E-consumer adoption of innovative last-mile logistics services : a comparison of behavioural models

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Abstract

This paper investigates consumers' behavioral responses to innovative last-mile delivery services (self-collection as an example) in the emerging e-commerce market of Singapore. Anchored on theoretical insights from attitude theories and Diffusion of Innovation (DOI) theory, the mediating role of the e-consumers' attitude between their beliefs and their behavioral intention is examined in three competing models. A total of 209 valid survey responses are collected and the data are analyzed using Structural Equation Modelling (SEM). Our study suggests an irreplaceable mediating role of attitude in determining the desirability of innovative last-mile delivery services. In particular, a sense of relative advantage and compatibility should be communicated to e-consumers. With an inter-disciplinary effort to integrate consumers' behavior in the management of last-mile logistics service innovations, this study contributes to the theoretical synthesis of these two streams of research. It also represents a unique angle to manage e-consumers' service concerns from the perceptual and the behavioral perspectives.

Keywords: Consumer adoption behavior; E-commerce; Innovation diffusion; Logistics service innovation; Consumer attitude; Self-collection; Last-mile logistics; Model comparison

1 Introduction

Under the mega trends of globalization and deregulation, the logistics industry is now dealing with intensive competitive pressure as well as increasing customer demand, which force the industry to handle things differently to develop service innovations (Busse and Wallenburg, 2011; Da Mota Pedrosa, 2012). While innovation is defined as an idea, practice, or object that is perceived as new by an individual or a group (Rogers, 1995), logistics service innovations refer to logistics-related services, basic or complex, that are new and helpful to a particular focal audience (Flint *et al.*, 2005). Examples of logistics innovations in recent decades include Electronic Data Interchange (EDI), Cross-Docking, Radio Frequency Identification (RFID), and Collaborative Planning, Forecasting and Replenishment (CPFR) (Fu, 2016; Grawe, 2009). By adopting innovative services, firms can increase productivity and attain higher service levels without expending more resources (Prahalad & Ramaswamy, 2004).

Despite the obvious significance and wide applications, service innovations have not been attracting much attention in logistics management (Flint *et al.*, 2005; Wagner and Sutter, 2012), and theory-driven research is especially lacking (Grawe, 2009). More recently, with the strong proliferation of e-commerce worldwide, innovative last-mile delivery solutions are also emerging, such as drone delivery (Murray and Chu, 2015), crowd-sourcing (Li & Hu, 2017), electric freight vehicle (Lebeau *et al.*, 2016), reverse logistics (Hazen *et al.*, 2011) and self-collection via Automated Parcel Station (APS) (Morganti *et al.*, 2014a, 2014b). As different from the logistics service innovations applied to the upstream supply chains in the intra-organizational or the inter-organizational context, last-mile logistics is a consumer-oriented business with a strong behavioral component (Collins, 2015). A thorough understanding of consumers' perceptions and behavioral responses towards the service innovations is imperative in providing desirable services that fulfil consumers' needs (Buettner, 2017; Collier & Kimes, 2012; Hazen *et al.*, 2012; Vogel *et al.*, 2017). However, this aspect of consumer behavioral element has rarely been addressed, which is the major knowledge gap in the extant literature of the e-commerce logistics. To fulfil this gap, this study investigates end-consumer adoption behaviors of innovative e-commerce logistics services.

In the broader innovation adoption studies, several models exist with regards to consumer adoption behaviors. Diffusion of Innovation (DOI) theory and attitude theories (such as Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM)) are two major schools of thoughts (Hanafizadeh *et al.*, 2014). More specifically, DOI theory proposes a comprehensive set of consumer beliefs (perceived characteristics of innovations, i.e., relative advantage, compatibility, complexity, observability and trialability) that has a direct effect on technology acceptance outcomes (Agarwal & Prasad, 1997; Baek *et al.*, 2017; Karahanna *et al.*, 2006; Rogers, 1995). Attitude theories, on the other hand, posit that the beliefs-to-adoption relationship is mediated by consumers' attitude towards innovations (Ajzen, 1991; Davis, 1989; Fishbein & Ajzen, 1975). Although these theories are often considered to complement each other (Moore & Benbasat, 1991; Petschnig *et al.*, 2014), there lies a major discrepancy between the two streams of theories with regards to the mediating role of attitude (Agarwal and Prasad, 1997).

In our study, competing models anchored on different theories are proposed to examine the role of consumers' attitude towards the adoption of innovative e-commerce delivery services. By so doing, we contribute to the extant literature in the following ways. Practically, we identify critical focal points (various consumers' beliefs and attitude) that influence the perceived desirability of the innovative services, thus providing practical insights on the long-term

sustainable management of logistics services from consumers' behavioral perspective. Particularly, the comparative influences of system characteristics (as perceived beliefs of innovations) and consumers' mind-set (attitude) on consumer adoption behaviors are evaluated and their complementary effect is assessed. Theoretically, by focusing the research on last-mile e-commerce logistics services, we enrich the sparse literature on logistics service innovations with the consumer behavioral element, extending the theorization of logistics innovations to the context of e-commerce delivery services. In addition, we systematically test the nomological network comprising beliefs, attitude and adoption intention using competing models. With a special focus on the mediating role of consumers' attitude, this study provides additional theoretical insights and empirical proof with regards to the validity of competing models of consumer adoption behavior.

While last mile logistics innovations are of diverse characteristics and in difference stages of development, Automated Parcel Station (APS) is a prominent application which has been made readily available to consumers. Examples of APS are ByBox in UK, PackStation in Germany (Dablanc *et al.*, 2015) InPost in Poland (Iwan *et al.*, 2016), and more recently, POPStation in Singapore (where the present study is conducted) (Choo, 2016). Hence, this study treats APS as a representative example of last-mile logistics innovations. By empowering consumers to self-collect their parcels at their convenient time, APS service not only allows for more consolidated deliveries, but also achieves a higher successful rate of first-time deliveries (Edwards *et al.*, 2010; Savelsbergh & Woensel, 2016; Song *et al.*, 2013). To this end, the APS service is beneficial from both operational and societal perspectives (Morganti *et al.*, 2014a, 2014b; Punakivi *et al.*, 2001). It represents a fundamental shift in the nature of e-commerce logistics as compared to conventional deliveries that entail many carriers making home deliveries to fragmented destinations of end consumers and cost hours of consumers' waiting time for parcel reception. Figure 1 depicts and compares the functionalities between home delivery and APS self-collection. However, the feasibility of any innovative service provision should always be balanced against the perceptions and behavioral responses of the consumers (Collier & Kimes, 2012). The benefits of the APS service cannot be realized without sufficient buy-in from consumers, whose behavioral responses (a shift from conventional home delivery) remain to be explored (see Figure 1). Herein, the APS service serves as a well-fitting observation basis to examine consumer behavioral responses to last-mile logistics service innovations.

Figure 1: Comparison between home delivery and APS self-collection

The remainder of the paper is organized as follows. The literature on logistics service innovations and consumer adoption behaviors is first reviewed, and competing models are then developed based on various theories on consumer behavior. Deploying the analytical technique of Structural Equation Modelling (SEM), the models are assessed by both non-nested and nested model comparisons. The paper concludes with academic and managerial implications as well as suggestions for future work.

2 Literature Review

2.1 Research Gap 1: The Missing Component in Managing Logistics Service Innovations

In general, academic research on logistics service innovations is limited (Wagner & Sutter, 2012). At the beginning of the last decade, logistics researchers started to address innovations in the logistics industry by focusing on how logistics firms generate innovative concepts and develop the innovative capacity. Flint *et al.* (2005) produced one of the pioneer works in this field, in which they developed a framework explaining the process of innovation generation and development within a logistics firm. This framework has been refined and tested in subsequent studies (Flint *et al.*, 2008) and similar studies can also be found in Wagner, (2008), Wagner, (2013), Grawe, (2009), Lee *et al.*, (2011), Da Mota Pedrosa, (2012), Da Mota Pedrosa *et al.*, (2015), Wagner & Sutter, (2012), and Su *et al.*, (2008).

Essentially, the innovation process consists of idea generation, product development, pilot testing, and more importantly, management of innovation diffusion / adoption among customers (Flint *et al.*, 2005). To complement early studies, recent logistics innovation research focuses on the interactions between firms' performance (e.g., competitive advantage) and diffusion of logistics service innovations (Grawe, 2009; Hazen *et al.*, 2011). It is argued that when firms observe the competitive advantage enjoyed by another firm due to innovation, those firms will subsequently seek to adopt the same innovation, which perpetrates the diffusion of the innovation within the industry (Grawe, 2009). Herein, the "theory of logistics innovation" is emerging, addressing the end-to-end process from logistics service innovation generation to logistics service innovation diffusion.

However, it is worth noting that majority of the prevailing logistics innovation research is restricted to an intra- or inter-organizational context, i.e. B2B, where generation / diffusion of service innovation is mainly an outcome of business considerations. Indeed, logistics is largely a B2B industry, thus innovative logistics services targeting at end-consumers are significantly less compared to those at the upper stream. Nevertheless, with the strong proliferation of B2C e-commerce globally, last-mile logistics is increasingly offering innovative services that interact directly with end-consumers (Bhattacharjya *et al.*, 2016). Given the omni-channel logistics offerings, the end-consumers of logistics services, or "logsumer" as termed by DHL, have possessed more and more power to dictate how their last-mile needs are to be organized (DHL, 2013, 2015). A clear understanding of "logsumer" behaviors in response to innovative logistics service offerings becomes relevant.

Therefore, notwithstanding the advancement in the theorization of logistics innovation, the behavior responses of consumers are a critical component that is currently missing in the emerging theory of logistics service innovations. Given the rising power of end consumers in the B2C e-commerce market, it is especially timely and pressing to incorporate studies on consumer adoption behaviors into the research of logistics service innovations. Ultimately, in

the context of last-mile logistics, it is end-consumers' perceptions and evaluations of the innovation that motivate its development and determine its diffusion.

2.2 Research Gap 2: The Ambiguous Role of Attitude in Consumer Adoption Theory

Since the perspective of consumer adoption has rarely been addressed in logistics management literature, insights could be borrowed from other well-established research fields in consumer adoption behaviors. Intensive research efforts have been applied to a large variety of disciplines, such as IT system adoption, healthy lifestyle adoption, adoption of green purchase behavior, etc. The Diffusion of Innovation (DOI) theory and attitude theories (such as Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB)) emerge, among others, as two major theories that explain consumer adoption behaviors (Hanafizadeh *et al.*, 2014). While TRA and TPB provide a fundamental understanding of almost all human behaviors (Ajzen, 1991; Fishbein and Ajzen, 1975), DOI theory focuses specifically on individual's adoption process of innovations.

A major difference exists between attitude theories and DOI theory. In particular, while, in both TRA and TPB, the construct of attitude is explicitly included as a mediator between beliefs and adoption intention (Agarwal and Prasad, 1997), DOI theory suggests a direct relationship between the perceived characteristics of innovations (beliefs) and the outcome of the adoption decision (Agarwal & Prasad, 1997; Choudhury & Karahanna, 2008; Rogers, 1995). However, the clear distinction between the two streams of theories is increasingly softened, which leads to theoretical integration, but also ambiguity, especially in the mediating role of attitude. Some researchers have introduced the attitude construct as a mediator to the direct relationship in DOI studies (Petschnig *et al.*, 2014; Taylor & Todd, 1995), claiming that DOI theory clearly includes "innovation evaluation" and "attitude formation" as a part of an innovation diffusion process. However, the DOI theory is silent on how the attitude is formed and how it contributes to adoption or rejection decisions (Agarwal & Prasad, 1997). Hence, whether it is theoretically-sound to include attitude as a mediator to DOI theory requires further validation. On the other hand, the mediating role of attitude is not consistently maintained, even in research based on attitude theories. For example, drawing upon TRA, TAM conceptualizes attitude as a central mediator in explaining individuals' adoption behavior of technology-related systems (Davis, 1989), yet Davis *et al.* (1989) found that certain beliefs (perceived usefulness) can impact on the actual use irrespective of attitude. A refined TAM2 in subsequent work further excludes attitude from its theoretical arguments, relating beliefs directly to usage intentions (Karahanna *et al.*, 2006; Venkatesh & Davis, 2000).

Table 1: Summary of selected studies

Source	Theory	Innovation	Innovation characteristics	Adoption outcome	Included attitude as a mediator?	Considered alternative model?
Agarwal & Prasad, 1997	DOI, TAM	World Wide Web	RAD, PEOU, CPA, TRI, Visibility, Result demonstrability, Image, Voluntariness	Current use, Future use intention	No	No
Chen & Huang, 2016	TAM, TRA, TPB	Domestic technology	Social norm, PU, PEOU, PBC	INT	Yes	Yes
Choudhury & Karahanna, 2008	DOI	Auto insurance transactions	RAD	INT	No	Yes
Deb & Lomo-David, 2014	TAM, DOI	Mobile-banking	PEOU, PU, Trust, Society condition, Facilitating condition	INT	Yes	No
Karahanna <i>et al.</i> , 1999	DOI, TAM	Software package	PU, Image, CPA, PEOU, Visibility, Result demonstrability, TRI	INT (Adoption and continuance)	Yes	Yes
Karahanna <i>et al.</i> , 2006	DOI, TAM	Customer relationship management system	CPA, PU, PEOU	Actual use	No	No
Kaushik & Rahman, 2015	TAM	Self-service banking	PEOU, PU, Need for interaction, Perceived risk	INT	Yes	No
Koenig-Lewis <i>et al.</i> , 2010	DOI, TAM	Mobile-banking	CPA, PU, PEOU, Cost, Credibility, Trust, Risk	INT	No	No
Kulviwat <i>et al.</i> , 2014	TAM	Tablet devices	PU, PEOU	ATT	N/A	Yes
Lee, 2012	TRA	Electronic toll collecting	PEOU, Price fairness, Satisfaction, Fashion consciousness, Risk	INT	Yes	No
Petschnig <i>et al.</i> , 2014	DOI, TAM, TPB	Alternative fuel vehicle	RAD, CPA, PEOU, OBS, TRI, Ecology, Image, Design, Profitability, Risk, Personal norm, Social Norm	INT	Yes	No
Taylor & Todd, 1995	DOI, TRA, TPB	E-device to make VCR	RAD, CPL, CPA, Normative influence, Efficacy, Facilitating condition	INT	Yes	Yes
Watchravesringkan <i>et al.</i> , 2010	TPB	Fashion innovation	PU, PEOU, Innovativeness, Fashionability	INT	Yes	No

RAD: Perceived Relative Advantage, CPA: Perceived Compatibility, CPL: Perceived Complexity, TRI: Perceived Trialability, OBS: Perceived Observability, PU: Perceived Usefulness, PEOU: Perceived Ease of Use, INT: Intention to use / adopt, ATT: Attitude towards adoption

Clearly, there are ambiguities concerning the mediating role of attitude in consumer adoption behaviors. A brief review on more recent adoption literature shows that attitude theories and DOI theory are viewed to be complementary (see Table 1). Much research has been devoted to identifying salient beliefs that influence individuals' adoption behavior (e.g., Karahanna *et al.*, 2006; Karahanna *et al.*, 1999; Koenig-Lewis *et al.*, 2010), whereas little attention has been paid to clarify the ambiguity of attitude as a mediator. In most studies, a single model is proposed and a confirmatory approach is taken to assess the empirical validity of the single model. Only a limited number of studies are conducted in an exploratory manner by proposing alternative models to accommodate different theories. Therefore, a knowledge gap exists with regards to the mediating role of attitude in the models of adoption behaviors.

In view of the knowledge gaps discussed above, this study aims to apply consumer adoption theories to the specific context of logistics service innovations by addressing the following questions. First, how does consumers' attitude towards the innovative logistics service influence the perceived desirability of the service and ultimately their decision to engage with the service? Second, what are the beliefs of innovations that are perceived as attractive features that promote consumer adoption of the last-mile service? Finally, how do consumers' beliefs and attitude interact to form their decision to adopt the service?

3 Proposed Competing Models

As very few studies can be found that are focused on adoption behaviors of last-mile logistics innovations, the present study anchors on insights of the broader adoption research, where a rich body of theoretical studies have been accumulated over decades of research. Theoretical insights from studies on general innovation adoption, management information system (MIS) adoption, and self-service technology (SST) adoption, are synthesized to build various competing models in explaining consumer adoption behaviors of last-mile logistics innovations. Their relevance to our research lies in the emphasis on an individual's receptivity to the new concept itself as well as to the service technologies, which is likely to be a major barrier of consumer adoption of innovative logistics services.

3.1 Salient Beliefs (Perceived Characteristics) of Innovation

According to Tornatzky & Klein's (1982) meta-analysis of more than 100 innovation studies, perceived relative advantage (RAD), perceived compatibility (CPA) and perceived complexity (CPL) are shown to be consistently related to an individual's adoption decision. Also, RAD and CPA are consistently among the best predictors of consumer adoption behaviors (Agarwal & Prasad, 1997; Karahanna *et al.*, 1999; Koenig-Lewis *et al.*, 2010; Moore & Benbasat, 1991; Petschnig *et al.*, 2014; Plouffe *et al.*, 2001; Rogers, 1995). On the other hand, a recent review by Weigel *et al.* (2014) indicated that CPL as a predictor of adoption behaviors failed to generalize across studies. Other recent studies also suggested an inconclusive result as to the predicting power of CPL (Duan *et al.*, 2010; Hameed & Counsell, 2014). This is probably due to the high penetration of technology into consumers' daily life so that the perceived complexity becomes a less significant factor. It should be pointed out that the focus of this study is not to provide an exhaustive list of salient beliefs of innovation but to include the most empirically salient ones for further examination. Hence, for the purpose of this study, only RAD and CPA are considered as consumers' salient beliefs of last-mile logistics innovations (APS in this case). Definitions of RAD and CPA are as follows (Rogers, 1995):

Perceived Relative Advantage (RAD): the degree to which an innovation is perceived as being better than its precursor;

Perceived Compatibility (CPA): the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters.

In the context of last-mile logistics innovation, we redefine RAD and CPA as follows:

RAD: the degree to which the innovative last-mile logistics service is perceived as a better alternative than its competing conventional service (for example, in the case of APS self-collection service, RAD refers to the degree to which consumers perceive it as a better alternative than home delivery).

CPA: the degree to which the innovative last-mile logistics service is perceived as being consistent with consumers' value, needs, lifestyle and past experiences (for example, a working professional may perceive APS self-collection service as being more compatible with his/her lifestyle than a non-working counterpart).

3.2 Model 1: An Application of DOI Theory

As discussed in the earlier section, the original DOI theory generally posits a direct relationship between consumers' perceived characteristics of innovations and the outcome of their adoption decision (Rogers, 1995). Empirical evidence on such a direct relationship can be found in relevant adoption studies, such as Agarwal & Prasad (1997), Choudhury & Karahanna (2008), and Koenig-Lewis *et al.* (2010).

Furthermore, building on an extensive review of eight prominent models, a Unified Theory of Acceptance and Use of Technology (UTAUT) is proposed by Venkatesh *et al.* (2003), which also suggests a direct relationship between individual's beliefs and the behavioral intention (Kurila *et al.*, 2016). UTAUT model has been shown to outperform the eight reviewed models in terms of explained variance. Although the omission of attitude construct in UTAUT model might be due to its application to a B2B context (a utilitarian-based decision) (Aldás-Manzano *et al.*, 2009), still, it serves as another powerful argument in favor of the direct relationship.

Notably, it is often overlooked that DOI theory relates perceived characteristics directly to actual behaviors (adoption/rejection, continuance/discontinuance) instead of behavioral intention (Agarwal & Prasad, 1997), whereas the majority of adoption studies use behavioral intentions as a predictor of actual behaviors. This "intention-behavior" association can be explained by cognitive dissonance theory (Festinger, 1957), which argues that perceived discrepancies between behavioral intention and actual behavior cause a psychological tension (cognitive dissonance). To minimize such a psychological tension, individuals tend to align their behavior with intention. To a certain extent, the association between intention and behavior has been taken for granted and has been adopted as a common practice (Bhattacharjee, 2001; Jeyaraj *et al.*, 2006). For the present study, the measurement of the level of the actual adoption might be difficult to obtain, as APS development is still at an early stage and consumers are in pre-adoption stage deciding on whether to adopt the innovation. Thus, in this paper, the construct of adoption intention is used instead of the actual adoption behavior.

Therefore, the following model is proposed:

Model 1: Consumers' perceived characteristics (a. RAD, and b. CPA) of last-mile innovations are directly related to their adoption intention (see Figure 2).

Figure 2: Model 1 (An application of DOI theory – no mediation)

3.3 Model 2: An Application of Attitude Theories

Contrary to DOI theory, the causality of “belief-attitude-intention” is fundamental to all attitude theories. For example, TRA posits that an individual’s attitude towards an object is influenced by his/her readily accessible beliefs, and attitude is one of the main antecedents of an individual’s behavioral intention (Fishbein and Ajzen, 1975). The central argument is that the perceptual beliefs only contribute to the attitude formation and attitude is the immediate predictor of behavioral intention. Empirically, the attitude-mediated relationship is well reflected in adoption literature of consumer studies and its explanatory power has been well demonstrated (Chen & Huang, 2016; Davis, 1989; Jeyaraj *et al.*, 2006; Karahanna *et al.*, 1999; Kaushik & Rahman, 2015; Petschnig *et al.*, 2014; Taylor & Todd, 1995).

Herein, we propose the following as a competing model:

Model 2: The relationship between consumers’ perceived characteristics (RAD and CPA) of last-mile innovations and their adoption intention is fully mediated by consumers’ attitude towards the innovations (see Figure 3).

Figure 3: Model 2 (An application of attitude theories – full mediation)

3.4 Model 3: A Combination of DOI and Attitude Theories

While the theoretical support and empirical evidence can be found for both the direct model and the fully mediated model, a hybrid model is further proposed combining structural relationships in Model 1 and Model 2. Herein, a partially mediated model is presented. It also serves as a baseline model for comparative analysis to be conducted in the later section.

Model 3: The relationship between consumers’ perceived characteristics (RAD and CPA) of last-mile logistics innovations and their adoption intention is partially mediated by consumers’ attitude towards the innovations (see Figure 4).

Figure 4: Model 3 (A combination of DOI and Attitude Theories – partial mediation)

4 Methodology

4.1 Survey Design

Street intercept surveys were conducted, targeting online consumers who are either current users of APS (adopters) or non-users (non-adopters). To ensure a good representation of the overall population, the survey was conducted at selected locations in different parts of Singapore (east, south, west, north and central areas) and for several time periods of the day/week (morning, afternoon and evening; weekday and weekend). More specifically, the survey consists of four sections. Section one was a brief introduction of the APS service regarding its working mechanism and availability in Singapore (where the study is conducted). A picture of POPStation (the dominant APS system in Singapore) and its operational concept were used as an illustration on the cover page of the survey questionnaire. Unlike the conventional home delivery, the freight operator would emplace the e-commerce parcel in one of the lockers of the POPStations of the consumer's choice, and a notification message (containing a password, a barcode and the location of the POPStation) would be sent to the consumer via a registered hand-phone number, informing that the parcel is ready for collection. By keying in the consumer's hand-phone number (or scanning the provided barcode) and the matching password at the system interface of the POPStation, the locker containing the consumer's parcel would open automatically and the consumer can then self-collect the parcel (<https://www.mypopstation.com>).

In order to ensure that every respondent (particularly non-adopter) was completely clear with the concept of APS, the surveyors were instructed on the detailed working mechanisms of APS during the training process. They were in turn requested to verbally brief the respondents on the parcel collection process using the illustration on the survey questionnaire's cover page before the survey. Section two of the survey contained two streaming questions: the first disqualified respondents who never shopped online and the second directed adopters and non-adopters to subsequent sections designed separately for them. While adopters were asked to recall their motivations for trying out the APS for the first few times, non-adopters were asked to give answers based on their overall understanding. Section three and Section four were the main parts of the survey. Section three contained questions regarding consumers' perceptions, attitude and intention of initial adoption of APS, and Section four collected data on respondents' personal attributes such as demographic information, online shopping habit and household composition.

4.2 Measurements and Pre-Testing

Existing validated scales are reworded to fit the context of APS adoption. Measurements for perceived characteristics of APS (4 items for CPA, and 5 items for RAD) were adapted from Moore & Benbasat (1991) and Meuter *et al.* (2005). A seven-point Likert scale from strongly disagree (1) to strongly agree (7) was used. In addition, following the conventional practice (Collier *et al.*, 2014; Collier & Sherrell, 2010; Dabholkar & Bagozzi, 2002), three items measuring attitudes towards adoption of APS used a seven-point semantic differential scale with end points of bad / good, unpleasant / pleasant, dislike / like. Similarly, three items measuring intention to adopt APS also used a seven-point semantic differential scale with end points of unlikely / likely, impossible / possible, probably not / very probably (see Appendix).

Ajzen & Fishbein (1980) suggested that in order to elicit salient beliefs for each new context, population, and behavior, free-response format interviews should be conducted by asking the

interviewees about the consequences of the behavior in question without any probing by the interviewer. As the adjusted measurements had never been applied in the context of APS adoption, to ensure their applicability to the present study, short interviews were first conducted with 40 randomly-selected adopters of APS. By doing this, the criterion validity was preliminarily confirmed, showing that the proposed measurement items reflected the salient beliefs of APS.

A group of 4 researchers in the related field (2 adopters and 2 non-adopters of APS) were asked to complete the questionnaires. Feedback was obtained about the length of the questionnaire, the format of the scales, construct validity and questionnaire ambiguity; necessary adjustments were made to the instrument accordingly. Furthermore, the survey was pre-tested in a class of 56 undergraduate students. An exploratory factor analysis (EFA) was conducted and two items (RAD 2 and CPA 3) were removed due to low factor loadings or cross loading issues (see Appendix). Another EFA test was conducted with the revised measurement items and the result showed that each item was loaded as expected on its respective construct. The Cronbach's Alpha for each construct was also calculated and all measurements showed an acceptable level of reliability with Cronbach's Alpha greater than 0.70 (Nunnally & Bernstein, 1994).

4.3 Sample Statistics

After the pre-testing, the formal street intercept survey was conducted and a total of 236 questionnaires were obtained, of which 18 were disqualified due to incomplete information being provided. Among the remaining 218 questionnaires, 9 respondents indicated that they had no prior online shopping experiences and were thus excluded. Of the 209 valid responses, 156 were from potential adopters (non-users) of APS and 53 were from actual adopters (users) of APS. Table 2 benchmarks our survey sample distribution against the overall population distribution of Singapore (Infocomm Media Development Authority, 2015; Singapore Department of Statistics, 2017).

Table 2: Respondents' profile

	Survey sample (Frequency)			Survey sample (%)	Singapore population (%)
	Users	Non-users	Total		
Age (years old)					
Below 24	30	86	116	56	33 ^a
25 to 49	22	59	81	39	45 ^a
Above 50	1	11	12	6	22 ^a
Gender					
Female	31	94	125	60	51 ^b
Male	22	62	84	40	49 ^b
Type of housing					
Public housing	42	120	162	78	80 ^b
Condominium	8	15	23	11	14 ^b
Landed property	1	10	11	5	6 ^b
Others	2	11	13	6	0 ^b
Ave number. of household members	3.3				3.4 ^b

^a These figures refer to the statistics of Singapore population who are internet users

^b These figures refer to the statistics of Singapore population in general

As the younger people are generally more internet-savvy and provide a better indication of the future trend, we specially targeted young people as survey respondents, which explains the notable discrepancy on the age distribution between our survey sample and Singapore (internet) population as a whole. In fact, based on the national statistics, approximately 80% of internet users are from population less than 49 years old. This is due to the significantly lower proportion of internet users for the age group above 50. Research elsewhere also reports that young people are typically early adopters of innovations, which eventually filter through to older age groups (Laukkanen *et al.*, 2007, Koenig-Lewis *et al.*, 2010). Except for the disparity on the age distribution, all other descriptive statistics between survey respondents and the Singapore overall population are largely consistent.

4.4 Measurement Reliability, Validity and Common Method Bias

A confirmatory factor analysis was conducted to determine the measurement model fit. With reference to Table 3 for the confirmatory factor analysis, the fit indices indicate that the measurement model is a good fit with the data ($\chi^2=113.174$, $df=59$, $\chi^2/df=1.918$; CFI=0.977, TLI=0.970, RMSEA=0.066, SRMR=0.042) (Hu & Bentler, 1999; Yuen *et al.*, 2016).

Table 3: Confirmatory factor analysis

Construct	Measure	Standardized factor loading	t-value	CR	AVE
RAD	RAD 1	0.774	***	0.882	0.651
	RAD 3	0.798	11.874		
	RAD 4	0.855	12.689		
	RAD 5	0.798	12.102		
CPA	CPA1	0.816	***	0.883	0.717
	CPA2	0.920	15.280		
	CPA4	0.799	12.702		
ATT	ATT1	0.933	***	0.952	0.869
	ATT2	0.945	25.783		
	ATT3	0.918	23.582		
INT	INT1	0.900	***	0.942	0.843
	INT2	0.890	19.693		
	INT3	0.963	23.498		

Note: Model fit indices: $\chi^2=113.174$, $df=59$, $\chi^2/df=1.918$; CFI=0.977, TLI=0.970, RMSEA=0.066, SRMR=0.042. *** denotes a constrained relationship to 1.00 in order for identification

Table 4: Descriptive statistics and correlations

	Mean	SD	CPA	RAD	ATT	INT
1. CPA	4.911	1.389	0.651 ^a	0.298 ^c	0.224	0.164
2. RAD	4.573	1.495	0.629 ^b	0.717	0.349	0.362
3. ATT	5.032	1.325	0.473	0.591	0.869	0.624
4. INT	4.669	1.548	0.405	0.602	0.790	0.843

Notes:

^a Values of average variance extracted are along the main diagonal

^b Correlations between constructs are below the main diagonal

^c Squared correlations between constructs are above the main diagonal

The measurement model was also evaluated for reliability, convergent and discriminant validity. Table 3 shows the composite reliability (CR) of the four constructs being above 0.7, indicating the measurements are reliable (Hair *et al.*, 2010). The standardized factor loadings and average variance extracted (AVE) were analyzed to assess the convergent validity (Hair *et al.*, 2010). It is found that all standardized factor loadings and AVE values exceed the recommended value of 0.5, which indicate good convergent validity. As for discriminant validity, the assessment was conducted by comparing the AVE values with the squared correlations (Hair *et al.*, 2010). As shown in Table 4, all AVE values are higher than the values of squared correlations. Hence, the discriminant validity is also supported.

In addition, as all constructs were measured using the questionnaire instrument, the results may be susceptible to common method bias (CMB). Several recommended procedures were followed to minimize the potential CMB (Podsakoff *et al.*, 2003). Statements were inserted in the questionnaire to assure participants that there were no right or wrong answers, and to encourage them to respond as honestly as possible. Harman's single factor test was also used. All measurement items were loaded on a single factor. The fit indices are as follows: $\chi^2=915.908$, $df=65$, $\chi^2/df=14.091$, CFI=0.642, TFI=0.570, RMSEA=0.251, SRMR=0.148. As

results indicate a considerable worse model fit, CMB is unlikely to be a major issue in this study.

5 Results

Two comparative studies and a structural path analysis are conducted to explore the mediating effect of consumers' attitude towards last-mile logistics innovations. Study 1 compares Model 1 with Model 2. As they are non-nested models, the objective is to evaluate their overall model fit, their explanatory power concerning consumers' adoption intention, and their parsimony (Huh *et al.*, 2009; Rust *et al.*, 1995). Study 2 compares Model 2 with Model 3. As Model 2 is a nested model within Model 3, χ^2 significance tests are employed to assess the alternative models. Finally, as shown in Study 3, a structural path analysis of the best model identified in Study 1 and Study 2 is examined in further detail.

In all three studies, respondents' age and gender were used as control variables. Age has long been recognized as a key moderating variable in individuals' adoption of innovations (Morris and Venkatesh, 2000). More recently, Guo *et al.* (2016) examined the moderating effects of age differences on consumers' receptivity of technology-based service innovations. Laukkanen *et al.* (2007), on the other hand, studied individuals' differences of innovation resistance by comparing between younger consumers and mature consumers. Similarly, the critical impact of gender difference has also been well documented in the general consumer research (Wang, 2014) and the specific studies on innovation adoption (Venkatesh *et al.*, 2000; Lee *et al.*, 2013). To a certain extent, age and gender have been well established factors that influence the innovation adoption behavior of consumers. In this regard, it is necessary to control the effects of age and gender that may potentially distort the validity of our research models. Accordingly, age is dichotomized to produce two categories. Respondents older than the average age is grouped as the "older group" (coded as "0") and younger as the "younger group" (coded as "1"). Gender is also dichotomized into two groups with "1" representing the female group and "0" representing the male group.

5.1 Study 1: Model 1 VS. Model 2

In Study 1, as these two models are not structurally nested, the comparison usually involves three steps. 1) The model fit indices are assessed and compared against the acceptance criteria; 2) once the models demonstrate adequate fit with the data, explanatory power (R^2) of models are then compared; and 3) if both the model fit indices and the explanatory power are equivalent, the best model is the most parsimonious one (Huh *et al.*, 2009; Rust *et al.*, 1995). Accordingly, Model 1 and Model 2 in this study are evaluated for their overall model fit, their explanatory power to adoption intention and their parsimony.

Table 5: Result of model comparison (M1 vs M2)

	χ^2	df	χ^2/df	CFI	TLI	RMSEA	SRMR	AIC	R^2 (INT)
Model 1	98.275	51	1.927	0.969	0.960	0.067	0.058	152.275	0.366
Model 2	157.063	86	1.826	0.970	0.964	0.063	0.057	261.775	0.638

The structural test results of Model 1 and Model 2 are listed in Table 5. It is found that both models demonstrate an acceptable level of fit to the empirical data, with Model 2 performing only slightly better than Model 1 in terms of fit indices. More specifically, the critical fit indices of both models have passed the suggested criteria such as CFI>0.95, TLI>0.95, RMSEA<0.07 and SRMR<0.07. Model 2 yields slightly better results as reflected in all fit indices: CFI (0.001

higher), TLI (0.004 higher), RMSEA (0.004 lower) and SRMR (0.001 lower). However, given the negligible amount of improvement in model fit, no conclusion can be drawn as to which model is superior in terms of their fit indices.

However, the major difference of these two models is in the explained variance of consumer adoption intention (R^2). It is shown that while 36.6% variance of adoption intention can be explained by the direct model (Model 1), 27.2% more variance can be explained by adding an additional construct of attitude as a mediator (Model 2). If evaluated in isolation, Model 1 of R^2 of 36.6% can be safely regarded as an adequate model. Yet, its explanatory power is considerably weaker compared to the mediated model. Although adding the construct of attitude reduces the parsimony of Model 2 as reflected in Akaike Information Criterion (AIC) (Akaike, 1987), the significant enhancement on explanatory power justifies the reduction in parsimony. Herein, we conclude that Model 2 with attitude as a full mediator is the superior model compared to Model 1.

5.2 Study 2: Model 2 VS. Model 3

A nested model is a model that has the same constructs as another model, but specifies fewer structural paths to be estimated. The model with more degrees of freedom (df) is nested within the full model, or referred to as a baseline model. To add robustness in the comparison between the fully mediated model and the partially mediated model, we further introduce two alternative partially-mediated variants (see Figure 5 and Figure 6), denoted as Model 3a and Model 3b.

Figure 5: Model 3a (CPA Partial mediation)

Figure 6: Model 3b (RAD Partial mediation)

Table 6: Result of model comparison (M2 vs M3)

	χ^2	df	χ^2/df	CFI	TLI	R^2	Change in χ^2	Change in df	χ^2 test difference	Result
Model 3	147.255	84	1.753	0.973	0.967	0.656				
Model 2	157.063	86	1.826	0.970	0.964	0.638	9.808 (M2-M3)	2	p<0.05	Accept M3
Model 3a	156.210	85	1.838	0.970	0.963	0.638	8.955 (M3a-M3)	1	p<0.05	Accept M3
Model 3b	148.112	85	1.742	0.974	0.967	0.652	0.887 (M3b-M3)	1	p>0.05	Accept M3b

In our study, Model 2, Model 3a and Model 3b are models nested in Model 3, and Model 2 is further nested in Model 3a and Model 3b. Hence, the χ^2 tests are conducted in a sequential manner. The fundamental principle is that: 1) if the χ^2 test result is significant, the baseline or expanded model is to be accepted as its loss in df is justified by the significant enhancement of model fit; and 2) if the χ^2 test result is not significant, the nested model is to be accepted as it

represents a more parsimonious model with comparable fit to the baseline model (Diamantopoulos and Siguaw, 2000).

Table 6 presents the test result. When comparing the fully mediated model M2 with the partially mediated model M3, χ^2 difference test shows a significant result ($\chi^2_{M2} - \chi^2_{M3} = 9.808$, $df_{M2} - df_{M3} = 2$, $p < 0.05$), thereby accepting the expanded model M3. It indicates that the added direct paths significantly enhance the overall model fit. To further identify the best-fitting partially-mediated model, M3 is compared with its two variants M3a and M3b. More specifically, the comparison between M3 and M3a yields a significant result ($\chi^2_{M3a} - \chi^2_{M3} = 8.955$, $df_{M3a} - df_{M3} = 1$, $p < 0.05$), favoring M3. An insignificant result is obtained when comparing M3 with M3b ($\chi^2_{M3b} - \chi^2_{M3} = 0.887$, $df_{M3a} - df_{M3} = 1$, $p > 0.05$), and therefore, the more parsimonious model M3b is accepted.

Additionally, except for a negligible drop in R^2 compared to M3, M3b also possesses the best fit indices among the four competing models. Therefore, M3b is identified as the best model, demonstrating a partial mediator role of attitude, with the impact of CPA on consumer adoption intention being fully mediated, and the impact of RAD on intention being partially mediated by consumers' attitude.

The analysis of mediation effect proposed by Baron & Kenny (1986) was also conducted. More specifically, they suggested a three-step test: 1) the independent variable (IV) should significantly influence the dependent variable (DV); 2) the IV should significantly influence the mediator (M); and 3) a full mediated relationship exists when the IV does not significantly influence the DV, yet the M has a significant impact on the DV; a partial mediation effect exists when both the IV and M significantly influence the DV (Rafailidis *et al.*, 2017; Wang *et al.*, 2016). As shown in Table 7, consistent results are achieved, confirming the structural relations as proposed in M3b.

Table 7: Mediation effect test

IV	M	DV	IV to DV	IV to M	IV + M to DV		Mediating
					IV to DV	M to DV	
CPA	ATT	INT	0.447***	0.452***	0.068 [†]	0.837***	Full
RAD	ATT	INT	0.588***	0.515***	0.194**	0.764***	Partial

IV: independent variable; M: mediator; DV: dependent variable; ** $p < 0.05$, *** $p < 0.001$, [†] $p > 0.1$

5.3 Study 3: Structural Path Analysis

The structural model result of the best model (M3b) identified is shown in Figure 7. All the structural relations are empirically supported (age and gender as control variables do not seem to influence consumers' intention in a significant way with the inclusion of other predictors). Attitude is demonstrated to be the strongest direct predictor of consumers' adoption intention with the largest path coefficient. It also effectively mediates the path between consumers' beliefs on innovations and their adoption intention (see Table 8, Mediated effect of RAD to INT = 63%; Mediated effect of CPA to INT = 100%; Aggregated mediated effect = 70%). Hence, both as a direct predictor and an effective mediator, the construct of attitude is imperative in the consumer adoption decision.

Figure 7: Structural model results of the best model
(*p<0.05, **p<0.01, ***p<0.001, n.s. Not significant)

Table 8: Mediated effect

	Direct effect	Mediated effect	Total effect	% of mediated effect
RAD to INT	0.24	0.41 ^a	0.65	63%
CPA to INT	0	0.15 ^b	0.15	100%
Aggregated effect	0.24	0.56	0.80	70%

$$^a 0.41=0.52*0.79; ^b 0.15=0.19*0.79$$

In addition, the results also suggest that RAD and CPA of innovations influence consumer adoption intention in different manners. While CPA contributes only to the consumers' attitude formation, RAD also directly impacts on adoption intention. In terms of the total effects (see Table 8, RAD to INT=0.65; CPA to INT=0.15), RAD is also a relatively stronger contributor than CPA.

5.4 Discussion

Adopting an exploratory approach, this study examines the role of attitude in consumer adoption behaviors of last-mile logistics service innovations. Anchored on the theoretical perspectives of DOI theory and attitude theories, three models depicting no mediation, full mediation and partial mediation relationships (hybrid structure) are proposed and comprehensively evaluated. After systematic comparisons of competing models, our research shows that a hybrid model, built on synthesized insights from both DOI theory and attitude theories, yields the best result in predicting consumer adoption behaviors (measured by intention) of last-mile logistics innovations. With the aim to provide a holistic view of consumer adoption of logistics service innovations, this study brings the behavioral component of consumers into the emerging studies on the management of logistics service innovations, contributing to the nexus of the two streams of research. By doing so, it not only extends the theorization of logistics service innovations towards downstream consumer adoption studies, but also provides additional theoretical insights and empirical proof to the competing consumer adoption theories. Centering on the construct of attitude, this study emphasizes its irreplaceable role of a mediator in determining the perceived desirability of innovative last-mile logistics services, which ultimately contributes to their usage of the service.

More specifically, it is found that while all proposed models are considered acceptable, their explanatory power, parsimony and overall model fit vary. Overall, partially-mediated models are superior compared to the fully-mediated model, and the model without attitude as a mediator is inferior despite it being parsimonious. In particular, mediated models (fully and partially) possess a considerably stronger explanatory power compared to the direct model (no

mediation), whereas the RAD partially-mediated model demonstrates the best overall model fit among all the mediated models based on the results of the nested χ^2 significant tests.

In this regards, our findings are consistent with prior DOI literature which regards the relative advantage and the competitiveness of innovations as salient considerations of consumers (Choudhury & Karahanna, 2008; Petschnig *et al.*, 2014). More importantly, our study further suggests that it is not only about characteristics of the service innovation per se, but also how those characteristics are presented to and thus perceived by the consumers. Ultimately, what matters is the attitude that is uniquely formed by the individual consumer upon his / her personalized interpretation of the innovation. To this end, as consistent with insights of attitude theories (Taylor & Todd, 1995; Wang *et al.*, 2018), the primacy of attitude in consumers' decision-making process is well reflected in our research findings. Therefore, in the context of the current study, it is suggested that both the direct effect favored in DOI theory and the mediated effect reflected in attitude theories are joint contributors to the process of consumer adoption of last-mile logistics service innovations.

In the best model identified, the mediated impact and the direct impact of attitude are compared. The result shows a clear role of attitude as an important mediator between consumers' beliefs on the innovation and their intention to adopt the innovation. Nonetheless, some beliefs (RAD in this study) do directly impact on the adoption intention, further confirming a partial mediating role of attitude. Additionally, although only the beliefs on relative advantage and compatibility are modelled in our study, the difference regarding their relationship with consumers' attitude and intention is clearly presented. Our results indicate that perceived compatibility leads to consumers' adoption intention via the formation of a favorable attitude, whereas beliefs on relative advantage of the innovation contributes to consumers' adoption intention both directly and indirectly via attitude.

Herein, the results seem to differentiate the effects of consumers' beliefs on their adoption decisions. While some beliefs (RAD in this study) exert a primary influence on the formation of the adoption intention, others (CPA in this study) may take a secondary role that only supports the attitude formation process. However, most prior research assumes overly straightforward relationships among consumers' beliefs, attitudes and intentions of service innovations, while the differentiated effects have been rarely investigated. Indeed, the subtle differences reflect a complex psychological mechanism that underpins consumers' decision-making process. While both DOI theory and attitude theories explain the process to certain extents, integrated efforts with an exploratory approach are necessary to unveil the complex mechanism. Our study represents one of such exploratory attempts to distil the subtle differences.

6 Conclusion

This research is among the first to conceptualize and validate consumer adoption behaviors in the field of e-commerce delivery services with a strong emphasis on the behavioral components. To this end, it provides a unique approach of logistics service management by emphasizing on consumers' behavioral responses. Essentially, the successful introduction and long-term management of innovative last-mile e-commerce logistics services depend on accurate prediction and interpretation of consumer behavioral responses to such services. The proposed hybrid model identifies critical focal points (critical beliefs and attitude) that most effectively influence the perceived desirability of the service, leading to consumer adoption behaviors. Theoretically, with an inter-disciplinary effort to integrate psychology of consumer behavioral

with the management of innovative logistics services, this study contributes to the theorization of logistics service innovations with a special focus on end-consumers, and broadens the rich literature on consumer adoption studies. Furthermore, while the various adoption models consisting of beliefs, attitude and intentions have been extensively examined in extant studies, our study advances the understanding of the nomological network by systematically evaluating the competing models. Detailed discussion on theoretical contributions and practical insights are as follows.

6.1 Theoretical Contributions

Theoretical contributions of our studies are multifold, to the theorization of logistics service innovations, to the literature of consumer adoption behavior and to the nexus of the two research disciplines.

First, this study is among the first few attempts to theorize consumer behaviors in the field of last-mile e-commerce logistics. To this end, it extends the theoretical research on logistics management to the last-mile context and also enriches the literature on consumer adoption behaviors with logistics components, both of which are currently lacking in extant literature. While B2B research has dominated the logistics studies, we argue that the power of end consumers is rising given the proliferation of B2C e-commerce, especially in the emerging e-commerce market such as Singapore. It is highly timely to incorporate the consumer behavioral elements into the broader logistics management literature. Particularly, with an interdisciplinary effort, we applied the well-established adoption theories to study the consumer adoption behaviors of last-mile logistics innovations, using APS self-collection service as an example. It is found that consumers' attitude towards the logistics service innovations is the deterministic factor that influences consumer adoption behaviors. It is not only the strongest predictor of consumer adoption intention, but also an effective mediator of consumers' beliefs towards the innovation. This is in line with the attitude theories (Fishbein & Ajzen, 1975) and more recent research applied to the logistics context (Wang *et al.*, 2018). In this regard, our study evidences the applicability of attitude theories to the last-mile logistics context and calls for more further research efforts to be devoted to unveiling logistics consumers' behaviors.

Second, adopting an exploratory approach, we reconcile the competing views on consumer adoption literature by systematically evaluating the competing models based on their explanatory power, parsimony and overall model fit. Anchored on synthesized insights from both DOI theory and attitude theories, a hybrid model is identified as the best model. In the hybrid model, while attitude theories provide the mediated association of "belief-attitude-intention" as the base theoretical structure, DOI theory supplements the model with specific beliefs on innovations and further advocates a direct effect between certain beliefs and adoption intention. Based on our comparisons, we argue that while the mediating role of attitude as underlined in attitude theories is unquestionable, the direct effects reflected in DOI theory do contribute to a stronger model in explaining consumer adoption behaviors of last-mile logistics innovations. In this light, the results suggest that both DOI and attitude theories are complementary. Collectively, they provide a better nomological understanding of consumer adoption behaviors of logistics innovations.

Finally, this study demonstrates a method to compare the competing models (nested and non-nested) in search for the best model that explains consumer adoption behaviors of last-mile logistics service innovations. By doing so, this study facilitates a meaningful fusion and integration of theoretical insights from different research streams. While the similar hybrid

structures have been examined in earlier studies (Huh *et al.*, 2009; Petschnig *et al.*, 2014; Wang *et al.*, 2018), our study advances the extant literature by offering an in-depth evaluation on the comparative performance of the hybrid model against its competing alternatives. Notably, all proposed models are statistically acceptable, yet it is only through systematic comparisons that the best model can be identified and interpreted. Herein, we recommend more studies to explore alternative theories by adopting a comparative methodology so as to create theoretically-sound syntheses.

6.2 Managerial Implications

From the perspective of logistics operators, our study also contributes to the management of the emerging issue of e-commerce last-mile delivery.

Service offering (functionality) versus Consumer acceptance (attitude): To start with, logistics operators must realize that a successful implementation of last-mile logistics innovations depends on consumers' acceptance on such innovative concepts. What motivates consumer adoption of innovative logistics services over conventional alternatives is of paramount importance. Our research indicates that consumers' attitude towards the innovation is the most influential factor that determines their adoption intention. While enhancing the functionality of the innovation is critical, our study suggests that the major obstacle in the innovation diffusion among the consumers is likely to reside in their mind-set (Kulviwat *et al.*, 2014). Hence, logistics service managers are suggested to introduce innovation logistics services to consumers only if the latter are (psychologically) ready for a change. On the other hand, logistics service managers need to actively monitor and direct consumers' attitude towards their innovative service offerings.

“Good” is not good enough - Deliver “better”: In particular, this study reveals that perceived relative advantage is a direct predictor of consumers' intention to adopt logistics innovations, whereas perceived compatibility only indirectly affects consumers' adoption intention. This implies that the motivation is not sufficiently strong to invoke adoption behavior if the innovation is only functionally attractive, rather it is the perception of being a “better” service that would create the stimulus strong enough for consumers to adopt it. Therefore, in order to communicate such a message to consumers, the logistics service managers should market the innovative service by emphasizing on its unique and advantageous features which are superior to the conventional alternatives. For example, in case of APS self-collection service, APS operators can stress the advantage of 24/7 accessibility of APS while restricting the delivery period of home deliveries to daytime on workdays. By doing so, it is also an effective way to shape consumers' positive attitude towards the innovation.

Compatibility – By building innovation into lifestyle: Furthermore, a sense of compatibility of the services also positively influences consumers' attitude, as revealed in our study. Consumers form more favorable attitudes when the delivery services are perceived to be compatible with their lifestyles, their needs and their current situations. While its impact on consumers' adoption intention is not as direct as the perceived relative advantage, favorable attitudes shall ultimately lead to a stronger adoption intention. To this end, it is important to build the delivery services into consumers' lifestyle so as to promote a sense of compatibility. In the context of APS self-collection service, logistics operators may actively invite consumers to participate in self-collection by linking the collection trips to consumers' daily commute trips. In this regard, a careful selection of the location of the self-collection facilities is crucial to ensure compatible collections that can be easily integrated into consumers' daily activities. On the other hand,

logistics operators may also encourage consumers to self-collect parcels with active mobility, such as walking and cycling. The personalized records on the active trips can then be provided to respective consumers, which can be further translated into exercise mileages as well as carbon emission reduction. By so doing, consumers may establish a personal relevancy to the service, which leads to a perception of compatibility and thus a favorable attitude towards the service innovation.

Match innovation to innovative consumer: Finally, it must be emphasized that consumers' attitude plays a deterministic role in the formation of consumers' adoption intention. Except for the characteristics of innovations, consumers' personal profile may also influence their adoption of service innovations. In particular, the degree of consumers' innovativeness is an important attribute that leads to varied levels of receptivity towards service innovations. Given the same service offering, consumers who are high in innovativeness may develop more favorable attitudes towards innovation service offerings, whereas less innovative consumers may show hesitation and resistance. Again, it can be related to consumers' perception on compatibility of the innovation, i.e. innovative consumers may perceive the innovative service as a compatible choice, whereas less innovative consumers may perceive it as a violation of their personal attributes. From the logistics operator's perspective, it is important to respect the different consumers by offering services with varied levels of innovativeness. Essentially, logistics operators should provide consumers with free choices among the alternatives so that consumers can engage with the service that is compatible with their personal attributes. To this end, logistics operators need to have a clear understanding of their customers, based on which an effective strategy can be designed and implemented by matching the right innovative services to the right consumers.

6.3 Limitation and Recommendation

Several limitations exist in this study. First, our study is conducted based on the data of 209 valid responses. While such a sample size is often considered statistically acceptable when examining a small number of well-established variables (Hazen *et al.*, 2015), more responses shall enhance the stability of the model and strengthen the rigor of the research findings. In particular, responses from the older consumers are not well reflected in this study. Given the growing proportion of elderly people in our society, it is also important to understand their logistics needs. Therefore, while the intended sampling strategy is in favor of younger respondents in our study, future studies can be conducted based on a boosted sample from the older consumers. Special attention shall be paid to compare the behavioral differences between younger and older consumers with respect to their receptivity to innovative logistics service offerings.

Second, the survey sample of the current study consists of a relatively uneven distribution of the (smaller) adopter group and the (larger) non-adopter group. This is due to the fairly recent implementation of APS service in Singapore, which makes it difficult to obtain a balanced sample of adopters and non-adopters. While no observable difference can be found regarding the demographical differences between the two groups, the adopter group seems to give consistently higher ratings of the measurement items compared to the non-adopter group (see Appendix). Seemingly, consumers' prior experience with the service exerts a great influence on their general perceptions and future adoption intention of the service. In this regard, interesting insights may be generated by conducting a multi-sampling analysis between the two sub-groups. However, as comparisons between the two sub-sample groups are not the focus of our study, no further analysis is carried out along this line. In addition, the relatively uneven

sample also restricts a meaningful multi-sampling analysis to be conducted. Therefore, we suggest future researchers to explore the effects of prior service experiences on consumers' future adoption intention.

Third, as the focus of this study is on the mediating role of attitude in consumer adoption behavior, we only include two salient beliefs on innovations in the theoretical models. Other beliefs factors discussed in DOI theory and attitude theories, such as perceived ease of use, perceived observability and perceived trialability may also have significant impact on consumer adoption behavior, either directly or via attitude as a mediator. In addition, perceived risk is a re-occurring belief that affects consumer adoption of innovative products / services (Koenig-Lewis *et al.*, 2010; Lee, 2012). As most logistics innovations involve technology-based unmanned service, the sense of trust in the reliability of the innovative service is likely to be an important consideration when consumers decide to adopt / reject the logistics innovation. We encourage future research to explore further in this direction as well.

In addition, this study is also limited in its scope in that it is restricted to only one last-mile logistics innovation application. Comparisons on consumer adoption behavior across different innovative logistics services can be conducted and valuable insights can be obtained from the comparisons (Collier *et al.*, 2014; Curran & Meuter, 2005; Kaushik & Rahman, 2015). It will also contribute to the generalizability of the results. Along the development of last-mile logistics innovations, further efforts could be directed to studies that compare adoption behaviors of different logistics innovations.

Notwithstanding the limitations, to the best of our knowledge, this study is among the first to address consumers' concerns on innovative last-mile logistics service with a strong emphasis on behavioral components. Inspired by both innovation diffusion literature and attitude theories, this paper identifies various beliefs and attitude as major focal points that influence the desirability of innovative last-mile services to consumers. With an inter-disciplinary effort to integrate consumers' behavioral psychology in the management of last-mile logistics service innovation, this study offers a unique angle to manage consumers' service concerns from the perceptual and behavioral perspectives.

References List

- Agarwal, R., & Prasad, J. (1997). The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. *Decision Sciences*, 28(3), 557–582.
- Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behavior and Human Decision Processes*, 50, 179–211.
- Ajzen, I., & Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ., Prentice-Hall inc.
- Akaike, H. (1987). Factor analysis and AIC. *Psychometrika*, 52(3), 317–332.
- Aldás-Manzano, J., Ruiz-Mafé, C., & Sanz-Blas, S. (2009). Exploring individual personality factors as drivers of M-shopping acceptance. *Industrial Management & Data Systems*, 109(6), 739–757.
- Baek, H., Oh, S., Yang, H.-D., & Ahn, J. (2017). Electronic word-of-mouth, box office revenue and social media. *Electronic Commerce Research and Applications*, 22, 13–23.
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research. *Journal of Personality and Social Psychology*, 51(6), 1173–1182.
- Bhate, S., & Lawler, K. (1997). Environmentally friendly products: Factors that influence their adoption. *Technovation*, 17(8), 457–465.
- Bhattacharjya, J., Ellison, A., & Tripathi, S. (2016). An exploration of logistics- related customer service provision on Twitter: The case of e-retailers. *International Journal of Physical Distribution & Logistics Management*, 46(6/7), 659–680.
- Bhattacharjee, A. (2001). Understanding information systems continuance: an expectation confirmation model. *MIS Quarterly*, 25(3), 351–370.
- Buettner, R. (2017). Predicting user behavior in electronic markets based on personality-mining in large online social networks: A personality-based product recommender framework. *Electronic Markets*, 27(3), 247–265.
- Busse, C., & Marcus Wallenburg, C. (2011). Innovation management of logistics service providers. *International Journal of Physical Distribution & Logistics Management*, 41(2), 187–218.
- Chadee, D., Sharma, R. R., & Roxas, B. (2016). Linking and leveraging resources for innovation and growth through collaborative value creation: A study of Indian OSPs. *Asia Pacific Journal of Management*, 1–21.
- Chen, N.-H., & Huang, S. (2016). Domestic technology adoption: comparison of innovation adoption models and moderators. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 26(2), 177–190.
- Chen, S.-C., & Hung, C.-W. (2016). Elucidating the factors influencing the acceptance of green products: An extension of theory of planned behavior. *Technological Forecasting and Social Change*, 112, 155–163.
- Choo, C. (2016). *Master Thesis: Impact of a Delivery Point Network for Urban E-Commerce Deliveries*. Singapore.
- Choudhury, V., & Karahanna, E. (2008). The relative advantage of electronic channels: A multidimensional view. *MIS Quarterly*, 32(1), 179–200.
- Collier, J. E., & Kimes, S. E. (2012). Only if it is convenient: Understanding how convenience influences self-service technology evaluation. *Journal of Service Research*, 16(1), 39–51.
- Collier, J. E., & Sherrell, D. L. (2010). Examining the influence of control and convenience in a self-service setting. *Journal of the Academy of Marketing Science*, 38, 490–509.
- Collier, J. E., Sherrell, D. L., Babakus, E., & Horky, A. B. (2014). Understanding the differences of public and private self-service technology. *Journal of Services Marketing*, 28(October 2012), 60–70.
- Collins, A. T. (2015). Behavioural Influences on the Environmental Impact of Collection/Delivery Points. In F. Behnam, M. Bell, D. Hensher, & J. Sarkis (Eds.), *Green Logistics and Transportation: A Sustainable Supply Chain Perspective*: 15–34. Springer International Publishing Switzerland.
- Curran, J. M., & Meuter, M. L. (2005). Self-service technology adoption: comparing three technologies. *Journal of Services Marketing*, 19(2), 103–113.
- Da Mota Pedrosa, A. (2012). Customer integration during innovation development: An exploratory study in the logistics service industry. *Creativity and Innovation Management*, 21(3), 263–276.
- Da Mota Pedrosa, A., Blazevic, V., & Jasmand, C. (2015). Logistics innovation development: a micro-level perspective. *International Journal of Physical Distribution & Logistics Management*, 45(4), 313–332.
- Dabholkar, P. A., & Bagozzi, R. P. (2002). An attitudinal model of technology-based self-service: Moderating effects of consumer traits and situational factors. *Journal of the Academy of Marketing Science*, 30(3), 184–201.
- Dablan, L., Morganti, E., & Fortin, F. (2015). *Alternatives to Home Deliveries, Final Report*. https://www.metrans.org/sites/default/files/MF14-52a_DeliveriesforOnlineShoppingFinalReport_052215_0.pdf.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.
- Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, 35(8), 982–1003.
- Deb, M., & Lomo-David, E. (2014). An empirical examination of customers' adoption of m-banking in India. *Marketing Intelligence & Planning*, 32(4), 475–494.
- DHL. (2013). *DHL Trend Research 2013. Logistics Trend Radar: Delivering Insight Today. Creating Value Tomorrow!* Troisdorf, Germany.
- DHL. (2015). *Omni-channel Logistics: A DHL Perspective on Implications and Use Cases for the logistics Industry*. Troisdorf, Germany.
- Diamantopoulos, A., & Siguaw, J. A. (2000). *Introducing LISREL: A Guide for the Uninitiated*. CA: Sage: Thousand Oaks.
- Duan, Y., He, Q., Feng, W., Li, D., & Fu, Z. (2010). A study on e-learning take-up intention from an innovation adoption perspective: A case in China. *Computers and Education*, 55, 237–246.
- Edwards, J., McKinnon, A., Cherrett, T., McLeod, F., & Song, L. (2010). Carbon dioxide benefits of using collection-delivery

- points for failed home deliveries in the United Kingdom. *Transportation Research Record: Journal of the Transportation Research Board*, 2191, 136–143.
- Festinger, L. A. (1957). *A Theory of Cognitive Dissonance*. Evanston, IL: Row and Peterson.
- Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. MA: Addison-Wesley.
- Fleig, L., Ngo, J., Roman, B., Ntzani, E., Satta, P. (2015). Beyond single behaviour theory: Adding cross-behaviour cognitions to the health action process approach. *British Journal of Health Psychology*, 20(4), 824–841.
- Flint, D. J., Larsson, E., & Gammelgaard, B. (2008). Exploring processes for customer value insights, supply chain learning and innovation: An international study. *Journal of Business Logistics*, 29(1), 257–281.
- Flint, D. J., Larsson, E., Gammelgaard, B., & Mentzer, J. T. (2005). Logistics innovation: A customer value-oriented social process. *Journal of Business Logistics*, 26(1), 113–147.
- Fu, H.-P. (2016). Comparing the factors that influence the adoption of CPFR by retailers and suppliers. *International Journal of Logistics Management*, 27(3).
- Grawe, S. J. (2009). Logistics innovation: a literature-based conceptual framework. *The International Journal of Logistics Management*, 20(3), 360–377.
- Guo, X., Zhang, X., & Sun, Y. (2016). The privacy-personalization paradox in health services acceptance of different age groups. *Electronic Commerce Research and Applications*, 16, 55–65.
- Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2010). *Multivariate Data Analysis*. Upper Saddle River, NJ: Prentice Hall.
- Hameed, M. A., & Counsell, S. (2014). Establishing relationships between innovation characteristics and IT innovation adoption in organisations: A meta-analysis approach. *International Journal of Innovation Management*, 18(1): 1–41.
- Hanafizadeh, P., Keating, B. W., & Khedmatgozar, H. R. (2014). A systematic review of Internet banking adoption. *Telematics and Informatics*, 31(3), 492–510.
- Hazen, B. T., Cegielski, C., & Hanna, J. B. (2011). Diffusion of green supply chain management. *The International Journal of Logistics Management*, 22(3), 373–389.
- Hazen, B. T., Overstreet, R. E., & Boone, C. A. (2015). Suggested reporting guidelines for structural equation modeling in supply chain management research. *The International Journal of Logistics Management*, 26(3), 627–641.
- Hazen, B. T., Wu, Y., Cegielski, C. G., Jones-Farmer, L. A., & Hall, D. J. (2012). Consumer reactions to the adoption of green reverse logistics. *The International Review of Retail, Distribution and Consumer Research*, 22(4), 417–434.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55.
- Huh, H. J., Kim, T. (Terry), & Law, R. (2009). A comparison of competing theoretical models for understanding acceptance behavior of information systems in upscale hotels. *International Journal of Hospitality Management*, 28(1), 121–134.
- Infocomm Media Development Authority. (2015). Annual survey on infocomm usage in households and by individuals 2015. Singapore: Infocomm Media Development Authority.
- Iwan, S., Kijewska, K., & Lemke, J. (2016). Analysis of parcel lockers' efficiency as the last mile delivery solution—the results of the research in Poland. *Transportation Research Procedia*, 12, 644–655.
- Jeyaraj, A., Rottman, J. W., & Lacity, M. C. (2006). A review of the predictors, linkages, and biases in IT innovation adoption research. *Journal of Information Technology*, 21(1), 1–23.
- Karahanna, E., Agarwal, R., & Angst, C. M. (2006). Reconceptualizing Compatibility beliefs. *MIS Quarterly*, 30(4), 781–804.
- Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs stable. *MIS Quarterly*, 23(2), 183–213.
- Kaushik, A. K., & Rahman, Z. (2015). Innovation adoption across self-service banking technologies in India. *International Journal of Bank Marketing*, 33(2), 96–121.
- Koenig-Lewis, N., Palmer, A., & Moll, A. (2010). Predicting young consumers' take up of mobile banking services. *Marketing Intelligence and Planning*, 28(5), 410–432.
- Kulviwat, S., Bruner II, G. C., & Neelankavil, J. P. (2014). Self-efficacy as an antecedent of cognition and affect in technology acceptance. *Journal of Consumer Marketing*, 31(3), 190–199.
- Kurila, J., Lazuras, L., & Ketikidis, P. H. (2016). Message framing and acceptance of branchless banking technology. *Electronic Commerce Research and Applications*, 17, 12–18.
- Laukkanen, T., Sinkkonen, S., Kivijärvi, M., & Laukkanen, P. (2007). Innovation resistance among mature consumers. *Journal of Consumer Marketing*, 24(7), 419–427.
- Lebeau, P., Macharis, C., & Van Mierlo, J. (2016). Exploring the choice of battery electric vehicles in city logistics: A conjoint-based choice analysis. *Transportation Research Part E: Logistics and Transportation Review*, 91, 245–258.
- Lee, B. C. Y. (2012). The determinants of consumer attitude toward service innovation – the evidence of ETC system in Taiwan. *Journal of Services Marketing*, 26(1), 9–19.
- Lee, H.-J., Fairhurst, A., & Cho, H. J. (2013). Gender differences in consumer evaluations of service quality: self-service kiosks in retail. *The Service Industries Journal*, 33(2), 248–265.
- Lee, S. M., Lee, D., & Schniederjans, M. J. (2011). Supply chain innovation and organizational performance in the healthcare industry. *International Journal of Operations & Production Management*, 31(11), 1193–1214.
- Leonidou, L. C., Leonidou, C. N., & Kvasova, O. (2010). Antecedents and outcomes of consumer environmentally-friendly attitudes and behaviour by antecedents and outcomes of consumer environmentally-friendly attitudes and behaviour. *Journal of Marketing Management*, 26, 1–39.
- Li, D., & Hu, L. (2017). Exploring the effects of reward and competition intensity on participation in crowdsourcing contests. *Electronic Markets*, 27(3), 199–210.
- Marcus, B. H., Stone, E. J., Dubbert, P. M., McKenzie, T. L., Dunn, A. L. (2000). Physical activity behavior change: Issues in adoption and maintenance. *Health Psychology*, 19(1), 32–41.

- Meuter, M. L., Bitner, M. J., Ostrom, A. L., & Brown, S. W. (2005). Choosing among alternative service delivery Modes: An investigation of customer trial of self-service technologies. *Journal of Marketing*, 69(2), 61–83.
- Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2(3), 192–222.
- Morganti, E., Dablane, L., & Fortin, F. (2014). Final deliveries for online shopping: The deployment of pickup point networks in urban and suburban areas. *Research in Transportation Business and Management*, 11(February 2012), 23–31.
- Morganti, E., Seidel, S., Blanquart, C., Dablane, L., & Lenz, B. (2014). The impact of E-commerce on final deliveries: Alternative parcel delivery services in France and Germany. *Transportation Research Procedia*, 4(0), 178–190.
- Morris, M. G., & Venkatesh, V. (2000). Age differences in technology adoption decisions: Implications for a changing work force. *Personnel Psychology*, 53, 375–403.
- Murray, C. C., & Chu, A. G. (2015). The flying sidekick traveling salesman problem: Optimization of drone-assisted parcel delivery. *Transportation Research Part C: Emerging Technologies*, 54, 86–109.
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory*. New York, NY: McGraw-Hill.
- Petschnig, M., Heidenreich, S., & Spieth, P. (2014). Innovative alternatives take action - Investigating determinants of alternative fuel vehicle adoption. *Transportation Research Part A: Policy and Practice*, 61, 68–83.
- Plouffe, C., Hulland, J., & Vandenbosch, M. (2001). Research report: richness versus parsimony in modeling technology adoption decisions – understanding merchant adoption of a smart card-based payment system. *Information Systems Management*, 12, 208–222.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903.
- Prahalad, C. K., & Ramaswamy, V. (2004). Co-creation experiences: The next practice in value creation. *Journal of Interactive Marketing*, 18(3), 5–14.
- Punakivi, M., Yrjölä, H., & Holmström, J. (2001). Solving the last mile issue: reception box or delivery box? *International Journal of Physical Distribution & Logistics Management*, 31(6), 427–439.
- Rafailidis, A., Trivellas, P., & Polychroniou, P. (2017). Impact of government brand-building promotion on enterprise financial performance: empirical evidence from China. *Total Quality Management and Business Excellence*, 28(9-10), 1134–1148.
- Rogers, E. M. (1995). *Diffusion of Innovation* (4th ed.). New York: Free Press.
- Rust, R. T., Lee, C., & Valente Jr., E. (1995). Comparing covariance structure models: A general methodology. *Research in Marketing*, 12, 279–291.
- Savelsbergh, M., & Woensel, T. V. (2016). City logistics: Challenges and opportunities. *Transportation Science*, 50(2): 579–590.
- Singapore Department of Statistics. (2017). Population trends 2017. Singapore: Singapore Department of Statistics.
- Song, L., Guan, W., Cherrett, T., & Li, B. (2013). Quantifying the greenhouse gas emissions of local collection-and-delivery points for last-mile deliveries. *Transportation Research Record: Journal of the Transportation Research Board*, 2340, 66–73.
- Su, Q., Song, Y., Li, Z., & Dang, J. (2008). The impact of supply chain relationship quality on cooperative strategy. *Journal of Purchasing and Supply Management*, 14(4), 263–272.
- Su, S.-I. I., Gammelgaard, B., & Yang, S.-L. (2011). Logistics innovation process revisited: insights from a hospital case study. *International Journal of Physical Distribution & Logistics Management*, 41(6), 577–600.
- Taylor, S., & Todd, P. (1995). Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions. *International Journal of Research in Marketing*, 12(2), 137–155.
- Tornatzky, L., & Klein, K. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management*, 29(1), 28–43.
- Venkatesh, V., & Davis, F. (2000). A theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. *Management Science*, 46(2), 186–204.
- Venkatesh, V., Morris, M., & Ackerman, P. (2000). A longitudinal field investigation of gender differences in individual technology adoption decision-making processes. *Organizational Behavior and Human Decision Processes*, 83(1), 33–60.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478.
- Vogel, D., Zhao, J., Zhu, Z., Guo, X., & Chen, J. (2017). Introduction to the special issue on service-oriented E-business development. *Electronic Markets*, 27(3), 197–198.
- Wagner, S. M. (2008). Innovation Management in the German transportation industry. *Journal of Business Logistics*, 29(2), 215–231.
- Wagner, S. M. (2013). Partners for business-to-business service innovation. *IEEE Transactions on Engineering Management*, 60(1), 113–123.
- Wagner, S. M., & Sutter, R. (2012). A qualitative investigation of innovation between third-party logistics providers and customers. *International Journal of Production Economics*, 140(2), 944–958.
- Wang, E. S.-T. (2014). Perceived control and gender difference on the relationship between trialability and intent to play new online games. *Computers in Human Behavior*, 30, 315–320.
- Wang, S., Fan, J., Zhao, D., Yang, S., & Fu, Y. (2016). Predicting consumers' intention to adopt hybrid electric vehicles; using an extended version of the theory of planned behavior model. *Transportation*, 43, 123–143.
- Wang, X., Yuen, K. F., Wong, Y. D., & Teo, C. C. (2018). An innovation diffusion perspective of e-consumers' initial adoption of self-collection service via Automated Parcel Station. *International Journal of Logistics Management*, 29(1), 237–260.
- Watchravesringkan, K., Hodges, N. N., & Kim, Y.-H. (2010). Exploring consumers' adoption of highly technological fashion

products: The role of extrinsic and intrinsic motivational factors. *Journal of Fashion Marketing and Management*, 14(2), 263–281.

Weigel, F. K., Hazen, B. T., & Cegielski, C. G. (2014). Diffusion of innovations and the Theory of Planned Behavior in information systems research: A meta-analysis. *Communications of the Association of Information Systems*, 31(1), 619–636.

Yuen, K. F., Thai, V. V., & Wong, Y. D. (2016). Are customers willing to pay for corporate social responsibility? A study of individual-specific mediators. *Total Quality Management and Business Excellence*, 27(8), 912–926.

Appendix: Measurement Items

Constructs, measurement items and sources	Mean (User)	Mean (Non-user)
<i>Perceived compatibility</i> (Source: Moore & Benbasat, 1991; Meuter <i>et al.</i> , 2005)		
CPA1: Using APS to self-collect my parcels would be compatible with my lifestyle	5.30	4.77
CPA2: Using APS to self-collect my parcels would be compatible with my needs	5.43	4.83
CPA3: Using APS to self-collect my parcels would be compatible with the way I like to receive parcels*	-	-
CPA4: Using APS to self-collect my parcels would be compatible with my current situation.	5.55	4.60
<i>Perceived relative advantage</i> (Source: Moore & Benbasat, 1991; Meuter <i>et al.</i> , 2005)		
RAD1: Using APS would improve my overall parcel reception experience compared to home delivery	4.94	4.15
RAD2: Using APS would make it easier to receive my parcels compared to home delivery*	-	-
RAD3: Using APS would enable me to receive my parcel more quickly compared to home delivery	5.24	4.67
RAD4: Using APS would be advantageous compared to home delivery	5.32	4.57
RAD5: Using APS is the best way to receive my parcels	5.09	4.11
<i>Attitude</i> (Source: Collier <i>et al.</i> , 2014; Dabholkar & Bagozzi, 2002)		
ATT1: I would feel Good-Bad to self-collect my parcel using APS for my next online purchase	5.43	4.82
ATT2: It would be Pleasant-Unpleasant to self-collect my parcel using APS for my next online purchase	5.43	4.91
ATT3: For my next online purchase, self-collection using APS would be Favorable - Unfavorable	5.47	4.94
<i>Intention</i> (Source: Collier <i>et al.</i> , 2014; Dabholkar & Bagozzi, 2002)		
INT1: It would be Very likely-Very unlikely for me to use APS self-collection for my next online purchase	5.26	4.32
INT2: For my next online purchase, it is Possible-Impossible for me to use APS self-collection	5.42	4.56
INT3: I would Very probably – Probably not use APS self-collection for my next online purchase	5.30	4.45
* Items dropped out from further analysis due to cross loading or low factor loading		