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Exploring Consumer Adoption of Mobile Shopping Apps From a Perspective of Elaboration Likelihood Model

Thi Huong Giang Vo, Fengchia University, Taiwan
Kuang-Wen Wu, Fengchia University, Taiwan*

ABSTRACT

This study aims to integrate perceived risk into elaboration likelihood model, develop a comprehensive research model to explain dual routes of persuasive communication through various factors affecting individual acceptance and usage of mobile shopping apps, and identify the antecedents of consumers' perceived risk in the context of mobile shopping. Structural equation modeling is adopted to test the proposed model. Information quality has a negative effect on perceived risk (central route), while source credibility has a positive impact on perceived usefulness (peripheral route). The antecedents of perceived risk including information quality, source credibility, familiarity, and personal innovativeness are divided into four categories: cognition-based, affect-based, experience-based, and personality-oriented. The four antecedents significantly affect consumer perceived risk in adopting mobile shopping apps. The results show that consumer perceived usefulness and perceived risk affect consumer behavioral intentions of mobile shopping app adoption.

KEYWORDS

Elaboration Likelihood Model, Mobile Shopping Adoption, Perceived Risk, Perceived Usefulness

1. INTRODUCTION

Mobile devices such as smartphones and tablets have rapidly changed the way consumers shop online and provided a better shopping experience in electronic commerce, leading to a substantial rate of change in consumer behavior and interaction with retailers through the establishment of mobile channels. This has brought about the emergence of mobile commerce, also known as m-commerce as "an extension of e-commerce where business activities are performed in a wireless environment using mobile devices" (Zhang et al., 2012). In 2017, global m-commerce sales reached 58.9% of total e-commerce spending. By 2021, m-commerce will be estimated to account for 72.9% of the e-commerce market (eMarketer, 2018), and be viewed as the latest trend and best complementary to consumer purchase processing online (Marriott et al., 2017). Many successful online companies have created mobile apps and mobile-compatible websites to accommodate for this expanding market, such as Amazon, Shopee, Lazada, and have developed effective business strategies and marketing techniques as a result. Professionals and business managers emphasized the importance of explicating consumer behavior for the successful management in the recent development of m-commerce (Hung et al., 2012). Consumer adoption of mobile shopping apps is an emerging area in m-commerce which

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presents interesting challenges and opportunities for both retailers and app developers (Chopdar et al., 2018). Despite the growing prevalence of mobile shopping, insufficient research has been conducted to determine how mobile users process their behavioral intentions of shopping online through mobile apps.

It was found that Technology Acceptance Model and Unified Theory of Acceptance and Use of Technology were the dominant theories used by researchers in understanding user intentions in mobile shopping context (Chhonker, 2018). On the other hand, the ELM uses a dual route process to describe how attitude is formed and reinforced by persuasive arguments. In other words, it was used to provide a framework to help explain how individuals process information and the effective outcomes of persuasive communications. ELM has been extensively researched and reported in many fields such as social psychology (Chaiken and Maheswaran, 1994; Petty & Cacioppo, 1986), marketing (MacInnis et al., 2002), information technology (Bhattacherjee & Sanford, 2006; Sussman & Siegal, 2003), and e-commerce (Cheung et al., 2008). Furthermore, the findings of research by Mak et al. (1997) explicated that the dual route of information processing is valid in the context of persuasion by experts, yet the same results of ELM in the context of mobile shopping are undetermined. Nevertheless, the theoretical principals of ELM and the findings of previous studies have shown that in the context of mobile shopping, information quality and source credibility play an important role in influencing the adoption of information system as consumers often pay attention to the information of product/service when shopping online. Hence, further research can apply the ELM as theoretical foundation into investigating the effective persuasive processes involved in the mobile shopping context.

Another concern of this study is to examine the role of perceived risk in predicting consumer behavioral intention in mobile shopping. Perceived risk is an important ingredient that inhibits use of potential buyers in consumer Internet decision-making process (Kim et al., 2008). Indeed, prior research indicated that consumers would complete their online purchasing process on a medium with more reliable characteristics rather than on mobile devices (Luo et al., 2010). Consumers' perception of risk becomes an important barrier especially in adopting electronic systems (Dwivedi et al., 2017). Specifically, perceived risk in m-commerce refers to consumers' evaluation of the difference in performance and quality of the purchased product in comparison with their pre-purchase expectations. Furthermore, consumers are burdened by and take more substantial responsibilities for buying through m-commerce due to the self-service technologies adopted into the mobile devices (Cunningham et al. 2005). Additionally, in the stage of software development innovations and technologies, people tend to be more insecure about not only the product/service itself but also the efficiency or reliability of the underlying potential of the platform technology used by devices (Park & Tussyadiah, 2016). Hence, in the context of m-commerce, a higher perceived risk of a mobile shopping app will report less consumer intention of adopting the app (Verkijika, 2018). Given the increasing prevalence of mobile commerce and also multidimensional nature of perceived risk in mobile-based platform, there is an urgent need to provide a more thorough analysis of an online consumer's shopping process. Since perceived risk is likely to play an essential role in online transactions, it is important to identify the antecedents of a consumer's perceived risk in the context of mobile shopping.

Although research of m-shopping adoption has been conducted in various contexts, there are few studies considering the role that mobile apps have in this field (Kim et al., 2014). As such research on mobile shopping apps should provide a more comprehensive consideration of the various factors influencing consumer adoption and use in addition to persuasive messages. However, based on the research framework, ELM often only considers the effects of information quality and source credibility on consumer attitude. Thus ELM may need to be extended when applied into different contexts (e.g., m-commerce) through considering more dependent variables in order to include the aspects of belief, feeling and intentions (Nguyen & Do, 2017). This helps enhance the reasonable explanation of adding variable perceived risk into the model. In this regard, a comprehensive model assessing the factors affecting the adoption of m-shopping apps and also the roles of variables between persuasive messages and consumer behavioral intention is important as it can inform both researchers and

practitioners on understanding consumer behavior of m-shoppers. Focusing on exploring consumer adoption of mobile shopping apps from a perspective of ELM, this study intends to investigate the following two research questions:

1) What are the antecedents that affect consumers' preceived risk in the context of mobile shopping?
2) How do information quality and source credibility affect consumers' adoption of mobile shopping apps through perceived usefulness and perceived risk toward those apps?

The structure of the paper is the sequence of introduction, followed by the literature review in which this study explains research model and develops research hypotheses. Then methodology including research instrument, data collection, and statistical methods is presented. Next is the section of the key results and main findings of the research. Finally the discussion section includes potential implications for both practice and research along with future works.

2. LITERATURE REVIEW

2.1 Elaboration Likelihood Model

ELM was first developed in the field of social psychology, its key prediction is that attitudes are changed through central route and peripheral route (Petty et al., 1983). In the central route, the cognitive efforts are required to evaluate product-relevant arguments and deduce the persuasive messages. When using the peripheral route, people are persuaded by positive or negative cues or simple cues to make a simple reference about the advocated position (Petty & Cacioppo, 1986). Based on ELM arguments, at the high level of elaboration, individuals are motivated to process the messages through the central route. In contrast, peripheral route processing involves a low level of message elaboration (Bhattacherjee & Sanford, 2006).

Most studies on ELM adopt information quality and source credibility to be two of the most common constructs in central routes and peripheral routes respectively (Rucker & Petty, 2006). Mak et al. (1997) proposed that argument strength was a significant predictor used in central route to persuasion, whereas source credibility of the persuasive message acted as an important peripheral cue. Particularly, the theoretical tenets of ELM and findings from past research suggest that, in the context of mobile shopping, information quality and source credibility should play facilitating roles in affecting the acceptance of mobile shopping, as the product/ service information is of great interest to consumers when shopping online (Yi et al., 2013).

ELM is considered as one of the most useful and applicable model to elucidate the persuasive information process (Teng et al., 2014). Thus, it provides a theoretical framework for understanding and explaining consumer behavior of mobile shopping apps adoption. Besides, businesses today can choose from various types of communication systems to produce and offer the persuasive messages to recipients (Li, 2013). Hence this study focuses on a specific information system of mobile shopping apps to investigate the dual information process in online shopping.

2.2 Perceived Risk

Perceived risk refers to "the uncertainty with the possibility of facing the negative consequences of a product or service" (Featherman and Pavlou, 2003). Perceived risk is used as consumers' perception or measurement of negative consequences (Natarajan et al., 2018). Gillett (1976) proposed that the impact of perceived risk is different among various platforms on which consumers make buying decisions. Likewise, online shopping is generally much more risky than shopping at a conventional retail store (Michelle Bobbitt and Dabholkar, 2001).

According to Kim et al. (2008), the antecedents that influence consumer trust and consumers' perceived risk in e-commerce can be divided into four categories. First, cognition-based antecedents refer to the features and characteristics of a business trust which are observed and perceived by consumers such as privacy and security, system reliability, and information quality. Second, affect-based antecedents are related to human emotions, thoughts and feelings of a person originating from business-customer interactions such as consumer review, reputation, and recommendation. Third, experience-based antecedents are associated with consumer experiences in an online environment toward either e-retailers' performances or online shopping such as personal familiarity, Internet experience, and social network involvement. Forth, personality-oriented antecedents are described as individual's traits and habits that dispose a person towards certain behaviors; as they are long-term stable, relatively consistent over situations and differ across individuals, marketers may find it tough to control such as need for uniqueness, shopping style, and innovativeness. In the interest of developing a more comprehensive framework, we will consider some selected dimensions of all abovementioned categories regarding consumers' perceived risk. Specifically, we will examine information quality as cognition-based antecedent, and source credibility as the affect-based antecedent because consumers could increase trustworthiness once they find a reliable seller (Xiao et al., 2017). We will also examine consumer familiarity and personal innovativeness to reflect experience-based and personality-oriented antecedents respectively.

Information quality refers to the quality of information systems comprising pertinence, timeliness, precision, and completeness; besides, the online shopping uncertainties and risks are influenced by the quality of information available on the Internet (Yi et al., 2013) because the high quality information should help the quality of conducting transactions remain at the highest possible level and thus reduce consumers' transaction-related uncertainty and risk (Kim et al., 2008). Nicolaou and McKnight (2006) also support the important role of information quality in decreasing consumer perception of risk. However, the negative and direct relationship between information quality and consumer's perceived risk has not been confirmed in the online context (Bebber et al., 2017; Kim et al., 2008). This study argues that high quality information of the mobile shopping apps decreases the degree of risk perceived by consumer toward the app.

H1: Information quality of the mobile shopping app negatively affects consumer's perceived risk.

Source credibility is related to user perceptions of the ability and motivation of the message source to produce accurate, valid and truthful information (Kelman & Hovland, 1953), and perceived credibility of information source is assessed through expertise, trustworthiness or reputation (Kang & Namkung, 2018). When perceived risk is high, people are motivated to search specific sources for detailed information closely related to the situation (Cho & Lee, 2006). Nevertheless, the high level of perceived risk may result in a more widespread search for relevant information they need from such sources which help increase perceived information usefulness, thereby largely reduce risk based on the source (Cho & Lee, 2006; Flanagin et al., 2014). Furthermore, related research found significant and positive effects of the dimensions of source credibility including expertise, trustworthiness and reputation on perceived risk (Hussain et al., 2017; Kim & Lennon, 2013). It is proposed that the perceived risk on mobile shopping online is lower when the app represents a credible source.

H2: Source credibility of the mobile shopping app negatively affects consumer's perceived risk.

Consumer's familiarity with online selling party is described as the level of consumer's acquaintance with the seller, and it is built upon existing knowledge of both retailer and the process of purchasing product (Kim et al., 2008). Previous positive usage experiences with an e-retailer and its service could guide to establish the desired awareness, good image and expectations in the minds

of consumers (Kim et al., 2008). According to Alba and Hutchinson (1987), consumers who are more familiar with a brand will be less likely to perceive the uncertainty during buying process. By simplifying the buyer-seller relationships, high-familiarity consumers with the websites results in lower perceived risk, complexity or uncertainty (Kim et al., 2008). For instance, familiarity with an e-retailer (e.g., amazon.com) helps consumers avoid some uncertainty and complexity when directly searching and buying goods from the Internet (Gefen, 2000). Besides, it is found in related research that familiarity has direct and negative effect on the perceived risk associated with its purchase (Bailey, 1999; Richardson et al., 1996) and also has an indirect influence on the differences in risk through different variables (Mieres et al., 2006). However, the argument of Kim et al. (2008) that familiarity alleviates some of the consumer's perceived risk is not significant. This study argues that the more consumers know about the shopping app, the lower the perceived risk of the mobile shopping app seems to be.

H3: Consumer's familiarity with online selling party negatively affects consumer's perceived risk in adopting mobile shopping app.

Personal innovativeness refers to a person's tendency to embrace and use new information technology (Joo et al., 2014; Milošević et al., 2015). Kim et al. (2017) stated that innovators are more likely to be ready for exploring new technology products. And highly innovative people are more apt to actively seek information and provide effective feedback about new technology as well as better at dealing with uncertainties and adopting innovation than others (Milošević et al., 2015; Rogers, 2003). In other words, Agarwal and Prasad (1998) proposed that a person who is willing to take risks and unhesitantly experience new technology is related to a high level of individual innovativeness. Futhermore, consumer innovativeness is proposed as an antecedent of perceived risk in consumption contexts involving technological systems and has a negative effect on perceived risk in mobile travel booking (Park & Tussyadiah, 2016). It is predicted that when consumers are more receptive to new technology, they find shopping online through mobile app less risky.

H4: Personal innovativeness negatively affects consumer's perceived risk in adopting mobile shopping app.

2.3 Perceived Usefulness

Perceived usefulness is considered as an important determinant in explaining consumer's system usage behavior in multiple contexts (Segars & Grover, 1993). It refers to the degree of expected overall impact of information system use on consumer's performance (Davis et al., 1989) and represents the instrumentality of the system (Bhattacherjee, 2001). Especially, perceived usefulness plays a critical role in adopting new technology such as m-commerce once it is perceived to be more useful than other options (Chong, 2013). Since mobile shopping apps apply those technologies that will be useful to appeal to users, this study examines the effect of perceived usefulness on intention to adopt the shopping apps.

Many studies emphasize that information quality is important to adopt central route to persuasion in ELM (Kim et al., 2016). High level of information quality is helpful to users' perception of usefulness of the system and facilitate better decision making (Saeed and Abdinnour-Helm, 2008). According to Kim et al. (2016), when information is of higher quality, it is more useful for consumers to complete online shopping. Similarly, when users receive the content of persuasive messages with higher quality, they experience higher levels of perceived usefulness of the system (Li, 2013). Indeed, the more high quality information the mobile shopping apps provide to consumers, the more useful it is to buy product online through apps.

H5: Information quality of the mobile shopping app positively affects consumer's perceived usefulness.

The message supposedly prepared by a credible source is likely to contribute to consumer's affective or cognitive evaluation with respect to perceived usefulness in the context of information system acceptance (Li, 2013). Chen et al. (2014) found that source credibility positively influences potential users' perceived usefulness. Correspondingly, if the source of informational message is perceived to be highly credible, consumers will have a higher perception of the usefulness of online shopping system (Kim et al., 2016). In other words, consumers feel effective to buy on that platform when the mobile shopping app is credible.

H6: Source credibility of the mobile shopping app positively affects consumer's perceived usefulness.

2.4 Perceived Risk, Perceived Usefulness and Mobile Shopping Apps Adoption

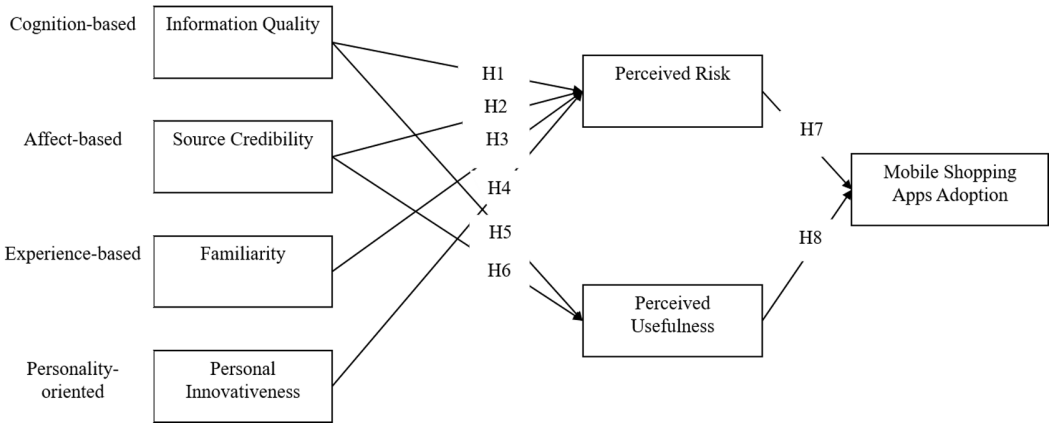
Dwivedi et al. (2017) reported that consumer's risk perception of Internet technologies causes significant resistance to adopt new technology system. In the context of m-commerce, people who perceive higher risk of using an m-commerce app will have lower intention of adopting it (Verkijika, 2018). It is clearly expected that the probability that consumers choose to buy a product on a mobile app is low when they perceive mobile shopping to be high risk (Slade et al., 2015). Besides, Zhang et al. (2012) demonstrated the negative influence of perceived risk on consumer's m-commerce adoption.

H7: Perceived risk negatively affects consumer's mobile shopping app adoption.

Conversely, Davis et al. (1989) confirmed the positive relationship between perceived usefulness and consumer acceptance and use of information technology. In online shopping, existing research has indicated the effects of information usefulness on both intended adoption and continuous usage intention of information technology (Cheung et al., 2008). Adams et al. (1992) also demonstrated that perceived usefulness significantly influences attitude toward an online retailer and had a significant impact on intentions to use the online retailer.

H8: Perceived usefulness positively affects consumer's mobile shopping app adoption.

Figure 1. Proposed research model



3. METHODOLOGY

3.1 Research Instrument

In this study, a multi-item and Likert-type scale is designed to measure the constructs, based on pre-validated items from past research but a revised version of the questionnaire is presented to fit the context of mobile shopping. The three items used to measure information quality were drawn from research by Gao et al. (2015). The three items used to measure source credibility were adapted from studies by Chaiken & Maheswaran (1994); Mak et al. (1997). The three items measuring consumer's familiarity with online selling party were taken from research by Gefen (2000). The four items used to measure personal innovativeness were drawn from studies by Agarwal & Prasad (1998). To measure perceived risk, we adapted five items from research by Featherman & Pavlou (2003), and Kang et al. (2012). Perceived usefulness was measured with four items from previous research by Gefen et al. (2003), Crespo et al. (2009), and Mahatanankoon et al. (2005). To measure consumer mobile shopping apps adoption, we adapted three items from studies by McKnight et al. (2002), Pavlou & Chai (2002). All of these 25 items were phrased using a typical 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5).

3.2 Data Collection

Before conducting a survey, the prefinal version of the translated questionnaire into Vietnamese was be pilot tested on a small sample (n=30) of the respondents to know if there is confusion and suggestion for possible improvements of the items. The final version of the questionnaire is administered to a sample of the students in Vietnam as the participant group through an online survey. Then the student participants were instructed to recruit another people they were familiar with. The requirement was that the respondents who had experienced any mobile shopping apps within the prior 6 months. Each respondent was asked to provide the name of a mobile shopping application which the respondent had downloaded, accessed, or purchased from. An independent backward translation was performed to ensure the accuracy of the translation. Among 553 collected responses, the survey yielded 410 valid questionnaires which were coded for analysis. From the population, the sample comprised 154 males (37.6%) and 256 females (62.4%). The majority of the respondents (79.3%) were 18-24 years of age, Respondents who were attending university or bachelor program comprised a majority of the respondents (65.1%). More than half of the respondents (53.2%) has personal income from $250-$500 per month, 44.9% with monthly income less than $250.

3.3 Statistical Methods

Data gathered by the questionnaire survey method were analyzed in several steps and using multiple statistical methods. First, validity analysis was conducted and research instrument validity was tested. Content validity involving literature reviews and then follow-ups with the pilot study has been ensured. Second, Cronbach's a was used to verify the internal consistency reliability (Feldt & Kim, 2008). Convergent validity was tested by performing explanatory factor analysis in order to uncover the underlying structure of a relatively large set of variables (Hair et al., 2006). Discriminate validity was tested using confirmatory factor analysis in order to determine the degree to which measures of different latent variables are unique enough to be easily differentiated from other constructs (Costello and Osborne, 2005).

Structural equations model fit was tested using the fit indices proposed by Hooper et al. (2008): X^2, goodness-of-fit-statistics (GFI), the incremental fit index (IFI), normed-fit index (NFI), comparative-fit index (CFI), Tucker-Lewis index (TLI) and the root mean square error of approximation (RMSEA). Finally, the structural equations model was used for testing linear relationships among latent (unobserved) variables and manifest (observed) variables.

4. RESULTS

This study conducted an exploratory factor analysis by using SPSS 24 to test whether significant cross loadings existed. The results indicated that all cross loadings were less than 0.5 as threshold. Factor loadings for information quality were ranged from 0.862 to 0.922. Factor loadings for source credibility were ranged from 0.812 to 0.981. Factor loadings for familiarity were ranged from 0.794 to 0.906. Factor loadings for personal innovativeness were ranged from 0.743 to 0.986. Factor loadings for perceived risk were ranged from 0.821 to 0.966. Factor loadings for perceived usefulness were ranged from 0.736 to 0.987. Factor loadings for mobile shopping adoption were ranged from 0.820 to 0.957. SEM was adopted to analyze the data by using AMOS 20. This study examined the measurement model to test reliability and validity, and examined the structural model to test research hypotheses. Content validity was attained by adapting items from the literature and our previous research

4.1 Measurement Model Assessment

A confirmatory factor analysis (CFA) was performed to validate and empirically test the validity of the items and the seven underlying factors. According to the recommended acceptance level by Hair et al. (2006), the resultant fit statistics indicated that the overall fit of the measurement model was good with X^2= 825.882 and df = 254 (p = 0.000). Furthermore, the goodness of fit index (GFI) = 0.892; the comparative fit index (CFI) = 0.949; the normed fit index (NFI) = 0.928; Tucker-Lewis index (TLI = 0.939); the incremental fit index (IFI) = 0.949 were satisfactory. Finally, the root mean square error of approximation (RMSEA = 0.074, with values < 0.08 indicating good fit), one of the indices best suited to our model with a large sample, indicated that the structural model was a reasonable fit.

Construct validity includes convergent and discriminant validities. Table 1 lists the standardized factor loading, composite reliabilities (CR), the average variance extracted (AVE) and Cronbach α values. All standardized factor loading were greater than 0.7 at a significance of $p < 0.001$, ranging from 0.714 to 0.967. AVE for all constructs exceeded the recommended level of 0.50, ranging from 0.714 to 0.851, and CR exceeds 0.7, ranging from 0.901 to 0.966. In addition, all α-values are larger than 0.7 suggesting a good reliability (Nunnally, 1978). These values suggested good convergent validity of the measurement scale (Fornell and Larcker, 1981)

Discriminant validity was examined by comparing the squared correlation between a pair of construct with the AVE (Fornell and Larcker, 1981). The square root of AVE for each construct is significantly larger than its correlation coefficients with other factors. As presented in table 2, discriminant validity of all constructs was statistically supported. In summary, the results of the measurement model support the reliability and validity of constructs proposed in the model, which underpins the further testing of the research hypotheses.

4.2. Structural Model Assessment and Hypotheses Testing

The proposed model was estimated using SEM. The results of the full structural model showed that there was a good fit of data to the proposed model X^2= 825.882 and df = 254 (p = 0.000); the goodness of fit index (GFI) = 0.892; the comparative fit index (CFI = 0.949), the normed fit index (NFI = 0.928); Tucker-Lewis index (TLI = 0.939); the incremental fit index (IFI = 0.949); the root mean square error of approximation (RMSEA = 0.074). Regarding the hypothesis tests, figure 2 shows the SEM results with standardized path coefficient and p-values. Table 4 presents the results of the individual tests of the significance of the relationship among the variables. Among the three relationships tested, all were found to be significant at the a level of 0.01.

The H1, suggesting that information quality of the mobile shopping app negatively affects consumer's perceived risk, was accepted (β = -0.327; t-value = -4.429; $p < 0.001$). The H2, suggesting that source credibility of the mobile shopping app negatively affects consumer's perceived risk, was accepted. The results clearly show β= -0.435 with t-value of -5.572 at $p < 0.001$. The H3, suggesting that consumer's familiarity with online selling party negatively affects consumer's perceived risk

Table 1. Reliabilities and confirmatory factor analysis properties

Construct (Cronbach's alpha)	Standardized factor loading	Composite reliabilities	AVE
Information quality (0.899)		0.901	0.752
Information quality 1	0.851		
Information quality 2	0.852		
Information quality 3	0.897		
Source credibility (0.930)		0.933	0.824
Source credibility 1	0.853		
Source credibility 2	0.967		
Source credibility 3	0.899		
Familiarity (0.911)		0.912	0.776
Familiarity 1	0.845		
Familiarity 2	0.905		
Familiarity 3	0.891		
Innovativeness (0.908)		0.909	0.714
Innovativeness 1	0.854		
Innovativeness 2	0.809		
Innovativeness 3	0.850		
Innovativeness 4	0.866		
Perceived risk (0.966)		0.966	0.851
Perceived risk 1	0.917		
Perceived risk 2	0.927		
Perceived risk 3	0.911		
Perceived risk 4	0.916		
Perceived risk 5	0.941		
Perceived usefulness (0.918)		0.921	0.745
Perceived usefulness 1	0.870		
Perceived usefulness 2	0.813		
Perceived usefulness 3	0.879		
Perceived usefulness 4	0.888		
Mobile shopping apps adoption (0.923)		0.924	0.803
Mobile shopping apps adoption 1	0.923		
Mobile shopping apps adoption 2	0.888		
Mobile shopping apps adoption 3	0.876		

Table 2. Correlations matrix among the latent constructs.

Variables	1	2	3	4	5	6	7
1. Information quality	**0.867**						
2. Source credibility	0.674	**0.908**					
3. Familiarity	0.666	0.754	**0.881**				
4. Innovativeness	0.674	0.731	0.711	**0.845**			
5. Perceived risk	-0.723	-0.787	-0.762	-0.781	**0.922**		
6. Perceived usefulness	0.690	0.793	0.730	0.762	-0.789	**0.863**	
7. Mobile shopping adoption	0.633	0.696	0.633	0.737	-0.774	0.786	**0.896**

All of the correlations are significant at the 0.01 level.

Figure 2. Results of structural model

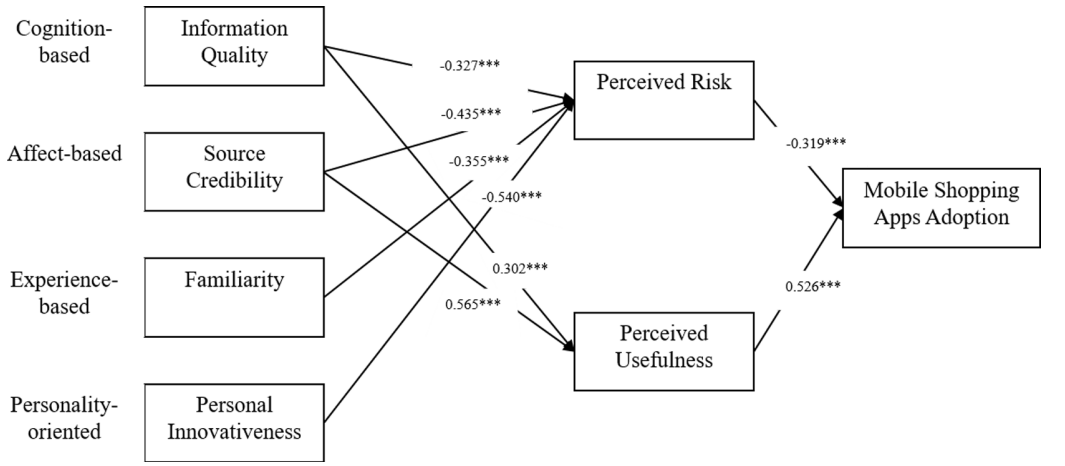


Table 3. Fit indices for the research model

Fitness indicator	Model estimated	Explanations
Chi-square (X^2)	825.882	
Degrees of freedom (df)	261	
p-value	0.000	
X^2/df	3.2	Good, close to 3
GFI	0.892	Good, close to 0.9
NFI	0.928	Very good result
CFI	0.949	Very good result
IFI	0.949	Very good result
TLI	0.939	Very good result
RMSEA	0.074	<0.08, a good result

in adopting mobile shopping app, was accepted (β = -0.355; *t*-value = -3.723; $p < 0.001$). The H4, suggesting that personal innovativeness negatively affects consumer's perceived risk in adopting mobile shopping app, was accepted (β = -0.540; *t*-value = -5.355; $p < 0.001$).

The H5 stated that information quality of the mobile shopping app positively affected consumer's perceived usefulness (β = 0.302; *t*-value = 6.013; $p < 0.001$). The H6 stated that source credibility of the mobile shopping app positively affected consumer's perceived usefulness (β = 0.565; *t*-value= 11.624; $p < 0.001$). The resutls indicate that H5 and H6 were supported.

Finally, the H7, proposing that perceived risk negatively affects consumer's mobile shopping app adoption, was also accepted. The standard solution of path coefficient estimate from perceived risk to consumer's mobile shopping app adoption was -0.319 with the *t*-value = -8.700 which supported the existence of a negative effect between them at 0.1% significance level. The H8, proposing that perceived usefulness positively affects consumer's mobile shopping app adoption (β = 0.526; *t*-value = 8.890; $p < 0.001$), was accepted. The results also showed that H7 and H8 were supported. As shown in table 3, all the hypothesized relationships were supported in the estimated structural model.

Table 4. Results of SEM

Structural equations	Coefficients (β)	t-values	P	VIF	Result
Information quality → Perceived risk	-0.327	-4.429	***	1.336	Supported
Source credibility → Perceived risk	-0.435	-5.572	***	1.216	Supported
Familiarity → Perceived risk	-0.355	-3.723	***	1.416	Supported
Personal Innovativeness → Perceived risk	-0.540	-5.355	***	1.261	Supported
Information quality → Perceived usefulness	0.302	6.013	***	1.177	Supported
Source credibility → Perceived usefulness	0.565	11.624	***	1.177	Supported
Perceived risk → Mobile shopping apps adoption	-0.319	-8.700	***	1.000	Supported
Perceived usefulness → Mobile shopping apps adoption	0.526	8.890	***	1.000	Supported

5. DISCUSSION

5.1 Results

This study examined consumers' information processing in mobile shopping apps context applying ELM. The aim of the study was to propose a model that integrated the ELM and perceived risk and also empirically test a comprehensive model to explore factors that influence consumers' perceived risk when using the mobile shopping apps.

First, based on the theoretical foundation of ELM, the findings of this study confirmed the significant relationships among information quality, source credibility, perceived risk, perceived usefulness, and mobile shopping app adoption. Specifically, information quality was found to have a more influential impact on perceived risk than perceived usefulness, which indicated that consumers may use information quality to identify their intentions of using mobile shopping app through evaluating perceived risk of the app as the central route of information processing. It can be explained

that as consumers can have chances to obtain information through not only the mobile shopping apps but other platforms such as company website or SNSs, it caused a less impact of information quality on perceived usefulness. While source credibility was reported to have a greater impact on perceived usefulness than perceived risk, it is suggested that in peripheral route, consumers may use source credibility to evaluate the perceived usefulness and develop adoption intention. Because a high credible source of information can increase consumers' perceptions of usefulness when facing information overload on Internet.

Second, information quality, source credibility, familiarity and personal innovativeness are found to be the factors that significantly affect consumers' perceived risk in the context of mobile shopping. These results are consistent with the findings in research by Kim et al. (2008) about four categories of antecedents of perceived risk including cognition-based, affect-based, experience-based and personality-oriented factors. Based on this concept, personal innovativeness was found to have a greater impact on perceived risk than others. The possible reason for this strong effect was explained by Rogers (2003) that innovators are those who are more likely to face and be ready to deal with uncertainty, and individuals with higher levels of personal innovativeness are expected to have positive ability to accept risks and adapt a new technology rather than others.

Third, the study confirmed that both perceived usefulness and perceived risk in turn influence consumer intention in adopting mobile shopping apps to purchase the product/service, which is consistent with previous studies (Zhang et al., 2012; Lee et al., 2006). In detail, the findings show that consumers tend to make online purchase through mobile devices if they find that the shopping apps are useful. In contrast, when consumers perceive the shopping apps with high risk, they are less likely to accept to use the apps to purchase online.

5.2 Theoretical Implications

First, this study enriched the literature of ELM and proposed an integrated model by grounding a new variable in ELM and applying them into a new concept to provide a broad understanding and interpretation of consumer behavior regarding m-commerce. This study also contributed to the ELM research literature by treating information quality and source credibility as common dimensions used in different information processing paths through perceived risk and perceived usefulness. It suggests that research took the perspective of ELM to understand two major routes to persuasion of consumer mobile shopping app adoption. Besides, this study supports a notable negative correlation between perceived usefulness and perceived risk which indicates that the higher risk the mobile shopping app exists, the less useful it is to be adopted as an online shopping platform.

Second, this research grasped at diving deeper into the perceived risk construct and provide insight into its facets by employing elements from four categories of antecedents of perceived risk from a different point of view. In addition to the app features such as information quality and source credibility, the significant effects of consumers' characteristics including familiarity and personal innovativeness were also examined. Thus, the study provides a comprehensive and up-to-date understanding of the risk-related factors that consumers consider as they engage in mobile shopping. In general, considering both individual's intention of adoption and information processing makes an important contribution to the emerging literature on m-commerce.

5.3 Managerial Implications

In order to enhance perceived usefulness and minimize perceived risk, e-retailers should offer high quality information and source credibility through their shopping apps. Specifically, the information provided by the apps should be relevant to the consumers' needs. It is neccesary to provide up-to-date information by periodically updating product information to keep up with consumption trends. Furthermore, the apps should provide unbiased information people can rely on by presenting the product reviews of consumers. It also helps make the app perceived as a credible source in the

business. Demand for the transparency in the vendors' operation information is necessary to increase the trustworthiness and reliability of the devices.

In addition to the app features such as information quality and source credibility, the retailers offering the products through mobile shopping apps need to further their understanding of consumers' characteristics with respect to familiarity and personal innovativeness to reduce their perceived risk in shopping online. The app developers can take advantage of the proliferation of SNSs as a marketing channel for building up the image of shopping apps, which helps generalize their familiarity to consumers. The design including interface and underlying operation should not be dramatically different from other m-commerce apps. Hence any individuals who were familiar with buying products online from any mobile shopping apps can easily access the process of purchasing from this. Besides, consumers who are more innovative and active in using technology should be targeted by the managers because they are more likely to adapt a new application.

From a practical standpoint, this study would help both e-retailers and app developers in encouraging consumers to try and stick with the mobile shopping app. This could be done by motivating managers to better incorporate perceived usefulness and perceived risk into building mechanisms to enhance the user acceptance and use of mobile shopping apps.

5.4 Limitations and Future Research

The decision making behavior of online consumers can be moderated by different variables, such as user expertise or product involvement, which may also moderate use of central and perpheral routes. The study should consider some moderating variables which help improve the comprehensive of ELM and contribute to different information processing paths in the context of m-commerce. The majority of survey participants are 18-24 years of age, the difference may limit the generalizability of the study to a larger population. Therefore, future studies could conduct research with respondents from other age groups or large cross-country population because those effects may vary across user population. Moreover, the results were not restricted to shopping in a market associated with a particular product or service. The research question should be further examined with more specific categories of products within utilitarian and hedonic categories in order to clarify the understanding about consumers' various behaviors when they purchase a product through mobile apps. Lastly, this study is limited to a selection of variables related to perceived risk, and four groups of factors served as the antecedents of perceived risk included in the research model are not expected to be inclusive of all possible factors. Hence, future research should take into account other factors with respect to the categories as well as other contextual ones.

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APPENDIX A

Information Quality	Mobile shopping app provides me with information that is relevant to my needs.
	Mobile shopping app provides me with sufficient information.
	Mobile shopping app provides me with up-to-date information.
Source Credibility	The mobile shopping app has integrity
	The mobile shopping app is reliable
	The mobile shopping app is trustworthy
Familiarity with the Online Selling Party	I am familiar with searching for items on this mobile shopping app.
	I am familiar with the process of purchasing from this mobile shopping app.
	I am familiar with buying products online from any mobile shopping apps.
Personal Innovativeness	I heard about a new information technology, I would look for ways to experiment with it
	Among my pears, I am the first one to try out new information technologies
	In general, I am not hesitant to try out new information technologies
	I like to experiment with new technologies
Perceived Usefulness	The mobile shopping app would be useful for buying the products online.
	The mobile shopping app would enhance my effectiveness in buying the products online.
	The mobile shopping app would enable me to buy the products online more quickly.
	I find that m-commerce is more convenient than using the internet on computers and notebooks.
Perceived Risk	Mobile shopping app may not perform well and process payments incorrectly.
	Using mobile shopping app would add great uncertainty to payments.
	The security systems built into the mobile shopping app are not strong enough to protect my account.
	Internet hackers (criminals) might take control of my account if I used the mobile shopping app.
	My decision to use mobile applications for shopping involves a higher risk.
Behavioral Intention	I would choose the mobile shopping app as a preference to purchase the products online.
	I would be willing to use the mobile shopping app to purchase the products online.
	Given the chance, I intend to shop by the mobile phone app.

Thi Huong Giang Vo is a Lecturer in Department of Business Administration at Ho Chi Minh City University of Food Industry in Vietnam and a PhD candidate in PhD Program in Business at Feng Chia University, Taiwan. Her research interests are internet marketing, e-commerce, and consumer behavior.

Kuang-Wen Wu (Ph.D., Lynn University, U.S.A.) is an associate professor in the Department of International Business at Feng Chia University in Taiwan. He was the director of Department of International Business. His research interests are Internet marketing, international marketing, and branding. His researches are published in Computers in Human Behavior, International Journal of Mobile Communications, and Corporate Social Responsibility and Environmental Management, among others.