may refer to food satisfaction in the during consumption stage. Given the widely-proven positive association between food satisfaction and repurchase intention in dining contexts, we propose the following hypothesis to develop a research model (Figure 1):

H4. Consumers' food satisfaction positively influences their repurchase intentions.

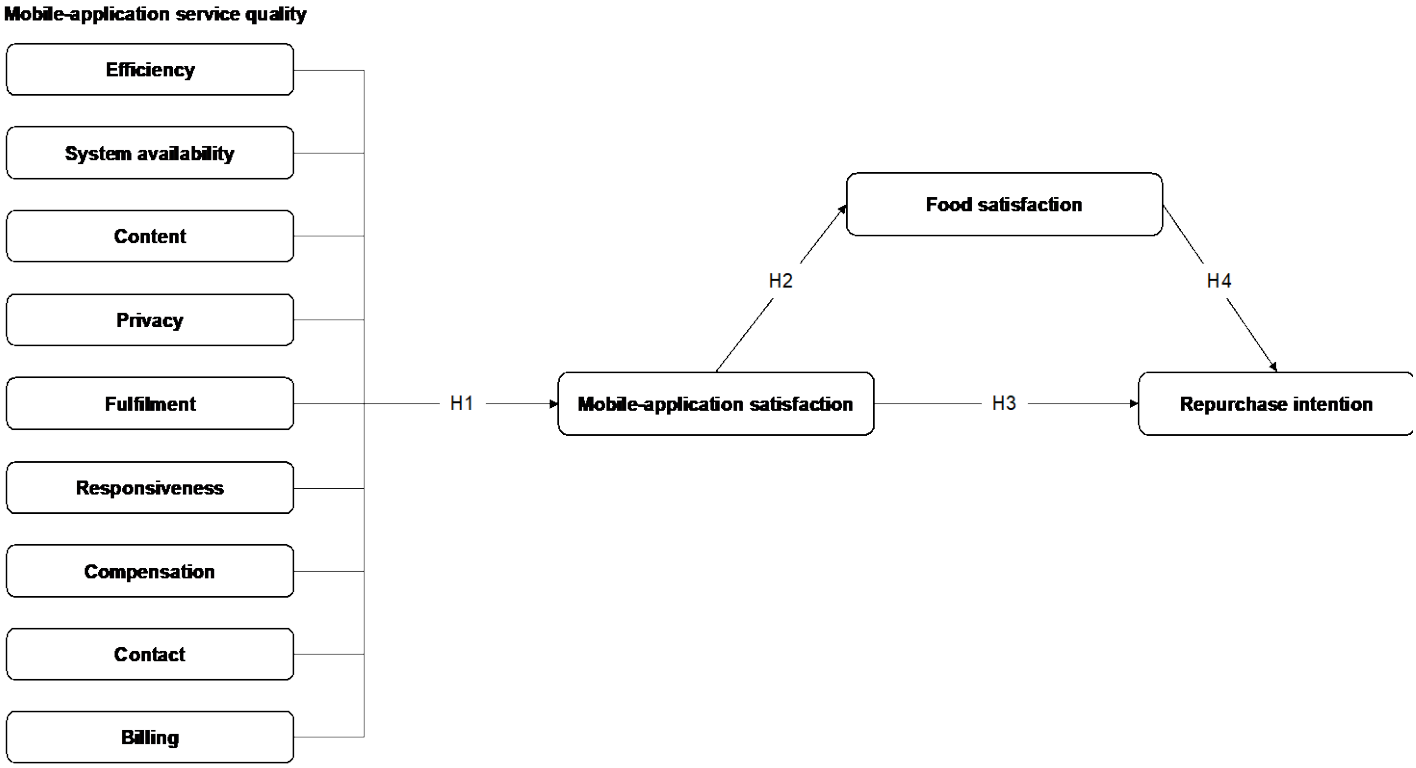


Figure 1. Proposed research model

## 3. Method

### *3.1. Study context*

This study was conducted in Hong Kong for two reasons. First, China is the most prominent country of online food delivery service usage, reaching more than 470 million users and generating 40 billion U.S. dollars in 2019. The optimistic future of the online food delivery market in Hong Kong was also reflected by the business development plan of Meituan, an online food delivery service giant, who is planning to expand their business to Hong Kong (Jiang, 2022). Second, while the epidemic situation has improved globally, the Hong Kong government maintains relatively strict social distancing policies that build citizens' habit of consuming online food delivery services (Liu, 2022).

### *3.2. Data collection*

We developed a cross-sectional online survey to collect information from consumers aged 18 or above who had used online food delivery services to order fast foods (e.g., burgers, pizzas, fried chickens, and soft drinks) in the day they completed this survey. The criterion of fast foods was imposed to reduce the confounding effects of food types, because the food quality of fast foods is expected to have a relatively low variance due to the food standardized strategies (Tien, 2019). Specifically, a screening question (i.e., "Which of the following foods have you ordered through online food delivery apps today?") was asked to screen out invalid responses. The online survey consisted of 57 questions across four sections. Before beginning the online

survey, respondents were provided with a definition and examples (i.e., Uber Eats, Foodpanda, and Deliveroo) of online food delivery services for clarity.

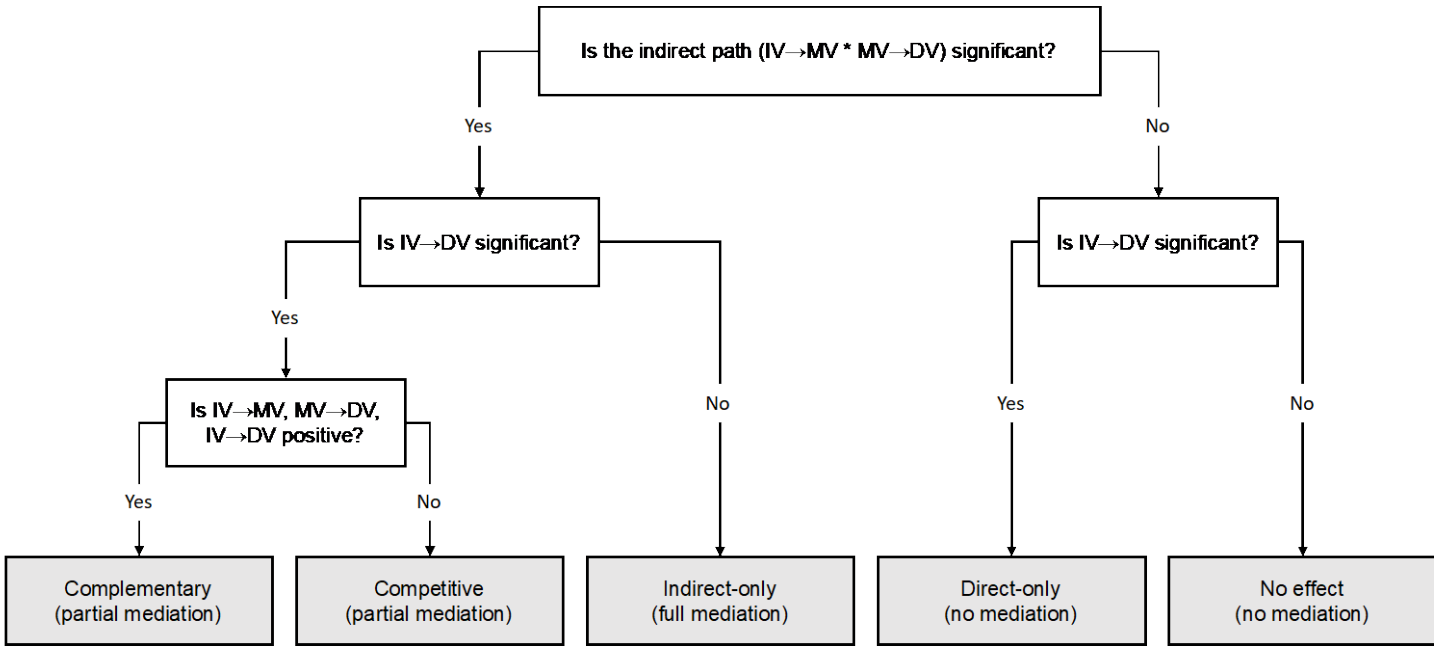
The first, second, and third survey sections included 51 items scored on 7-point Likert scales (1="strongly disagree"; 7="strongly agree") to measure nine dimensions of mobile app service quality (efficiency: 4 items; system availability: 4 items; content: 8 items; privacy: 3 items; fulfilment: 9 items; responsiveness: 7 items; compensation: 2 items; contact: 4 items; billing: 5 items) (Huang et al., 2015), app satisfaction (1 item; Ji et al., 2016), food satisfaction (1 item; Ji et al., 2016), and repurchase intention (3 items; Ho & Chung, 2020) regarding one's most recent experience ordering from an online food delivery service (see Supplementary Table 1). Specifically, as suggested by Rodrigues et al. (2021), repurchase intention was conceptualized as a formative construct, because repurchase intention was formed rather than defined by its underlying dimensions (i.e., intention to reuse, intention to recommend, and intention to consider) that captures a unique aspect of the construct's domain. The final section solicited respondents' anonymous demographics and behavioural characteristics. The survey was originally prepared in English and was translated into Chinese by the first author. Back-translation was then performed by the second author to ensure that all Chinese-language questions were accurate. All authors are native speakers of Chinese with professional proficiency in English.

Before data were gathered through the main survey, the instrument was piloted with 20 experienced online food delivery users (10 native English speakers and 10 native Chinese speakers). Items' phrasing and formatting were modified slightly in accordance with the pilot respondents' feedback. For instance, a question about respondents' consumption patterns was changed to refer to consumption during the COVID-19 pandemic because pilot respondents expressed that their ordering experiences were limited before then.

Actual data collection took place over a two-week period in February 2022 (i.e., the fifth wave of the pandemic in Hong Kong) using the Qualtrics platform for survey development. With the help of Rakuten Insight, a Hong Kong-based survey company that distributed the survey to their panel members, a quota sampling technique was implemented to achieve gender-balanced participation. Since gender has been recognized to have significant confounding effects on consumer's attitudes towards online food delivery service (Francioni et al., 2022), the gender quota was specifically applied to eliminate possible confounding effects in model testing. The online survey resulted in 1,000 valid responses after 82 invalid responses were eliminated based on the following criteria: 1) gender quota exceeded (i.e., 500 men and 500 women) (n=61); 2) survey completed within 2.5 minutes (n=7); 3) relatively low standard deviation across all scale items (i.e., less than .25) (n=3); and 4) failed the attention check (n=11) (Lin et al., 2020). Respondents ranged from 18 to 75 years old, with an average age of 42. With an undergraduate degree or above (58.4%), most respondents earned between HKD$15,000 (around GBP£1,382) and HKD$45,000 (around GBP£2,764) monthly (32.5%). Since they consumed online food delivery service almost five times per week and spent HKD$99 (around GBP£11) per order, the sample was deemed as experienced online food delivery users who are familiar with the online food delivery mobile app service quality.

*3.2. Data analysis*

1000 valid responses, well above the minimum sample size of 100 for conducting structural equation modelling (Hair et al., 2013), were transferred into IBM SPSS 26.0 and SmartPLS 3 for three-stage analysis. First, one-way analyses of variance (ANOVAs), Chi-square tests, and linear regression analyses were conducted to examine demographic and behavioural variation in repurchase intention. Second, confirmatory factor analysis was performed to assess the reliability and validity of the measurement model. Third, partial least squares structural equation modelling (PLS-SEM) was carried out with a bootstrap resampling procedure. PLS-SEM, in contrast to covariance-based SEM, was deemed more appropriate due to this study's aim to understand predictive relationships among constructs; additionally, the proposed hypotheses were drawn from multiple behavioural models but not well-established theories (Hair et al., 2011). Mediation testing (H2a and H3a) was conducted based on Zhao et al.'s (2010) approach (Figure 2), whose suitability for PLS-SEM was validated by Lin et al. (2020) in the online food delivery context.




*Note.* IV = Independent variable (i.e., five dimensions of meaning of work); MV = Mediating variable (i.e., work engagement); DV = Dependent variable (i.e., career commitment)

Figure 2. Mediation testing (Zhao et al., 2010, p. 201)

## 4. Findings

*4.1. Demographic and behavioural variation in repurchase intention*

Four demographic characteristics and two behavioural characteristics served as control variables in this study. The authors explored these variables' explanatory cross-sectional variation effects on repurchase intention. One-way ANOVAs, Chi-square tests, and linear regression analyses suggested that younger customers ($t$=-2.434; $p$<0.05) and frequent customers ($t$=6.743; $p$<0.001) displayed stronger repurchase intentions than other respondents (Table 2).

Table 2. Demographic and behavioural variation in repurchase intention

| Control variables | Frequency/Mean | $F/X^2/t$ (Variations in repurchase intention) |
|---|---|---|
| **Demographic characteristics** | | |
| Gender | | 0.198$^{ns}$ |
| *Male* | 500 (50.0%) | |
| *Female* | 500 (50.0%) | |
| Age (average) | 42.0 | -2.434* |
| Monthly income level | | 1.284$^{ns}$ |
| *<HKD$15,000 (≈<GBP£1,382)* | 167 (16.7%) | |
| *HKD$15,000–HKD$30,000 (≈GBP£1,382–GBP£2,764)* | 415 (41.5%) | |
| *HKD$30,001–HKD$45,000 (≈GBP£2,765–GBP£4,147)* | 231 (23.1%) | |
| *HKD$45,001–HKD$60,000 (≈GBP£4,148–GBP£5,529)* | 94 (9.4%) | |
| *>HKD$60,001 (≈>GBP£5,530)* | 93 (9.3%) | |
| Education level | | 0.612$^{ns}$ |
| *Primary school* | 6 (0.6%) | |
| *Secondary school* | 255 (25.5%) | |
| *Post-secondary school* | 155 (15.5%) | |
| *Undergraduate degree* | 424 (42.4%) | |
| *Postgraduate degree* | 160 (16.0%) | |
| **Behavioural characteristics** | | |
| Weekly usage of online food delivery during the pandemic* | 4.46 | 6.743*** |
| Average spending per order per person | HKD$99.0 (GBP£11.0) | 0.163$^{ns}$ |

*Notes*. *during the two-week data-collection period in February 2022; one-way ANOVA test was reported by $F$ value; Chi-square test was reported by $X^2$ value; linear regression test was reported by $t$ value.

### *4.2. Measurement model assessment*

Three items (i.e., PE1, FUL5, and BIL5) were dropped for constructs' reliability and validity, because their factor loadings were lower than 0.6. Convergent validity was assessed using Fornell and Larcker's (1981) three recommended criteria: 1) all factor loadings significantly exceeded 0.6; 2) all composite reliability values were greater than 0.7; and 3) all average variance extracted values were greater than 0.5 (Table 3). All Cronbach's alpha values greater than 0.7 further verified the reliability of constructs in the research model (Nunnally & Bernstein, 1994). All heterotrait–monotrait ratio values were less than 0.9 (0.383–0.864), substantiating constructs' discriminant validity (Henseler et al., 2015). The standardized root mean square residual value was 0.070, less than the 0.08 needed to avoid model misspecification (Henseler et al., 2015). All variance inflation factors were less than 3 (1.250–2.987). Multicollinearity was therefore not a threat to the model's validity (Lin et al., 2020). Besides, the result of Harman's single factor test confirmed the absence of common method bias, because the unrotated solution explained 41.893% variance, which is below the threshold of 50% (Podsakoff & Organ, 1986).

Table 3. Results of reliability and convergent validity analysis

| Constructs | Factor loading | CR | AVE | CA | Mean | SD |
|---|---|---|---|---|---|---|
| **Mobile app service quality** | | | | | | |
| **Efficiency** | | **0.864** | **0.681** | **0.761** | **5.143** | **0.901** |
| *EF1* | Dropped | | | | - | - |
| *EF2* | 0.879 | | | | 5.435 | 1.010 |
| *EF3* | 0.691 | | | | 5.470 | 1.034 |
| *EF4* | 0.891 | | | | 5.355 | 1.045 |
| **System availability** | | **0.851** | **0.590** | **0.772** | **4.920** | **0.819** |
| *SA1* | 0.831 | | | | 5.276 | 0.963 |
| *SA2* | 0.822 | | | | 5.313 | 0.947 |
| *SA3* | 0.690 | | | | 4.455 | 1.183 |
| *SA4* | 0.720 | | | | 4.637 | 1.158 |
| **Content** | | **0.926** | **0.640** | **0.906** | **4.998** | **0.769** |
| *CON1* | 0.799 | | | | 5.104 | 0.991 |
| *CON2* | 0.789 | | | | 4.973 | 1.019 |
| *CON3* | 0.813 | | | | 4.911 | 1.076 |
| *CON4* | 0.844 | | | | 5.163 | 0.926 |
| *CON5* | 0.808 | | | | 5.069 | 0.929 |
| *CON6* | 0.764 | | | | 5.062 | 0.992 |
| *CON7* | 0.780 | | | | 5.226 | 0.973 |
| **Privacy** | | **0.846** | **0.647** | **0.736** | **4.533** | **0.903** |
| *PRI1* | 0.767 | | | | 4.284 | 1.145 |
| *PRI2* | 0.837 | | | | 4.527 | 1.076 |
| *PRI3* | 0.808 | | | | 4.788 | 1.130 |
| **Fulfilment** | | **0.926** | **0.611** | **0.909** | **5.038** | **0.785** |
| *FUL1* | 0.794 | | | | 4.907 | 1.057 |
| *FUL2* | 0.781 | | | | 4.889 | 1.066 |
| *FUL3* | 0.800 | | | | 5.055 | 0.977 |
| *FUL4* | 0.746 | | | | 4.960 | 1.018 |
| *FUL5* | Dropped | | | | - | - |
| *FUL6* | 0.782 | | | | 5.104 | 0.960 |
| *FUL7* | 0.820 | | | | 4.998 | 0.971 |
| *FUL8* | 0.799 | | | | 5.203 | 0.998 |
| *FUL9* | 0.727 | | | | 5.184 | 0.990 |
| **Responsiveness** | | **0.891** | **0.540** | **0.859** | **4.587** | **0.863** |
| *RES1* | 0.746 | | | | 4.440 | 1.199 |
| *RES2* | 0.756 | | | | 4.386 | 1.192 |
| *RES3* | 0.806 | | | | 4.751 | 1.037 |
| *RES4* | 0.735 | | | | 4.510 | 1.115 |
| *RES5* | 0.661 | | | | 4.730 | 1.244 |
| *RES6* | 0.731 | | | | 4.792 | 1.164 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *RES7* | 0.702 | | | | 4.497 | 1.262 |
| **Compensation** | | **0.883** | **0.790** | **0.739** | **4.435** | **1.043** |
| *COM1* | 0.920 | | | | 4.506 | 1.094 |
| *COM2* | 0.856 | | | | 4.364 | 1.247 |
| **Contact** | | **0.927** | **0.759** | **0.895** | **4.670** | **0.902** |
| *CONT1* | 0.857 | | | | 4.555 | 1.061 |
| *CONT2* | 0.856 | | | | 4.585 | 1.033 |
| *CONT3* | 0.891 | | | | 4.796 | 0.996 |
| *CONT4* | 0.882 | | | | 4.742 | 1.050 |
| **Billing** | | **0.903** | **0.699** | **0.856** | **5.117** | **0.842** |
| *BIL1* | 0.820 | | | | 5.299 | 0.955 |
| *BIL2* | 0.866 | | | | 5.224 | 0.970 |
| *BIL3* | 0.848 | | | | 5.066 | 1.066 |
| *BIL4* | 0.807 | | | | 4.880 | 1.038 |
| *BIL5* | Dropped | | | | - | - |
| **Mobile app satisfaction** | | **-** | **-** | **-** | **5.148** | **0.977** |
| *MAS1* | - | | | | 5.148 | 0.977 |
| **Food satisfaction** | | **-** | **-** | **-** | **5.087** | **0.929** |
| *FS1* | - | | | | 5.087 | 0.929 |
| **Repurchase intention (formative construct)** | | **0.883** | **0.810** | **0.928** | **5.148** | **1.018** |
| *RI1* | 0.531 | | | | 5.252 | 1.083 |
| *RI2* | 0.308 | | | | 5.262 | 1.109 |
| *RI3* | 0.261 | | | | 4.929 | 1.202 |

*Notes*. Chi-square value=6356.550; p<0.001; CR=composite reliability; AVE=average variance extracted; CA=Cronbach's alpha.

As a non-parametric analysis method, PLS-SEM does not rely on many parametric model fit indices common for covariance-based SEM, such as goodness-fit statistic, comparative fit index, and root mean square error of approximation, because they do not align with the non-parametric nature of PLS-SEM (Au & Tsang, 2022). Hair et al. (2017) recommended normed fit index (NFI) and standardized root mean square residuals (SRMR) as the two reliable indices to assess model fit when performing PLS-SEM. Specifically, the results showed that the measurement model fit the data well because the NFI value was higher than 0.85 and the SRMR value was less than 0.08 (Hu & Bentler, 1999).

### *4.3. Structural model assessment*

The assumptions for linearity, normality, homoscedasticity, and multicollinearity were verified through normal probability plots and scatterplots prior to performing PLS-SEM. Figure 3 depicts the SEM results. The model explained 46.4% of the variance in mobile app satisfaction, 55.1% in food satisfaction, and 48.6% in repurchase intention. Bootstrapping with 5,000 resampling iterations confirmed that four out of nine dimensions of mobile app service quality significantly enhanced respondents' mobile app satisfaction ($\beta_{efficiency}$=0.113, $p$<0.01; $\beta_{fulfilment}$=0.233, $p$<0.001; $\beta_{contact}$=0.072, $p$<0.05; $\beta_{billing}$=0.170, $p$<0.001), partially

supporting H1. Mobile app satisfaction significantly enhanced respondents' food satisfaction (β=0.742, $p$<0.001) and repurchase intentions (β=0.430, $p$<0.001); H2 and H3 were thus supported. Food satisfaction significantly influenced repurchase intention (β=0.316, $p$<0.001), lending support to H4.

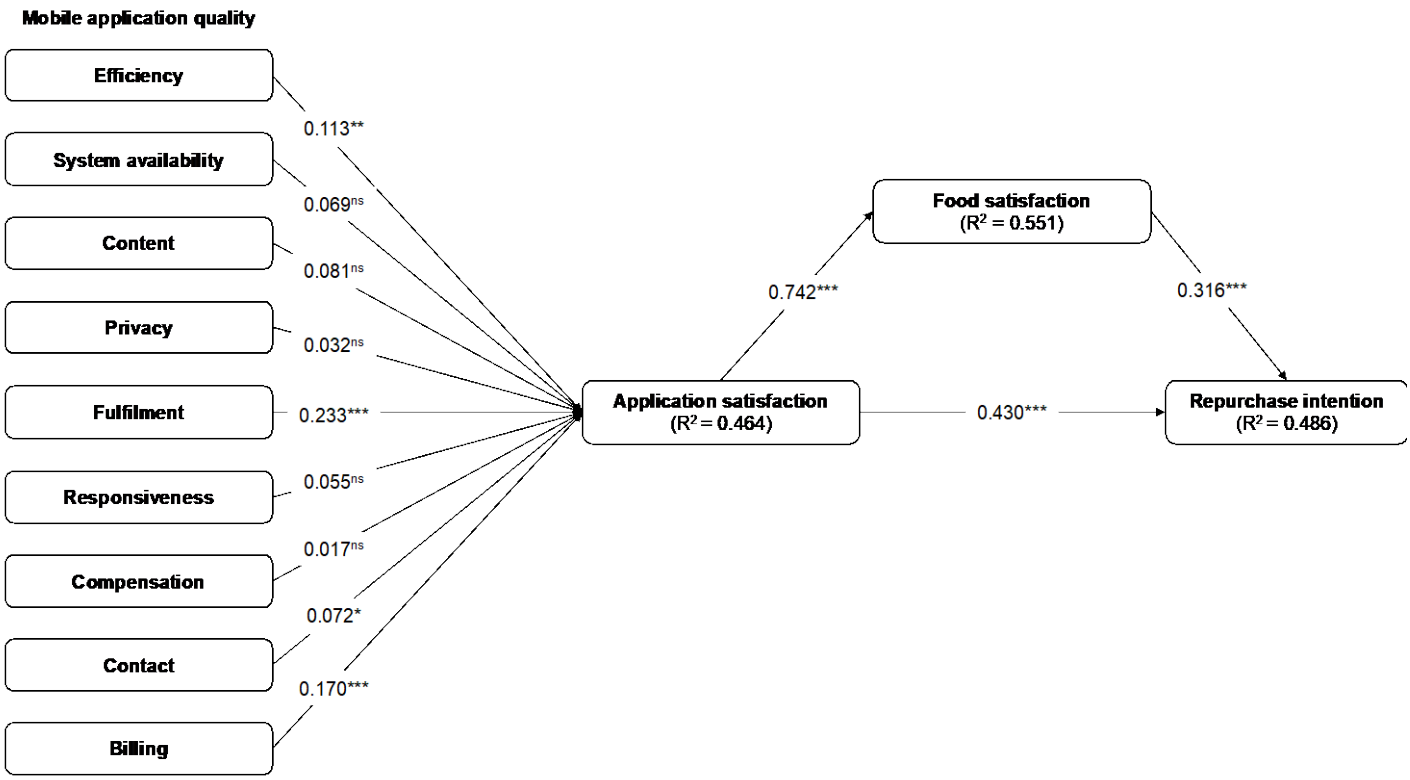



Figure 3. Structural equation modelling

Following Zhao et al.'s (2010) mediation testing approach, mobile app service quality was found to significantly mediate the effects of (a) efficiency ($\beta_{\text{food satisfaction}}$=0.070, $p$<0.001; $\beta_{\text{repurchase intention}}$=0.033, $p$<0.01), (b) fulfilment ($\beta_{\text{food satisfaction}}$=0.106, $p$<0.01; $\beta_{\text{repurchase intention}}$=0.063, $p$<0.001), and (c) billing ($\beta_{\text{food satisfaction}}$=0.113, $p$<0.01; $\beta_{\text{repurchase intention}}$=0.051, $p$<0.001) on food satisfaction and repurchase intention (Table 4), partially supporting H2a and H3a.

Table 4. Results of mediation testing

| IV | IV → DV | IV → MV | MV → DV | Indirect effect | Mediating effect | Sobel's z |
|---|---|---|---|---|---|---|
| **Mediating relationship between mobile app service quality (IV) and food satisfaction (DV)** | | | | | | |
| *Efficiency* | 0.043$^{ns}$ | 0.113** | 0.742*** | 0.070*** | Full mediation | 11.299*** |
| *System availability* | 0.010$^{ns}$ | 0.069$^{ns}$ | 0.742*** | 0.040$^{ns}$ | No mediation | |
| *Content* | 0.069$^{ns}$ | 0.081$^{ns}$ | 0.742*** | 0.040$^{ns}$ | No mediation | |
| *Privacy* | 0.038$^{ns}$ | 0.032$^{ns}$ | 0.742*** | 0.013$^{ns}$ | No mediation | |
| *Fulfilment* | 0.133** | 0.233*** | 0.742*** | 0.133*** | Complementary mediation | 222.298*** |
| *Responsiveness* | -0.033$^{ns}$ | 0.055$^{ns}$ | 0.742*** | 0.027$^{ns}$ | No mediation | |
| *Compensation* | -0.022$^{ns}$ | 0.017$^{ns}$ | 0.742*** | 0.008$^{ns}$ | No mediation | |
| *Contact* | 0.043$^{ns}$ | 0.072* | 0.742*** | 0.038$^{ns}$ | No mediation | |
| *Billing* | 0.014$^{ns}$ | 0.170*** | 0.742*** | 0.106*** | Full mediation | 165.707*** |
| **Mediating relationship between mobile app service quality (IV) and repurchase intention** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Efficiency* | 0.161*** | 0.113** | 0.426*** | 0.033** | Complementary mediation | 11.296*** |
| *System availability* | 0.028ns | 0.069$^{ns}$ | 0.426*** | 0.019$^{ns}$ | No mediation | |
| *Content* | 0.054ns | 0.081$^{ns}$ | 0.426*** | 0.019$^{ns}$ | No mediation | |
| *Privacy* | -0.062ns | 0.032$^{ns}$ | 0.426*** | 0.006$^{ns}$ | No mediation | |
| *Fulfilment* | 0.091ns | 0.233*** | 0.426*** | 0.063*** | Full mediation | 204.421*** |
| *Responsiveness* | -0.009ns | 0.055$^{ns}$ | 0.426*** | 0.013$^{ns}$ | No mediation | |
| *Compensation* | 0.039ns | 0.017$^{ns}$ | 0.426*** | 0.004$^{ns}$ | No mediation | |
| *Contact* | -0.049ns | 0.072* | 0.426*** | 0.018$^{ns}$ | No mediation | |
| *Billing* | 0.159*** | 0.170*** | 0.426*** | 0.051*** | Complementary mediation | 157.892*** |

*Notes*. MV=mobile app service satisfaction; ***$p$<0.001, **$p$<0.01, *$p$<0.05, $^{ns}p$>0.05.

## 5. Discussion

### *5.1. Effect of mobile app service quality on mobile app satisfaction*

Grounded on Parasuraman et al.'s (1985) gap model, the positive relationship between mobile app service quality and mobile app satisfaction seems straightforward. Many scholars have empirically validated their positive relationship in contexts such as mobile banking (Trabelsi-Zoghlami et al., 2020), mobile shopping (Kim et al., 2021), mobile communication (Wang et al., 2019), and online food delivery (Suhartanto et al., 2019). However, by adopting the mSERVQUAL model to conceptualize mobile app service quality as a multidimensional construct, our results advanced this straightforward relationship by demonstrating that the effects of mobile app service quality on mobile app satisfaction vary across service quality dimensions.

Four dimensions of service quality (i.e., efficiency, fulfilment, contact, and billing) significantly elevated users' mobile app satisfaction. Contradictory to Kim et al. (2021), who noted that mobile shoppers favoured accessible service quality over convenience, our significant service quality dimensions were convenience-oriented: they generally reflected whether online food delivery service users could access mobile apps to place food orders efficiently. This particular finding somewhat highlighted the convenient nature of online-to-offline services, because online food delivery service serves as an alternative dining option, at least during the pandemic when many restaurants were forced to close and social gatherings were prohibited.

Five service quality dimensions (i.e., system availability, content, privacy, compensation, and responsiveness) had insignificant impacts on users' mobile app satisfaction. The non-significant roles of system availability and content contradicted research on mobile app design (Berraies et al., 2015). Trabelsi-Zoghlami et al. (2020) suggested that system design (i.e., system availability) and information quality (i.e., content) did not significantly affect e-trust in terms of mobile banking because customers place less emphasis on the aesthetic features of functional mobile apps (e.g., online food delivery mobile app). Ray et al. (2019) also observed that how online food delivery mobile apps list restaurants could significantly reduce customers' repurchase intentions. The insignificant role of privacy insinuates that online food delivery service usage entails fewer

risks than mobile banking (Trabelsi-Zoghlami et al., 2020) and mobile shopping services (Kim et al., 2021), as online food delivery involves far less sensitive data collection.

### *5.2. Effect of mobile app service quality on food satisfaction*

Mobile app satisfaction fully mediated the effects of (a) efficiency and (b) billing on food satisfaction, implying a spillover effect of convenience-oriented service quality attributes on food satisfaction. In other words, if customers believe that an online food delivery mobile app offers a smooth ordering process, they are more likely to be satisfied with their meal. Customers expecting an efficient ordering process are usually rushed. For example, Jensen and Drozdenko (2008) pointed out that customers who were in a hurry assigned 37% more value to a product. In other words, time pressure can therefore explain these significant mediating relationships; such pressure has been acknowledged as a scarcity appeal that conveys exclusivity and improves customers' product evaluations (Gierl et al., 2008).

A complementary mediation relationship manifested in this study regarding the effect of fulfilment on food satisfaction. Fulfilment describes the extent to which a mobile app fulfils one's perceptions of service promises, mirroring customers' emotional responses. Consistent with Ladhari et al. (2017), this significant relationship indicates that customers are more likely to be satisfied with product offerings (i.e., food) if their emotional states are fulfilled.

### *5.3. Effect of mobile app service quality on repurchase intention*

Similar to the mediating role of mobile app service satisfaction on food satisfaction, mediation relationships were observed for the respective effects of efficiency, fulfilment, and billing on repurchase intention. As discussed above, efficiency and billing reflect customers' perceived time pressure to fulfil dining needs. Perceived time pressure, as a situational variable affecting consumers' decisions (Vermeir & Van Kenhove, 2005), is widely thought to persuade customers in the hospitality industry (Huang et al., 2020). Ray et al. (2019) reported a direct impact of fulfilment (i.e., consumer experience) on online food delivery service repurchase intention. Our findings conversely align with those of Ladhari et al. (2017) with respect to a full mediation relationship. Put simply, emotional fulfilment can spark customers' behavioural intentions in a shopping context.

## 6. Contributions, limitations, and future research directions

### *6.1. Theoretical contributions*

This study makes four main contributions to the knowledge base around mobile commerce, online food delivery services, and mobile app service quality. First, this study is the first of its kind in hospitality to evaluate online food delivery services' mobile app service quality. Despite several investigations into online food delivery service quality (e.g., Cheng et al., 2021), most have focused either on service outcomes or

service delivery processes while overlooking mobile apps' service quality. This perspective is important not only because Ray et al. (2019) asserted that the suboptimal design of food-ordering mobile apps has cast doubt on their future in a post-pandemic world, but also because online food delivery service is an online-to-offline service that starts once customers login to the mobile app. In other words, the online food delivery mobile app presents customers with the first image of the overall service quality in the pre-consumption stage, determining their perceptions in the during-consumption stage.

Second, while mobile app quality has generated extensive scholarly attentions in m-commerce studies, many conceptualizations of mobile app quality stemmed from frameworks emerged from e-commerce to focus more on the technical quality than the service quality of mobile apps (e.g., Choi et al., 2008). However, Balasubraman et al. (2002) asserted that e-commerce and m-commerce are two distinct marketing concepts, with the later emphasizing service orientation of an electronic platform. Specifically, online food delivery mobile apps are far more than an information source or a transaction platform, they are more likely visual service providers to deliver services on behalf of practitioners. Drawing on the conceptualization of mobile app service quality proposed by Huang et al. (2015), this study complemented the one-sided discussion on the technical quality of a mobile app in m-commerce by capturing the service orientation in the online food delivery context.

Third, unlike hospitality studies framing service quality as a second-order construct, this work expanded the global multidimensional conceptualization of mobile app service quality: we built a model to compare the effects of service quality dimensions on online food delivery users' mobile app satisfaction, food satisfaction, and repurchase intentions. High service quality is believed to engender greater satisfaction (i.e., mobile app satisfaction and food satisfaction) and repurchase intention. However, the impacts of service quality appear to differ dimensionally. Considering service quality dimensions as first-order constructs can highlight distinct interrelationships. Specifically, five (i.e., system availability, content, privacy, responsiveness, and compensation) out of nine service dimensions were found insignificantly influence mobile app satisfaction in the online food delivery context. Since only a multidimensional conceptualization can identify such distinct relationships among different components of mobile app service quality, scholars should hence be cognizant of the confounding effects induced by specific dimensions.

Lastly, drawing on the Associate Network Theory, this study reaffirmed the spillover effects of mobile app satisfaction on food satisfaction and repurchase intention in the online food delivery setting. While spillover effects between service satisfaction (e.g., mobile app satisfaction) and product satisfaction (e.g., food satisfaction) have widely been recognized in the hospitality contexts, whether service satisfaction has a spillover effect on product satisfaction or vice versa remains doubtful. However, since the consumption process of online food delivery services starts when customers log in to the mobile app, search for restaurant information, and place an order via the app (Suhartanto et al., 2019), we adopted a longitudinal perspective to conceptualize mobile app satisfaction (i.e., service satisfaction) as consumers' attitudinal response in the pre-consumption stage and food satisfaction (i.e., product satisfaction) as attitudinal response in the during-

consumption stage, arguing that mobile app satisfaction in the pre-consumption stage can translate to food satisfaction in the during-consumption stage due to its spillover effect across different consumption stages. Specifically, the study findings confirmed the spillover effect of mobile app satisfaction on food satisfaction, providing a novel theoretical foundation with which to interpret customers' food satisfaction in the online food delivery context.

### *6.2. Practical contributions*

This study also bears practical value for three major stakeholders in the online food delivery sector: online food delivery service providers, restaurateurs, and mobile payment companies. First, while the online food delivery sector has experienced rapid growth during the pandemic, service providers may find our results useful for enhancing the service quality of food-ordering mobile apps. Investments in mobile app service quality can cultivate competitive advantages in the catering industry, especially as the online food delivery sector's potential for post-pandemic survival seems unclear. Online food delivery service providers are encouraged to enhance their mobile apps' efficiency, fulfilment, and billing procedures by designing an intuitive ordering process that addresses consumers' needs. These three service quality dimensions exerted significant direct and indirect impacts on repurchase intention. For example, service providers may consider offering pre-order options (e.g., allowing customers to place orders a day in advance) to render the ordering process more efficient.

Second, in addition to of primarily focusing on food quality, restaurateurs should partner with online food delivery service providers to improve mobile app service quality. Unique from on-site food consumption, customers' online food consumption experiences do not begin with the meal; instead, this process unfolds when they log in to a mobile app to search for restaurant information. As this study confirmed the spillover effects of mobile app satisfaction on food satisfaction and repurchase intention, restaurateurs could offer customized dining packages (i.e., fulfilment) and deliver comprehensive restaurant/food information (i.e., content) to help enhance the mobile apps' service quality, which may result in higher food satisfaction and repurchase intention in return.

Lastly, our findings could serve as guidance for mobile payment companies seeking to grow their market share in the online food delivery sector. Societal attitudes toward mobile technology adoption have shifted amid the pandemic (Polizzi et al., 2020): the mobile payment industry has become much more competitive, and many mobile payment companies have launched incentive programs to attract customers to online food delivery. Rather than only encouraging short-term usage, mobile payment companies may foster long-term patronage by implementing a smooth ordering process. We noted that billing significantly influenced users' mobile app satisfaction and repurchase intentions.

### *6.3. Limitations and future research directions*

Although this study was rigorously performed, four limitations can inspire future work. First, a Hong Kong-based survey company administered our survey. The sample was thus expected to mainly consist of Hong Kong residents. Additional research is needed to determine whether our results can be generalized, particularly because consumers' dining behaviour varies culturally (Lin et al., 2021). Second, consumers' evaluations of mobile app services may differ with demographic characteristics (e.g., gender, age group, and nationality) and situational factors (e.g., online food delivery service providers, cuisine types, and phone operating systems), none of which were taken into account in this study. Third, this research was carried out during the pandemic – a time when online food delivery services were growing exponentially. Subsequent work should compare consumers' perceived mobile app service quality before, during, and after the COVID-19 pandemic to reinforce the model's validity. Fourth, while the study sample consisted of experienced online food delivery users who are familiar most mobile app features identified by Huang et al.'s (2015) mSERVQUAL model, some respondents may not have enough experiences on some specific features (e.g., compensation) of an online food delivery mobile app. Lastly, to maintain the study focus on the spillover effect of mobile app service quality, this study stemmed from a unidimensional conceptualization of satisfaction to measure mobile app satisfaction food satisfaction with two single items. Specifically, while the face validity was checked in the pilot test, the interpretation of the measurement items may be different across different cultural backgrounds. Taking the cultural differences into consideration, future scholars are encouraged to consider the multidimensional nature of satisfaction and develop more robust measures in the online food delivery context.

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