Factors affecting user acceptance for NFC mobile wallets in the U.S. and Korea

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Abstract

Purpose – The purpose of this paper is to identify the factors affecting user acceptance for NFC mobile wallets in both Korean and US markets.

Design/methodology/approach – The proposed model extends the UTAUT2 model with new constructs of credibility (CR) and service smartness (SS). This study was analyzed using partial least square structural equation modeling on data collected from 701 college students between the ages of 18 and 29.

Findings – The results of this study demonstrate that performance expectancy (PE), effort expectancy (EE), CR, SS and habit (HB) have strong positive relationships with a user's behavioral intention to use NFC mobile wallets. Comparing the results of the USA and South Korea, there are different results regarding PE and CR.

Research limitations/implications – This study shows that all factors except social influence (SI) have significant positive relationships with the intention to adopt NFC mobile wallets: Among the original UTUAT2 factors, PE, EE and HB are important determinants of NFC mobile wallet adoption and the new constructs, CR and SS, are significant determinants that influence BI. However, the target respondents are limited to college students of South Korea and the USA Thus, caution should be used when applying the results of this study towards less ICT developed countries and towards different age groups.

Practical implications – This study provides multiple practical contributions. First, this study emphasizes HB as the strongest factor for adopting NFC mobile wallets in both South Korea and the USA Second, this study also highlights the importance of SS. Third, this study reveals that SI is not associated with the adoption of NFC mobile wallets. Fourth, nationality differences between the USA and South Korea account for the differences in consumer behaviors.

Originality/value – This study has two main contributions: First, this study introduces a modified UTAUT2 model with two new variables (CR and SS) useful for NFC mobile wallets. Second, this study compares the results of partial least square structured equation models (PLS-SEM) of the two nationality groups, South Korea and the USA

Keywords UTAUT, PLS-SEM, Technology adoption, NFC mobile wallets

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1. Introduction

Since Apple announced its first smartphone in 2007, smartphone payment apps, i.e. mobile wallets, have been available in the mobile payment service market (Shin, Lee, & Odom, 2014). A mobile wallet carries a smartphone user's financial information, such as bank account, credit/debit card account, or retail store account. Near Field Communication (NFC) technology enables two devices, such as a smartphone and a point-of-sale (POS) terminal, to communicate with each other within a very short distance, which is suitable for contactless payment (Shin & Lee, 2014). Once Apple accepted NFC technology with its iPhone 6 in 2014, "Apple pay" has been a hot issue in the mobile payment service (MPS) industry. In 2015, Samsung and Google respectively launched "Samsung pay" and "Android pay." According to the reports by Industry market research companies (eMarketer, 2015; Accenture, 2015) expected that MPS would grow fast. However, the recent studies (PYMNT.com, 2017) about NFC mobile payment of the three providers showed that US NFC mobile wallet adoption has been slow in the last three years. All three providers' adoption rates were less than 6% in 2017. In their 2018 survey, Apple pay has increased to 13%, but Samsung pay and Android pay were still 5% and 7%. It is because each NFC mobile wallet is dependent on a specific smartphone, which is known as a walled garden model. For example, only iPhone users can use "Apple pay" in stores equipped with "Apple pay" readers. According to a 2018 survey by eMarketer (Garcia, 2018), a US digital market research company, the primary payment methods in the USA are debit cards (47%), cash (26%), credit cards (23%) and mobile payments (1%). Even if the US NFC mobile payment adoption rate seems to grow because it is measured by mobile wallet experience (not by usage frequency), payment by NFC mobile wallets is not mainstream in the USA.

Meanwhile, in the East Asian countries, such as China, Japan and South Korea, there has been a growing demand for mobile wallets. According to the recent research (ResearchAndMarkets.com, 2019) about global mobile payment, Asia Pacific leads the world usage of mobile payments. While smartphone-based mobile wallets originated in the USA, the US market penetration rate has been lower than that of East Asian countries.

The NFC Mobile wallets are expected to change smartphone users' behaviors through the transition from leather wallets with credit/debit/store plastic cards to mobile wallets with loaded credit/deb/it/store card information. During the era of strong competition among the three MPS providers, understanding smartphone users' driving factors for using NFC mobile wallets is important. The main research question in this study is what factors make smartphone users in South Korea and the USA accept the NFC mobile wallets and to explore the difference and similarity of accepted factors in both countries.

This paper is organized in the following order: In Section 2, brief literature review and theoretical background of the research model are presented. In Section 3, data analysis and research results are given and research methods are given in Section 4. The discussion and the conclusion are added in Section 5.

2. Theoretical background

2.1 Brief literature review

Dahlberg, Guo, and Ondrus (2015) reviewed articles for mobile payment from 2007 to 2014. One of the three research areas in their analysis was mobile payment adoption studies. The main objective of a technology-enabled service adoption study is the understanding of consumer preferences and their reasons for adopting the technology-enabled service, which is important to service providers trying to generate a valuable service for their consumers. The consumer behavior papers for mobile payment have been less than or equal to five papers per year between 2007 and 2013. In 2014, the number of consumer behavior papers

was 12, indicating recent interest in this area. The most frequently used model in the previous studies was the technology acceptance model (TAM), followed by the unified theory of acceptance and use of technology (UTAUT) and the diffusion of innovation (DOI) theory. Dahlberg et al. (2015) listed 27 factors used in previous mobile payment studies. In addition to the factors in these three models (TAM, UTAUT, DOI), trust, security and cost were reported to strongly influence the adoption of mobile payment.

There are several recent mobile payment studies other than the ones that Dahlberg *et al.* (2015) mentioned. Shin *et al.* (2014) studied mobile payment adoption behaviors for remote mobile payments, and they found that security, cost and convenience were the three main factors the smartphone users kept in mind when making mobile payments. Shin and Lee (2014) studied mobile payment user behaviors of NFC mobile payment using an integrated model of technology readiness and technology acceptance. In their findings, four constructs of technology readiness (innovativeness, optimism, discomfort and insecurity) significantly influenced the perceived ease of use; two constructs of technological characteristics (responsiveness and smartness) also influenced the perceived usefulness, but only the perceived usefulness had a significant effect on the intention to use. Pham and Ho (2015) studied NFC mobile payment adoption in Taiwanese consumers. They categorized the determinant factors into three groups: product-related factors (usefulness, ease of use, compatibility, risk, cost, trialability, additional values), personal-related factors (innovativeness and absorptive capacity) and attractiveness. They found that most of all factors in the three groups influenced intentions to adopt NFC mobile payment. Oliveira, Thomas, Baptista, and Campos (2016) studied the main determinants of mobile payment adoption using the extended UTAUT2 with the innovation characteristics of the DOI. They found that compatibility, perceived technology security, performance expectations, innovativeness and social influence (SI) had significant direct and indirect effects over the adoption of mobile payment.

There are several studies about the comparative analysis of mobile user behaviors of the USA and Korea. The main reason for comparing these two countries is that while the USA has been an originator of internet technologies and an innovator of mobile services, Korea is a fast follower in new services of internet and mobile technologies (Shin *et al.*, 2014). In addition, Korea has a higher market adoption rate of new technologies such as smartphones and mobile data network. Cho compared mobile user attitude and behavior of m-commerce and smartphones (Cho, 2008; Cho, 2009). She revealed different behavioral attitudes of mobile users in the two countries' college students. For m-commerce, Korean mobile users showed significant importance towards price, service and technology factors, and for smartphones, they were very sensitive to the convenience factor. Sung and Mayer (2012) compared the perception of mobile devices of college students from two countries. Korean students showed a higher preference for mobile devices compared to their US counterparts. Shin *et al.* (2014) compared the mobile user behavior of mobile payment services in Korea and the USA They found that even though Korean users had more experience in the mobile payment frequency, US mobile users were more sensitive towards security in using mobile payment. Lee and Shin (2016) found in their smartphone addiction study that social interaction was not a factor related to smartphone usage behaviors in both countries, and the main drivers for smartphone addiction were ease of use for Korean users and emotional life for US users.

There is one comparative study regarding mobile payments between the U.S and China. Fan, Shao, Li, and Huang (2018) performed multi-group comparison analysis on the attitudes of the mobile payment users of two different countries. They assumed that the two determinants of mobile payment usage would be perceived security and trust. They found

that the impact of security was significantly higher for Chinese users compared to the US users. Their work verified that while globalization would make people from different countries hold similar attitudes toward mobile payments, differing business environmental factors, such as prevalence and penetration of mobile payments, result in discrepancies in attitudes toward mobile payments between Chinese users and the US users.

2.2 Theoretical background

Previous research about consumer behavior for new information technology has tried to explain why people accept services provided by new information technologies. In order to effectively achieve these research objectives, various research models have been proposed and developed. These studies have produced empirical models using a variety of exogenous variables, and these exogenous variables have been used as predictors of consumer attitudes and intentions.

The most frequently used technology acceptance research models are the technology acceptance model (TAM) and the unified theory of acceptance and use of technology (UTAUT). The TAM model suggested that three factors (perceived ease of use, perceived usefulness and attitude toward using the technology) influence users' motivations, which determine their intentions to use the new technology (Davis, 1989). UTAUT is a general model of technology adoption and has four factors (performance expectancy [PE], effort expectancy [EE], SI and facilitating conditions) that influence behavioral intentions to use a technology (Venkatesh, Morris, Davis, & Davis, 2003).

Numerous studies have been conducted using the above two frameworks, but it can be seen that research models have changed with the development of information technology. Given the pace of technological development, continuous changes in the research model seemed inevitable. The above two models were improved with new variables. TAM2 was extended by adding a new variable of subjective norm. Venkatesh, Thong, and Xu (2012) added three new variables into the original UTUAT model to emphasize the importance of hedonic motivation, price value and user habit (HB), which is called UTAUT2. Of the proposed models to date, it is clear that the UTAUT2 is a relatively new, well-established contemporary research model for adoption of mobile information technology such as mobile banking, mobile commerce and mobile social networking (Karjaluoto, Shaikh, Leppaniemi, & Luomala, 2020).

However, the UTAUT2 model has difficulty explaining the emerging acceptance of new MPS such as NFC mobile wallets. For example, unlike entertainment-focused technologies such as mobile games and music, the value of "hedonic motivation" is virtually non-existent or meaningless to the NFC mobile wallets. Mobile wallets are also provided free of charge from banks and service providers. Any mobile wallet users can download the mobile payment app to their smartphones and use it without paying any price. Therefore, "price value" is not a suitable variable to predict or explain consumer behavior for NFC mobile wallets. According to Venkatesh *et al.* (2003, 2012), "facilitating conditions" were measured by the user's knowledge or resources. However, the facilitating conditions of MPS are related to technical guarantees rather than individual conditions, such as knowledge or experience.

These differences show that it is not appropriate to explain the acceptance of NFC mobile wallets using the existing UTAUT2. That is, we need a new modified model of technology acceptance that is specific to the NFC mobile wallets. Based on this understanding, this study presents the UTAUT-NFC Mobile Wallet model. In the UTAUT-NFC Mobile Wallet model, "facilitating conditions," "hedonic motivation," and "price value," which are not suitable for the actual use environment, are removed from the model. In place of the three

omitted factors, two new factors, "credibility" and "service smartness" are added. Credibility (CR) is the users' expectations that NFC mobile wallet services will be free of technical errors and will be provided accurately. "Service smartness" is users' perception that NFC mobile wallets are a smart or intelligent service. These two technical integrity characteristics (CR and smartness) are more important than personal knowledge in facilitating NFC mobile wallets. Table 1 shows how the UTAUT-NFC Mobile Wallet model has evolved and lists the determinants of behavior and attitudes used by each model.

2.3 Mobile payment studies with unified theory of acceptance and use of technology

Venkatesh, Thong, and Xu (2016) reviewed information systems papers published between 2003 and 2014 and found there were 37 UTAUT extensions. In the 37 technology adoption studies, various information technology adoption studies, such as online gaming, mobile banking, social networking, e-government and e-learning, used additional constructs to the UTAUT model. Among all 37 UTAUT extension studies, only Ashare and Mousa's study (2014) was related to mobile payment. In Table 2, there are 12 more MPS studies using UTAUT models other than Ashare and Mousa's study (2014). Among the 13 UTAUT based mobile payment studies in Table 2, 12 studies used an extended UTAUT model, which is modified by adding/deleting constructs. The most frequently used additional constructs in Table 2 are risk (6 times) and trust (5 times), followed by security (4 times) and cost (3 times). While four studies focused on NFC mobile payment, the other 9 studies look at the general use of smartphone MPS.

In Table 2, three studies (Alshare & Mousa, 2014; Abrahão, Moriguchi, & Andrade, 2016; Karjaluoto *et al.*, 2020) did not use the "facilitating conditions" construct in their modified models. Alshare and Mousa (2014) argued that the "facilitating conditions" construct was not included in their model because the usage of MPS didn't require any other special device other than a smartphone, and therefore, the "facilitating conditions" became less important to the MPS users. In Table 2, two studies (Abrahão *et al.*, 2016; Karjaluoto *et al.*, 2020) did not use the "price value" construct in their modified UTAUT model. Abrahão *et al.* (2016) argued that buying a mobile device compatible with MPS was an issue of cost instead of an issue of price value of MPS. As mentioned in the previous section, the authors did not include "facilitating conditions" and "price value" in the UTAUT-NFC Mobile Wallet.

3. Hypotheses and research model

According to Venkatesh *et al.* (2003), performance efficiency (PE) is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance," and effort efficiency (EE) is defined as "the degree of ease associated with the use of the system." Consumers are motivated to use new technology when they believe that the new technology will improve their job performance without difficulty. Venkatesh *et al.* (2003) developed PE and EE as factors based on perceived usefulness and perceived ease-of-use in the TAM theory. While convenience and quick response in MPS allows for MPS users

Table 1. Evolution of the technology acceptance research framework (*new variable)

Research model	Exogenous variables in Model
UTAUT	Performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC)
UTAUT2	PE, EE, SI, FC, hedonic motivation (HM)*, price value (PV)*, habit (HB)*
UTAUT-NFC Mobile Wallet	PE, EE, SI, HB, credibility (CR)*, service smartness (SS)*

Table 2.
Mobile payment studies using the UTAUT model

Authors & year	Basic model	Deleting construct	Adding construct	Technology	Market
Wang and Yi (2012)	UTAUT		Risk	Mobile Payment	China
Alshare and Mousa (2014)	UTAUT	Facilitating Conditions	Security	Mobile Payment	Qatar
Tossy (2014)	UTAUT		Trust, Risk	Mobile Payment	Tanzania
Teo *et al.* (2015)	UTAUT		Trust, Cost	Mobile Payment	Malaysia
Slade, Dwivedi, Piercy, and Williams (2015a), Slade, Williams, Dwivedi, and Piercy (2015b)	UTAUT		Trust, Innovativeness, Risk	Mobile Payment	United Kingdom
Slade *et al.* (2015a, 2015b)	UTAUT2			NFC Mobile Payment	United Kingdom
Morosan and DeFranco (2016)	UTAUT2		Privacy, Security	NFC Mobile Payment	United States
Abrahão *et al.* (2016)	UTAUT	Facilitating Conditions, Price Value	Cost, Risk	Mobile Payment	Brazil
Oliveira *et al.* (2016)	UTAUT2	Habit	Comparability, Innovativeness, Security	Mobile Payment	Portugal
Khalilzadeh *et al.* (2017)	UTAUT		Attitude, Self-Efficacy, Security, Trust	NFC Mobile Payment	United States
Manaf and Ariyanti (2017)	UTAUT2		Trust	Mobile Payment	Indonesia
Sobti (2019)	UTAUT		Risk, Cost, Demonetization Effect	Mobile Payment	India
Karjaluoto *et al.* (2020)	UTAUT2	Facilitating Conditions, Social Influence, Price Value	Risk	NFC Mobile Payment	Finland

to increase job performance, ease of use in MPS encourages the adoption of MPS (Tossy, 2014).

Venkatesh *et al.* (2003) defined SI as "the degree to which an individual perceives that important others believe he or she should use the new system." Venkatesh *et al.* (2003) explained that social environments had a significant influence on the adoption of new technology. SI is very similar to a subjective norm in TAM2 and SI is supposed to be a very strong factor for adopting MPS (Tossy, 2014).

The first three hypotheses of all 11 mobile payment studies in Table 2 are related to PE, EE and SI. The authors make the first three hypotheses that PE, EE and SI have a positive effect on behavioral intention (BI) to adopt NFC mobile wallets:

H1. PE has a positive effect on BI for adopting NFC mobile wallets.

H2. EE has a positive effect on BI for adopting NFC mobile wallets.

H3. SI has a positive effect on BI for adopting NFC mobile wallets.

Trust and security have been significant factors in e-commerce and mobile banking studies and trust and security would also be factors for MPS (Khalilzadeh, Ozturk, & Bilgihan, 2017). In Table 2, five studies used trust as a positive factor affecting MPS, and four studies used security as a negative factor for mobile payment service adoption. Yuen, Yeow, Lim, and Saylani (2010) examined factors affecting consumer acceptance of internet banking services using an extended UTAUT model and they compared the outputs between developing countries and developed countries. One factor they used in their model was perceived CR. They found that consumers in the developed countries were more concerned over perceived CR. They argued that establishing trust prior to the subscription of internet banking service (IBS) was important and consumer's trust in the security of internet banking transactions would be important in the long run. Therefore, they concluded that trust on the IBS providers and security on IBS transactions are the two bases for consumer's CR. Therefore, CR is assumed to be a positive factor for NFC mobile wallet adoption:

H4. CR has a positive effect on BI for adopting NFC mobile wallets.

Smart products or intelligent products are products with human-like intelligence. Rijsdijk and Hultink (2009) verified that product smartness had associations with relative advantages, which also had positive relationships with the adoption of smart products. According to the study about NFC mobile payment in South Korea (Shin and lee, 2014), smartness was a predictor for perceived usefulness. Lee and Shin (2018) investigated consumer perception of smartphone smartness using five smartness characteristics: autonomy, adaptability, reactivity, multi-functionality and the ability to cooperate. They found that adaptability and multi-functionality had significant influences on consumer satisfaction. Adaptability is defined as being compatible with the consumer's way of life and multi-functionality is defined as integrating multi-modal functions into an innovative product or service. MPS is a good example of smart service with multi-functionality and adaptability; it is a service of integrated functions such as mobile connectivity, payment transactions and evidence of transactions. In addition, a function of payment is a necessary service in consumers' way of life. Service smartness (SS) is assumed to have a positive effect on BI to adopt NFC mobile wallets.

H5. SS has a positive effect on BI for adopting NFC mobile wallets.

Venkatesh *et al.* (2012) added the three additional constructs hedonic motivation, price value and HB to their original UTAUT model and they named it UTAUT2. HB is defined as "the extent to which people tend to perform behaviors automatically because of learning."

Morosan & DeFranco (2016) assumed that there is a positive relationship between m-commerce HB and using MPS. They validated the proposition about HB. A study about mobile banking using UTAUT2 (Baptista & Oliveira, 2015) also validated that HB was a positive factor for both BI and use behavior. In this study, HB is assumed to be a factor for NFC mobile wallet adoption:

H6. HB has a positive effect on BI for adopting NFC mobile wallets.

The UTAUT model supports the relationship between BI and use behavior for adopting new technology. Since the UTAUT (Venkatesh *et al.*, 2003) and UTAUT2 (Venkatesh *et al.*, 2012) models were published, applications of the UTAUT and UTAUT2 models would accept the relationship between BI and UB. Therefore, the authors hypothesized:

H7. Behavior Intention has a positive effect on Use Behavior for adopting NFC mobile wallets.

Figure 1 presents the UTAUT-NFC Mobile Wallet model.

4. Research method

A survey website was constructed in the U.S and South Korea to facilitate the collection of data. The questionnaire includes a set of the required demographic questions but not the identity of the respondents. It also includes the original constructs of the UTAUT model and other constructs that are useful for further analysis. For the original constructs of PE, EE, SI and HB, four questions are set for each construct. For the BI of the UTAUT model, three questions are set. Since this research is to extend the UTAUT model to explain payment service better, there are more questions related to the new constructs such as CR and SS.

In this research, partial least square (PLS) method is used for analysis. PLS is a relatively new multivariate analysis technique of structural equation modeling (SEM) that enables researchers to answer a set of interrelated research questions (Lai, Lai, & Jordan, 2009). Especially, PLS is used when the conditions of the study include the following: small sample size, little previous theory, predictive research purpose (Bacon, 1999; Wong, 2013). In addition, PLS-SEM provides flexible handling of more advanced model elements, such as moderator variables (Sarstedt, Ringle, Smith, Reams, & Hair, 2014). PLS-SEM is considered to be a suitable analysis method in this analysis because of the lack of any previous studies and the inclusion of multi-group analysis.

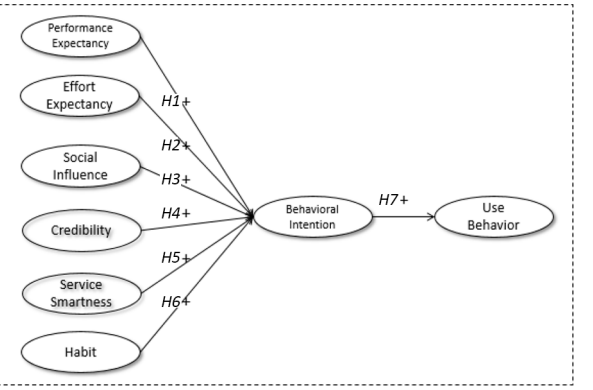

Figure 1.
Proposed research model

4.1 Measurement development

Measurement items of the construct were developed based on two stages. In the first step, every measure in the model was borrowed from the previous studies to get initial validity and then modified to fit in the MPS research context. In the second step, a list of defined constructs and items were submitted to a group of academicians for content validity. They are required to rate items on a Likert scale (1 = very disagree ~ 5 = very agree) as to whether the measurement items fit the constructs.

The questions regarding the original constructs from UTAUT2 (PE, EE, SI, HB, and BI) were borrowed from the original questions of Venkatesh *et al.* (2012) and modified regarding the context of MPS. Since this research is to extend the UTAUT model to explain NFC mobile wallet services, more questions related to the new constructs, such as CR and SS, were borrowed from previous research and modified to fit the context of NFC mobile wallets. The questions for CR and SS constructs originated from Mallat and Tuunainen (2008) and Pechmann and Ratneshwar (1994), respectively. Table 3 presents the items used in this study.

4.2 Sample characteristics

A total of 701 respondents completed the online survey. They were college students with a range in ages from 18 to 29. Of the entire sample, 405 (57.8%) respondents were from South Korea, and 296 (42.2%) were from the USA. A total of 312 were male (44.5%) and 389 (55.5%) were female. Table 4 summarizes respondent characteristics.

4.3 Reliability and validity of measures

It is essential to test the reliability and validity of the variables to complete the PLS-SEM test. The criteria of PLS to measure the internal consistency is by means of Cronbach's alpha and other coefficients. Cronbach's alpha score and composite reliability should be above 0.7 (Nunnally, 1978). In this study, both the alpha scores and composite reliability coefficients are all above the minimum (Table 5).

Factor analyses were performed to test the validity of the questions. This analysis uses the PCA (principal component analysis) extraction method with a VARIMAX rotation option. In the test result (Table 6), nine factors explaining 82.5% of total variance were extracted, as expected.

In addition to factor analysis, the Fornell-Larcker test is performed to check for additional discriminant validity. Fornell and Larcker (1981) suggested that the square root of average variance extracted (AVE) could be used to establish discriminant validity when the calculated value is larger than other correlation values among the latent variables. Table 7 presents the results of the Fornell-Larcker test, where the square root of AVE is written in bold. The correlations between variables are placed in the lower left triangle of Table 8. For example, the square root of HB is 0.910, and this number is larger than the correlations in the column of HB (0.557, 0.411, 0.516, 0.386), and also larger than those in the row of HB (0.710, 0.336, 0.359). A similar result is also made for other variables. The Fornell-Larcker test results indicate that discriminant validity is well established.

4.4 Results

A path model to identify the hypotheses is tested by using the PLS technique. An examination of the R^2 value shows that the research model demonstrates a substantial amount of the variance. In the model, the R^2 values of BI and UB are 0.669 and 0.158, respectively.

Construct	Items	Authors, year
Performance expectancy	1. I find NFC mobile wallets useful in my daily life 2. Using NFC mobile wallets helps me accomplish financial service more quickly 3. Using NFC mobile wallets helps me accomplish things more quickly 4. Using NFC mobile wallets increases my productivity	Venkatesh *et al.* (2012)
Effort expectancy	1. Learning how to use NFC mobile wallets is easy for me 2. My interaction with NFC mobile wallets solution is clear and understandable 3. I find NFC mobile wallets easy to use 4. It is easy for me to become skillful at using NFC mobile wallets	Venkatesh *et al.* (2012)
Social influence	1. People who are important to me think that I should use NFC mobile wallets 2. People who influence my behavior think that I should use NFC mobile wallets 3. People whose opinions that I value prefer that I use NFC mobile wallets	Venkatesh *et al.* (2012)
Credibility	1. Bank offering NFC mobile wallets are reliable enough to do financial transactions 2. NFC mobile wallets are reliable enough to do financial transactions 3. The NFC mobile wallets payment process is reliable enough to do financial transactions 4. NFC mobile wallets are doing its best to enhance security	Mallat and Tuunainen (2008)
Service smartness	1. NFC mobile wallets are intelligent 2. NFC mobile wallets are smart	Pechmann and Ratneshwar (1994)
Habit	1. The use of NFC mobile wallets has become a habit for me 2. I am addicted to using NFC mobile wallets 3. I must use NFC mobile wallets	Venkatesh *et al.* (2012)
Behavioral intention	1. I intend to continue using NFC mobile wallets in the future 2. I will always try to use NFC mobile wallets in my daily life 3. I plan to continue to use NFC mobile wallets frequently	Venkatesh *et al.* (2012)

Table 3.
Items used UTAUT-NFC mobile wallet

	Korea		U.S.	
Gender	Male	Female	Male	Female
n (%)	218 (53.8%)	187 (46.2%)	94 (31.8%)	202 (68.2%)

Table 4.
Respondent characteristics

According to the empirical test results, every hypothesis except *H3* is accepted at the significance level of 0.05. Table 8 and Figure 2 illustrate the empirical results of this study. According to the path coefficient score at 0.05 significance level, PE, EE and HB have significant and positive effects on BI, and BI has a direct influence on UB. The new constructs of CR and SS have a significant positive effect on BI. However, the *p*-value of SI, which is a part the original UTAUT model, does not represent a significant relationship at the 0.05 significance level. Comparing coefficients, HB has the strongest effect on BI.

4.5 Multi-group analysis

A multi-group analysis (PLS-MGA) is conducted using the nationality measurement item. The main idea of PLS-MGA is to check if the variance of the path coefficient of

PLS differs significantly across the two groups after the bootstrapping procedure (Wong, 2016). To achieve this analysis goal, all respondents are divided into two subgroups according to their nationality (Korea and the USA).

At the significance level of 0.05, in the result of Korea, all factors except for CR and SI are supported, and in the result of the USA, all factors except PE and SI are supported. SI is not supported in both countries, which appears to be a common feature of the two countries. In the Korean respondent group, PE and EE are important predictors of BI, but CR and SI are not. On the contrary, in the US respondent group, CR is a significant factor to BI, but PE and SI are not. In both countries, HB is the strongest factor to adopt. Table 9 and Figure 3 present a comparison of results in both countries.

	Cronbach's alpha	Composite reliability	AVE
Performance Expectancy (PE)	0.912	0.938	0.792
Effort Expectancy (EE)	0.909	0.936	0.785
Social Influence (SI)	0.926	0.953	0.871
Credibility (CR)	0.907	0.935	0.782
Service Smartness (SS)	0.913	0.958	0.920
Habit (HB)	0.897	0.936	0.829
Behavior Intention (BI)	0.899	0.937	0.833
Use Behavior (UB)	0.896	0.935	0.827

Table 5.
Reliability analysis

	CR	PE	EE	SI	HB	SS
CR3	0.833	0.096	0.238	0.195	0.074	0.090
CR2	0.829	0.126	0.230	0.214	0.065	0.129
CR4	0.820	0.127	0.160	0.135	0.119	0.179
CR1	0.757	0.149	0.212	0.219	0.084	0.188
PE2	0.105	0.823	0.283	0.042	0.190	0.117
PE3	0.131	0.821	0.289	0.080	0.179	0.135
PE1	0.125	0.778	0.287	0.083	0.213	0.188
PE4	0.164	0.760	0.145	0.211	0.271	0.140
EE2	0.235	0.169	0.844	0.078	0.118	0.105
EE1	0.252	0.204	0.792	0.156	0.050	0.177
EE3	0.185	0.369	0.776	0.027	0.095	0.124
EE4	0.222	0.303	0.759	0.110	0.103	0.153
SI2	0.196	0.117	0.078	0.878	0.204	0.077
SI1	0.236	0.105	0.124	0.862	0.175	0.107
SI3	0.250	0.092	0.098	0.845	0.269	0.080
HB2	0.042	0.225	0.048	0.213	0.880	0.086
HB3	0.084	0.229	0.068	0.254	0.843	0.072
HB1	0.191	0.272	0.218	0.190	0.764	0.145
SS2	0.288	0.245	0.241	0.127	0.157	0.821
SS1	0.287	0.270	0.255	0.146	0.142	0.812
Eigen Value	3.268	3.240	3.174	2.663	2.513	1.651
Variance %	16.339	16.200	15.872	13.317	12.566	8.253
Total Variance %	82.546					

Table 6.
Factor analysis

5. Discussion and conclusion

5.1 Theoretical implication

This study investigates factors that will influence the adoption of NFC mobile wallets using a modified UTAUT model. This study extended the UTAUT2 model with new constructs of CR and SS. This study found the following four theoretical implications. First, with a 0.05 significance level, all factors except SI have significant positive relationships with the intention to adopt NFC mobile wallets but the relationship between SI and BI is not supported. This study affirmed the assumption that among the original UTUAT2 factors, PE, EE and HB are important determinants of mobile wallet adoption. Second, this study affirmed that among the six factors presented HB is the strongest factor to influence BI,

Table 7. Fornell–Larcker Test results

	BI	CR	EE	HB	PE	SS	SI	UB
BI	*0.912*							
CR	0.499	*0.884*						
EE	0.552	0.544	*0.886*					
HB	0.710	0.336	0.359	*0.910*				
PE	0.651	0.404	0.617	0.557	*0.890*			
SS	0.571	0.560	0.551	0.411	0.550	*0.959*		
SI	0.500	0.502	0.325	0.516	0.346	0.379	*0.933*	
UB	0.394	0.482	0.311	0.386	0.305	0.355	0.501	*0.909*

Table 8. PLS-SEM Bootstrapping test

Hypothesis	Path coefficient	SD	T-value	P-value
H1. PE → BI	0.194	0.046	4.192	0.000**
H2. EE → BI	0.127	0.040	3.182	0.002**
H3. SI → BI	0.069	0.037	1.875	0.061
H4. CR → BI	0.095	0.033	2.846	0.005**
H5. SS → BI	0.137	0.035	3.859	0.000**
H6. HB → BI	0.432	0.035	12.360	0.000**
H7. BI → UB	0.394	0.027	14.378	0.000**

Notes: *$p < 0.05$; **$p < 0.01$

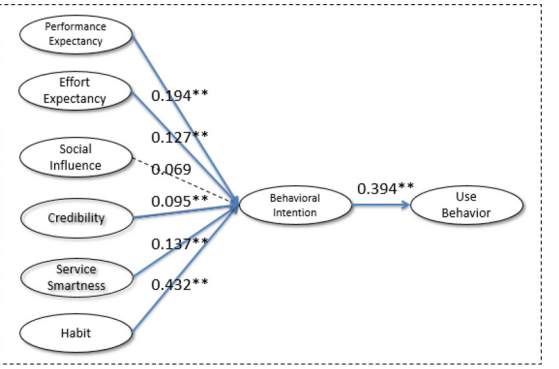

Figure 2. PLS-SEM output

which is a consistent result as Yen and Wu's (2016) mobile financial service adoption. Third, the new constructs, CR and SS, are significant determinants to influence BI. CR is a combined construct with security and trust, which were used in the previous studies, but SS is used for the first time in the mobile wallet studies. Fourth, this study affirmed that different countries had different results for technology adoption even if applying the same model. Between Korea and the USA, the common factors to be accepted in the NFC mobile wallet adoption are EE, SS and HB. Different results exist in the factors of PE and CR.

5.2 Managerial implication

This study provides multiple practical contributions. First, this study emphasizes the importance of HB to influence BI. In this study, HB is the strongest factor for adopting NFC mobile wallets in both South Korea and the USA

Korean smartphone commuters have experienced smartphone transportation passes since 2009 (Shin & Lee, 2014). Commuters in Korea have used "T-Money" which is a rechargeable, prepaid, smartcard for paying subway, bus, or taxi services. Mobile T-Money is an integrated T-money with the smartphone's USIM cards connected to an NFC chip. Korean commuters could pay transportation fees with their smartphones, which is the same function as NFC mobile wallets. Korean mobile wallet users had experienced mobile transportation payments before they used other types of mobile wallets, which makes a HB of NFC mobile payment in everyday commuter life.

In the USA, even though three NFC mobile payment providers ("Apple pay," "Samsung pay," and "Android pay") are competing for the MPS market, the most widely used mobile payment is the Starbucks mobile app payment, which is limited to only Starbucks stores (Kate, 2018). Therefore, the best way to make a successful NFC mobile wallet strategy is to make NFC mobile wallet payment a HB to users. For example, providing a reward for

	Korea				U.S.			
	Path	S.E	T	P	Path	S.E	T	P
H1.	0.224	0.056	3.976	0.000**	0.129	0.076	1.706	0.089
H2.	0.096	0.047	2.014	0.045*	0.142	0.072	1.979	0.048*
H3.	0.081	0.043	1.870	0.062	0.100	0.058	1.725	0.085
H4.	0.064	0.041	1.571	0.117	0.185	0.071	2.599	0.010
H5.	0.130	0.050	2.627	0.009**	0.106	0.052	2.016	0.044*
H6.	0.428	0.050	8.489	0.000**	0.393	0.057	6.869	0.000**
H7.	0.475	0.038	12.474	0.000**	0.528	0.039	13.446	0.000**

Notes: *p < 0.05; **p < 0.01

Table 9.
PLS-SEM Bootstrapping test for Korea and the USA

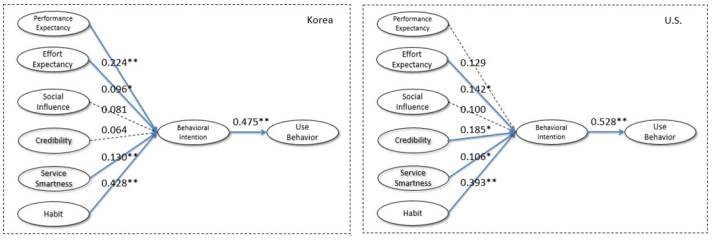

Figure 3.
Comparison between South Korea and USA

frequent payment of even small amounts by NFC mobile wallets will make smartphone users habitually use their NFC mobile wallets.

Second, this study also highlights the importance of SS. NFC Mobile wallets do multiple functions. They not only do mobile payments but also keep a receipt of the transaction and calculate a balance. They also can accumulate reward points of a loyalty program. Therefore, NFC mobile wallet users usually consider NFC mobile wallets as a smart service. Starbucks mobile app with the integration of its loyalty program makes it the number one proximity mobile payments in the USA Kate (2018). The experience of using a smartphone for paying for coffees, earning reward points, and adding coupons make buying a cup of coffee HB.

Third, this study reveals the SI is not associated with the adoption of NFC mobile wallets. SI is a common factor not to be accepted in both countries, which is consistent with a result of three previous MPS studies in Table 2 (Manaf & Ariyanti, 2017; Teo, Tan, Ooi, & Lin, 2015; Wang & Yi, 2012). Whether SI is a supporting factor or not to adopt NFC mobile wallets can be explained by users' decision processes; it is associated with users' own needs to adopt NFC mobile wallets or influence of social pressure such as friends and family to transact with each other. If users' decisions were independent compared to the influence of other users, the influence of SI could be reduced. In addition, when using NFC mobile wallets, the user should be very careful not to open a passcode or financial information, which makes using NFC mobile wallets a personal, independent activity.

Fourth, nationality differences between the USA and South Korea account for the differences in consumer behaviors. In the results of this study, PE is not supported in the USA and CR is not supported in South Korea.

In the 2017 consumer payment study (TSYS.com, 2017), 77% of the US consumers prefer payment via Credit/Debit cards. The report said that even though paying by mobile wallets was growing among younger consumers, only 9-10% of smartphone owners loaded their credit/debit cards onto their mobile wallets. Therefore, US consumers do not consider smartphone NFC mobile wallets as a more useful payment method than plastic credit/debit cards. This could explain why PE is not a supporting factor in the US NFC mobile wallet market.

In the early days of MPS, because of a lack of biometric authentication methods such as fingerprint scanning, iris scanning, face/voice recognition, it might have been more difficult to use NFC mobile wallets for authentication for MPS transactions and the NFC mobile wallets users might have been more concerned with security and risk. In South Korea, as mentioned earlier, there has been a decade of experience of NFC mobile transportation passes. Korean smartphone users who use public transportation have experienced smartphone payment methods as transportation passes without issue (Shin *et al.*, 2014). The good transportation payment experiences have made Korean smartphone users less concerned with CR issues.

5.3 Limitations

This study has several limitations regarding the results. First, the target respondents are limited to college students with an age range between 18 and 29. They are the generation of open to accepting smartphone technology. It may produce different results for NFC mobile wallet adoption when using a different age group of respondents. Secondly, South Korea and the USA are one of the leading countries for ICT technologies such as smartphones, mobile internet and mobile TV (Shim, Shin, & Weiss, 2006) and their smartphone users have a tendency to accept a new trendy technology. Caution should be used when applying the results of this study towards less ICT developed countries and towards different age groups.

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