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Exploring Transaction Security on Consumers' Willingness to Use Mobile Payment by Using the Technology Acceptance Model

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Abstract: In recent years, with the increase in Fintech innovation, mobile payment has played an important role. This research is to investigate factors affecting consumers' willingness to use mobile payment. The study found that perceived ease of use and perceived usefulness have a significant positive impact on consumer's adoption of mobile payments. In addition, from empirical research on the mediating effect of transaction security on attitudes toward using it and behavioral intention to use, the study found that transaction security has a significant mediating effect, and empirical data shows that transaction security can strengthen consumers' behavior towards using mobile payment intention, this also explained why the penetration rate of mobile payments in developed countries is lower than in developing countries. In summary, to encourage consumers to willingly use the new mobile payment tool, in addition to making the tool easy to use and useful, it is crucial that transaction security can assure consumers' willingness to use mobile payment.

Keywords: mobile payment; technology acceptance model; transaction security; structural equation method

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1. Introduction

In recent years, the e-commerce boom has caused mobile payment to be widely used, which has in turn further facilitated the rapid development of e-commerce. With increasing numbers of transactions and the introduction of newer equipment, products and solutions, online payments have become more diverse. Payment technologies have developed from paying with physical credit cards in-store to B2B, B2C and C2C models supported by online purchases. Upon breaking the physical locational boundaries, the rise in e-commerce platforms guarantees the quality of products while reducing the asymmetry of information between vendors and consumers. More importantly, according to Al Hogail and Al Shahrani (2018), this phenomenon helps to alleviate consumer concerns towards a lack of trust on payment cash flows, and the interaction of these two factors further caused the proliferation of e-commerce platforms such as Amazon and Shopee [1].

At the same time, online transaction models and payment tools with Chinese characteristics started to emerge in Mainland China, namely Alipay and Yu'e Bao, with direct payments between buyers and sellers. Such a transaction mode encompasses the risk of the seller not delivering the goods and the buyer defaulting. Alipay then pioneered the secured transaction mode, i.e., after the buyer places an order, the funds are first deposited into Taobao.com. After confirming the receipt of all goods, Taobao would then deposit the money into the seller's account. Secured transaction emerged to solve the trust problem of online transaction payment. Alipay's secured transaction, nonetheless, was initially inefficient, with a high error rate, and the payment success rate was only 60%. Since 2010, Alipay has launched fast payment, which eliminated the need for credit card holders to sign contracts with banks during the opening process, and truly realized cross-system, cross-terminal and cross-browser payment methods. The payment success rate has risen

sharply to 90%. This new payment method brought unprecedented payment experience to online payment users back then. From 2007 to 2009, the annual transaction volume of Alipay increased fivefold from RMB 47.6 billion to 287.1 billion, accounting for 49.8% of the online payment market. The Ant Group subsequently introduced other financial services such as the payment tools that integrated online shopping and lending. In coherence with Christensen et al. (2016) Jobs to be Done theory, this disruptive innovation of decentralization and borderline decentralization, simultaneously satisfies consumers' needs in functional, social, and emotional aspects [2]. The demand has turned Ant Group into a large and successful FinTech company. In recent years, with ever-improving mobile phone functionalities, combined with better mobile internet access (e.g., from 4G to 5G), it has become easier for consumers to make payments with mobile phones. The result is an increase in mobile payments on in-person payments, in-store purchases, and online payments. Many internet platforms and startups such as FinTech have entered the field of mobile payment (e.g., LINE pay, Google pay, Apple pay, etc.). Financial institutions in Taiwan have also cooperated with these mobile payment providers to promote online credit cards.

For mobile payment technology to be accepted by consumers, consumer trust is a very important factor, and transaction security is key to gaining consumer trust [1,3–5]. Until 2016, only 60% of Taiwanese taxpayers filed tax returns online, mainly due to their distrust of the online tax filing system and fear of personal information leakage. According to the "Mobile Payment Consumer Survey" conducted by the Industrial Intelligence Research Institute of Taiwan Information Policy Association, the primary consideration that may affect the use of mobile payment is "security", which accounts for 53.1%. According to Nikkei Chinese Website (14 April 2022), the cashless ratio in 2020 is close to 30%; while the Taiwan Business Times (3 February 2021) reported that the Institute of Industrial Intelligence (MIC) of the Information Policy Council released the mobile payment consumer survey in late 2020 and reported the changes in consumer usage habits during the epidemic in early 2020. Among the common transaction methods, mobile payment (60.3%) is still lower than that of physical card (76.3%) and cash (75.5%). Transaction security is surely an important factor for consumers when using mobile payments. Eriksson et al. (2021) explored the resistance of mobile payment [6]; relevant studies found that perceived security and privacy risks are the reasons for the resistance to mobile payment [7–11].

Chang and Lo (2020) found that trust and assurance are important factors in mobile payment adoption; therefore, understanding the mobile payment adoption process is necessary for service providers to convince potential users that mobile payment is worthwhile [12]. Rogers's (2003) Innovation Diffusion Theory posited that innovation was a process of passing things out, and this process requires a formation period, so the process of diffusion communication includes knowledge, persuasion, decision, execution, and confirmation [13]. In the persuasion stage, consumers must be persuaded that the innovation has relative advantages, compatibility, less complexity, trialability, and observability. If such innovation did not have trialability and observability, it would not be able to gain the trust of consumers, thus resulting in its failure, and would eventually become a non-diffusion of innovation, as coined by Moore (1999) [14].

In recent years, during the COVID-19 pandemic since February 2020, cash has been increasingly perceived as the transmission channel of the virus. Liébana-Cabanillas et al. (2020) advocated mobile payment modes such as QR code or NFC that do not require cash transactions, which can indeed avoid infection due to physical contacts [15]. Of the risks of COVID-19, Chiu and Jhang (2022) found that the public was worried that the virus would spread through cash transactions, so whether it is physical or online consumption, mobile payment has surpassed debit cards and credit cards as transactions [16]. In addition, mobile payment can break geographical restrictions and make transactions more convenient, which possibly contributed to the rise in mobile payment in recent years. Nonetheless, users who enjoyed the convenience would also worry about the risk of personal information leakage and transaction security. According to Eriksson et al. (2021), many described

security issues as their main concern for mobile payments, including trust and reliability of technologies such as mobile phones, apps and contactless payments, worrying about potential monetary loss from unauthorized transactions, the risk of leakage and misuse of private information [6].

Recent studies on the relationship between mobile payments and consumers mostly focus on exploring the impact of consumer attitudes and behaviors on the development of mobile payments [17,18], and less research on transaction security factors. Therefore, the main motivation of this study is to understand how transaction security affects consumers' attitudes toward mobile payment, and whether such attitudes also affect their behavioral intentions. The purpose of this study is to use Davis's (1989) technology acceptance model [19,20] and to use the Structural Equations Modeling to test the proposed relationship exploring transaction security on consumers' willingness to use mobile payment.

2. Literature Review

2.1. Mobile Payment

Mobile payment is a popular research topic in the field of contemporary FinTech. With the rise of various mobile payment models, which have enriched the shopping experience of consumers. Mobile payment models with multiple channels have increased the feasibility of online transactions. Eriksson et al. (2021), based on the theory of innovation resistance (IRT), explored the reasons for the non-diffusion of mobile payments, and found that functional barriers and psychological barriers contributed to non-proliferation [6]. Functional aspects included three barriers, use, value, and risk, which would arise when consumers expect significant change from adopting innovations. Psychological resistance aspects included traditional and image barriers, which would surface when consumers' norms and traditions are inconsistent with their perceptions of service or product image [21]. The reasons behind the risk barriers included perceived security risks and reliance on a mobile phone. Many users regarded security as their main concern for mobile payments. The trust and reliability of technologies (e.g., mobile phone, applications and contact-less technologies) signified the possible risk of monetary loss (e.g., fear of unauthorized transactions), and the risk of leakage and misuse of private information were among the main concerns of respondents.

Mallat (2007) found that the relative advantages of mobile payments included independence of time and place, availability, the possibility of remote purchases, and avoidance of queuing, while its disadvantages included premium pricing of payments, complexity of payment procedures, lack of a wide range of merchants acceptance and perceived risk [9]. Another advantage of mobile banking is the free access to locations (Laukkanen and Lauronen, 2005), so the compatibility of mobile payments with consumer purchase transactions, habits, and preferences has a corresponding impact on the process of diffusion [22].

To study behavioral intentions of mobile payment consumers, Daştan and Gürler (2016) adopted Davis' (1989) technology acceptance theory and conducted research through the structural equation modeling in the form of questionnaires [17,19,20]. They found that perceived trust, perceived mobility and attitudes had a positive impact on the adoption of mobile payment systems, while perceived usefulness and perceived ease of use had no impact on the adoption of payment systems. In addition, perceived reputation is positively correlated to perceived ease and has a significant positive effect on mobile payment system adoption [23,24]. Other studies concluded that no effect was found between perceived usefulness and mobile payment systems adoption, which contradicts and does not support past research [17,25]. Francisco et al. (2020) studied consumers' intention to use Apple Pay, a mobile payment tool, and found that perceived value was the largest variable affecting the intention to use the proposed payment system, followed by perceptions of utility and risk, with conclusions similar to past research by Davis (1989), Chandra et al. (2010), and Liébana-Cabanillas et al. (2017) [18,19,25]. Mobile payment is also a kind of electronic payment, the research indicated that electronic payment systems are designed to play an important and essential role in achieving and maintaining financial stability. They improve

banking management and reduce risks; governments are supporting the development of mobile payment around the world [24,26].

2.2. Technology Acceptance Model

Technology acceptance model (TAM) emerged from Fishbein and Ajzen's theory of reasoned actions (TRA) [27]. According to TRA, one oftentimes logically and systematically deals with relevant information, and his/her actions are determined by a conscious behavioral intention to enact. Behavioral intentions are jointly determined by individual attitudes and subjective norms according to relative weights, and a person's attitude toward an action is determined by the main beliefs about the consequences of performing the action and the evaluation of those consequences. A person's subjective norms depend on normative beliefs and motives for compliance. Subjective norm represents the approval or disapproval of the behavior by important persons who influence the party and affects the party's cognition. Attitude refers to an individual's positive and negative emotions towards a specific behavior, and behavioral intentions reflect the individual's willingness to behave in a certain way [27].

Davis (1989) used the causal relationship of the TRA theory to explain the behavior of individuals accepting information technology and developed the technology acceptance model [19,20]. TAM shows that the perceived usefulness of information technology and the perceived ease of use are the two main determinants of the behavioral intention to use. Davis believed that perceived usefulness was a person's belief that using it would improve their job performance, while perceived ease of use refers to a person's use it with minimal efforts. Ease of use cognition also positively affects usefulness cognition, which indirectly affects use intention. Therefore, usefulness cognition is the main factor affecting the intention to use, and easy-to-use cognition is the secondary factor. The relationship between these external variables (perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use and actual usage) is shown in Figure 1 below.

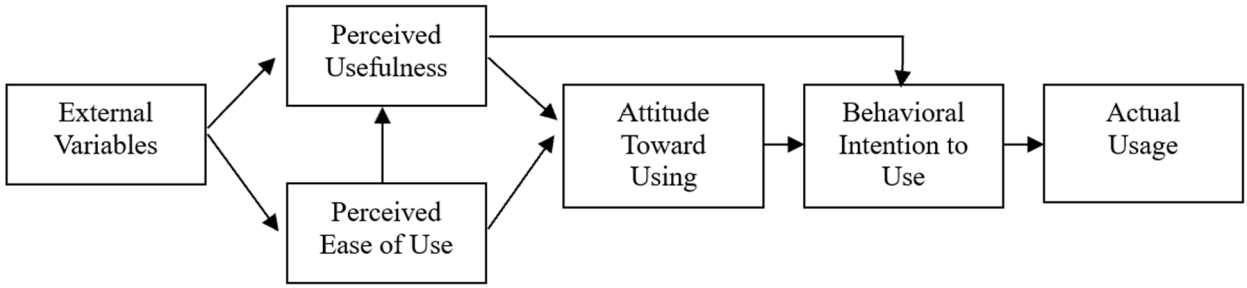

Figure 1. The structure of TAM (drawn via this research by referencing Davis's (1989) Technology Acceptance Model) [19,20].

TAM can explain the user's acceptance behavior of using information technology from the perspective of users' internal cognition. It is one of the most commonly used theoretical models to study users' technology acceptance. The main purpose of the TAM is to provide a basis for providing a general explanation for the determinants of user acceptance of technology products. This theory points out that the performance of human behavior is determined by the individual's behavioral intention, and the behavioral intention is affected by the individual's attitude toward behavior and subjective standards [25]. TAM has been applied to the study of the use behavior of e-mail systems and editing software and established a questionnaire about perceived usefulness and perceived ease of use. The results of this study found that perceived usefulness and perceived ease of use had a positive impact on behavioral intention, and perceived usefulness had a stronger impact on use behavior than perceived ease of use. Chawla and Joshi (2019) used TAM to explore consumer attitude and intention to adopt the mobile wallet in India, their study found that factors like perceived ease of use, perceived usefulness, trust, security, facilitating conditions and lifestyle compatibility have a significant impact on the consumer attitude

and intention to use mobile wallets [28]. Alswaigh and Aloud (2021) used the technology acceptance model to study the application of mobile wallets in Saudi Arabia, they found that perceived usefulness, perceived ease of use, lifestyle compatibility, and facilitating conditions are direct predictors of user behavior in accepting mobile wallet payments [29]. Therefore, users' perceived ease of use towards information technology positively affects their behavioral intentions.

In summary, Davis' TAM has been widely used in the research on the acceptance of new information technology and has been backed by proliferate literatures. With the continuous revision of information technology and increasing the integrity of its theory, as summarized in Figure 1 above, this study employs TAM as the foundation to explore the relationship between proximal action payment (external variables), perceived usefulness and perceived ease of use, which may affect their attitude toward using and behavioral intention to use. Variables are then added to further explain the magnitudes of impacts.

2.3. Transaction Security

Many well-known domestic and foreign scholars have pointed out that security and trust are the biggest considerations for consumers in their research on online transaction issues. Alswaigh and Aloud (2021) found that trust occurs when one party has confidence in an exchange partner's reliability and integrity [29]. Users need to utilize a new service with comfort, safety, and fewer feelings of risk. Many studies have concluded that trust has a positive effect on user intention to adopt mobile payment [30,31]. Security is the biggest consideration for customers when banking online, therefore privacy protection and information security management are key for users' confidence towards websites. Only when consumers' transaction security of payment can be assured will consumers dare to transact through online or mobile payment. BLanford (1996) pointed out that confidentiality and data security on the Internet is imperative [32]. This study refers to "Secure Electronic Transaction" released in 1996 regarding transaction security constructs, which are then modified to fulfill research-specific needs applicable to the mobile payment transaction security context. The five transaction security constructs such as confidentiality, integrity, authentication, transaction non-repudiation, privacy and other security requirements are summarized as follows:

1. Confidentiality: Transactions cannot be traced over public networks, and information about transactions cannot be obtained by unauthorized intermediaries. All information transacted in an e-commerce environment is kept confidential.
2. Integrity: Transactions must not be disrupted or interfered with. It should be confirmed that the content of the electronic transaction has not been changed during the transmission between the client and the server—that is, the information cannot be arbitrarily added, deleted or modified during the transaction processing.
3. Authentication: There needs to be assurance that the identity of a subject or resource is characteristic of the person it declares. Authentication applies to users, programs, systems, and information.
4. Transaction non-repudiation: The sender of the transaction has its own unique electronic signature, making it impossible to deny the fact of sending this document.
5. Privacy: Transactions should remain inviolable, and messages sent and received over the Internet cannot be read, modified or intercepted by any other parties.

In summary, in e-commerce and online banking services, security is regarded as a website's basic construction requirement, and its confidentiality and data security are very important issues in online services, and it is amongst clients' greatest concerns [33].

3. Research Method and Design

3.1. Conceptual Framework

This research employs structural equation modeling as a foundation, whose variables include perceived ease of use (PEOU) and perceived usefulness (PU). This study explores the relationship between use attitude toward using (ATT) and behavioral intention to use

(BI), and then utilizes transaction security perception as the mediating variable between attitude toward using and behavioral intention to use to clarify whether there is a path difference. To describe the concept of this research in detail, a structural diagram was developed, as shown in Figure 2.

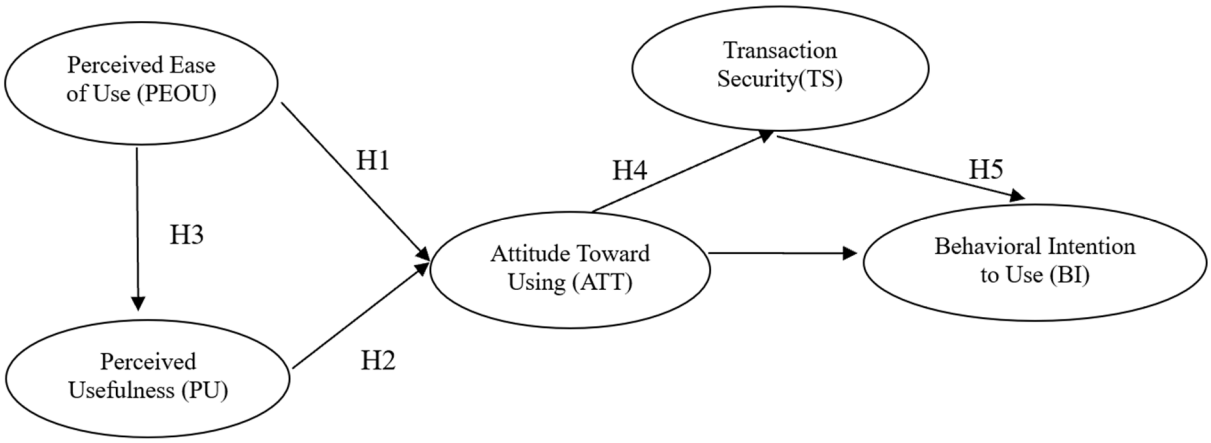

Figure 2. Conceptual framework.

According to the study's objectives, structure and literature review, the research hypotheses to be tested are established and described as follows:

Hypothesis 1 (H1). *Perceived ease of use of proximity mobile payment function positively impacts attitude towards using*.

Perceived ease of use was defined by Davis (1989) as underlying users' subjective perception of the level of ease or difficulty towards learning to operate a new information system [19,20]. The lesser effort the user incurs when learning such information technology, the more positive feeling he or she may have about this technology. If users of the proximity mobile payment function think that the operation of the proximity mobile payment is easy to learn, they will have a positive and accepting attitude towards the proximity mobile payment function.

Hypothesis 2 (H2). *Perceived usefulness of proximity mobile payment function positively impacts attitude towards using*.

Perceived usefulness was defined by Davis (1989) as underlying users' subjective perception that the operation of certain information system could improve his or her work performance [19,20]. In this study, perceived usefulness is to explore how users can improve their work or life performance when they operate proximal action payment, so that they can have a positive and accepting attitude towards the function of proximal action payment.

Hypothesis 3 (H3). *Mobile payment users' perceived ease of use of proximity mobile payment positively impact on perceived usefulness*.

Davis (1989) posited that users do not need to expend too much effort in learning information technology, and at the same time can improve users' performance at work [19,20]. The user's "perceived ease of use" of information technology has a positive effect on the "perceived usefulness" of information technology. In this study, if the user thinks that the mobile phone is easy to use, they will consider the mobile phone to be a useful tool.

Hypothesis 4 (H4). *Attitude toward using positively impacts behavioral intention to use*.

Taylor and Todd (1995) found that individuals' willingness to use a certain information system technology in the future refers to the possibility that individuals intend to use a certain technology or information system in their subjective consciousness [33]. TAM supports that behavioral intentions are also affected by individuals' attitudes towards technology use and perceived usefulness. When users perceive that using the function of proximity mobile payment will help improve the efficiency of study or work, the more positive evaluation they will have on the proximity mobile payment, and the more willing they are to use such functions.

Hypothesis 5 (H5). *Mobile payment users' Transaction security awareness has a mediating effect on attitude toward using and behavioral intention to use.*

Rong (2020) defined security as the freedom from danger, risk, worry, doubt and worry, and transaction security would encompass security consideration under the transaction method and payment-related services that consumers recognize in the shopping channel [34]. Proximity mobile payment is also a shopping channel, so in this study, we refer to the interpretation of the definition of transaction security proposed by Rong. In respect of transaction security, the proximity mobile payment is an electronic transaction. Therefore, this study uses the "secure electronic transaction protocol", which includes security such as confidentiality, integrity, authentication, transaction non-repudiation, and privacy. The five transaction security aspects of demand, this study assumes that the "transaction security perception" of the users of the proximity mobile payment will have a mediating effect on the user's "use attitude" and "behavioral intention".

3.2. Research Subjects

The research objects are users who are currently using or may use proximity mobile payment. Considering the collaboration of Taiwan Mobile Payment Co., Ltd. with local financial institutions, it will be conducted by the public who handle banking related business. Questionnaire In order to understand the relationship between people's views on proximity mobile payment and transaction security perception, this research uses questionnaires to collect data, of which 423 questionnaires were recovered, of which 400 were valid, and with an effective recovery rate of 94.5%.

4. Analysis of Results

4.1. Confirmatory Factor Analysis

4.1.1. Perceived Ease of Use

After the confirmatory factor analysis of the perceived ease of use, the GFI value was 0.976, the CFI value was 0.988, and the RMSEA value was 0.105, demonstrating that the fit has reached the critical value of ideal fit. In addition, the standardized factor loadings except for PEOU6 less than 0.5, it is shaved in the sample, while the other samples were all above 0.5 (0.916, 0.856, 0.932, 0.786, and 0.855 respectively) indicating that the observed variables of this research model reached the level of measuring potential dimensions. Table 1 shows a well-fitted model of the perceived ease of use dimension through CFA.

Table 1. TAM of perceived ease of use.

Construct	Indicator	Standardized Factor Loading	Unstandardized Factor Loading	*p* Value	GFI	CFI	RMSEA
PEOU	PEOU1	0.916	1	***	0.976	0.988	0.105
	PEOU2	0.856	1.004	***			
	PEOU3	0.932	1.070	***			
	PEOU4	0.786	0.889	***			
	PEOU5	0.855	0.947	***			

*** $p < 0.001$. Source: calculated by this research.

4.1.2. Perceived Ease of Use

After the confirmatory factor analysis of the perceived ease of use, the GFI value was 0.957, the CFI value was 0.979, and the RMSEA value was 0.141, demonstrating that the fit has reached the critical value of ideal fit. In addition, the standardized factor loadings except for PU6 less than 0.5, it is shaved in the sample, while the other samples were all above 0.5 (0.843, 0.935, 0.902, 0.909 and 0.766, respectively), indicating that the observed variables of this research model reached the level of measuring potential dimensions. The results above demonstrated a well-fitted model of the perceived ease of use dimension through CFA, with five questions left for follow-up analysis, as shown in Table 2.

Table 2. CFA of perceived ease of use.

Construct	Indicator	Standardized Factor Loading	Unstandardized Factor Loading	*p* Value	GFI	CFI	RMSEA
PU	PU1	0.843	1	***	0.957	0.979	0.141
	PU2	0.935	1.123	***			
	PU3	0.902	1.065	***			
	PU4	0.909	1.059	***			
	PU5	0.766	1.021	***			

*** $p < 0.001$. Source: calculated by this research.

4.1.3. Attitude toward Using

After the confirmatory factor analysis of the perceived ease of use, the GFI value was 0.987, the CFI value was 0.997, and the RMSEA value was 0.045, demonstrating that the fit has reached the critical value of ideal fit. In addition, the standardized factor loadings were all above 0.5 (0.890, 0.895, 0.908, 0.741, 0.898 and 0.880, respectively), thus indicating that the observed variables of this research model reached the level of measuring potential dimensions. In sum, attitude toward using would be a good fit model, as validated by CFA. All six questions were deemed appropriate to remain for follow-up research. See Table 3 for details.

Table 3. CFA of attitude towards using.

Construct	Indicator	Standardized Factor Loading	Unstandardized Factor Loading	*p* Value	GFI	CFI	RMSEA
ATT	ATT1	0.890	1	***	0.957	0.979	0.141
	ATT2	0.895	1.032	***			
	ATT3	0.908	1.028	***			
	ATT4	0.741	0.749	***			
	ATT5	0.898	1.025	***			
	ATT6	0.880	1.085	***			

*** $p < 0.001$. Source: calculated by this research.

4.1.4. Behavioral Intention to Use

After the confirmatory factor analysis of the perceived ease of use, the GFI value was 0.902, the CFI value was 0.958, and the RMSEA value was 0.222, demonstrating that the fit has reached the critical value of ideal fit. In addition, the standardized factor loadings were all above 0.5 (0.857, 0.921, 0.912, 0.923 and 0.932, respectively), thus indicating that the observed variables of this research model reached the level of measuring potential dimensions. In sum, attitude toward using would be a good fit model, as validated by CFA. All five questions were deemed appropriate to remain for follow-up research. See Table 4 for details.

Table 4. CFA analysis for behavioral intention to use.

Construct	Indicator	Standardized Factor Loading	Unstandardized Factor Loading	*p* Value	GFI	CFI	RMSEA
BI	BI1	0.857	1	***	0.902	0.958	0.222
	BI2	0.921	1.053	***			
	BI3	0.912	1.035	***			
	BI4	0.923	1.054	***			
	BI5	0.932	1.050	***			

*** $p < 0.001$. Source: calculated by this research.

4.1.5. Transaction Security

After the confirmatory factor analysis of the perceived ease of use, the GFI value was 0.911, the CFI value was 0.964, and the RMSEA value was 0.179, demonstrating that the fit has reached the critical value of ideal fit. In addition, the standardized factor loadings were all above 0.5 (0.924, 0.933, 0.953, 0.940, 0.953 and 0.608, respectively), thus indicating that the observed variables of this research model reached the level of measuring potential dimensions. In summary, attitude toward using would be a good fit model, as validated by CFA. All six questions were deemed appropriate to remain for follow-up research. See Table 5 for details.

Table 5. CFA of perceived usefulness.

Construct	Indicator	Standardized Factor Loading	Unstandardized Factor Loading	*p* Value	GFI	CFI	RMSEA
TS	TS1	0.924	1	***	0.911	0.964	0.179
	TS2	0.933	1	***			
	TS3	0.953	1.008	***			
	TS4	0.940	1.008	***			
	TS5	0.953	0.992	***			
	TS6	0.608	0.602	***			

*** $p < 0.001$. Source: calculated by this research.

4.2. Reliability, Validity and Fit Analysis

4.2.1. Reliability

In this study, the Cronbach's α value is used to measure the reliability between items under the same dimension, which covers the following five dimensions. The Cronbach's α value of each dimension variable is as follows: The alpha value of ease of use is 0.939, the alpha value of attitude to use is 0.949, the alpha value of behavioral intention is 0.959, and the alpha value of transaction security is 0.977. The empirical results show that the Cronbach's α value of each dimension variable is greater than 0.7, which means that the internal consistency and stability of the questionnaire in this study are good. Cronbach's α values of the following variables are shown in Table 6.

4.2.2. Validity

Convergent Validity

As shown in Table 7, the combined reliability of perceived ease of use is 0.9397, and the average extraction of variance is 0.7578; the combined reliability of perceived usefulness is 0.9410, and the average extraction of variance is 0.7623; the combined reliability of attitude to use is 0.9492, the average variance extraction is 0.7579; the combined reliability of behavioral intention is 0.9598, and the average variance extraction is 0.8270; the combined reliability of transaction security is 0.9590, and the average variance extraction is 0.7990; The combined reliability values of all facets were greater than 0.7, and the average variance extraction values were greater than 0.5, indicating that the model had convergent validity.

The combined reliability (CR) and average extraction of variance (AVE) values of each aspect are listed in Table 7.

Table 6. CFA of perceived usefulness.

Construct	Factor	Chronbach's α
PEOU	PEOU1 I think it is easy to learn how to use proximity mobile payment. PEOU 2 I think it is easy to use proximity mobile payment to complete my tasks. PEOU 3 To me, proximity mobile payment is easy to understand. PEOU 4 I think proximity mobile payment is flexible to use. PEOU 5 It is easy for me to become familiar with using proximity mobile payment.	0.939
PU	PU1 The use of proximity mobile payment can improve the convenience of my life and work. PU2 By using proximity mobile payment, I can complete payments faster. PU3 Proximity mobile payment improves my efficiency when making payments. PU4 Proximity mobile payment makes payments easier. PU5 Proximity mobile payment can improve the quality of my life and work.	0.939
ATT	ATT1 I think it is a good idea to use proximity mobile payment. ATT2 I think proximity mobile payment is a good payment tool. ATT3 I think proximity mobile payment is an intelligent idea. ATT4 I think proximity mobile payment is an advanced idea. ATT5 I think proximity mobile payment is valuable to me. ATT6 Overall, I'm willing to use proximity mobile payment.	0.949
BI	BI1 In the future, I will use proximity mobile payment instead of other payment methods. BI2 In the future, I will use proximity mobile payment often. BI3 In the future, proximity mobile payment will become part of my daily life. BI4 In the future, I will recommend others to use proximity mobile payment. BI5 In the future, I will encourage friends and family to use proximity mobile payment.	0.959
TS	TS1 I think customer data can securely transfer through proximity mobile payment. TS2 I think proximity mobile payment has a good reputation for security. TS3 I think proximity mobile payment has a good design for payment security protocols. TS4 I think proximity mobile payment contains state-of-the-art technologies available to protect transactions. TS5 I think proximity mobile payment provides security protection in the shopping process. TS6 I think proximity mobile payment contains appropriate encryption and privacy protections are in place to ensure successful transactions.	0.977

Source: Calculated by this research.

Table 7. Combined reliability and average extraction of variance values for each dimension.

Construct	Combined Reliability	Average Variance Extraction
PEOU	0.9397	0.7578
PU	0.9410	0.7623
ATT	0.9492	0.7579
BI	0.9598	0.8270
TS	0.9590	0.7579

Source: calculated by this research.

Discriminant Validity

The square of the coefficient of the covariation relationship constructed by the two constructs is compared with the variance extraction amount (AVE) of the two constructs. All the squares are less than the variance extraction amount, indicating discriminant validity; if not, there may be no difference.

As seen in Table 8, the comparison of perceived ease of use for perceived usefulness, usage attitude, behavioral willingness, and transaction security shows that perceived ease of use is different from others; perceived usefulness is related to usage attitude, behavioral willingness, transaction security, the results show that the perceived usefulness is different from others; the use attitude is different from behavioral willingness and transaction security, the results show that the use attitude is different from others. Finally, behavioral willingness is compared to transaction security, the results show that there is a

difference between behavioral intention and transaction security, so this study meets the criteria of discriminant validity, and through the AVE comparison, it is determined that the measurement models have discriminant validity.

Table 8. Discriminant validity between constructs.

Construct	PEOU	PU	ATT	BI	TS
PEOU	0.7578				
PU	0.6209	0.7623			
ATT	0.5670	0.6464	0.7579		
BI	0.4475	0.4610	0.7046	0.827	
TS	0.3136	0.2470	0.4212	0.5256	0.799

Source: Calculated by this research.

4.2.3. Test of Goodness-of-Fit

Referring to the fitness index, the analysis results show, in terms of the absolute fitness index, the overall goodness-to-fit test. The fitness indicators shown in Table 9 all meet the standard, indicating that the fit of research model is ideal.

Table 9. Goodness-of-fit test for SEM of this research.

Goodness-of-Fit	Fit Model	Ideal Indicator	Fit Level
CMIN/DF	2.904	<3	Good
GFI	0.808	>0.9	Not Good
AGFI	0.902	>0.9	Good
RMSEA	0.085	<0.07	Not Good
PGFI	0.680	>0.5	Good
PNFI	0.828	>0.5	Good
NFI	0.914	Between 0 and 1 and closer to 1	Good
RFI	0.905	Between 0 and 1 and closer to 1	Good
IFI	0.935	Between 0 and 1 and closer to 1	Good
CFI	0.935	Between 0 and 1 and closer to 1	Good

Source: Summarized by this research.

4.3. Overall Model Analysis

Testing of Hypotheses

The estimated coefficients of observed variables for each potential dimension are shown in Tables 4–10, and the estimated results of the overall model are shown in Figure 3.

Hypothesis 1 (H1). *Perceived ease of use of proximity mobile payment function positively impacts attitude towards using.*

This hypothesis means that, when the users of the proximity mobile payment function think that the operation of the proximity mobile payment is simple and easy to learn, they will have a positive and accepting attitude towards the proximity mobile payment function. Table 10 shows, through structural model coefficient and hypothesis verification, that there is a positive correlation coefficient between perceived ease of use and attitude to use (p-value < 0.05), that is, there is a significant positive direct effect (standardized factor loading is 0.326), so H1 is valid.

Hypothesis 2 (H2). *Perceived usefulness of proximity mobile payment function positively impacts attitude towards using.*

This hypothesis means that users can improve their work or life performance when operating ear-end mobile payment and make them have a positive and accepting attitude towards fear-end mobile payment functionalities. Table 10 shows a positive correlation

coefficient between perceived usefulness and attitude toward use (p-value < 0.05), that is, there is a significant positive direct effect (standardized factor loading is 0.541), so H2 is valid.

Table 10. Discriminant validity between constructs.

Construct	Variable	Standardized Factor Loading	Unstandardized Factor Loading	SE	CR T-Value	p-Value
PEOU → PU		0.789	0.751	0.049	15.354	***
PEOU → ATT		0.326	0.368	0.066	5.581	***
PU → ATT		0.541	0.642	0.073	8.817	***
ATT → TS		0.650	0.732	0.051	14.393	***
TS → BI		0.249	0.214	0.029	7.304	***
ATT → BI		0.732	0.709	0.041	17.112	***
PEOU	PEOU1	0.908	1.034	0.040	25.940	***
	PEOU2	0.858	1.049	0.046	23.017	***
	PEOU3	0.921	1.102	0.041	26.765	***
	PEOU4	0.805	0.949	0.046	20.715	***
	PEOU5	0.867	1.000			
PU	PU1	0.864	0.976	0.049	19.827	***
	PU2	0.920	1.052	0.049	21.497	***
	PU3	0.902	1.014	0.048	20.982	***
	PU4	0.899	0.999	0.048	20.911	***
	PU5	0.787	1.000			
ATT	ATT1	0.886	0.907	0.034	26.523	
	ATT2	0.892	0.937	0.035	26.998	***
	ATT3	0.904	0.932	0.033	27.876	***
	ATT4	0.748	0.689	0.036	19.021	***
	ATT5	0.899	0.933	0.074	27.493	***
	ATT6	0.890	1.000			
BI	BI1	0.857	1.000			
	BI2	0.922	1.054	0.039	26.752	***
	BI3	0.918	1.041	0.039	26.379	***
	BI4	0.921	1.052	0.040	26.316	***
	BI5	0.927	1.045	0.039	26.727	***
TS	TS1	0.918	1.000			
	TS2	0.931	1.004	0.030	33.960	***
	TS3	0.951	1.013	0.028	36.435	***
	TS4	0.945	1.019	0.029	35.260	***
	TS5	0.956	1.001	0.027	36.847	***
	TS6	0.917	0.980	0.031	32.010	***

*** $p < 0.001$. Source: Calculated by this research.

Hypothesis 3 (H3). *Mobile payment users' perceived ease of use of proximity mobile payment positively impact on perceived usefulness*.

This hypothesis means that, when users think that the ear-end mobile payment is easy to use, they will consider the proximity mobile payment to be a useful tool. Table 10 shows a positive correlation coefficient between perceived ease of use and perceived usefulness (p-value < 0.05), that is, there is a significant positive direct effect (standardized factor loading is 0.789), so H3 is valid.

Hypothesis 4 (H4). *Attitude toward using positively impacts behavioral intention to use*.

This hypothesis means that, when users perceive that using the function of proximal action payment will help them to learn or work efficiently, they will have a more positive

evaluation of the proximity payment, so they are more willing to use the proximity payment function. Table 10 shows a positive correlation coefficient between attitude and behavioral intention (p-value < 0.05), that is, there is a significant positive direct effect (standardized factor loading is 0.732), so H4 is valid.

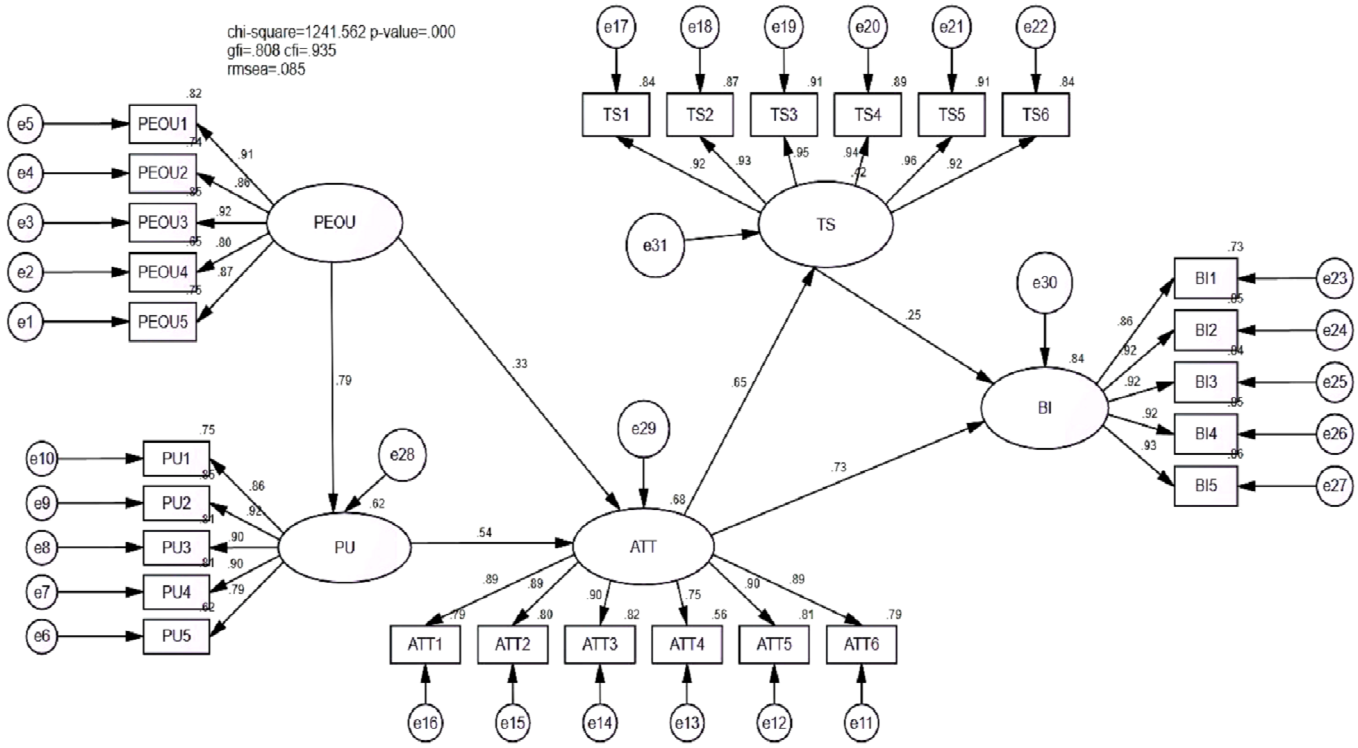

Figure 3. Overall model analysis. Source: summarized by this research.

4.4. Analysis of Mediating Effect

Mediating effects include direct effects, indirect effects and total effects. In this research, Sobel test was used to determine whether the intermediary effect of "transaction security" exists. Sobel test coefficients are as Table 11.

Table 11. Sobel coefficients.

Constructs	Standardized Factor Loading	Unstandardized Factor Loading	SE	CR	Construct
ATT → TS	0.650	0.732	0.650	14.393	***
TS → BI	0.249	0.214		7.304	***
ATT → BI	0.732	0.709	0.041	17.112	***

*** $p < 0.001$. Source: calculated by this research.

In the case that α equals 0.05, since the Z value of 6.56274 is much larger than the critical value of 1.96, there is a significant mediating variable "transaction security" between "use attitude" and "behavioral intention." As there is also a significant relationship between "attitude toward using" and "behavioral intention to use" (t-value 17.112 ***), "transaction security" has a partially mediated effect.

The converted data in this study are shown in Table 12. The direct effect of attitude is 0.732, and the total effect is 0.894. It is inferred that transaction security is the mediating effect. Therefore, the empirical data of the total effect and direct effect show that transaction security can be strengthened on consumer behavioral intent to use mobile payments.

Table 12. Mediating effect of transaction security.

Constructs	Direct Effect	Indirect Effect	Total Effect
ATT → BI	0.732	0.162	0.894
ATT → TS	0.650		
TS → BI	0.249		

Source: calculated by this research.

4.5. Summary of Results

With the rapid growth in e-commerce as a sector of the business world over the last few years, there has been a growing interest in FinTech research on the issue of mobile payments as a consequence of the rapid growth of e-commerce. The technology acceptance model and structural equation model are used in this study to analyze the factors that influence the acceptance of mobile payments. Based on the summary of results, the confirmatory factor analysis of the observed variables indicates that there is a well-fitted model for the dimension of observed variables based on the confirmatory factor analysis. This study also showed that the Reliability, Validity, and Fit Analyses of the model had a good verification effect. Based on the results of testing the hypotheses in this study, it was found that all hypotheses were valid, which indicates that the perceived ease of use and perceived usefulness of mobile payment devices has the potential to influence behavioral intentions. As a result of the experimental testing of the mediating effects of transaction security, it was found that an increase in consumer willingness to use mobile payments is correlated with an increase in transaction security.

5. Conclusions

The study found the path coefficients of perceived ease of use and perceived usefulness to consumers' attitude towards use are 0.33 and 0.54, respectively (as shown in Figure 3), and there is a significant positive impact, because if the innovative function is easy to learn and practical, it will indeed make consumers more receptive to the innovative technology, and from the perspective of the path coefficient value, the perceived usefulness has a greater impact on the consumer's attitude towards use. However, this study's findings contradict those of Chandra et al. (2010) and Daştan and Gürler (2016) in terms of perceived ease of use and differs from that of Daştan and Gürler (2016) in terms of perceived usefulness [17,25]. Daştan and Gürler's (2016) results differed mainly because in their study, they believe that not every consumer is familiar with mobile payment technology [17]. Hence, if a person is technically savvy, mobile payment applications can be easily used for some but may be difficult to others; the relationship between perceived ease of use and mobile payment adoption systems may then be negligible in this respect. However, the empirical results of this study are consistent with the findings of Schierz et al. (2010) and Kim et al. (2010) [23,24], and perceived usefulness are consistent with Chandra et al. (2010), Schierz et al. (2010) and Kim et al. (2010) [23–25].

Furthermore, this study employed empirical evidence on the mediating effect of transaction security on usage attitudes and usage intentions and found that transaction security can strengthen consumers' behavioral intention to use mobile payment, thus implying that consumers will be affected by transaction security whether they want to use mobile payment tools or not. In recent years, with the advancement of communication and network technology, mobile payment has become increasingly common. In some regions such as mainland China, mobile payments account for a significant proportion of transactions (e.g., AliPay or WeChat Pay for taxi or shopping in the market). However, in Taiwan or Japan, even though Line pay, Apple pay, or Google pay and mobile Internet access are commonplace, the proportion of cash payment in transactions is still high. The main reason behind the varying degrees of adoption may be due to personal data protection and transaction security considerations. Eriksson et al. (2021) explore the resistance of mobile payment, they found that cognitive transaction security (perceived security) and personal data security, this also explained why the penetration rate of mobile payments in

developed countries is lower than in developing countries. Privacy risks are the cause of mobile payment resistance, so the results of this study on transaction security are consistent with those obtained by Eriksson et al. (2021) [6].

In terms of practical contributions, it was found that both perceived ease of use and perceived usefulness have a significant positive impact on consumers' attitude towards using this technology, with the latter having more impact. This means that mobile payment programs or devices should not only be easy to understand, but also have more complete functions to attract consumers' love. In terms of research on transaction security (perceived security), mobile payment providers can be recommended because empirical evidence shows that the effect of users' behavioral intention through transaction security is greater than the effect of using attitude and behavioral intention. Therefore, consumers attach great importance to transaction security. Unless transaction security is guaranteed, this technology is not easy to be spread. Additionally, it may form the phenomenon of non-diffusion of innovation according to Moore (1999) [16]. In Taiwan and Japan, consumers are not using mobile payment significantly because other payment tools, such as credit cards, are very common. If consumers feel that the security of mobile payment transaction can be assured, it is possible to increase their willingness to use mobile payment services. Mobile payment tools, therefore, must have perceived ease of use, perceived usefulness, and more importantly, perceived security of transactions in order to make consumers more likely to use them.

In terms of theoretical contributions, in relation to Davis's (1989) TAM model, the empirical evidence of this study proves that perceived ease and perceived usefulness have a significant positive impact on consumer attitudes, and consumers' attitudes have a positive impact on intention, so the conclusions of this study are consistent with the theoretical arguments of the technology acceptance model. However, this study further derives that perceived transaction security has a mediating effect on attitude toward using and behavioral intention to use, which, in the context of Davis's (1989) TAM, has validated that, whether the end consumer will adopt new technology, transaction security (perceived security) or other variables must be taken into consideration [19,20].

Regarding research limitations, this research leverages responses to questionnaire from Taiwanese subjects on acceptance towards mobile payment. The development of mobile payment in different countries are not equal, so research can study reasons of the development differentiation of mobile payment in different countries. It is recommended to do future research.

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