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Understanding the effects of physical experience and information integration on consumer use of online to offline commerce

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ABSTRACT

Online to Offline (O2O) commerce commands intense attention from both academic and practical fields, but the unique features of O2O commerce and how these features affect consumer use of O2O commerce remain unclear. Based on an analysis of the features of O2O commerce, we build a research model integrating perceived value theory and the technology acceptance model to examine the influence of the features of O2O commerce on consumer use intention. The research model is tested with data collected from a field survey using structural equation modelling. Two crucial features of O2O commerce, namely, "physical experience" and "integration of online and offline information", are shown to exert significant impacts on consumer use intention via the classic core constructs of perceived benefit, perceived usefulness, and perceived value. The findings validate the two features' impact on consumer use of O2O commerce via both technological and economic attributes. The implications for merchants' and platforms' operation in O2O commerce are discussed.

1. Introduction

The ubiquity of Internet access and the popularity of smartphones have led to a trend involving the integration of online and offline commerce. Consumers gradually have gotten used to searching and buying goods and services online but then completing their consumption in a physical store, which is known as online to offline (O2O) commerce (Li, Shen, & Bart, 2018; Rampell, 2010). The core challenge of O2O commerce for sellers is to find consumers online and lead them into a real store (He, Cheng, Dong, & Wang, 2016; Rampell, 2010). The concept began on group-buying platforms in service industries such as catering, travel, and entertainment, with companies such as National Express, Restaurant.com, Ctrip, and Dianping.com leading the way. However, the concept has now been extended to the purchase of tangible goods. For example, customers of John Lewis & Partners can place orders in online stores and then pick up their goods in physical stores. In addition, O2O commerce can also function the other way around, that is, "offline to online". For example, a consumer may access the online page of the product by scanning a quick response (QR) code (which can be posted on the product in a physical store or can be advertised in any public locations), order and pay for it online, and then wait for the product to be delivered. QR codes are very popular, and their creative use in different locations can be a very attractive and innovative marketing strategy. The O2O market keeps continuously increasing, with thousands of platforms having been launched (iResearch, 2018). In 2018, it was reported that the revenue of local lifestyle service O2O operators in China reached 160 billion US dollars in 2017, representing an increase of 49.6 % compared with 2016 (iResearch, 2018). O2O commerce has become an attractive pattern to keep more and more consumers engaged in and is currently the frontier of E-commerce and a trillion dollar market opportunity (Nielsen, 2017; Orendorff, 2018).

In China, consumers often regard physical department stores as showrooms or free fitting services for their online shopping, which has been a headache for physical retailers (McKenzie & Yip, 2018) because many consumers do not make any purchases in these physical stores and they still choose to ultimately transact online to take advantage of the cost savings of online stores. As a result, storeowners are being defeated by e-retailing, and many traditional retailing giants have collapsed (Wang, 2018). However, American consumers prefer to adopt

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the "research online, purchase offline" pattern to buy more customized goods, which erodes the profits of online retailers. This is called cross-channel free-riding (Chiu, Hsieh, Roan, Tseng, & Hsieh, 2011). To solve the free showroom and free-riding problems, retailers are trying to integrate online and offline operations into one complete retailing channel: O2O commerce. O2O commerce contributes to an omni-channel customer experience that is composed of individual customer touchpoints over a variety of channels that seamlessly connect, allowing customers to pick up where they left off on one channel and continue the experience on another.

Therefore, some online retailers are eager to establish an offline presence to provide some positive physical shopping experience in their services. For example, Amazon, eBay, and Alibaba have all launched trials of physical stores, allowing consumers to complete purchases via smartphones in showroom centres (Orendorff, 2018). Similarly, offline retailing merchants are eager to seek online opportunities for those markets that the physical stores are unable to reach. Walmart, Argos, and Suning Appliance are good examples of retailers that match prices of their goods in both their online and offline stores. Evidently, retailers are moving to exploit the benefits of both online and offline operations, making the integration of online and offline channels a decisive strategy for business development. Although business managers recognize the potential advantages of O2O commerce, some merchants are not successful in exploiting these advantages because of the reduced understanding of consumer behaviour in O2O commerce. Many merchants have left the O2O market, and approximately 70 % of O2O platform operators were eliminated in 2016 in China (Xiao, Guo, & Ambra, 2019; iResearch, 2018; Xiao, Zhang, & Fu, 2019). Given the fierce competition in the crowded O2O market, an increased understanding of consumer behaviour in O2O commerce is eagerly required by practitioners.

Even though there have been some studies focusing on consumer behaviour in O2O commerce, these works neglect to examine the influence of the features of O2O commerce on consumer behaviour. Thus, our study tries to address two research gaps. First, the unique features reflecting the O2O pattern's characteristics have not been highlighted. For example, the physical experience (PE) and the integration of online and offline information (IOOI) have not been investigated. In fact, existing studies have not pinpointed these characteristics of the pattern. We propose the need to examine the effects of these features on consumers' usage of O2O commerce. In addition, O2O commerce can be viewed as consumers utilizing information systems and smart terminals to make purchase transactions via Internet connections. Thus, the second gap is to integrate technological and economic attributes to reflect the roles of O2O consumers. As such, when consumers use O2O commerce, they play two roles, namely, as new technology adopters and as consumers making purchases via the technologies they use. We use the technology acceptance model (TAM) to explain the former role and perceived value theory (PVT) to explain the latter role, which explain how the features of O2O commerce affect consumers' perceived value, perceived usefulness, attitude, and use intention. Thus, there is a need for empirical evidence to validate the incorporation of both roles in a research model to explain consumer use of O2O commerce.

The existing literature is silent regarding how the unique features of O2O commerce affect consumer use. Here, we explore the following research questions: *What are the unique characteristics of O2O commerce, and how do these characteristic relate to consumer use?*

To answer the research questions, we pinpoint the main features of O2O commerce based on an analysis of the different O2O shopping patterns. Then, using these findings, we develop a research model by incorporating the technological and economic attributes as a whole to predict consumers' use intention of O2O commerce. Next, we test the model with data collected in a field survey. Finally, the results are presented and discussed.

The study contributes to theory by highlighting two unique features of O2O commerce and validating the mechanisms of their impact on consumer use of O2O commerce via both technological and economic attributes. This study also provides practical insights for merchants and platforms to operate in O2O commerce.

2. Theoretical foundation

2.1. Information technology adoption theories

Theories associated with innovation adoption can be divided into psychology-based, technology-based, and economics-based categories.

2.1.1. Psychology-based theories

Psychology-based behaviour research lays the theoretical foundation for innovation adoption studies. The theory of reasoned action (TRA) is the original model suggesting that attitude and subjective norm determine behaviour intention (Fishbein & Ajzen, 1975). This was followed by the theory of planned behaviour (TPB), which incorporates perceived behaviour control into the TRA (Ajzen, 1985). Thereafter, based on social psychology, innovation diffusion theory was developed to explain innovation diffusion in individuals and groups (Rogers, 1995). More recently, flow theory has been applied to explain innovation adoption, reflecting full involvement, enjoyment, and attention of an innovation adopter's mental state (Zhou, 2013a,b). In addition, emotion is also used as a core predictor of the acceptance of artificial intelligence devices (Gursoy, Chi, Lu, & Nunkoo, 2019).

2.1.2. Technology-based theories

Technology-based theories are also widely used to explain the innovation adoption of information technology fields. The technology acceptance model (TAM) applies two classic constructs, i.e., perceived usefulness and perceived ease of use, to explain user acceptance of information technology in workplaces (Davis, 1989). Since its introduction, the TAM has been very popular with researchers (Qi, Li, Li, & Shu, 2009; Taylor & Todd, 1995; Venkatesh & Davis, 2000; Venkatesh, 2000). Subsequently, the Unified Theory of Acceptance and Use of Technology (UTAUT) improves on the TAM with a higher explanation of variance in behaviour intention (Venkatesh, Davis, Davis, & Morris, 2003). DeLone and McLean (2004) incorporate system quality, information quality, and service quality to explain the success of information systems. The information systems success model (ISSM) has been used to investigate ubiquitous computing adoption in businesses (Kim, Shin, Chae, & Oh, 2009) and RFID systems use in libraries (Dwivedi, Kapoor, Williams, & Williams, 2013). These models are still popular with researchers. For example, the revised UTAUT has been used to explain present IT innovations such as mobile bank adoption among Jordanian customers and the adoption of mobile health (Alalwan, Dwivedi, & Rana, 2017; Dwivedi, Shareef, Simintiras, Lal, & Weerakkody, 2016; Dwivedi, Rana, Jeyaraj, Clement, & Williams, 2019), electronic government systems (Rana, Dwivedi, Lal, Williams, & Clement, 2017), and mobile food ordering apps (Alalwan, 2020). In addition, a unified model of electronic government adoption (UMEGA) has been validated and in fact outperforms any other model in the context of e-government (Dwivedi et al., 2017).

2.1.3. Economics-based theories

Another stream of innovation adoption research is based on economic theories. One of the foundations here is prospect theory, which emphasizes the determinative role of a value function in consumer's risky choices under uncertainty (Kahneman & Tversky, 1979). Network externality theory (NET) suggests that the value of goods and services could be affected by the number of other users (Katz & Shapiro, 1985). This theory has been applied to examine the influence of network externality on use intention (Gandal, 1994). In addition, perceived value theory (PVT) has been proposed to predict consumers' buying decisions in an innovation context, incorporating the variables of perceived benefit, monetary cost, and perceived risk (Wood & Scheer, 1996). Due to the limitations of the TAM in explaining the individual use of mobile

Table 1
The studies of consumer behaviour in O2O commerce.

Type of topics	Literature	Theory basis	Findings
Adoption or acceptance	Kang & Namkung, 2019	TAM, TPB	Information quality and source credibility affect trust, attitude and behaviour intention via usefulness and ease of use in food O2O commerce.
	Roh & Park, 2019		Convenience, compatibility, and subjective norm affect intention via usefulness and ease of use in food delivery O2O commerce.
	Cho et al., 2018		Position accuracy, situation-based provisionability, instant connectivity, web loom, economics affect use intention via usefulness, ease of use, and internal reaction in the O2O context.
	Wu et al., 2015		User experience evaluation and mobile anxiety moderates the effect of attitude on intention in catering O2O commerce.
	Yan et al., 2018		Subjective perception and social group positively influence willingness via the TAM in O2O commerce.
	Lin et al., 2017		Perceived innovation leads to greater usefulness and ease of use.
	Li, 2018		The effectiveness of TAM and TPB is compared in the O2O commerce context.
	Chen et al., 2019	ISSM, TPB	Quality of system service, subjective norm, trust, social interaction, convenience, and perceived risk predict satisfaction and adoption intention. Satisfaction also affects adoption intention.
Loyalty to O2O commerce	Hwang & Kim, 2018	ISSM	Perceived information service quality and O2O service quality affect satisfaction with the platform and O2O service, leading to O2O loyalty.
	Hsu & Lin, 2018	PVT	Perceived value affect satisfaction and loyalty to social networking O2O apps.
	Pei et al., 2019	TAM	PU and PEU positively predict user experience that leads to satisfaction and loyalty to O2O platforms.
Purchase behaviour in O2O commerce	Xiao et al., 2017, 2018; Xiao, Guo et al., 2019; Xiao, Zhang et al., 2019	NET and trust transfer theory	Network externalities and trust affect consumers repurchase intention in O2O commerce.
	Chang et al., 2018	ISSM	Quality predicts online satisfaction, values affect offline satisfaction, and two dimensions of satisfaction predict purchase intention.
	Sun, 2018	Stimulus-organism-response model	Information richness, personality, economic, and visually affect pleasure and arousal, which lead to purchase intention in O2O commerce.
	Hsieh, 2017	Pleasure-arousal-dominance model, emotion-cognition-behaviour theory	Three emotion states, i.e., pleasure, arousal, and dominance, affect store environment and social enhancement, which lead to recommendation and purchase intention.

commerce, some studies construct theories based on PVT, highlighting the role of the consumers rather than technology adopters (Kim, Gupta, & Chan, 2007; Kleijnen, Wetzels, & Ruyter, 2007; Yang, Man, & Zhang, 2012).

To avoid the limitations of any single theory, studies have often integrated several theories into one model to explore the complexity of innovation adoption more comprehensively, such as TAM and task-technology fit model (Dishawa & Strong, 1999; Klopping & McKinney, 2004); TAM and NET (Wang et al., 2004); TAM, TPB, and flow theory (Jung, Wiley-patton, & Perez-Mira, 2009; Lu, Wang, & Zhou, 2009); ISSM and flow theory (Zhou, 2013a,b); and ISSM and commitment-trust theory (Wang, Wang, & Liu, 2016).

2.2. O2O consumer behaviour studies

Research associated with O2O consumer behaviour has been flourishing in recent few years and has included examining adoption and post-adoption behaviours such as use intention, loyalty, and purchase behaviour in O2O commerce. The relevant literature is summarized in Table 1.

Most of the O2O adoption studies are based on the TAM. Researchers generally incorporate some predictors into the TAM to explain O2O consumer behaviour, for example, information quality and source credibility (Kang & Namkung, 2019); convenience, compatibility, and subjective norm (Roh & Park, 2019); and location-based service characteristics (Cho, An, & Hao, 2018). Wu, Zhao, and Tzeng (2015) incorporate mobile anxiety and user experience evaluation as moderators into the TAM to investigate the adoption of mobile O2O commerce by offline catering consumers. However, some research just examines O2O consumer behaviour with traditional models and typical constructs such as TPB, TAM, and ISSM (Chen, Hsiao, & Hsieh, 2019; Li, 2018; Lin, Chen, & Chuang, 2017; Yan, Wang, & Zhang, 2018).

Regarding research into the post-adoption of O2O commerce, extant studies explain O2O user's behaviour based on quality-satisfaction-loyalty (Hwang & Kim, 2018), perceived value-satisfaction-loyalty (Hsu & Lin, 2018), user experience-satisfaction-loyalty (Pei, Xue, Yang, Li, & Li, 2019), and trust-repurchase framework (Xiao, Fu, & Liu, 2018). In addition, some psychological theories have also been used to explain O2O consumer purchase behaviour, such as the stimulus-organism-response model (Sun, 2018) and emotion-cognition-intention theory (Hsieh, 2017).

Based on the aforementioned review, most researchers explore consumer behaviour in O2O commerce based on common constructs affecting IS innovation adoption or post-adoption behaviour but neglect the influence of unique characteristics of O2O commerce on consumer behaviour. One of the great differences between O2O commerce and pure E-commerce is that consumers are engaged in physical experience in the transaction process in the O2O model. We are aware that some studies do examine the construct of user experience's effect on user behaviour (Huang, Zhou, Liao, Mo, & Wang, 2017; Pei et al., 2019; Wu et al., 2015), but this is taken to mean a general evaluation of shopping experience, which is quite different from physical experiences such as the availability of experiencing space, facilities, and services in physical stores in the O2O context. Although Huang et al. (2017) hypothesize that consumer experience of offline shopping contributes to their offline shopping channel choice, they do not investigate how offline shopping experience impacts consumer use of O2O commerce. In summary, the extant literature does not empirically test the influence of the unique features of O2O commerce on consumers' usage.

3. Research model and hypotheses

3.1. O2O conception

We define O2O commerce as an online to offline or offline to online transaction channel through which merchants incorporate online

operations and physical experience into one seamless channel, providing the benefits of rich online information, convenient online payment manner, lower online price, offline physical experience, and offline customer services (Hwang & Kim, 2018; Yang, Yu, Zhang, He, & Gong, 2016).

The concept of O2O commerce differs considerably from "pure click", "research online, purchase offline (ROPO)", and "brick and click". O2O commerce highlights the integration of online and offline channels, working together, taking advantage of both e-commerce and traditional retailing, and providing consumers with a customized physical experience. For the "pure click" model, consumers finish their transaction online, and online stores take charge of delivering goods to them, which lacks a physical experience within the purchase process. For the ROPO model, consumers browse products and reviews online and then make their purchase offline; there is no inter-communication between the online and offline stores. The "brick and click" model means merchants adopt multi-channel services, including physical retailing, online retailing, and click and pick services. They provide multiple channels for consumers and allow consumers to pick up online-ordered goods at convenient physical stores, making the scope of the "brick and click" model much larger than the O2O model.

3.2. Research model

O2O commerce has both a technological and economic nature. In this study, to reflect consumers' perceptions of both the technological and economic attributes of O2O commerce, we integrate the TAM and PVT to explain consumers' intention to use O2O commerce via major technological factors such as perceived usefulness and perceived ease of use (Davis, 1989; Kang & Namkung, 2019) and economic factors such as perceived value, perceived benefit, cognitive effort, and perceived risk (Hsu & Lin, 2018). Hence, we integrate the TAM with PVT to better explain consumers' usage of O2O patterns.

Importantly, we incorporate the unique features of O2O commerce as antecedents in the model to explore their influence. As mentioned in the introduction, the innovative idea of O2O is to provide consumers with the advantages of both online transactions and offline services; thus, on one hand, the physical experience in real stores is regarded as one necessary feature that overcomes the shortcomings of pure-click e-commerce, and on the other hand, the integration of online and offline information should be a critical condition that connects online and offline stores and allows consumers to acquire online information, switch between online and offline stores freely, transact swiftly, and interact with offline merchants seamlessly (Xiao, Guo et al., 2019; Hwang & Kim, 2018; Xiao, Mi, Zhang, & Ma, 2017, 2018; Xiao, Zhang et al., 2019; Yang et al., 2016). We conceptualize these two features as two characteristic constructs of O2O commerce.

Therefore, we develop the research model shown in Fig. 1.

3.3. Features of O2O commerce

3.3.1. Consumer physical experience

O2O commerce is different from pure-click commerce. It provides consumers with both the rich physical experiences in real stores and the benefits of online transactions. Therefore, physical experience (PE) is regarded as a characteristic construct of O2O commerce in our model. Experience refers to a memorable event created by services and goods via customer personal engagement, which is one of the economic attributes in the consumption process (Pine & Gilmore, 1998). In our study, customer physical experience is defined as the extent to which consumers are allowed to visit the physical stores to try the goods or services, such as test the functions and feel the quality and services in the context of O2O commerce.

PE is integrated into the whole consumption process via O2O commerce, which is actually a service offered by the merchants. It allows consumers to fit, trial, and touch the goods before purchase. Then, consumers pick-up and check them after purchase, or they purchase services online and consume them offline. Consumers can enjoy other customer services in the experience centre, such as consulting and post-purchase maintenance. Therefore, PE is a value-added service for O2O consumers (Pei et al., 2019; Wu et al., 2015). PE directly determines consumers' value judgement of the offerings (Huang et al., 2017). In addition, according to the service-dominant logic theory, from the perspective of the offline service of O2O merchants, PE is a feature of the interaction between consumers and merchants, which may also create value for consumers (Vargo & Lusch, 2004). PE allows consumers to make a satisfactory purchase, which creates experiential value for them (Mathwick, Malhotra, & Rigdon, 2001). Based on the above discussion, we deduce that PE is valuable for consumers to make a purchase via the O2O pattern. Thus, we propose the following hypothesis:

H1a. Physical experience has a positive effect on the perceived value of O2O.

Prior research shows that PE can be regarded as one of the critical success factors for e-retailers, particularly those selling customized and luxury goods (He, 2018), because it allows consumers to buy a well-fitting good and make sound shopping decisions and then greatly promote sales (Huang et al., 2017; Verhagen & Dolen, 2009). In O2O commerce, PE makes a difference in consumer's decision making. Based on PE, consumers gain a thorough understanding of the products, and then they can purchase the right product at the right price; thus, satisfaction is improved. Therefore, consumers may perceive more benefits of O2O commerce due to the increased engagement in the physical experience in offline stores. Therefore, the following hypothesis is proposed:

H1b. Physical experience has a positive effect on the perceived benefit of O2O.

A notable shortcoming of online shopping is that there is no chance for consumers to experience the product prior to ordering online (Elven, 2019). The main way to obtain product information is to look through the product's web page and others' reviews or to talk with online customer-service staff (if available); however, concerns about the size, colour, texture, functions, quality, etc. remain (Jahng, Jain, & Ramamurthy, 2007). As a result, the proportion of returned purchases in online shopping is much higher than that in offline shopping (Hsiao & Chen, 2012). Since the goods delivered may not be as described in the online store, it is understandable that customers may be dissatisfied or disappointed about their online purchases (Liao, 2017; Yang, Liu, Li, & Yu, 2015). Establishing an offline showroom is a feasible way to battle this, allowing customers to improve their impression of the goods and services advertised (Huang et al., 2017). Thus, physical experience may decrease the extent of information asymmetry about products sold online. Because perceived information asymmetry is confirmed as one of the main sources of perceived risk in e-commerce (Yang et al., 2015), customers' physical experience is likely to relieve consumers' perceived risk in the O2O pattern (Chiu et al., 2011). Therefore, we propose the following hypothesis:

H1c. Physical experience has a negative effect on the perceived risk in O2O.

3.3.2. The integration of online and offline information

Integration of online and offline information (IOOI) is defined as the degree to which online information is kept integrated with offline information of the presentations in physical stores in a real-time manner such that a product or service order can be swiftly confirmed and consumers can switch between the online system and offline stores seamlessly (Anderson, 1981; Oh, Teo, & Sambamurthy, 2012). IOOI provides the information infrastructure for consumers to take advantages of both online transactions and offline physical services. IOOI involves how offline and online information are combined when

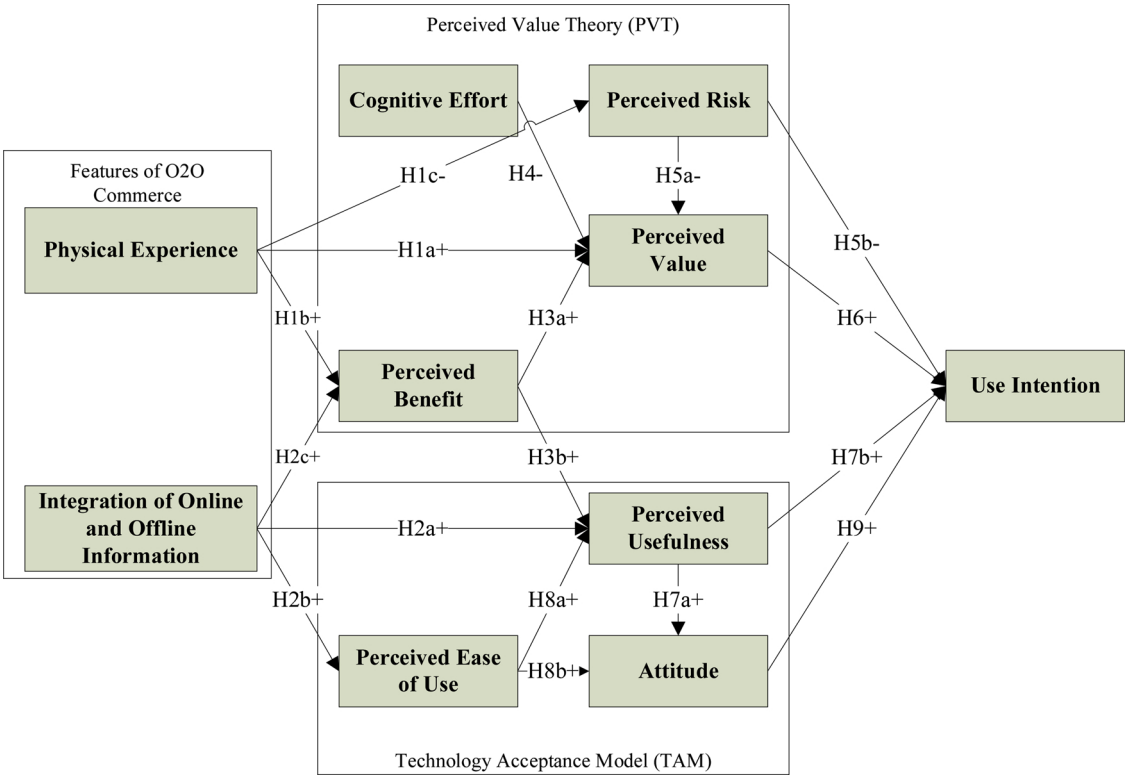

Fig. 1. Research model.
Note: *, **, and *** indicates $p < 0.05$, 0.01 and 0.001 significance levels, respectively.

consumers physically experience the product and service. Ideally, consumers are looking for consistency and enhancement(s) in product/service information as a result of the physical experience.

IOOI is the necessary information technology condition for O2O from an IT perspective and makes O2O different from other models because it integrates online and offline channels into one channel (Oh et al., 2012). In the O2O physical store, the scenario may be that a consumer enters the webpage of the goods via their smartphone to learn the quality details and read any reviews. At the same time, consumers physically inspect and try the goods (Zhang, Ren, Wang, & He, 2018). Through this pattern, purchase efficiency will likely be dramatically improved. If the consumer progresses the purchase online, their order can be confirmed efficiently by a salesclerk in the physical store, which may allow them to pick the goods up immediately (Herhausen, Binder, Schoegel, & Herrmann, 2015). These functions enable consumers to make smarter purchases, allowing consumers to use all of the information to evaluate the alternatives conveniently. Thus, we proposed the following hypothesis:

H2a. IOOI has a positive effect on the perceived usefulness of O2O commerce.

In addition, IOOI makes it easier to use and realize the potential of O2O commerce. It blurs the boundaries between online and offline shopping and makes it much easier for consumers to switch freely from online platforms to physical stores (Nielsen, 2018), which has not been possible before (Liao, 2017). The freedom of consumers to check out physical stores if desired can boost consumer confidence and flexibility in their decisions as to whether to proceed with the transactions. Consumers can also access real-time reviews from others easily via IOOI functions. With the features of IOOI, consumers may think that it is easy to take full advantage of O2O commerce; therefore, we propose the following hypothesis:

H2b. IOOI has a positive effect on the perceived ease of use of O2O commerce.

In our study, IOOI represents the technological attributes of O2O commerce, which allows consumers to make purchases smoothly and efficiently at each stage of O2O commerce, thereby saving time and effort. In addition, a smarter purchase, good price, and high-tech shopping experience also give consumers great satisfaction (Pei et al., 2019). At the same time, IOOI unifies online and offline information of O2O commerce, which also improves the information quality provided to consumers. According to the findings of Chang, Hsu, and Yang (2018) and Chen et al. (2018), the information quality of O2O system is confirmed to also predict consumer satisfaction. Consumer satisfaction is considered one critical component of the perceived benefit of O2O commerce. As such, consumers may benefit considerably from IOOI of O2O commerce, so we hypothesize the following:

H2c. IOOI has a positive effect on the perceived benefit of O2O commerce.

3.4. Economic attributes of O2O commerce

3.4.1. Perceived benefit

Perceived benefit refers to a consumer's perception of the gains from a transaction (Wood & Scheer, 1996). In this study, O2O allows consumers to benefit from both online transacting and having an offline physical experience. Online benefits consist of ubiquitous connectivity, increased convenience, availability of online consumer reviews, and competitive price, and so on; offline benefits may include the physical experience of trying the product, a pickup service, or a post-purchase service and, of course, consumption of the service if the online-ordered item is a service.

Wood and Scheer (1996) suggest a positive relationship between perceived benefits and perceived value, which has also been verified in the field of mobile commerce (Kim et al., 2007; Kleijnen et al., 2007;

Yang et al., 2012). In the context of O2O commerce, we hypothesize that perceived benefit has a similar effect on perceived value:

H3a. Consumer's perceived benefit has a positive effect on the perceived value of O2O.

We treat perceived benefit as a construct with formative measures including high information and product quality, high satisfaction, experience, flexibility, and good price (Coltman, Devinney, Midgley, & Venaik, 2008; Manzano, Navarré, Mafé, & Blas, 2009). Information quality has been verified to predict perceived usefulness in the context of online banking (Montazemi & Qahri-Saremi, 2015) and food O2O commerce (Kang & Namkung, 2019). Flexibility has also been verified to affect the perceived usefulness of mobile services (Nicolás, Castillo, & Bouwman, 2008). These benefits are helpful to enhance and improve consumer's purchase decision-making. For example, if consumers can access the online store when visiting the same-branded physical store, they may gain access to useful information such as online price, reviews, and sales data, which may improve the shopping efficiency for them and assist them in the selection of the right offerings. Thus, we make the following hypothesis:

H3b. Consumer's perceived benefit has a positive effect on the perceived usefulness of O2O.

3.4.2. Perceived sacrifice

Consumers may bear some sacrifices when using O2O, such as the cost of mobile data service. These could be monetary or non-monetary costs. The former may include the cost of mobile terminals and the charge made by the mobile telecom companies, but typically, potential O2O adopters have smartphones and pay for mobile data (or just use any available free WiFi); therefore, O2O rarely results in an additional unbearable monetary cost to consumers. Research has shown that the effect of perceived monetary cost on perceived value is insignificant for mobile payment service (Yang et al., 2012). As a result, we just consider non-monetary costs. It is argued that non-monetary costs include cognitive effort cost and consumers' perceived risks in the adoption of O2O (Kleijnen et al., 2007; Wood & Scheer, 1996). Thus, we treat cognitive effort and perceived risk as two dimensions of perceived sacrifice.

Cognitive effort (effort cost) is the effort required to understand the concept of O2O and how it works to complete a purchase (Kleijnen et al., 2007). Consumers may not immediately understand its processes and benefits when being introduced to it for the first time, especially for the more complex interaction between offline and online stores. Thus, consumers have a learning cost. Consumers who are more technologically savvy may adopt through offline and online interactions with ease, but others may give up as a result of the additional cognitive effort. Kleijnen et al. (2007) validate the negative influence of cognitive effort on the perceived value on the mobile channel. We hypothesize that consumers' cognitive effort has a similar effect on the perceived value on O2O:

H4. Consumer's cognitive effort has a negative effect on the perceived value on O2O.

Perceived risk is defined as consumers' perception of the likely losses resulting from the use of O2O commerce in this study (Bauer, 1960; Featherman & Pavlou, 2003; Mitchell, 1999). It refers to some kind of non-monetary cost consumers have to consider in purchase decision-making (Wood & Scheer, 1996). Extant studies validate the negative impact of perceived risk on perceived value of mobile service (Kleijnen et al., 2007), perceived value of mobile payment (Yang et al., 2012), and utilitarian and hedonic value of B2C e-commerce (Chiu, Wang, Fang, & Huang, 2014).

In O2O commerce, as mentioned in H1b, the perceived risk may be reduced or counteracted as a result of consumers' physical experience; however, consumers still encounter the risk of privacy exposure, payment error, etc., which could still have an effect on perceived value (Liu, Xia, Gao, Jiang, & Zhang, 2019; Yang et al., 2016). Hence, we propose the following hypothesis:

H5a. Consumer's perceived risk has a negative effect on the perceived value of O2O.

Previous studies also suggest a negative impact of perceived risk on behaviour intentions such as E-services adoption intention (Featherman & Pavlou, 2003; Kleijnen, Wetzels, & Ruyter, 2004), purchase intention in e-commerce (Lopez-Nicolas & Molina-Castillo, 2008; Nicolás et al., 2008), and acceptance intention of mobile payment (Yang et al., 2015).

In our study, O2O commerce is different from pure e-commerce and physical retailing. It lowers information asymmetry between sellers and buyers via IOOI and PE; therefore, the impact of perceived risk on behaviour intention may be different (Yang et al., 2015). However, to examine the influence of perceived risk on consumer's intention to use O2O commerce and to ensure consistency with previous studies (Featherman & Pavlou, 2003; Slade, Dwivedi, Piercy, & Williams, 2015), we propose the following hypothesis:

H5b. Consumer's perceived risk has a negative effect on consumer's use intention.

3.4.3. Perceived value

Perceived value refers to consumers' evaluation of a product or service based on their perception of the trade-off of sacrifices and benefits (Kleijnen et al., 2007). Perceived value theory indicates that consumers' value perception of products plays a crucial role in purchase decision-making (Kahneman & Tversky, 1979; Wood & Scheer, 1996). Perceived value has been proven to significantly affect the adoption of mobile services in previous studies (Kim et al., 2007; Kleijnen et al., 2007; Yang et al., 2012).

In our study, the adoption behaviour of O2O commerce is actually a characteristic of consumption activities. Consumers also consider its value; they also have to balance the benefits, costs, and risks. We define perceived value in this article as consumers' subjective evaluation of benefits and sacrifices resulting from O2O adoption (Kim et al., 2007; Wood & Scheer, 1996) and propose the following hypothesis:

H6. Consumers' perceived value has a positive effect on the use intention of O2O pattern.

3.5. Perceived technology attributes

The technological attributes of O2O commerce are also important considerations for consumers. In this aspect, the TAM has been a solid foundational theory to explain user acceptance of new technology with its core constructs of perceived usefulness, perceived ease of use, and attitude (Davis, 1989).

The TAM is widely used to explain the adoption of various IT innovations, such as e-commerce (Klopping & McKinney, 2004), mobile commerce (Wu & Wang, 2005; López-Nicolás, Molina-Castillo, & Bouwman, 2008; Liu & Li, 2011; Kim, Lee, & Mirusmonov, 2010; Schierz, Writz, & Schilke, 2010; Keramati, Mojir, Larijani, & Taeb, 2012), and O2O commerce (Kang & Namkung, 2019; Roh & Park, 2019). It has been argued that the TAM has limited innovativeness, but how its classic constructs (perceived usefulness and perceived ease of use) are incorporated in the model and which constructs are taken as TAM's predictors are important.

In our study, consumers take advantage of the O2O system to obtain both online convenience and physical experience to confirm purchase decision-making (either realize higher purchase performance or decline to purchase the product after evaluation) and ultimately a satisfactory shopping experience. Thus, higher perceived usefulness may lead to a more positive attitude towards O2O (Davis, 1989; Wu et al., 2015).

H7a. Perceived usefulness has a positive effect on consumer attitude to

O2O commerce.

As one of the core constructs of TAM, perceived usefulness has been confirmed multiple times to influence behaviour intention (Davis, 1989); most studies based on the TAM support this assertion (Klopping & McKinney, 2004; Venkatesh & Davis, 2000; Venkatesh, 2000). However, Liu and Li (2011) argue that perceived usefulness has an insignificant impact on behaviour intention in the context of mobile hedonic services. Kang and Namkung (2019) argue perceived usefulness plays an important role in consumers' decision making about the use of O2O commerce. The more usefulness in O2O commerce consumers perceive, the higher their intention to use it (Cho et al., 2018; Roh & Park, 2019). Considering the difference between O2O commerce and mobile hedonic services, we maintain consistency with most of the research based on the TAM. Thus, we propose the following:

H7b. Perceived usefulness has a positive effect on consumer O2O use intention.

Perceived ease of use is another core construct of the TAM, which has been verified to impact usefulness by Davis (1989). Most TAM-related research confirms this assertion (Dishawa & Strong, 1999; Venkatesh & Davis, 2000; Venkatesh, 2000). Some studies find an insignificant link between ease of use and usefulness in the context of mobile hedonic services such as mobile TV because users may think highly of enjoyment and involvement but not ease of use (Liu & Li, 2011; Pagani, 2011). In our study, the operations on O2O platforms should be easy to use and streamlined; otherwise, if it is too complicated or troublesome to operate, consumers may doubt its usefulness, and therefore, ease of use leads to higher perceived usefulness of O2O commerce (Cho et al., 2018; Roh & Park, 2019). Hence, we propose the following hypothesis:

H8a. Perceived ease of use has a positive effect on perceived usefulness of O2O.

The effect of perceived ease of use on attitude is first examined in the TAM (Davis, 1989). Many other studies validate its significant explanation of attitude (Dishawa & Strong, 1999; Qi et al., 2009; Taylor & Todd, 1995; Wu et al., 2015). However, other studies report an insignificant link between perceived ease of use and attitude of the adoption of mobile TV services (Pagani, 2011) or mobile hedonic services (Liu & Li, 2011). However, O2O commerce systems focus on utilitarian functions, which are different from hedonic services. Given the high levels of competition and popularity of O2O patterns in the marketplace, O2O platforms should be easy to use for consumers to reap the full benefits of O2O. We thus deduce that perceived ease of use may also affect attitude towards the O2O platform (Cho et al., 2018; Roh & Park, 2019). Thus, we propose the following hypothesis:

H8b. Perceived ease of use has a positive effect on consumer's attitude towards O2O.

Prior literature verifies the positive relationship between attitude and behaviour intention from the perspective of psychology and technology acceptance theories (Ajzen, 1985; Davis, 1989; Fishbein & Ajzen, 1975). Recently, other studies also validate the impact of attitude on behaviour intention of information technology/system acceptance (Dwivedi et al., 2019) or in the context of e-government system adoption (Dwivedi et al., 2017; Rana, Dwivedi, Williams, & Weerakkody, 2016; Rana et al., 2017). In our study, based on the evaluation and judgement of all O2O commerce's attributes, consumers form the synthesis attitude, which may highly affect their use intention of the pattern. Positive attitudes towards O2O patterns may results in a higher use intention (Kang & Namkung, 2019; Liu & Li, 2011; Wu et al., 2015). Therefore, we propose the following hypothesis:

H9. Consumer's attitude to O2O has a positive effect on use intention.

4. Methodology

We use structural equation modelling to test our research model. First, we adapt the measurement of all the constructs in our model based on previous studies. Then, we conduct a field survey to collect data. Finally, we use SPSS 20 and SmartPLS 3 (Ringle, Wende, & Becker, 2015) to analyse the reliability and validity of the scale and to test the proposed hypotheses.

4.1. Measurement development

The wordings of the constructs we used are derived from extant studies as shown in Table 2. The measures are adapted to the context of O2O commerce.

In our model, perceived risk and perceived benefit consist of many facets, and therefore, their measures are handled as formative items (Coltman et al., 2008, Manzano et al., 2009). The definitions and sources of constructs are shown in Table 2. All the items of the constructs in the model are listed in Appendix A.

4.2. Sample and data collection

4.2.1. Pilot test

A survey questionnaire was designed to capture these measures. All of the items were recorded on a seven-point Likert scale ranging from strongly disagree "1" to strongly agree "7". To ensure the questionnaire was readable and clearly expressed, a preliminary test was conducted with 15 college students. Based on their comments and suggestions, the questionnaire was revised for clarity. After that, a larger scale pilot test was administered in five classes of college students majoring in e-commerce, and 140 responses were collected. An exploratory factor analysis was conducted with SPSS 20, according to the loadings on the corresponding factors; we deleted the items whose loadings were lower than 0.5 (Hair, Black, Babin, Anderson, & Tatham, 2010; Nunnally, 1978). Thus, the research scales were improved.

4.2.2. Formal survey

The field survey was conducted in offline stores of O2O merchants in Shandong province, China. First, the questionnaire was posted on a professional survey website (www.sojump.com), and a QR code was created from the URL of the questionnaire. The QR code was printed on cards and display racks so that research assistants could present them at the entrances and counters of O2O merchants. The O2O merchants participating in this research included restaurants, hotels, shopping centres, furniture stores, tourist attractions, fashion stores, and electronic appliance stores, representing more than 50 stores. Customers who entered the stores were invited to scan the QR code using their cell phone to fill in the questionnaire online. The first screening question was about knowledge and use of O2O commerce; those who had no knowledge or experience of O2O commerce were excluded. Then, the respondents would be asked about their last remembered use of O2O commerce. According to the O2O feature the responses uses, the questionnaire was slightly varied automatically to adapt the response's usage settings of O2O commerce. Respondents were paid 10 CNY if they filled questionnaires completely.

4.2.3. Sample statistics

The survey lasted for two months, and 416 valid responses were collected with a valid rate of 69.33 % of total responses. The descriptive analysis of respondents is shown in Table 3.

According to the descriptive analysis, three categories of O2O commerce pattern are covered. The most popular is "ordering online, consuming offline", which accounts for 47.6 % of the total O2O transactions in the sample. Among the O2O merchants, the catering and

Table 2
Definitions and sources of constructs.

Constructs	Definitions	Sources
Physical Experience	The extent to which consumers are allowed to visit the physical stores to try the goods or services, such as test the function and feel the quality and service.	Schmitt, 1999; Qi et al., 2009
Integration of Online and Offline Information	The degree to which the seller's online data is kept integrated with the offline information of the presentations in physical stores in real-time so that the ordering information can be swiftly confirmed and consumers could switch between online system and offline stores seamlessly.	Oh et al., 2012;Yang et al., 2016
Perceived Value	Consumers' subjective evaluation of benefits and sacrifices resulted from O2O use.	Kim et al., 2007
Perceived Benefit	Consumers' perception of all the gains from O2O commerce use.	Kim, Rao, & Ferrin, 2008; Lee, 2009; Shin, 2010
Perceived Risk	Consumers' perception of the likely losses resulting from O2O use.	Kim et al., 2008; Yang et al., 2015
Cognitive Cost	The efforts poured into understanding the concept of O2O and the process of its operation and learning how to make a purchase.	Kleijnen et al., 2007
Perceived Usefulness	The degree to which the user perceives that the use of O2O pattern would improve the performance of purchasing.	Davis, 1989; Kim et al., 2010
Perceived Ease of Use	The degree by which the user perceives that the O2O system would be easy to be understood, operated, and skilfully mastered.	
Attitude	Consumer's subjective opinion and judgement about the O2O pattern.	Liu & Li, 2011;Dwivedi et al., 2013
Use Intention	Consumer's willingness to use the O2O pattern to purchase in the future.	Kim et al., 2010;Rana et al., 2016

entertainment sector is used the most (42.5 %). Approximately 38.9 % of respondents complete the transaction via cell phone. In total, 60.3 % of transaction prices are lower than 100 CNY.

Most of the respondents were 18-35. This finding is consistent with reports ([Nielsen,2018], Nielsen, 2017 2018) that showed 67 % of people who used O2O commerce were aged 18–35 years and that the average age of online consumers was 33. Thus, our sample's representativeness is comparable with prior national surveys conducted recently.

4.3. Data analysis

4.3.1. Factor analysis

To assess the factor structure, we conduct an exploratory factor analysis with SPSS 20. First, we conduct the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test. The sampling adequacy is 0.903, and Bartlett's test of sphericity is significant. These findings indicated that the sampling data are suitable for factor analysis (Hair et al., 2010).

Since we adopt formative measures of perceived risk and perceived benefit, we just extract factors from reflective measures (Coltman et al., 2008). The results of factor analysis with VARIMAX rotation are shown in Table B1 in Appendix B. All indicators are loaded on the salient factor, and 69.38 % cumulative variance is explained. All the loadings of items to the responding factors are greater than 0.5, which meets the criterion suggested by Hair et al. (2010). In addition, the cross-loadings of indicators on other factors are also lower than the loadings on the corresponding factors, indicating a clear factor structure.

4.3.2. Reliability and validity

The partial least-square approach is used to test the reliability and validity of the measurement model with SmartPLS 3 (Ringle et al., 2015). Composite reliability (CR) and Cronbach's alpha are employed to test the scale reliability of reflective constructs. According to the results in Table 4, all the values of the CR of constructs are greater than 0.8, and Cronbach's alpha values are greater than 0.7 except for formative variables, suggesting that the reliability of the scales is acceptable (Fornell & Larcker, 1981). We assess the validity through average variance extracted (AVE) and a comparison of the square roots of AVEs and correlations of constructs. As indicated in Table 4, all the AVEs are greater than 0.5, demonstrating reasonable convergent validity; the values on the diagonal are greater than the corresponding inter-correlation coefficients of the constructs, indicating that the discriminative validity is also acceptable (Fornell & Larcker, 1981; Liu, Wang, & Huang, 2017).

Moreover, we use the heterotrait-monotrait (HTMT) ratio to test the discriminative validity of the constructs. As shown in Table E1 in Appendix E, all of the HTMT ratios are less than 0.8, revealing no discriminant validity violation (Voorhees, Brady, Calantone, & Ramirez, 2016).

Additionally, we also test the convergent validity via standard loadings of items as shown in Table F1 in Appendix F. All loadings are greater than 0.6, which means the convergent validity for each factor is acceptable (Hair et al., 2010).

In addition, we conduct a multicollinearity analysis of the formative indicators to test the reliability of formative constructs as shown in Table 5 (Coltman et al., 2008). All of the VIFs were less than 3, indicating that there is no serious multicollinearity problem in these indicators (Hair, Ringle, Sarstedt, & Hult, 2014).

To test the validity of perceived risk and perceived benefit, the weights and p-values of the formative indicators are evaluated as shown in Table 5 (Coltman et al., 2008). The weights of PR3, PR5, PB2, and PB4 are insignificant. According to Cenfetelli and Bassellier (2009), removing the formative indicators with insignificant weights should be based on theoretical relevance. We re-examine the descriptions of those items and find that PR3, PB2, and PB3 exhibit minimal relevance to the responding constructs. Furthermore, if these items are removed, the explained R^2 of perceived risk and perceived benefit is slightly increased by 0.1 %. Thus, we remove PR3, PB2, and PB3 but retain PR5 in the following hypothesis tests.

We also examine the common method bias with the full collinearity test (Kock, 2015). The VIFs for all constructs in the research model are obtained via the PLS algorithm in SmartPLS 3 (Ringle et al., 2015), as shown in Table D1 in Appendix D. All VIFs are less than 3.3; thus, the model should be free from common method bias (Kock, 2015).

4.3.3. Hypothesis tests

Prior to hypothesis testing, we analyse the multicollinearity of the structure model via the values of Variance Inflation Factor (VIF). The VIF values (ranged from 1.000–1.738) are shown in Table C1 in Appendix C, which shows that multicollinearity is not a problem in this model (Hair et al., 2014).

We used SmartPLS 3 to test the structural model (Ringle et al., 2015). The results are depicted in Fig. 2.

First, from the perspective of the features of O2O commerce, physical experience is found to have a significant negative influence on perceived risk and to be significantly associated with perceived value and perceived benefits. IOOI has positive influences on perceived usefulness, perceived ease of use, and perceived benefit at a significance level of 0.001. Thus, the core hypotheses H1a-c and H2a-c are supported. Regarding economic attributes, perceived benefit exerts strong

Table 3
Descriptions of samples.

Variables	Frequencies	Percentages (%)
Gender		
Male	200	48.08
Female	216	51.92
Age		
Less than 18	7	1.68
18-30	326	78.36
31-40	69	16.59
Greater than 40	14	3.37
Education		
Master degree or upper	84	20.20
Graduate	271	65.14
Undergraduate or lower	61	14.66
Career		
Business employee	131	31.49
Government & other organization staff	67	16.11
Student	182	43.75
Others	36	8.65
O2O commerce patterns		
Ordering online, consuming offline	198	47.60
Experiencing offline, purchasing online	20	4.81
Purchasing online, picking up offline	88	21.15
Hybrid pattern	110	26.44
Merchant types		
Catering and entertainment	177	42.55
Hotels & tourist attractions	89	21.39
Shopping malls	28	6.73
Others	122	29.33
Payment manner		
Mobile payment	162	38.94
Web page payment	106	25.48
Others	148	35.58
Payment amount (CNY)		
Less than 100	251	60.34
101 to 500	135	32.45
Greater than 500	30	7.21

influences on perceived value and perceived usefulness, supporting H3a-b. Cognitive effort, as one of the main perceived sacrifices, is found to be significantly related to perceived value; thus, H4 is supported. However, the influences of perceived risk on perceived value and use intention were not significant, which indicates H5a-b are not supported. As the main antecedent of use intention, perceived value is found to have a strong influence at the significance level of 0.001; thus, H6 is supported. From perceived technology attributes, perceived usefulness is significantly related to attitude and use intention; thus, H7a-b are supported. The influences of perceived ease of use on perceived usefulness and attitude are validated; thus, H8a and H8b are also supported. Finally, attitude, as the classic predictor of behavioural intention, is also confirmed to be significant, so H9 is supported. The hypothesis test results are summarized in Table 6.

In addition, to further test the predictive relevance of the model, we obtain Stone-Geisser's Q2 via the blindfolding algorithm of SmartPLS 3 (Ringle et al., 2015), which is shown in Table G1 in Appendix G. All values of the measure (Q2) of cross-validated redundancy for all endogenous constructs are greater than 0, indicating the explanatory constructs have predictive relevance (Hair et al., 2014).

Table 5
Reliability and validity test of formative constructs.

Constructs	Items	Weights	VIFs	p-values
Perceived Risk	PR1	−0.476	2.110	0.047
	PR2	0.918	1.460	0.000
	PR3	0.054	2.858	**0.861**
	PR4	0.657	2.328	0.002
	PR5	−0.349	2.958	0.255
Perceived Benefit	PB1	0.370	1.563	0.000
	PB2	0.045	1.833	**0.581**
	PB3	0.441	1.694	0.000
	PB4	−0.039	1.686	**0.600**
	PB5	0.451	1.709	0.000

5. Discussions and implications

5.1. Result discussions

The results of hypothesis testing validate the important functions of PE and IOOI in consumer use of O2O commerce. Two features of O2O commerce are found to have significant influence on consumer perceptions of both economics and technology attributes of O2O commerce based on perceived value theory and the TAM. Both perceived value theory and the TAM are validated in this model, and the main predictors of use intention, i.e., perceived value, perceived usefulness, and consumer's attitude, are all shown to have significant effects.

PE is found to be a crucial factor for consumers to participate in the process of O2O commerce. PE has a significant influence on perceived value, perceived benefit, and perceived risk. In physical stores, consumers can feel the quality, experience the service, and confirm whether the products meet their expectations. As a result, the level of consumer perceived risk is lowered. Thus, PE is verified as an important antecedent construct of economic attributes in the adoption of O2O commerce.

IOOI is the bridge between the virtual and real world, which determines the extent of the information integration between online and offline operations. The results show that it exerts great influence on the core technological attributes and perceived benefit. Thus, consumers think highly of it and regard it as important, resulting in usefulness and benefits for them. IOOI also makes the system more seamless. Without IOOI, it will be impossible to realize the operation of the O2O patterns.

Cognitive effort is one type of non-monetary cost to the consumer and has a significant negative effect on perceived value, which is consistent with previous studies. It suggests that consumers make a salient amount of effort to learn how to use the O2O system, which significantly lowers consumers' value perception of the O2O system.

Table 4
Results of reliability and validity test of reflective constructs.

Constructs	α	CR	AVE	AD	CE	IOOI	PE	PEU	PU	PV	UI
AD	0.755	0.856	0.669	0.818							
CE	0.881	0.918	0.737	−0.264	0.858						
IOOI	0.833	0.878	0.545	0.423	−0.146	0.739					
PE	0.856	0.903	0.700	0.381	−0.123	0.652	0.836				
PEU	0.875	0.914	0.727	0.524	−0.399	0.400	0.372	0.853			
PU	0.845	0.896	0.682	0.437	−0.165	0.524	0.404	0.445	0.826		
PV	0.819	0.881	0.649	0.564	−0.364	0.338	0.346	0.480	0.376	0.806	
UI	0.833	0.899	0.747	0.523	−0.177	0.320	0.280	0.366	0.355	0.544	0.864

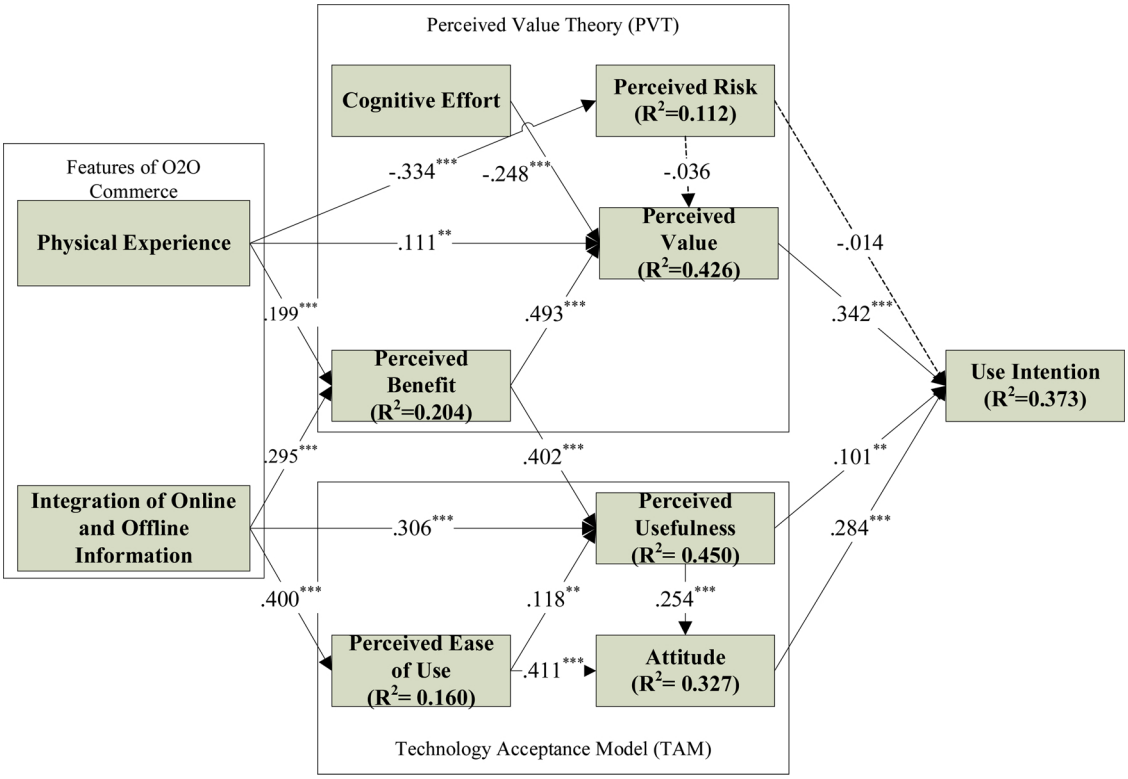

Fig. 2. The results of the hypothesis test.

Table 6
The results of structure parameter estimates.

Hypotheses	Standardized path coefficients	t-value	Supported Yes/No
H1a: Physical experience → Perceived value	0.111	2.303	Yes
H1b: Physical experience → Perceived benefit	0.199	3.253	Yes
H1c: Physical experience → Perceived risk	−0.334	7.690	Yes
H2a: IOOI → Perceived usefulness	0.306	5.906	Yes
H2b: IOOI → Perceived ease of use	0.400	6.899	Yes
H2c: IOOI → Perceived benefit	0.295	4.996	Yes
H3a: Perceived benefit → Perceived value	0.493	11.540	Yes
H3b: Perceived benefit → Perceived usefulness	0.402	8.227	Yes
H4: Cognitive effort → perceived value	−0.248	5.564	Yes
H5a: Perceived risk → Perceived value	−0.036	0.758	**No**
H5b: Perceived risk → Use intention	−0.014	0.288	**No**
H6: Perceived value → Use intention	0.342	6.193	Yes
H7a: Perceived usefulness → Attitude	0.254	4.911	Yes
H7b: Perceived usefulness → Use intention	0.101	2.155	Yes
H8a: Perceived ease of use → Perceived usefulness	0.118	2.327	Yes
H8b: Perceived ease of use → Attitude	0.411	8.030	Yes
H9: Attitude → Use intention	0.284	5.344	Yes

Therefore, for those who are not familiar with O2O, it is necessary to train them to use the O2O platform.

Perceived benefit is a classic predictor of perceived value in perceived value theory, which is also proven to have a positive relationship with perceived value in this model. In addition, perceived benefit positively influences perceived usefulness. Thus, the benefits of O2O commerce partly determine consumer's perception of system usefulness.

Regarding the technological attributes of the O2O pattern, perceived ease of use is shown to have significant effects on both perceived usefulness and consumer's attitude, and perceived usefulness is also proven to have an indirect influence on use intention though attitude, which is consistent with previous studies.

Unexpectedly, perceived risk is not found to be significantly related to perceived value and use intention, which may be due to the significant negative influences of consumer's physical experience on perceived risk. Generally, perceived risk is a significant negative factor against a consumer adopting an innovation service, such as mobile payment. However, different results are noted for O2O commerce because it is incorporated into consumers' experience in the business model. In addition, we validate that consumers' physical experience significantly relieves their concerns about the product or service quality, function, etc. In the previous study, information asymmetry is confirmed as a strong antecedent of perceived risk (Yang and Zhang,

2012); however, consumers' physical experience greatly eliminates most information asymmetry in O2O commerce. Therefore, it is reasonable that the effect of perceived risk is not salient in this study, representing one of the advantages of O2O commerce.

5.2. Theoretical implications

Our study answers the research question by validating the impact of PE and IOOI on consumer's use of O2O patterns. The two constructs reflect the typical characteristics of O2O commerce, which therefore differentiates itself from other electronic commerce patterns. The construct of PE investigated in this article is different from user experience regarded as user perception of using products or services in O2O commerce (Pei et al., 2019; Wu et al., 2015). User experience is verified to enhance consumer behaviour (Wu et al., 2015) and positively impact consumer's satisfaction (Pei et al., 2019), but our investigation examines the functions of physical experience as one nature of O2O commerce. Specifying and empirically testing the construct of PE in the context of O2O commerce also expand the thinking of other works, notably Huang et al. (2017).

The construct of IOOI is different from the integration of online and offline channels (Herhausen et al., 2015) and consumer perception of channel integration (Zhang et al., 2018). IOOI focuses on the information integration of O2O commerce, which is also regarded as one special channel. However, the other two constructs focus on channel integration, which has a significant effect on consumer behaviour in multi-channel operations. Based on our findings, researchers can further explore the role of the two key constructs in consumer behaviour for specific O2O commerce types or the omnichannel pattern, which is described in detail in Section 6.

In addition, we fill the first research gap by uncovering the influencing mechanism of PE and IOOI on consumer behaviour in O2O commerce, which demonstrates strong predictability of PE and IOOI. PE is confirmed as an important determinant to lower perceived risk level in the O2O commerce context, and thus, the effects of perceived risk on perceived value and use intention are no longer significant, which is similar to the research in the online-offline channel integration model (Herhausen et al., 2015). We validate an effective measure to lower perceived risk, which extends existing knowledge about perceived risk theory and advances the findings of other studies (Chen et al., 2019; Yang et al., 2015). The study also illuminates the specific functions of PE and IOOI by which other researchers can further confirm in O2O merchants' operations.

Furthermore, we incorporate both economic and technological attributes into a more comprehensive research model to explain users' behaviour with the dual roles of both consumers and IT innovation adopters, which fills the second gap mentioned in the introduction section. Previous studies generally focus on just one type of attributes of innovation acceptance. For example, Kim et al. (2010) examine the technological factors affecting the use of mobile payment, Oh, Chung, and Yoon (2014) test the influences of the technology readiness on the adoption of mobile Internet services, and Park and Kim (2014) also investigate the effects of technological attributes on mobile cloud service adoption. Additionally, some studies explore user adoption of mobile commerce from economic attributes (Chiu et al., 2014; Kim & Oh, 2011; Kim et al., 2007; Kleijnen et al., 2007). Therefore, our study provides theoretical relevance for exploring the acceptance of IT innovations from both technological and economic perspectives.

Finally, the positive relationships between perceived usefulness and use intention, perceived ease of use and attitude, and perceived ease of use and perceived usefulness are also confirmed in the O2O commerce context, which is different from the work of Liu and Li (2011) and Pagani (2011). This finding demonstrates that the two classical constructs of TAM may present different utility in different IT innovation contexts.

5.3. Managerial implications

The findings also provide some practical insights for businesses and managers. To a large extent, the success of O2O commerce depends on enriching consumer experience and pervasive information interaction between online and offline channels. Therefore, to prompt consumer use of O2O, merchants should introduce some technological innovations (e.g., artificial intelligence capabilities) into its operations from both online and offline sides.

5.3.1. Strategies for physical experience

In O2O commerce, merchants are encouraged to provide opportunities for consumers to experience the goods and services offered in physical stores, which is also an opportunity for merchants to impress customers. To create an impressive experience for consumers, first, O2O merchants have to clarify the mission and function of their physical experience centres. The purchase could be of a tangible or intangible product. For tangible products, O2O retailers can provide pre-sales services such as demonstration, trial, and consulting and post-sales services such as technology support, maintenance, delivery and distribution, and return and exchange. The services offered will depend in part on the function positioning of their experience centre. However, for service O2O merchants, the physical experience is quite different. In the service sectors, consumers' physical experience is integrated into consumption. Here, merchants also need to clarify what impression they want to create after consumers experience their service (e.g., friendly, high-tech impression, and high personalization) and then specify the service content.

Furthermore, O2O merchants may provide the facilities and equipment for consumers to experience their goods and services and exploit the opportunity to showcase their knowledge, experience and competence in the product/service. For example, they can provide some sample machines or checking equipment for testing. Beyond that, a setup of a highly personalized experience centre with the right atmosphere and decoration could further influence a positive outcome.

In addition, the services or goods consumers experience in stores should be in line (if not enhanced) with their online specification. Even the physical environment and style should be consistent with its online stores. Thus, consumers will not worry about the inconsistency between online and offline offerings, and they can feel free to experience the goods and services in a physical store or a service outlet, which can make an experiential difference in their O2O consumption.

5.3.2. Strategies of IOOI in O2O commerce

IOOI is another important technological feature of O2O commerce. In the process of the purchase transaction, consumers should be able to easily switch between online and offline modes and obtain online/offline information (experience) freely, which are the key characteristics of IOOI.

IOOI makes it possible for merchants to realize the collaboration and coordination between online and offline operations. To ensure the success of IOOI, merchants or O2O platforms are encouraged to adopt secure cloud computing technology. Physical stores' product specification, pricing, ordering and inventory information should be completely consistent with their corresponding online store. Since merchants commonly have many physical outlets, secure cloud platforms are applied to maintain data synchronization. With QR code scanning via smartphones or interactive interfaces of the terminals on the shelves, in-store consumers should be able to access other consumers' recommendations, including online comments, ratings, and sales records

in real time or to place an online order seamlessly. Online order details should be easily confirmed by merchants. The identity of consumers should also be swiftly authenticated in physical stores. Additionally, once an order is generated in a merchant's online system, the merchants should be able to respond to the orders in a timely fashion such that consumers may subsequently be able to completely track the orders online in real time.

For technologically more advanced merchants, given the availability of high-speed 5 G mobile networks, they can adopt virtual reality (VR) technology to allow consumers to integrate the virtual and real world for enhancing the consumer experience (Zhang, Wu, & Liu, 2019). For example, tourist attractions could be more magically experienced by tourists using VR technology. The utilization of VR could potentially be the frontier of IOOI in O2O commerce.

With the implementations of physical experience and IOOI, merchants can maximize the potential of O2O commerce. For example, Uniqlo has coordinated online and offline channels to a seamless "click and collect" model in China, which has demonstrated great success in sales and profitability (Wade & Shan, 2018). Our findings in this study provide insightful empirical evidence for successful O2O practice.

6. Conclusions

This study explores consumer adoption of O2O commerce based on perceived value theory and the technology acceptance model and examines the role of the unique features of O2O commerce in consumer adoption behaviour. We investigate the two unique constructs of O2O commerce, physical experience and the integration of online and offline information, which are confirmed as two antecedents of perceived value, perceived benefit, and perceived usefulness based on TAM and PVT. In addition, physical experience is shown to be an alleviator of perceived risk in an O2O context.

6.1. Limitations and directions of future research

Although our research describes the common traits of O2O commerce, we use data exclusively from China, and the observed behaviour could be influenced by local culture, customs, technology, and economy development. In addition, this study does not differentiate among the types of retail offerings (luxury vs. non-luxury products, tangible goods and intangible services). Future studies can investigate more specific product types in O2O commerce operating in different geographical settings to confirm the generalizability of the current findings.

Since there are many characteristics of O2O commerce, future studies should pay more attention to specific types, including location-based O2O commerce and mobile service O2O commerce. The specific characteristics may have other features. For example, location awareness and contextual service may play interesting roles in O2O commerce in addition to physical experience and information integration.

Based on our findings, future research may also investigate the effects of PE and IOOI on merchant's operation and performance. Of course, improving the O2O merchants' performance via enhanced customer experience/personalization and interactions in multichannel platforms are areas that O2O can improve by tapping into advanced technologies.

Although PE is validated as a compelling predictor of O2O consumer behaviour, its effects may vary in the different phases involved in purchasing activities. How PE exerts influence in the different stages of future O2O commerce could be another future direction. For tangible goods and intangible services, PE may play different roles in consumer behaviour, which is also another future research topic.

Finally, the omnichannel operation has been the most common alternative to the retailing giants, so how information integration affects channel integration should also be covered in future studies.

CRediT authorship contribution statement

Yongqing Yang: Conceptualization, Methodology, Software, Validation, Visualization, Investigation, Supervision, Formal analysis, Writing - original draft, Writing - reviewing & editing. **Yeming Gong:** Methodology, Data curation, Formal analysis, Visualization, Writing - reviewing & editing. **Lesley Land:** Methodology, Visualization, Writing - reviewing & editing. **Thomas Chesney:** Methodology, Visualization, Writing - reviewing & editing, Yeming Gong, Lesley Land, Thomas Chesney" does not match the list of acceptable roles. Please choose a role from the below list for this author: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Writing - original draft; Writing - review & editing.

Declaration of Competing Interest

None.

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Appendix A. Measures of constructs

Physical Experience (PE)

PE1: I can have physical experience in a real store.
PE2: I can check the offline offerings with the online description in a real store.
PE3: I can confirm the quality and performance of the offerings in a real store.
PE4: I can try the goods or services to see whether meeting my needs and expectations or not in a real store.

Integration of Online and Offline Information (IOOI)

IOOI1: The online finished order can be confirmed effectively by merchants offline.
IOOI2: The online ID of consumers can be confirmed offline conveniently.
IOOI3: The offline information of products and inventory is simultaneously related to online information.
IOOI4: Offline consumer experience could be posted online promptly.

IOOI5: The online information about sales, comments, etc. is available to consumers in the store.
IOOI6: Online orders can be responded and reminded promptly by merchants.

Perceived Benefit (PB)

PB1: O2O commerce makes me get both online information and offline physical experience.
PB2: The purchase price is much lower via O2O commerce than traditional shopping.
PB3: O2O commerce provides me with great flexibility in shopping.
PB4: I can buy genuine products with less effort, time, and money with O2O consumption.
PB5: I achieved a more satisfactory purchase through O2O pattern.

Cognitive Effort (CE)

CE1: It is complicated for me to use the O2O pattern.
CE2: It may take lots of effort to conduct shopping via O2O pattern.
CE3: It is difficult to clarify the detail of O2O commerce process.
CE4: It bothers me to shop via this approach.

Perceived Risk (PR)

PR1: The products or services purchased via O2O commerce are riskier in quality, size, performance, and genuineness than other methods of shopping.
PR2: Privacy information may more easily be exposed to the use of O2O shopping comparing with other shopping ways, such as personal information, sensitive information, and so on.
PR3: This purchase via O2O incurs my concern about the security of information, privacy, and capital.
PR4: The use of O2O commerce may lead to a financial risk to me, such as the exposure of checking account and passwords and return Difficulties, compared with other shopping methods.
PR5: There is a risk that the offering purchased via O2O commerce could not meet my needs or expectations.

Perceived Value (PV)

PV1: Considering the benefit, cost, and risk, I think O2O commerce is valuable.
PV2: Compared to the effort put into it, the use of O2O commerce is worthwhile to me.
PV3: It provides me with more benefits than sacrifices.
PV4: Overall, the use of O2O commerce delivers good value to me.

Perceived Usefulness (PU)

PU1: O2O commerce makes it easier to buy the desired product than pure e-commerce or brick-and-mortar stores.
PU2: The use of O2O commerce enables me to buy genuine products more economically.
PU3: The use of O2O commerce allows me to buy more fitted products with more attractive conditions.
PU4: O2O commerce makes it viable to buy a high-quality product in a real store at an Internet price.

Perceived Ease of Use (PEU)

PEU1: It is easy to use the O2O system.
PEU2: The operation processes of O2O commerce are understandable and clear.
PEU3: It is easy to purchase via O2O commerce for me.
PEU4: It is easy to be skilful at ordering via O2O commerce.

Attitude to O2O (AD)

AD1: It is a good idea to purchase via O2O commerce.
AD2: My perception of O2O commerce is positive.
AD3: I am in favour of the O2O purchase method.

Use Intention (UI)

UI1: I am willing to use the O2O pattern to purchase.
UI2: I intend to use an O2O pattern to shop if it is possible.
UI3: I expect to use an O2O pattern in shopping.

Appendix B

Table B1
Rotated component matrix.

Items	Components							
	1	2	3	4	5	6	7	8
PE1	0.154	−0.143	0.131	0.098	0.151	0.757	0.031	0.055
PE2	0.314	−0.041	0.153	0.118	0.066	0.781	0.028	0.023
PE3	0.469	0.049	0.100	0.112	0.098	0.692	0.097	0.039
PE4	0.465	0.049	0.070	0.132	0.150	0.651	0.102	0.122
IOOI1	0.661	−0.132	0.183	0.077	0.069	0.245	0.060	0.159
IOOI2	0.604	−0.144	0.219	0.144	0.146	0.089	0.138	−0.018
IOOI3	0.683	0.030	0.027	0.018	0.174	0.245	0.142	0.117
IOOI4	0.748	0.014	0.080	0.166	0.160	0.130	−0.037	0.031
IOOI5	0.681	0.081	0.017	0.070	0.169	0.198	0.017	−0.087
IOOI6	0.688	−0.071	0.093	−0.003	0.191	0.114	0.072	0.151
PU1	0.225	−0.101	0.294	0.157	0.696	0.000	0.103	0.133
PU2	0.218	−0.032	0.113	0.074	0.805	0.152	0.141	−0.089
PU3	0.166	0.004	0.115	0.120	0.796	0.136	0.120	0.094
PU4	0.295	−0.036	0.078	0.110	0.706	0.110	0.019	0.155
PEU1	0.119	−0.209	0.694	0.139	0.078	0.236	0.076	0.140
PEU2	0.033	−0.128	0.829	0.104	0.132	0.147	0.135	0.036
PEU3	0.217	−0.163	0.756	0.208	0.209	−0.019	0.130	0.114
PEU4	0.190	−0.159	0.801	0.211	0.149	0.089	0.043	0.098
AD1	0.259	−0.108	0.278	0.320	0.153	0.084	0.226	0.557
AD2	0.038	−0.039	0.065	0.068	0.058	0.054	0.070	0.856
AD3	0.183	−0.083	0.284	0.388	0.188	0.122	0.257	0.588
CE1	−0.014	0.834	−0.131	−0.090	−0.021	−0.076	0.023	−0.130
CE2	−0.040	0.862	−0.029	−0.131	−0.023	0.005	−0.078	0.098
CE3	0.003	0.846	−0.195	−0.117	0.023	−0.107	−0.018	−0.108
CE4	−0.063	0.783	−0.209	−0.169	−0.116	0.058	−0.071	−0.016
PV1	0.081	−0.123	0.118	0.689	0.243	0.113	0.068	0.108
PV2	0.067	−0.211	0.177	0.726	0.102	0.123	0.165	0.053
PV3	0.106	−0.087	0.183	0.777	0.015	0.085	0.241	0.058
PV4	0.137	−0.152	0.118	0.711	0.077	0.067	0.214	0.151
UI1	0.244	−0.034	0.112	0.321	0.115	0.069	0.691	0.212
UI2	−0.016	−0.086	0.138	0.228	0.153	0.055	0.818	0.076
UI3	0.118	−0.017	0.092	0.170	0.084	0.060	0.855	0.062
Eigenvalues	9.913	3.485	2.290	1.730	1.494	1.165	1.106	1.020
% of Variance	30.979	10.891	7.156	5.406	4.668	3.642	3.455	3.187
Cumulative %	30.979	41.87	49.026	54.433	59.1	62.742	66.197	69.384

Extraction Method: Principal Component Analysis.

Appendix C

Table C1
The VIFs of variables.

Factors	AD	CE	IOOI	PB	PE	PEU	PR	PU	PV	UI
AD										1.611
CE									1.132	
IOOI				1.738		1.000		1.293		
PB								1.466	1.211	
PE				1.738			1.000		1.307	
PEU	1.247							1.430		
PR									1.226	1.052
PU	1.247									1.275
PV										1.544
UI										

Appendix D

Table D1
The full collinearity test.

Factor	AD	CE	IOOI	PB	PEU	PR	PU	PV	PE	UI
AD		1.954	1.931	1.919	1.86	1.927	1.921	1.858	1.928	1.823
CE	1.333		1.379	1.310	1.191	1.270	1.335	1.331	1.397	1.389
IOOI	2.081	1.836		2.100	2.069	2.067	1.933	2.073	1.585	2.119
PB	2.138	1.750	2.239		2.140	1.943	1.862	2.004	2.041	2.128
PEU	1.746	1.674	1.817	1.743		1.739	1.772	1.823	1.779	1.808
PR	1.144	1.141	1.208	1.119	1.098		1.115	1.264	1.192	1.196
PU	1.746	1.62	1.672	1.587	1.749	1.811		1.769	1.848	1.766
PV	1.993	1.942	2.077	1.887	2.070	1.995	2.045		2.027	1.940
PE	1.870	1.619	1.443	1.850	1.792	1.858	1.867	1.896		1.891
UI	1.566	1.613	1.658	1.586	1.638	1.630	1.631	1.536	1.657	

Appendix E

Table E1
Heterotrait-Monotrait ratio (HTMT).

Factors	AD	CE	IOOI	PEU	PU	PV	PE
CE	0.299						
IOOI	0.493	0.167					
PEU	0.604	0.448	0.455				
PU	0.506	0.182	0.623	0.504			
PV	0.676	0.424	0.404	0.563	0.449		
PE	0.442	0.146	0.770	0.432	0.476	0.414	
UI	0.614	0.200	0.370	0.421	0.415	0.649	0.321

Appendix F

Table F1
The loading of factors.

Factors	AD	CE	IOOI	PE	PEU	PU	PV	UI
AD1	0.883							
AD2	0.625							
AD3	0.914							
UI1								0.873
UI2								0.868
UI3								0.851
CE1		0.842						
CE2		0.851						
CE3		0.886						
CE4		0.854						
PE1				0.767				
PE2				0.848				
PE3				0.871				
PE4				0.855				
OO1			0.772					
OO2			0.716					
OO3			0.753					
OO4			0.760					
OO5			0.676					
OO6			0.750					
PEU1					0.796			
PEU2					0.845			
PEU3					0.874			
PEU4					0.894			
PU1						0.831		
PU2						0.843		
PU3						0.840		
PU4						0.788		
PV1							0.760	
PV2							0.822	
PV3							0.831	
PV4							0.807	

Appendix G

Table G1
Cross-validated redundancy test.

Construct	SSO	SSE	Q^2 (1-SEE/SSO)
Attitude	1,248.000	999.471	0.199
Cognitive Effort	1664.000	1664.000	
IOOI	2496.000	2496.000	
Perceived Benefit	1,248.000	1,103.935	0.115
Perceived Ease of Use	1664.000	1,486.194	0.107
Perceived Risk	1664.000	1,625.559	0.023
Perceived Usefulness	1664.000	1,189.938	0.285
Perceived Value	1664.000	1,238.607	0.256
Physical Experience	1664.000	1664.000	
Use Intention	1,248.000	930.540	0.254

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