

A Case Study on South Korean Mobile Payment Applications: Samsung Pay vs Kakao Pay

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Abstract

This study describes users' perceptions regarding Samsung Pay (n=25) and Kakao Pay (n=25), the two popular mobile payment applications in South Korea. The survey included fifteen questions; eleven questions were about general uses and perceptions about mobile payments and the final four questions specifically branched between the payment systems. Overall, South Korean users have a very high usage of mobile payments on a regular basis. Subsequently, mobile payment applications in South Korea have been well developed in terms of both services and securities. This leads to a high satisfaction level of South Korean users regarding Samsung Pay and Kakao Pay.

Keywords: Samsung Pay, Kakao Pay, South Korea, mobile payment, online payment

Introduction

The smartphone adoption rate has been increasing rapidly in recent years. According to O'Dea,² the number of smartphone users in 2019 was more than

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three billion. Given that the world population in 2019 was almost eight billion,³ this means that nearly half the global population has access to and uses a smartphone.

Many debates have been structured around the subject regarding whether smartphones have positive or negative influences on people's lives. On the one hand, many studies have pointed out the drawbacks of smartphones, for example, Li, Gao, and Xu find that smartphone addiction was a problematic issue that caused dysfunctional behaviors, such as procrastination, when college students deal with difficult tasks.⁴ On the other hand, several studies have justified the advantages of using smartphones in multiple aspects of human lives, for instance, Vaterlaus, Aylward, Tarabochia, and Martin argue that smartphones have become the important tools to help build interpersonal communication skills for individuals in the adolescent stage of life.⁵ Although many debates will continue to develop on this topic, undoubtedly, the world today revolves around smartphones; at least with youngsters who are referred to as the smartphone generation.⁶

Smartphones can be used for many purposes. Other than for communication (messaging or calling), smartphones now can be used to access numerous sorts of information immediately, to seek fun, to help the user navigate terrestrially, and more. Recently, due to the advancement of technologies, users can now use smartphones to make financial transactions as well, through the online or mobile payment services. The first online payment service, PayPal, was founded in 1998, but it was not until 2011 that Google became the first major company to release a mobile wallet application—the Google Wallet.⁷ The use of mobile payment apps has been significantly increasing in the United States; the percentage of mobile users who make mobile payments has doubled in a one-year period.⁸ Further to this, O'Shea predicted that more than two billion consumers worldwide would use mobile payments by 2019,⁹ when around 36% of smartphone users would make in-store payment through apps at least once every six months.¹⁰ Indeed, mobile payment applications will become important tools to smartphone users.

The reasons mobile payment applications are being favored by consumers might come from the benefits and advantages that the apps deliver to users. When it comes to using public transport systems (for example, to board a public bus), Brakewood, Ziedan, Hendricks, Barbeau, and Joslin indicate that using mobile payment applications benefited both buyers (for purchasing tickets) and operators (for collecting fares).¹¹ That is, the mobile payment applications enabled both buyers and operators to spend less time on purchasing tickets or collecting fares, which reduces the time for boarding. As a result, the satisfaction levels of mobile payment users were significantly high; New Jersey Transit users who have been paying fares through mobile apps report high levels of satisfaction.¹² From the perspective of finance and economy, Meifang, He, Xianrong, and Xiaobo draw

the conclusion that the existence of mobile payment apps increase the money turnover rate for businesses rather than causing liquidity risk.¹³ Specifically, mobile payment apps were positive influences on the financial status of businesses (raising earnings growth and rate of investment returns and creating higher values and higher wealth for shareholders). Meifang, He, Xianrong, and Xiaobo thus concluded that the mobile payment apps were critical incentives in the new economy.¹⁴

On the other hand, since these apps directly store users' financial information on a smart device, users are sometimes discouraged in trying the apps¹⁵ and using a mobile payment system.¹⁶ Cases of data breaches have been increasing in the last decades with a greater range and scale and have even impacted big corporations such as Alibaba, LinkedIn, Weibo, and Facebook.¹⁷ Thus, these leaks of information and security violations are of concern for users of mobile payment applications.

As one of the biggest economies, South Korea has long been a playground for technological innovations. Among all countries in the world, South Korea put great emphasis on the advancement of technology. For instance, in 2020, South Korea stood only second, next to Israel, on the percentage of GDP spent in technological research and development.¹⁸ Additionally, South Korea has been at the top of Bloomberg's most innovative economies index for seven years, out of the nine years that the index has been published, holding its current first place from 2021.¹⁹ Furthermore, various aspects of South Korean lives are heavily integrated with technology: education, wireless internet, virtual reality, digital textbooks, and other advanced methods are used by individuals, teams, and classrooms at all levels.²⁰

Thus, in parallel to all the technological developments, South Korea is one of the most innovative countries for the development and utilization of mobile transaction applications, with the examples of Kakao Pay (2014), Naver Pay (2014), and Samsung Pay (2015). In South Korea, the number of mobile payment application users has surged to more than 82 million as of 2020.²¹ In fact, mobile transactions in South Korea might have had the biggest impact in placing it as one of the leading cashless countries in the world; in 2019, cash payment only accounted for around 17% of total transactions while the country witnessed a fintech adoption rate of 67% with payments services accounting for the majority.²² Hence, South Korea is indeed experiencing massive changes in society due to the existence of mobile payment applications.

In order to elaborate more about the impacts of mobile payment applications in general, this paper concentrates on two mobile payment apps (Samsung Pay and Kakao Pay) that have been functioning in South Korea for a while. The aim

of this study is to examine how users in South Korea perceive mobile payment applications in general and Samsung Pay or Kakao Pay in particular.

Literature review

Overview of Samsung Pay

Samsung Pay is a mobile payment and digital wallet application that was developed by the Samsung Group. Samsung Pay was first released in South Korea in 2015, and it was built to support online payments for Samsung users. Samsung Pay embraced both traditional and modern transaction technologies when enabling users to make payments in traditional payment terminals or card machines and NFC-enabled payment terminals. Other than that, Samsung Pay can be used for online payments, in-app payments and can be used as an electronic wallet. When using Samsung Pay, gift cards can be sent among family members and friends.²³

In order to use Samsung Pay, users must have a supported device, which is from the Samsung Galaxy series produced by the Samsung Group and a supported bank account, which is limited to the countries that Samsung Pay supports. According to Abhijeet,²⁴ Samsung Pay is supported in up to twenty-five countries: Canada, China, Germany, South Africa, Thailand, the United States, United Kingdom, Vietnam, and others. Next, users must register a Samsung Pay account, link the bank account to their Samsung Pay account, and choose one of the security methods (fingerprint, PIN number or iris verification) in order to make payments.²⁵ Samsung Pay also enable users to register multiple bank accounts into the app; thus, in order to help users manage their cards where the last four digits of a card number will be displayed in the card image. Moreover, Samsung Pay reduces customers' risk in using the app; for instance, Samsung Pay will lock customers' transaction account in case they lose their mobile phone.²⁶ Figure 1 shows the Samsung Pay interface.

Up until 2019, Samsung Pay has more than fourteen million subscribers with a total transaction volume worth forty trillion Korean Won (USD \$33.7 billion). The app accounted for 80% of the South Korean offline simple payment market in 2018, in which online payments contributed one-fourth of total payments. Additionally, Samsung Pay is looking forward to integrating other financial features into the app, such as overseas remittance and currency exchange services.²⁷

Overview of Kakao Pay

Kakao Pay is the online payment function that was integrated into KakaoTalk messenger in 2014. KakaoTalk is an all-in-one function application (e.g., calling

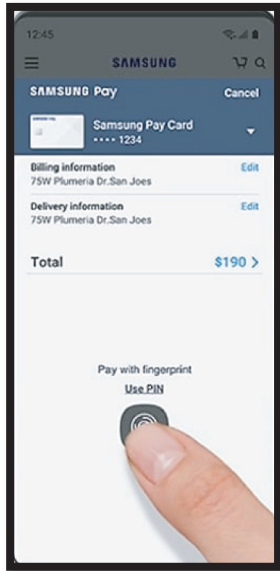


Figure 1 Samsung Pay user interface

a cab, finding hair shops, bus or subway mapping) that is owned by the Kakao Corporation. KakaoTalk is also the number one messaging app in South Korea, since the app covers more than 90% of South Korean messaging users.²⁸ With Kakao Pay, KakaoTalk users can make payments and transfer money online, which includes QR code or barcode payments, NFC payments, online payments, and in-app payments. KakaoTalk users can earn multiple sale promotions in the form of discounts or bonus money when paying at specific locations using Kakao Pay (for instance, in some convenience stores or some department stores). Additionally, users can utilize Kakao Pay as a digital wallet and can also pay utilities bills by using Kakao Pay or invest in the KakaoTalk account to earn back profit.²⁹

In order to use Kakao Pay, users must first register for a KakaoTalk account (which will require a functioning mobile number). Then, users need to link the KakaoTalk account to their bank accounts, which will allow online banking. After some verification steps that include choosing the security methods (fingerprint or PIN number), users can make transactions and payments on Kakao Pay, for example, transferring money to another friend's account. Although Kakao Pay has only been supported in South Korea, the app is aiming to extend cross-border payment services starting from Japan.³⁰ Additionally, Kakao Pay supports payment services for different online stores and social networks, for instance, Apple App Store, Google Play Store, YouTube Premium, South Korea's Coupang, and China's AliExpress.³¹ Figure 2 shows the Kakao Pay interface.

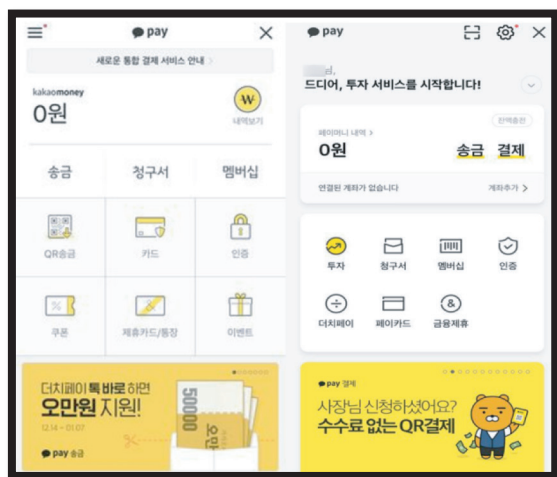


Figure 2 Kakao Pay user interface

In 2018, more than twenty-six million South Koreans used Kakao Pay monthly (more than half of the South Korea population). Additionally, twenty trillion Korean Won (USD \$17.7 billion) worth of transactions was made through Kakao Pay in 2018. Beside messaging and transportation services, payment services are the most successful function of KakaoTalk.³² KakaoTalk has been developing its payment sections to bring more convenience to users, most recently with the issue of the Kakao credit card service in collaboration with multiple South Korean banks.³³

Research Studies on Samsung Pay and Kakao Pay in South Korea

Samsung Pay and Kakao Pay have been extensively used in the South Korea market. According to Kim M., Kim S., and Kim J. (2019),³⁴ South Korean consumers mostly preferred payment methods without money. That is, South Korean consumers were keen on using bank cards and mobile or biometric payment methods over using cash. South Korean consumers perceived that the convenience, or lack of physical cash, for payments was the most important factor, while the possibility of the disclosure of personal information, the check-out time, or the cost of use only had a minor impact on the adoption of mobile payment methods (with the cost of use being the least important). However, due to the limited infrastructure for mobile or biometric payments in offline stores, the usage rate for mobile apps in offline payments was low. Kim et al. also pointed out that consumers' trust in technology linked directly with the incorporation of mobile or biometric payments.³⁵

Many studies have shown different reasons for the acceptance and rejection of Samsung Pay and Kakao Pay in South Korean society. For example, according to Lee J., Ryu, and Lee D. (2019),³⁶ the service network range played an important role in consumers' adoption rate of mobile payment apps, especially Kakao Pay. Since the Kakao Pay service network was limited when KakaoTalk first launched the function, users have often given up on Kakao Pay and changed to other payment services. Thus, Lee J., Ryu, and Lee D. argue that network externalities in operating mobile payment apps directly affected users' satisfaction.³⁷

On another point, Nan, Kim Y., Park, and Kim J. (2020)³⁸ discovered that users' satisfaction level on mobile payment apps in South Korea was the major reason for intentional prospective usage. That is, when users perceive that a mobile payment app is deeply useful (perceived usefulness), users were more likely to be satisfied with the app and will be loyal to the app. Another reason regarding satisfaction level was perceived security, which was positively linked with users' decision on the use of the type of application. Security issues of mobile payment apps in South Korea have been highlighted by other studies previously.³⁹

There are other attributes of mobile payment apps that have been attractive to users. Choi, Park, Kim, and Jung (2020)⁴⁰ argue that consumers looked for incentive bonuses (discounts or bonus money) when using mobile payments. It is suggested that Samsung Pay users were loyal to the app due to the incentive programs that Samsung Pay offered to users (for instance, allowing users to receive reward points that were worth a percentage of the total transaction when paying with the app). Different verification methods were also engaging attributes. Particularly, biometric authentications (fingerprint, iris scanning, or voice recognition) are widely used as South Korean consumers become more familiar with advanced technologies. Although the biometric authentications brought more advantages, the traditional verification method—PIN number—was still the most favored by users in South Korea. At the same time, Choi, Park, Kim, and Jung pointed out that users would always be uncertain with mobile payment apps' safety even though the apps guaranteed the highest level of assurance.⁴¹

Additionally, ease-of-use may have drawn South Korean consumers to the mobile payment apps. For instance, Nan, Kim Y., Park, and Kim J. (2020)⁴² indicate that ease-of-use has been prioritized in the South Korean mobile payment apps. An example of this was the user-friendly interface that Kakao Pay developed for its users. As a result, Kakao Pay users were familiar with using the app and did not see any difficulty in setting up and managing their accounts. Table 1 demonstrates the features of Samsung Pay and Kakao Pay mobile payment apps.

It is important to understand how the users of the mobile payment applications perceive the technologies. Unfavorable user perceptions will clearly lead to a

Table 1 Features of Samsung Pay and Kakao Pay mobile payment apps

Features	Samsung Pay	Kakao Pay
Supported devices	Galaxy smartphones only	Smart devices supporting Android and iOS
Compatibility with other apps	Not possible	To KakaoTalk
Payments	Gift/ membership In-store In-app Online Visa checkout	Credit card In-store (limited) In-app Online (limited) Wire transfer
Securities authentication	Iris scanning Fingerprint Pin number Tokenization	Face scanning Fingerprint Pin number
Other	Nearby deals viewer Anti-thief protection	Bills management Barcode scanning

lack of use or churn effect on the applications. Hence this research concentrates on unfolding the users' perceptions of the two mobile payment apps most highly used in South Korea.

Method

The Participants and Data Collection

Since the major aim of the study is to describe the most common mobile payment apps in South Korea, the researchers selected Samsung Pay (19.8%) and Kakao Pay (11.8%) based on their usage percentages in 2019 (Statista, 2020).⁴³ In the second step, the researchers had to select the study sample. To serve that purpose, the researchers utilized non-random purposeful sampling where participants' specific characteristics are inclusion criteria for the study.⁴⁴ For the current study, the researchers used one important criterion: "currently having only that specific app (Samsung or Kakao) on their mobile phone," which helps the researcher to know that the participant did not use both apps at the same time. The researchers did not want the participants to become confused about the features of the payment apps.

The researchers set up a table in the most crowded cafeteria of their university (located in Taejon at the geographical center of South Korea; a private and middle-categorized international higher education institution) and announced that they needed volunteers for a study on payment systems. On the banner, it

Table 2 The participants' demographics

App		Citizenship		Total	
		Korean	Non-Korean		
Kakao Pay	Gender	Female	13	4	17
		Male	8	0	8
	Total		21	4	25
Samsung Pay	Gender	Female	5	4	9
		Male	8	8	16
	Total		13	12	25

was specified that the volunteer participant must use only one of the apps at the current time. Once the volunteer participant approached the table, she or he was asked whether they use only one app. After the confirmation, the participant was given the survey and a coffee gift card. At the end of the week, the researchers collected 50 surveys, equally from each app user—25 Samsung Pay users and 25 Kakao Pay users.

Table 2 summarizes the basic characteristics of the study participants: 68% Korean and 32% Non-Korean, 52% female and 48% male.

Study Instrument and Data Analysis

The researchers developed their own study survey based on literature review findings and the features of both mobile payment apps. When the draft survey was ready, the researchers asked their colleagues to collect their comments for content validity reasons.⁴⁵ Moreover, one English language expert and holder of a PhD proofread the survey. Lastly, the researchers randomly asked two students to fill in surveys themselves and make comments on the draft survey. These two students were not included in the final number of participants.

The final survey form included fifteen major questions where the first three questions ask about demographics (citizenship, gender, and type of app). The following five questions focus on different issues for using mobile payment apps (device ownership, the frequency of use, purpose of use, additional fees, and security authentication). Question nine provides twelve sentences that would be answered on a five-level Likert scale from strongly agree to strongly disagree. Question ten tries to unfold the possible drawbacks of mobile payment apps. Question eleven provides a table of features regarding the mobile payment apps and ask the participants to state their satisfaction level on each of the features.

The survey has two branches after this point: two questions for Samsung pay users and two questions for Kakao pay users. The first group of questions of each branch gives a list of app-specific tools and asks the participants to state their satisfaction level. The second group of questions of each branch focuses on the general usability of the app on a five-level Likert scale from strongly agree to strongly disagree.

The collected data was entered into SPSS at the end of each day. The final dataset was taken to descriptive analyses initially where the necessary frequencies and percentages were calculated for all the survey questions, except question number nine. The mean scores and standard deviations of twelve sentences in question nine were calculated and tabulated accordingly.

The researchers decided to conduct comparison tests on these twelve sentences for question nine. Thus, they implemented a normality test to the dataset. The result showed that the data was not normally distributed, which guided the researchers to non-parametric tests. Mann-Whitney U tests showed no significantly differentiated items for the citizenship variable and showed only one item for the gender variable.

Results

In question four, the participants were asked to choose whether they owned a smartphone or a tablet device. The participants were given six options, in which the first four options were products of iOS and Android (“iPhone,” “iPad,” “Android Smartphone,” or “Android Tablet”); the fifth option was having no smartphone or tablet and the sixth option was “other.” In the results, the participants chose neither the fifth nor the sixth option. Table 3 shows that all the participants owned at least an iOS or Android—smartphone or tablet. More than half of the participants owned an Android smartphone (64%), while iPhone owners only accounted for around one-third of the people (36%). Simultaneously, tablet devices were not a popular choice since only 12% of participants reported an iPad and 8% of participants had an Android tablet.

In the following question, participants were asked to mark their usage frequencies on Mobile Payment Applications—MPAs (Samsung Pay or Kakao

Table 3 The smartphones and the tablets of the participants

Item	n	%	Item	n	%
iPhone	18	36	Android smartphone	32	64
iPad	6	12	Android tablet	4	8

Pay). As Table 4 shows, most participants were using MPAs at least once a week (48%); several people even used it frequently on a daily basis (44%). Only a few participants claimed that they used MPAs monthly (2%) and rarely (6%), which showed high frequencies for MPAs usage.

Question six asked how the participants spent their money on MPAs. Table 5 depicts that most of the participants used MPAs for purchasing everyday items such as groceries (60%). Additionally, paying for special occasions (holidays, birthdays, events, or meals out) were also a popular choice among the participants. Nonetheless, using MPAs for transportation payments (public transport, taxi) were not as common since only around 34% to 40% of participants chose these categories.

In the next question, participants were asked whether the MPAs that they were currently using charge additional fees for utilization (for example, a fee for transferring money, buying tickets to events, and other fees). Some 60% of the participants claimed that the apps did not charge any utilization fee, in contrast to 4% of the participants who replied positively. There were 18 participants (36%) who were unsure about the utilization fee.

Question eight was about participants' preferred security authentication when using MPAs (Table 6). Among the six options that were given, half of the participants chose fingerprint authentication as their most favorite tool. PIN number verification was also favored by the participants (40%). Barcode (6%), iris scanning (2%), and voice recognition (2%) were also chosen by a few participants, while none of the participants chose token as the favorite security tool.

Table 4 Frequencies of using MPAs

Frequency	N	%	Frequency	n	%
Daily	22	44	Monthly	1	2
Weekly	24	48	Rarely	3	6
			Total	50	100

Table 5 Purposes of using MPAs

Option	n	%	Option	n	%
Everyday items such as groceries	30	60	Meals out (restaurants/ takeaways)	22	44
Holiday/ birthday presents	29	58	Taxi fares	22	40
Event tickets	24	48	Public transport	17	34

Table 6 Preferred MPAs security authentication

Option	n	%	Option	n	%
Fingerprint	25	50	Iris scanning	1	2
Pin number	20	40	Voice recognition	1	2
Barcode	3	6	Token	0	0
			Total	50	100

Table 7 Survey of MPA use

Survey item	M	SD
1. It is easy to download the Mobile Payment App.	4.52	0.58
2. It is easy to set up the Mobile Payment App.	4.12	0.90
3. It is easy to start the transaction.	4.22	0.84
4. It is easy to receive the transaction details.	4.24	0.82
5. There are few steps required to complete the transaction.	3.94	0.93
6. Documentation or instructions are helpful and clear.	3.96	0.78
7. Customer service is easily available.	4.08	0.88
8. I enjoy using the app.	4.36	0.78
9. I can personalize the system.	3.60	0.88
10. Using this mobile payment app improves social interaction.	3.44	0.99
11. Using this mobile payment app gives me status.	3.50	1.04
12. It is fashionable to use the mobile payment app.	3.46	1.05

In the following question, the participants were asked to state their level of agreement toward twelve given sentences that were related to MPA use (Table 7). The level of agreement was on a 5-point Likert scale from “strongly agree” to “strongly disagree.” Overall, most of the participants agreed that MPAs were very easy to download, set up, and use; thus, participants had high satisfaction with the apps. The participants were also happy about the easiness of transactions. At the same time, the participants felt neutral about the connection between using MPAs and their social status.

In the next part of the survey, the drawbacks of MPAs were brought into the discussion. According to Table 8, the participants were mostly afraid of losing their mobile phones (56%). Security issues were the second concern (42%).

Table 8 Main drawbacks of MPAs

Drawbacks	N	%
Fear of losing mobile phone	28	56
Security concerns	21	42
My preferred retailers do not offer this payment option	9	18
Cost	9	18
Too complicated / confusing	5	10

In question eleven, the participants were asked to state their satisfaction level on different features of MPAs, on a 5-point Likert scale from “very satisfied” to “very dissatisfied” with an additional “unaware” option. The results were presented separately in two tables (Table 9 and Table 10) for the readability.

As presented in Table 9, Kakao Pay users were very satisfied with the app’s features. Most importantly, the users were most keen on the password authentication feature of Kakao (14 out of 25 people). In addition, some users were unaware of several features of Kakao Pay. Critically, the wire transfer feature seemed to be somewhat unknown to Kakao Pay users.

Table 9 Satisfaction level with Kakao Pay features

Features	Unaware	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	Total
Credit and Debit Card Payment	3	10	11	1	0	0	25
Rewards within app	4	7	7	6	1	0	25
Online Security	3	8	11	2	1	0	25
In-Store Payments	6	7	8	3	0	1	25
In-App Purchases	3	11	9	1	0	1	25
Password Authentication	4	14	7	0	0	0	25
Wire Transfer	9	8	6	2	0	0	25
Total	32	65	59	15	2	2	175

Table 10 Satisfaction level with Samsung Pay features

Features	Unaware	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	Total
Credit and Debit Card Payment	4	12	9	0	0	0	25
Rewards within app	3	9	6	6	1	0	25
Online Security	3	9	11	2	0	0	25
In-Store Payments	1	14	8	1	1	0	25
In-App Purchases	1	10	11	3	0	0	25
Password Authentication	1	14	9	0	1	0	25
Wire Transfer	5	10	6	4	0	0	25
Total	18	78	60	16	3	0	175

By the same token, users of Samsung Pay were also very satisfied with the app (Table 10). Password authentication and in-store payment were favorite features. Likewise, Samsung Pay users were also somewhat unaware of the wire transfer function. However, Samsung Pay received a higher satisfaction level comparing to Kakao Pay. Moreover, the number of Samsung Pay users who were unaware of the apps' functions was also fewer than those who used Kakao Pay.

In the next section, question twelve and thirteen were specifically directed at Samsung Pay users only (n=25). In question twelve, participants were required to reflect on their satisfaction level toward particular features of Samsung Pay, on a 5-point Likert scale from "very satisfied" to "very dissatisfied" with an additional "unaware" option. As can be seen from Table 11, the users were most satisfied with digital tokenization (14), followed by membership card or gift transactions (13), and fingerprint authentication (12). Iris scan authentication and Visa credit card checkout functions also received positive feedback from the participations, despite some users being unaware of these two features.

In the following question, Samsung Pay users were asked whether the listed features in Table 10 improved the usability of the app on a 5-point Likert scale from "strongly agree" to "strongly disagree." In brief, the participants mostly

Table 11 Samsung Pay features

	Unaware	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	Total
Digital Tokenization	3	14	5	3	0	0	25
Membership card and gift transaction	3	13	7	2	0	0	25
Fingerprint Authentication	3	12	10	0	0	0	25
Iris Scan Authentication	6	7	7	5	0	0	25
Visa Checkout	5	7	6	5	2	0	25
Total	20	53	35	15	2	0	

agreed about these features' contribution to the usability of the app ($M=4.29$, $SD=0.46$).

The final two questions (questions fourteen and fifteen) were specifically given only to Kakao Pay users. In question fourteen, the participants were asked about their satisfaction level toward particular features of Kakao Pay on a 5-point Likert scale from "very satisfied" to "very dissatisfied" with an additional "unaware" option (Table 12). In general, the users were most satisfied with Kakao Pay's authentication feature. Barcode scanning and Kakao Pay bill features also received positive satisfactory impression from the users.

In the final question, Kakao Pay users were asked whether the listed features in Table 11 improved the usability of the app on a 5-point Likert scale from "strongly agree" to "strongly disagree." In brief, the participants agreed about these features' contribution to the usability of the app ($M=4.09$, $SD=0.49$). Thus,

Table 12 Kakao Pay features

	Unaware	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	Total
Barcode Scanning	3	8	10	4	0	0	25
Kakao Pay Authentication	3	13	6	3	0	0	25
Kakao Pay Bill	2	9	10	3	1	0	25
Total	8	30	26	10	1	0	

comparing with the results of Samsung Pay users (question thirteen), Kakao Pay received less agreement on the improvement of usability of the app.

Comparative tests

After the descriptive statistics, the researchers decided to conduct further comparison-based analysis to have detailed results. Once the survey was checked, only the items in Table 7 (Survey of MPA use) seemed to be appropriate for comparative tests. Yet, the researchers had to choose between parametric and non-parametric tests. To serve that purpose, the researchers separately implemented normality tests to twelve questions around three independent variables: citizenship (Korean versus non-Korean), gender (female versus male), and the type of MPA (Samsung Pay versus Kakao Pay).

According to the Shapiro-Wilk test (a better fit when the sample size is smaller than 50), none of the items was greater than 0.05, which shows that the data was not normally distributed (Table 13). Therefore, the researchers selected non-parametric tests.

When Mann-Whitney U tests were conducted on the “citizenship variable” on these twelve items in Table 7, the results showed no statistically significant differences ($p > 0.05$) (Table 14).

Another group of Mann-Whitney U tests were implemented on the “gender variable” (26 females and 24 males) for around twelve items in Table 7. The results (Table 15) yielded only one statistically significant item differentiating the gender variable: item five (“there are few steps required to complete the transaction”). When the mean ranks were checked for this item, it seems that male participants agreed more than female participants.

Lastly, for Mann-Whitney U tests on “type of MPA,” the results showed no statistically significant differences ($p > 0.05$) (Table 16).

Discussion and conclusions

This study explored South Korean users’ perceptions regarding two popular mobile payment systems: Samsung Pay and Kakao Pay. Most participants claimed a high usage of Samsung Pay or Kakao Pay on a regular basis. Additionally, many participants agreed that both Samsung Pay and Kakao Pay were easy to set up on their smartphones. Overall, the participants were very pleased with the services provided by both Samsung Pay and Kakao Pay.

Our participants reported high frequencies of using the mobile payment applications (MPAs) for daily payments (groceries) and special occasion’s

Table 13 Shapiro-Wilk normality test results on citizenship, gender, and MPA types

Item #	Citizenship	Shapiro-Wilk			Gender	Shapiro-Wilk			MPA type	Shapiro-Wilk		
		Statistic	df	Sig.		Statistic	df	Sig.		Statistic	df	Sig.
1	Korean	.718	34	.000	female	.735	26	.000	Kakao	.728	25	.000
	Non-Korean	.638	16	.000	Male	.629	24	.000	Samsung	.671	25	.000
2	Korean	.815	34	.000	female	.847	26	.001	Kakao	.836	25	.001
	Non-Korean	.741	16	.000	Male	.716	24	.000	Samsung	.757	25	.000
3	Korean	.721	34	.000	female	.791	26	.000	Kakao	.685	25	.000
	Non-Korean	.736	16	.000	Male	.683	24	.000	Samsung	.815	25	.000
4	Korean	.773	34	.000	female	.749	26	.000	Kakao	.705	25	.000
	Non-Korean	.759	16	.001	Male	.799	24	.000	Samsung	.800	25	.000
5	Korean	.844	34	.000	female	.873	26	.004	Kakao	.848	25	.002
	Non-Korean	.884	16	.045	Male	.777	24	.000	Samsung	.773	25	.000
6	Korean	.851	34	.000	female	.812	26	.000	Kakao	.865	25	.003
	Non-Korean	.807	16	.003	Male	.853	24	.003	Samsung	.808	25	.000
7	Korean	.822	34	.000	female	.788	26	.000	Kakao	.815	25	.000
	Non-Korean	.859	16	.019	Male	.851	24	.002	Samsung	.846	25	.001
8	Korean	.708	34	.000	female	.740	26	.000	Kakao	.680	25	.000
	Non-Korean	.715	16	.000	Male	.762	24	.000	Samsung	.794	25	.000
9	Korean	.871	34	.001	female	.883	26	.007	Kakao	.887	25	.010
	Non-Korean	.887	16	.050	Male	.880	24	.008	Samsung	.858	25	.003
10	Korean	.875	34	.001	female	.883	26	.007	Kakao	.887	25	.010
	Non-Korean	.896	16	.069	Male	.864	24	.004	Samsung	.882	25	.008
11	Korean	.880	34	.001	female	.863	26	.003	Kakao	.878	25	.006
	Non-Korean	.880	16	.039	Male	.876	24	.007	Samsung	.878	25	.006
12	Korean	.874	34	.001	female	.869	26	.003	Kakao	.871	25	.005
	Non-Korean	.870	16	.027	Male	.875	24	.007	Samsung	.876	25	.006

payments (holidays, birthdays, events, or meals out). This demonstrates the high-level of acceptance of MPAs in the South Korean market, in which South Korean consumers were keen on using MPAs for multiple purposes. Lee J., Ryu, and Lee D. (2019)⁴⁶ have shown that South Korea consumers will adopt an MPA based on the app's network externalities range. Thus, the MPAs' owners,

Table 14 Mann-Whitney U tests based on citizenship variable

Items	Group	n	Mean rank	U	Z	P
1. It is easy to download the mobile payment app.	Korean	34	25.26	264.000	-0.191	0.849
	Non-Korean	16	26.00			
2. It is easy to set up the mobile payment app.	Korean	34	25.90	258.500	-0.303	0.762
	Non-Korean	16	24.66			
3. It is easy to start the transaction.	Korean	34	27.75	195.500	-1.751	0.080
	Non-Korean	16	20.72			
4. It is easy to receive the transaction details.	Korean	34	25.41	269.000	-0.068	0.946
	Non-Korean	16	25.69			
5. There are few steps required to complete the transaction.	Korean	34	26.76	229.000	-0.942	0.346
	Non-Korean	16	22.81			
6. Documentation or instructions are helpful and clear.	Korean	34	25.79	262.000	-0.223	0.823
	Non-Korean	16	24.88			
7. Customer service is easily available.	Korean	34	26.15	250.000	-0.489	0.625
	Non-Korean	16	24.13			
8. I enjoy using the app.	Korean	34	26.62	234.000	-0.873	0.382
	Non-Korean	16	23.13			
9. I can personalize the system.	Korean	34	24.87	250.500	-0.473	0.636
	Non-Korean	16	26.84			
10. Using this mobile payment app improves social interaction.	Korean	34	25.65	267.000	-0.110	0.913
	Non-Korean	16	25.19			
11. Using this mobile payment app gives me status.	Korean	34	24.69	244.500	-0.593	0.553
	Non-Korean	16	27.22			
12. It is fashionable to use the mobile payment app.	Korean	34	26.78	228.500	-0.937	0.349
	Non-Korean	16	22.78			

in this case the Samsung Group and the Kakao Corporation, have successfully extended the network services in all levels, from regular to premium stores. Especially when it comes to Kakao Pay, the Kakao Corporation has gone to exceptional lengths to make the payment function available to a high percentage of South Korea's population, though users have abandoned Kakao Pay for other mobile payment apps with more capabilities.⁴⁷ This finding suggests that better multiple services providing capability and wider connection of access to

Table 15 Mann-Whitney U tests based on gender variable

Items	Group	n	Mean rank	U	Z	P
1. It is easy to download the mobile payment app.	Female	26	24.58	288.000	-0.534	0.593
	Male	24	26.50			
2. It is easy to set up the mobile payment app.	Female	26	23.62	263.000	-1.027	0.305
	Male	24	27.54			
3. It is easy to start the transaction.	Female	26	26.40	288.500	-0.502	0.615
	Male	24	24.52			
4. It is easy to receive the transaction details.	Female	26	28.17	242.500	-1.473	0.141
	Male	24	22.60			
5. There are few steps required to complete the transaction.	Female	26	21.35	204.000	-2.209	0.027
	Male	24	30.00			
6. Documentation or instructions are helpful and clear.	Female	26	24.62	289.000	-0.479	0.632
	Male	24	26.46			
7. Customer service is easily available.	Female	26	28.02	246.500	-1.359	0.174
	Male	24	22.77			
8. I enjoy using the app.	Female	26	26.06	297.500	-0.311	0.756
	Male	24	24.90			
9. I can personalize the system.	Female	26	24.50	286.000	-0.534	0.593
	Male	24	26.58			
10. Using this mobile payment app improves social interaction.	Female	26	21.88	218.000	-1.923	0.054
	Male	24	29.42			
11. Using this mobile payment app gives me status.	Female	26	22.42	232.000	-1.611	0.107
	Male	24	28.83			
12. It is fashionable to use the mobile payment app.	Female	26	22.92	245.000	-1.347	0.178
	Male	24	28.29			

different platforms or information might be the key for companies to build their MPAs.

Additionally, our participants have moderately used MPAs in paying for transportation. The use of MPAs for transportation in South Korea is expected to be more popular among consumers due to its advantages in comparison with traditional methods.⁴⁸ Also, the result of high frequencies of using MPAs in South Korea in offline stores is different from the result which Kim M., Kim S., and Kim J. (2019)

Table 16 Mann-Whitney U tests based on MPA type

Items	Group	n	Mean rank	U	Z	P
1. It is easy to download the mobile payment app.	Kakao Pay	25	23.58	264.500	-1.068	0.286
	Samsung Pay	25	27.42			
2. It is easy to set up the mobile payment app.	Kakao Pay	25	24.18	279.500	-0.691	0.490
	Samsung Pay	25	26.82			
3. It is easy to start the transaction.	Kakao Pay	25	26.92	277.000	-0.758	0.448
	Samsung Pay	25	24.08			
4. It is easy to receive the transaction details.	Kakao Pay	25	27.86	253.500	-1.250	0.211
	Samsung Pay	25	23.14			
5. There are few steps required to complete the transaction.	Kakao Pay	25	22.50	237.500	-1.533	0.125
	Samsung Pay	25	28.50			
6. Documentation or instructions are helpful and clear.	Kakao Pay	25	23.56	264.000	-1.010	0.312
	Samsung Pay	25	27.44			
7. Customer service is easily available.	Kakao Pay	25	26.48	288.000	-0.508	0.611
	Samsung Pay	25	24.52			
8. I enjoy using the app.	Kakao Pay	25	28.24	244.000	-1.469	0.142
	Samsung Pay	25	22.76			
9. I can personalize the system.	Kakao Pay	25	24.44	286.000	-0.544	0.587
	Samsung Pay	25	26.56			
10. Using this mobile payment app improves social interaction.	Kakao Pay	25	25.30	307.500	-0.102	0.919
	Samsung Pay	25	25.70			
11. Using this mobile payment app gives me status.	Kakao Pay	25	26.80	280.000	-0.654	0.513
	Samsung Pay	25	24.20			
12. It is fashionable to use the mobile payment app.	Kakao Pay	25	25.82	304.500	-0.161	0.872
	Samsung Pay	25	25.18			

reported.⁴⁹ This contradictory result could come from either the sample size or the geographical location in South Korea. Therefore, more studies should be conducted to understand mobile payment in offline stores. Overall, the question of the impact of convenience on the actual usage of MPAs' users requires more research.

Regarding MPAs and different security authentication methods, half of the participants claimed that they were using fingerprint verification when making transactions, while PIN number verification was only the second favorite option.

Subsequently, bar-code scanning, iris scanning, voice recognition, and token authentication were not known or familiar to the participants. This result contradicts Choi, Park, Kim, and Jung's (2020)⁵⁰ findings that the South Korean consumers favored the PIN number method over other biometric identity authentications. We found that the usage rate of biometric identity authentications would probably rise if consumers were more familiar with the advanced technologies.⁵¹ It seems that South Korea consumers have been more familiar with fingerprint technology and favored fingerprints due to the advantages they brought, being more secure and more convenient. Thus, we can assume that other modern identity authentications (iris scanning and voice recognition), will eventually be accepted by the users when the advanced technologies are more common and simple to use.

In our study, more than half of the participants were afraid of losing their smartphones, the main access to the MPAs, which will create opportunities for theft. Simultaneously, many participants listed security concerns as a major drawback of the MPAs, despite the advanced security technologies that the apps have integrated. This result is similar to Choi, Park, Kim, and Jung's (2020)⁵² indication that South Korean users will always be concerned about security matters regarding MPAs. Thus, South Korean consumers perceive security an important aspect of the MPAs.⁵³ Integrating with the research of MPA usage in India by Pal, Herath, De, and Rao (2021),⁵⁴ it is possible that security is a critical concern for general users. Thus, we recommend further research into the relation between social traits and security.

In minimizing drawbacks, Samsung Pay seems to be more secure than Kakao Pay. That is, Samsung Pay has four security authentication methods with an anti-theft protection function as compared with only three security authentication methods for Kakao Pay (Table 1). Additionally, as only a small group of participants think MPAs are complicated to use, it is clear that the MPAs in South Korea have achieved ease-of-use attributes. This result is similar to Nan, Kim Y., Park, and Kim J.'s (2020)⁵⁵ study, which concluded that the MPAs in South Korea were user friendly.

Furthermore, Samsung Pay and Kakao Pay participants were highly satisfied with the apps and their functions. Nan, Kim Y., Park, and Kim J. (2020)⁵⁶ discovered that users' satisfaction level on mobile payment apps in South Korea were the major reason for usage. Therefore, it can be seen that Samsung Pay and Kakao Pay will achieve more growth in the market as these apps are regarded as pleasing to use. Although Samsung Pay received a higher satisfaction level comparing to Kakao Pay, the satisfaction differences are not significant.

In short, South Korea consumers have a high use of MPAs regularly for multiple payment types. Additionally, fingerprint verification is the most popular security

authentication method to users, followed by PIN numbers, and other biometric identity authentications. Subsequently, security is an important factor that decides the adoption rate of MPAs of South Korean consumers. Note that Samsung Pay has done better than Kakao Pay in term of security. It can be concluded that Samsung Pay and Kakao Pay will reach even higher growth in the South Korea mobile payments market. Indeed, all the findings provided guidelines that can be considered for future studies.

The present findings propose some practical suggestions. Although this research did not compare all other MPAs in the world, it is statistically obvious that mobile payment platforms are becoming more prevalent and their penetration into the dynamics of our lives is becoming more visible. More and more countries have begun to use MPAs, for example, Google Pay and Android Pay in the UK and EU, or Apple Pay in the US, and WeChat Pay and Ali Pay in China.

Since South Korean consumers adoption of MPAs is based on the network externalities of the app, it is recommended that MPAs that want to function in this market need to set the development of service network range as their priority. In addition, it is important to upgrade the security services continuously, by integrating advanced technologies into the transactions process and by providing customers with different authentication methods. Since there is much more high-tech theft in the world these days, it is important to ensure the security of the MPAs by identifying loopholes in each system, from both the developers and the customers' perspectives. Thus, any company marketing MPAs should popularize a familiarity with the advanced security technologies to users.

Lastly, this research has limitations. First, the sample size is not large enough to make different statistical tests and generalizations. Secondly, the research is based on users' answers and not their real-life practices. In another words, the participants' experiences and answers might not fully overlap. The reliability of the study depends on the honesty of the participants.

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Notes

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