

Positive and negative valences, personal innovativeness and intention to use facial recognition for payments

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Positive and Negative Valences, Personal Innovativeness and Intention to Use Facial Recognition for Payments

Abstract

Purpose

Facial Recognition Payment (FRP) has been attracting attention as an alternative payment mood. This research aims to investigate the future use of FRP for both mobile payment and point of sale payment.

Design/Method/Approach

The body of information on this topic is promoted by proposing the valence framework, where we used relative advantage, initial trust, perceived playfulness, and need for uniqueness as positive valence and perceived risk, technophobia, and perceived complexity as negative valence. This study also investigated the moderating effect of personal innovativeness on consumers' behavioral intention to use FRP-based payments. We collected data from 392 FRP users from China to test the model. We used Structural Equation Modeling (SEM) to evaluate the significant determinants influencing FRP use.

Findings

We found that relative advantage and privacy risk are the two most influential predictors of FRP use. The findings indicate that personal innovativeness acts as a moderator between negative valence and behavioral intention. This study provides valuable policy guidelines for the mobile or POS payment companies for adding FRP service into their default payment method.

Originality/Value

FRP is a relatively new technology that has not received much research attention in IS literature. Most studies on payment investigated enablers, and less effort has been given to study both enablers and inhibitors together. Furthermore, we employed SEM-based analysis to identify the most important factors influencing consumers' future use decisions.

Keywords: Facial recognition payment, valence framework, mobile payment, use intention, personal innovativeness, China.

1. Introduction

Many countries aim for a cashless payment infrastructure to make payments easier and faster. As a result, payment methods such as debit cards, credit cards, mobile, Near Field Communication (NFC), and Quick Reader (QR) codes have proliferated. These methods of payment require hardware such as a card or mobile phone to purchase products or services. The total digital payment transaction amounted to approximately \$ 4.14 trillion in 2019, projected to rise to \$ 6.7 trillion by 2023 (Statista, 2019). However, there are certain risks of transformation to the digital payment system. There has been a rise in fraud, such as breaches, hacking, and theft. According to Juniper Research, online and mobile payment fraud is fueled by numerous data breaches of stolen identity and payment information. The firm's estimation shows that the losses from online payment fraud have reached \$22 billion in 2019, which is likely to touch \$48 billion marks by 2023 (LexisNexis, 2019). The payment industry is expected to look into authentication technologies that are much more difficult to fake. A potential solution is to switch to biometrics to make payments safer (Clodfelter, 2010).

Facial recognition payments (FRPs) are one of the most modern developed methods for the payment industry. FRP (initially introduced by Alibaba in 2017) is a biometric authentication method that could limit digital payment fraud and make payments more comfortable and quicker. The FRP is currently used in China for mobile and POS payments, making the payment process frictionless. It is more convenient, efficient, and secure to use than mobile payment techniques such as scanning QR codes. FRP is more secure than other payment methods such as passwords or credit cards because individual facial attributes are difficult to duplicate, replicate, or lose.

Furthermore, It offers customers a new shopping experience in the new retailing period, which has the potential to boost the retail industry's development and transformation and increase consumer spending (Zhong et al., 2021). This research's key motivation is to better understand the technology acceptability of FRP, which can improve consumer shopping experiences and increase service efficiency. Currently, in over 300 cities in Mainland China, people can use Alipay's "Smile to Pay" and WeChat's "Frog Pro" for the POS payment system. Over 900 million Alipay users and one billion WeChat users can use FRP as an authentic mobile payment method. Among them, 61 million people in 2018 and 243 million people in 2020 used FRP as their payment method, likely

increasing to 761 million in 2022 (Sohu, 2021). FRP is also used in Super Market, Fashion stores, Restaurants, Banks, Hospitals, Streets, Bakeries, and Departmental Stores¹.

Despite FRP technology's massive potential as a payment system, its penetration is still low. Customers continue to prefer QR code-based payment methods for both m-payment and POS payment and use passwords or fingerprints as modes of payment authentication. When individuals decide whether to use a system or service, both positive factors (enablers) and negative factors (inhibitors) are subjugated (Cenfetelli, 2004). Particularly when the system involves privacy and financial security, consumers are more unwilling to use such a device. For instance, Oliveira et al. (2016) found that an individual's privacy concern and resistance to change were barriers to using biometric-based authentication in mobile payment. Similarly, Singh et al. (2020) found security concerns for customers when making payments through FRP authentication. As the FRP technology is relatively new, limited research has addressed how users view FRP to make payments (Singh et al., 2020). Most of the previous studies have focused primarily on payment through mobile applications, NFC-enabled mobile credit cards, and so forth (Okumus and Bilgihan, 2014, Li et al., 2014, Vickers, 2017).

Nevertheless, the available studies in biometric adoption in mobile payment primarily reflect the positive factors (benefits or enablers) that increase users' adoption of this technology (Wang et al., 2020, Ogbanufe and Kim, 2018). Few studies have focused on the risk and cost-related negative factors that affect the customers' behavioral intention during the purchasing process (Lin et al., 2014, Chin et al., 2020, Ozturk et al., 2017). Still, they overlooked the use of complexity and anxiety. In addition, prior literature lacks an understanding of how to mitigate the influence of negative factors on intention to use. Not all users perceive the negative factors equally important when they want to use a particular service (Talukder et al., 2021, Islam et al., 2020). For instance, it may be that consumers who possess innovativeness characteristics are more encouraged to use the FRP-based payments than others. For such consumers, the effects of negative factors may be mitigated due to their innovativeness characteristics. Identifying the negative aspects and the approaches to mitigate the impacts of negative factors on future use is highly beneficial from a

¹ *Alipay, WeChat Pay (m-payment) *Jack and Jones, Vero Moda (Fashion Store) *Carrefour, Walmart, JD unmanned stores (Super Market) *KFC, McDonald and Chinese Local Restaurants (Restaurants) *More than 300 cities departmental stores or bakeries *Agricultural Bank of China and China Merchants Bank (Banks)*Jiangxi Provincial People's Hospital *Wenzhou City FRP shopping street * Airport, Railway Station and VIP areas' automated vendor machine.

practical perspective and IT discontinuance stream of research (Soliman and Rinta-Kahila, 2020, Islam et al., 2022).

This study developed an integrated model by applying the valence framework (Peter and Tarpey Sr, 1975) (i.e., negative valence and positive valence). We tested our research model by collecting data from 392 FRP users from China. The study makes several contributions. First, we applied the valence framework to understand the user's positive and negative attributes towards a relatively new technology like FRP that significantly differs from other authentication and payment methods. We employed relative advantage, initial trust, perceived playfulness, and need for uniqueness as positive valence, whereas perceived risk, technophobia, and perceived complexity as negative valence. Secondly, we test the moderating effect of personal innovativeness on the relationships between negative valence and behavioral intention to use FRP.

2. Theoretical Background and Hypotheses

2.1 Previous Research on FRP

We observed a few research studies that have investigated users' opinions and adoption of FRP. In particular, we have observed an increasing interest in the privacy trade-off in the context of FRP. The privacy calculus model was integrated with innovation resistance by Liu et al. (2021). In this study, the authors discovered that the perceived effectiveness of a privacy policy has a considerable impact on privacy-related factors such as privacy control and perceived privacy risk. Li and Wang (2020) combined the benefits of FRP with privacy concerns, although their work lacked empirical evidence. We have also observed that scholars have investigated various factors that influence FRP usage intentions, with a particular focus on aspects related to system quality. For example, convenience, reliability, security, and non-contact were chosen as quality features of the FRP (Zhang, 2021), with the first three factors having negative impacts on users' resistance. Zhang and Kang (2019) argued that FRP is more secure than other payment authentication methods such as fingerprint or iris detection. Zhong et al. (2021) have applied TAM as main theoretical framework and demonstrated a number of positive factors such as perceived enjoyment, facilitating conditions, coupon availability, and ease of use influence FRP system adoption. Hu et al. (2021) identified the enablers and barriers that affect customers' perceived value and trust in the FRP context. Their results showed that convenience, privacy and financial risk have significant

influence on perceived value and trust which play an important role on consumers' decision making. In addition, Moriuchi (2021) considered usability of the technology and consumers' psychology by using UTAUT and Theory of Mind (ToM) theory to understand potential barriers and opportunities consumers face when using FRP.

Most previous research has looked at various factors influencing FRP adoption but hasn't explored the positive and negative aspects. Although Hu et al. (2021) considered a few benefits and risks to predict consumers' intention towards FRP, an inclusive model incorporating the wider positive and negative factors is still needed.

2.2 Valence Framework

We draw on the valence framework (Peter and Tarpey Sr, 1975) to analyze the factors affecting users' behavioral intention to use FRP. This approach uses a consumer decision-making "cognitive rationale" model that examines consumer behavior by taking positive and negative factors into account (Peter and Tarpey Sr, 1975). This paradigm, originating from the economic and psychological literature, as the two main components of consumer decision-making, represents the perceived benefit and perceived risk. The perceived benefit means that consumers are driven to optimize their positive results, while the perception of risk determines the potential negative effects to be reduced by consumers.

Prior literatures suggest that the valence framework is appropriate in online business platform, such as e-commerce (Kim et al., 2008, Mou et al., 2020); however, a number of extensions and modifications are supposed to implement in mobile payments context (Lu et al., 2011, Lin et al., 2014). Although the valence framework is relevant for this research, we believe that this study needs a specific extension and alteration of the valence framework. In FRP context, we need to capture its innovative features when examining its acceptance. The innovation diffusion theory (Rogers, 2003) identifies a collection of factors that may influence a person's willingness to accept new technology. Relative advantage, compatibility, complexity, image, trial ability, visibility, and results demonstrability are the factors to consider. Among these, relative advantage and complexity have provided the most consistent explanation for consumer action in adopting financial and payment technologies (Lu et al., 2011). After carefully considering the value of relative advantage and perceived complexity, we decided to include them in our model.

Individual user characteristics are an essential determinant of behavioral intentions toward an innovation (Agarwal and Karahanna, 2000). Previous studies have also confirmed the significant link between individual differences and IT acceptance (Venkatesh et al., 2012, Ozturk et al., 2017). On the other hand, the original valence framework ignores this critical relationship. Different groups of people may have different viewpoints about the new payment system, causing them to behave differently (Kim et al., 2010). When evaluating a novel thing or scenario, people consider both the positive and negative aspects (Fazio et al., 2015). Individuals also consider how closely the novel stimulus resembles positive versus negative past experiences (Fazio et al., 2015). In this sense, we aim to extend the traditional form of valence theory by adding perceived playfulness, need for uniqueness, and technophobia as the individual differences components to examine their relationships with the positive valence, the negative valence and users' behavioral intention to use FRP system.

Finally, because of greater risks of uncertainty and developing a sense of a loss of control when conducting transactions in digital platform like FRP, Customer trust may play an even bigger role in selecting whether or not to use FRP services (Lu et al., 2011). Therefore, customer initial trust was included in our research framework.

To explain online behavior, we summarize the past literature using the valence framework in Appendix A. We found that none of the previous studies has examined the moderating impact between negative valence and intention to use. Our review also reveals that none of the earlier studies investigated the effect of technophobia/technological anxiety on consumers' behavioral intention.

2.2.1 Extended Negative Valence Factors

The valence framework measures the perceived risk as one of the negative valences. Perceived risk relates to the irrational anticipation of failure or compromise in implementing a technology (Pham and Ho, 2015). Mallat (2007) found several perceived risks associated with the idea that someone could pay with the device if the device is lost and stolen. The author described the threat due to the struggle to make follow-ups on mobile payments and the absence of transaction records and documentation. Additionally, some participants in Mallat (2007) study perceived that m-payment service providers violated privacy and refused to reveal their details. Based on the above,

we divided perceived risk into financial risk and privacy risk because users are highly concerned about their personal information and financial losses. Online frauds have become common in modern payment systems, especially in China, where cash transactions have diminished every day.

The perceived risk of privacy is defined as the possibility of online companies inappropriately using personal information, thereby violating a customer's privacy (Nyshadham, 2000). Privacy risk is seen as a primary determinant of public endurance against emerging technology (Chen et al., 2013, Yang and Lin, 2015). It has a detrimental effect on the intention to use technology (Johnson et al., 2018, Klobas et al., 2019, Yi et al., 2020). The risk is much higher in the context of facial recognition as it stores very sensitive personal information. The consumers may feel that their information will be misused by the companies. Therefore, we employ the concept of privacy risk in our study to investigate how it relates to FRP-based payments. We also note that users' perception regarding privacy concerns in the payment context varies from that in other settings. Users are more worried about their privacy in the payment area because the mobile device is stolen, lost, and damaged. (Chari et al., 2001). In addition, cybercriminals are more likely to infringe on wireless data transfers since a transaction requires many wireless networks with different levels of protection embedded in the system (Varshney, 2003).

Our study expresses financial risk as to the possibility of financial losses because of online fraud. Online fraud has become a common problem in the modern payment system, especially in China, where cash transactions are almost obsolete. Many of the research in the developing economies such as China (Hall and Royles, 2018, Liang et al., 2018, Talukder et al., 2019), Brazil (Cruz et al., 2010), and Thailand (Sripalawat et al., 2011) have accurately identified monetary risk as a barrier to use. We suggest the following hypothesis based on the discussion above:

H1: Perceived risk has a negative effect on consumers' intentions to use FRP in payment.

Technophobia is a multidimensional construct combined with expressive, social, and attitudinal aspects (Gilbert et al., 2003, Cavdar Aksoy et al., 2020). Technophobia is the apprehension when new technology is used (Osiceanu, 2015). Initially, developing a new technology generates an uncertain atmosphere for consumers that often appears as a significant barrier to the acceptance of that technology (Khasawneh, 2018). The strong effect of psychological factors on high-tech purchasing intentions has been shown by previous studies (Viardot, 2004). Many researchers have used several methods such as technostress, technophobia, and cyberphobia to evaluate human

psychological responses to technology across different constructs with rapidly changing technological environments (Gilbert et al., 2003). Compared to demographic attributes, such as level of education, income levels, and standard of living, the role of technophobia in adopting innovation remains relatively underexplored (Sinkovics et al., 2002). Kulviwat et al. (2009) advised that technophobia and perceived benefits related to individual characteristics are included in future innovation adoption studies.

In this research, technophobia is defined as "an irrational fear and/or anxiety that individuals form as a response to a new stimulus that comes in the form of a technology which modifies and/or changes the individual's normal or previous routine in performing a certain task" (Khasawneh, 2015). Fear means that when one decides to pay through the FRP system, s/he thinks that it would be more complicated than paying through the counter. Anxiety means s/he thinks that FRP is not more beneficial than their previous payment system. Many studies have investigated that technology anxiety has a detrimental effect on the minds of consumers regarding the utility or perceived ease of use of new technology (Venkatesh and Davis, 2000, Chatzoglou et al., 2009, Aggelidis and Chatzoglou, 2009, Tsai et al., 2019). Thus, technophobia has a significant psychological reaction in the context of FRP, which may create a barrier towards its adoption.

H2: Technophobia has a negative effect on consumers' intention to use FRP in payment.

In addition, we chose perceived complexity as another negative valence in our model. Perceived complexity is a negative behavioral belief that can distort consumers' attitudes towards adopting an innovation (Cenfetelli and Schwarz, 2011). It is related to the increased effort needed when the number of features increases and becomes more complex, which can frustrate users more (Ayyagari et al., 2011). Moreover, the difference between abilities and expectations will also increase as the perception of technical complexity increases (Ayyagari et al., 2011). As a result, technology adoption and post-adoption literature have placed tremendous emphasis on examining the impact of ease of use on the adoption and use (Venkatesh et al., 2016). The general finding from the literature on adoption and post-adoption is that ease of use can have a substantial impact on both adoption and post-adoption behaviors (Islam and Mäntymäki, 2011). Especially, prior literature suggests that in the early stage of the use of new technology, it will be more critical (Islam and Mäntymäki, 2011, Islam and Mäntymäki, 2012). As FRP is comparatively a new technology, it is reasonable to think that many people might feel it is challenging to use because

of a lack of knowledge about FRP and vulnerability. In the FRP context, exposure refers a minor change in the direction of the camera or even the change in appearance will eventually lead to an error. The following theory is hypothesis suggested.

H3: Perceived complexity has a negative effect on consumers' intention to use FRP in payment.

2.2.2 Extended Positive valence

Innovation diffusion theory by Rogers (2003) is often referred to as one of the key theories for accepting and adopting research technology in various contexts. IDT explains how customers have opted to adopt a new idea, method, or technology, arguing that these decisions are focused mainly on a set of characteristics of innovation that contribute to subjective innovation assumptions (Rogers, 1995, Agarwal and Karahanna, 2000). As one of these features, the relative advantage was mainly appropriate in determining whether the benefits of using a technology justified the risks (Karahanna et al., 1999, Vishwanath and Goldhaber, 2003). Relative advantage implies that an invention is implemented more quickly as it is considered superior to or already accessible for the equivalent concept, product, or technique being superseded. The relative advantage in fields such as e-business or e-commerce has been studied very extensively (Zhu et al., 2006, Mndzebele, 2013, Sin et al., 2016), Internet and mobile banking (Karjaluoto et al., 2010b, Al-Jabri and Sohail, 2012, Yang et al., 2012), and instant messaging (Hsu et al., 2007), **smart watch adoption (Ghazali et al., 2020)**, among others.

We think that consumers' perception of using new technology such as FRP includes two advantages: technological advantage and use advantage. Technological advantage refers to faster processing and automation of identification which helps users complete the transaction without hassle and device. Use advantage refers to frictionless payment and low risk of theft that indicates smooth and risk-free transaction. In this study, we define relative advantage as the combination of technology and use the advantage of the FRP system, which enhances users' intention to use FRP. Consequently, the following hypothesis is therefore suggested.

H4: Relative advantage has a positive effect on consumers' intention to use FRP service.

Initial trust describes a person's ability to take chances to meet their requirements (Lu et al., 2011). Earlier studies have shown that trust in the online context is a significant precedent for adopting a system by customers such as e-commerce, online payment, and mobile payment (Kim and Park, 2013, Shi and Chow, 2015, Zhou, 2014). By analyzing mobile banking growth, Kim et al. (2008) found that customer perceptions of initial trust play an important role in encouraging their decision

to follow them. In a recent study, Talwar et al. (2020) also empirically show the effect of initial trust of pre and post-adoption behaviors. Users' intention to adopt a technology increases when s/he has to trust its source-target relationship (Gong et al., 2019, Chen et al., 2022). Users can create confidence in the target object by transferring enthusiasm from various trusted source objects (Sia et al., 2009, Belanche et al., 2014, Bock et al., 2012, Lowry et al., 2014). In the FRP context, trust on the source means trust on the FRP vendor machine, and trust on the target means trust on in WeChat or Alipay account. Hence, when the consumer used FRP, they believe that there are no possible fraud in both source and target points. We therefore assume that initial trust will play a major role in the intention of users to use FRP in payment. The following hypothesis is therefore suggested.

H5: Initial trust has a positive effect on consumers' intention to use FRP service.

Playfulness is a multidimensional term involving focus, interest, and pleasure. The extent characterizes how a consumer is curious about interaction with technology and believes that interaction is fun and exciting (Moon and Kim, 2001). Playfulness is a temporary emotional condition arising from an experience of the interaction between a person and an object (Ahn et al., 2007, Shang et al., 2005). Webster and Martocchio (1995) claimed that playfulness produces instant idiosyncratic feelings, such as engagement and satisfaction. Playful stimulation is a significant part of hedonic usage (Bilgihan, 2016, Holbrook et al., 1984). In the tourism context, Dong and Siu (2013) revealed that tourists would undoubtedly give positive feedback if they perceive service to be enjoyable and exceptional. In turn enjoyment can predict both satisfaction and continuance intention (Mäntymäki and Islam, 2014).

By combining the definition above, perceived playfulness in this study is a psychological condition that delivers users' individual identity and hedonism. Self-identity refers to the private part of oneself in the sense of the FRP in terms of how the individual perceives himself (Klarmann et al., 2013). This dimension exemplifies that users use new technology (e.g., FRP) to create a favorable self-image (Hudders et al., 2013) by integrating the symbolic significance of personality (Vigneron and Johnson, 2004). Hedonism is thought to be a subjective and intangible emotional gain (Wiedmann et al., 2009), which consumers may obtain through FRP use. Accordingly, consumers are paying through their face rather than using a password or fingerprint, which may create an individual identity. The idea of "no cashier, no queue, no cash or card or mobile phone, just scan the barcode and pay with consumer's face" may be motivating the consumers' to use FRP and the

payment procedure may be creating users' self-satisfaction. We postulate the following hypothesis on the basis of the discussion above.

H6: Perceived playfulness has a positive effect on consumers' intention to use FRP service.

The need for uniqueness first formulated and discovered through the theory of uniqueness by Snyder and Fromkin (1977). The need for uniqueness can be considered an individual attribute for pursuing brands or products or using technology to express a unique identity that will differentiate itself from others (Tian et al., 2001). It is vastly used in luxury product research (Blazquez et al., 2020, Choi and Kim, 2016, Vigneron and Johnson, 2004). Several researchers have identified that the need for uniqueness might increase consumers' desire to enjoy lucrative goods (Bian and Forsythe, 2012), which helps them to distinguish from others (Wiedmann et al., 2007) and express their individuality (Hennigs et al., 2012). In the FRP context, the need for uniqueness is a critical factor that can enhance users' social image and prestige. To elaborate, those with a greater need for uniqueness would consider the FRP to be more appropriate for expressing themselves to boost their social profile, and new payment methods would increase their social prestige. Particularly when other customers are waiting for payment in a line and FRP users are just walking and paying through their faces. The current research formulates the following hypothesis by combining the above findings and reasoning.:

H7: The need for uniqueness has a positive effect on consumers' intention to use FRP service.

2.3 Moderating effect of Personal Innovativeness

In this study, we argue that the impact of negative valence variables on the decision to use FRP would be moderated by personal innovativeness. "*Personal innovativeness refers to an individual's willingness to consider change and to try out an IT*" (Agarwal and Prasad, 1998). Personal innovativeness embraces an individual's curiosity, which is paramount in influencing the intention to use an IS (Agarwal and Prasad, 1998, Rogers, 1995). Peslak et al. (2011) argued that innovative and curious individuals about new systems would develop positive intentions and are likely to adopt new technology, unlike individuals who are reluctant to invest their effort and time to exploit new technology.

Personal innovativeness can be used as a moderator of the connection between technology features and behavioral intent and may increase perceived satisfaction (Jang and Lee, 2018).

Innovativeness has been used in numerous past research to determine customer behavioral intention and gratification (Joo et al., 2017, Lin et al., 2007, Tan and Ooi, 2018). However, the results were contradictory. Researchers have identified innovativeness as a significant predictor and moderator of behavior in technology adoption in a few studies (Leong et al., 2017, Lu et al., 2011). A highly creative customer favors new technology and intends to be happier with the latest services than a marginally creative customer (Tan et al., 2017). However, other studies have shown no substantial effect of innovativeness on the purpose and satisfaction of customers (Kim et al., 2010, Purba, 2015). Laukkanen et al. (2007) considered innovativeness the most potent indicator and an essential moderator for implementing new technologies.

Based on the above discussions, we found that personal innovativeness could significantly moderate the relationship between negative valence factors and the intention to use them. This is because consumers with a higher level of innovativeness are generally more optimistic about trying and adopting new technology. We postulate the following hypothesis based on the discussion above.

H8: The relationships (a) perceived risk → intention to use, (b) Technophobia → intention to use, AND (c) perceived complexity → intention to use will be stronger among the people who have a higher level of personal innovativeness.

All eight hypotheses and the proposed relationships are depicted in Figure 1.

[Insert Figure 1 here]

3. Research methodology

3.1 Study Context

The facial recognition system measures an individual's facial structure quantitatively and preserves the details as a facial print. The application uses machine learning algorithms to match a live or digital photo with the registered face-print for authentication. Once it identifies the user, it authorizes the deduction of funds from the individual's Alipay/WeChat account (Liu, 2020). In September 2017, Alibaba's financial affiliate Ant launched the "Smile to Pay" service in Hangzhou, where it is being trialed with KFC. The customer doesn't need to bring a smartphone for this payment process as they have already signed up for the Alipay service and allowed facial recognition. Alipay's FRP started its journey with the slogan of "no wallet, no cards, no phone, just

stand in front of payment machine and give a smile." Alipay has already replaced QR codes with facial recognition in authorized shops and POS machines in more than 300 cities (Jao, 2018).

For POS payment, Customers must have an Alipay/WeChat account with FRP enabled. To begin the payment procedure, the buyer stares directly into the 3D camera after placing an order. After that, Smile to Pay's AI scans the customer's face, verifies that the individual is standing there, and compares the biometric data to millions of other faces in its database. The AI matches the customer's face to their WeChat/Alipay wallet in less than two seconds. If the consumer is using FRP for the first time, they are asked for the phone number associated with their Alipay/WeChat account. The phone number serves as a two-factor verification code and assurance that the AI linked the proper face to the correct Alipay/WeChat account. If the client uses FRP in the future, instead of entering a phone number, they will only have to click a 'confirm' or 'cancel' button to complete the transaction (Senden, 2020).

[Insert Table 1 here]

3.2 Measurement of Constructs

A survey was performed to evaluate the proposed hypotheses. The questionnaire items were adapted from current and well-tested scales provided by previous studies and then slightly modified according to the context of the FRP. Five points of Likert scales with anchors ranging from "strongly disagree" to "strongly agree" were used to assess the opinion of the respondent on all measured items (Premkumar and Ramamurthy, 1995, Luck and Rubin, 1987). Following the method suggested by Brislin (1970), all things were translated and finished back-translated to simplified Chinese. The initial version of the questionnaire used in the study was pre-tested with a convenience sample to identify the item formulation and any language-related issues.

Regarding the sample size, for each set of variables, the thumb rule, the item-to-response ratio should range from 10:1 (Hair Jr et al., 2014). As 31 items were used in the questionnaire, more than 310 samples are sufficient for the inferential statistics testing. In Appendix B, all the items and their sources for each construct are listed.

3.3 Research design and data collection

The current study conducted quantitative research to investigate consumers' intentions to use FRP in payments. This cross-sectional study was conducted for six weeks and examined at one specific

time. Both offline and online surveys were conducted in this study. We distributed the questionnaire individually to the targeted respondents and asked them to answer the questionnaire. While most of them completed the questionnaire on the spot, some people requested to send the electronic questionnaire to their email. All respondent email address was noted by the researchers and subsequently sent the survey via email. Out of 339 hard copies and 91 online (email-based) surveys, a total of 430 data was collected. We excluded 38 questionnaires from future analyses because of invalid and missing data. There were a total of 392 correct and completed responses received. 66% were males among the 392 respondents, and 44% were females. Most of the respondents were between 20-30 years old (54%). 64% of respondents used FRP for both POS and m-payment, whereas 34% used either POS or m-payment as their payment method. All of them were actual FRP users, and used FRP multiple times. The demographic information is shown in Appendix C.

Respondents were fully informed of the intention of the research before engaging in the study and were assured of data confidentiality, ensuring that the responses were fully anonymized. They were told that participation was voluntary and were also given the right to withdraw from participation without consequences at any time and without the need to provide reasons. In the first section of the questionnaire, by checking the 'Agree' checkbox in response to the statement of "I voluntarily participate in this questionnaire," to participate in the research, all respondents indicated and registered their consent.

4. Data Analysis and Results

4.1 Common Method Bias

Psychological separation was achieved by using contextual shifts in the questionnaire to lessen the impact of standard method bias (CMB) (Craighead et al., 2011). We used statistical analysis to determine the severity of common method bias. First, the variance inflation factors (VIF) values (Table 2) of the constructs generated from the entire collinearity test were used to evaluate CMB. These figures were lower than the recommended 3.3 (Kock, 2015). We also used the latent method factor (LMF) (Podsakoff et al., 2003) to check for the presence of CMB. The findings revealed that a single construct was responsible for only 39.85% of the overall variation, significantly less than the suggested 50% (Eichhorn, 2014).

[Insert Table 2 here]

4.2. Measurement Model

We used SmartPLS 3.0 to analyze the data. The value of Cronbach's alpha coefficient was determined to measure the reliability of model variables in order to test the construct validity and reliability of variables in the current analysis. All the variables' alpha values reveal greater than 0.70 as recommended by Nunnally (1978). Next, to ensure convergent validity, we examined the item loading, composite reliability (CR), and average variance extracted (AVE) values of each construct. We considered an item loading of 0.7, CR of 0.8, and AVE of 0.5 as the threshold values (Hair et al., 2006). As shown in Table 3, all items loadings, construct's CRs and AVEs above the suggested threshold values. The chi-square value and chi-square-to-degrees-of-freedom ratio are both acceptable (2.3). At the same time, the standardized root mean squared residual (SRMR) is 0.044, smaller than recommended thresholds 0.08 proposed by Hu and Bentler (1999). The value of $d-G = 0.508$ smaller than 95% bootstrap quantile meet the judgment criteria proposed by Henseler et al. (2016). In addition, the value of $d-ULS = 0.192$ is also smaller than 95% bootstrap quantile (Table 4). The result of NFI is 0.91, which is above 0.90, considered acceptable (Byrne, 2016).

[Insert Table 3 here]

[Insert Table 4 here]

4.3. Discriminant Validity

We ensured discriminant validity by observing the correlation matrix presented in Table 2. We observed that the squared roots of AVE were all greater than the values of the inter-construct correlation (Table 5) (Henseler et al., 2015). Thus, the criteria for discriminant validity are satisfied. The Heterotrait-Monotrait Ratio (HTMT) can also be used to determine the discriminant validity of a model. For all structures, the HTMT ratio should not exceed 0.85 (Henseler et al., 2015). All of the construct ratios were lower than the acceptable value in the current study model (Table 6). Therefore, the results support the good discriminant validity of our research model.

[Insert Table 5 here]

[Insert Table 6 here]

4.3. Structural model

The structural model's overall fit indices show a satisfactory fit. The R^2 measures the variation explained in each endogenous variable and consequently of the model's predictive accuracy (in terms of in-sample prediction). The R^2 for our study is 0.846, which suggests that the structural model has predictive relevance (Hair et al., 2014). The Q^2 value, also known as blindfolding, is another way to assess the model's predictive usefulness. In our study, the Q^2 is 0.742, which is greater than zero suggest that the path model's prediction accuracy is adequate (Hair et al., 2014). We also analyze the effect size which determines an exogenous variable's predictive power was assessed based on the f^2 . A rule of thumb is that the value of 0.02, 0.15, and 0.35 is taken as small, medium and large effect size (Cohen, 2013). In terms of f^2 , PP and RA were found medium and large effect on BI (Table 2). We evaluated the structural model after the assurance of appropriate psychometric properties for the structural model. To validate support for hypothesized relationships, it is proposed that standardized coefficients of the path should be relevant at $p < 0.05$ (Byrne, 2016). The results of this analysis show support for seven of the eight hypotheses (see Figure 2).

[Insert Figure 2 here]

4.4. Assessment of Moderating Variable

In our research, we used personal innovativeness as a moderator to use FRP on the relationship between negative valence factors and BI. The Multi-Group Analysis (MGA) was employed to analyze the effect of moderating variables. We found significant differences between perceived risk and intention to use FRP ($\beta = -0.116$; $p < 0.01$). It indicates personal innovativeness moderates this relationship. However, there was no significant difference between perceived complexity and intention to use FRP ($\beta = 0.001$; $p < 0.957$) and technophobia and intention to use FRP ($\beta = 0.055$; $p < 0.066$). The degree of innovativeness does not moderate the proposed partnership in this context (see Figure 2).

5. Discussion and Recommendation

The purpose of this research was to examine the intention of consumers to use FRP for payment services. The study included relative advantages, initial trust, perceived playfulness, and need for uniqueness as a positive valance for explaining the functional, confidential, emotional, and social

aspect of FRP, It also includes perceived complexity, perceived risk, and technophobia as a negative valence for explaining risk and barriers (psychological and use) aspect of FRP. The results show that the most significant predictor is a relative advantage. This means that people believe that FRP is more beneficial in comparison to other existing alternatives. This result is consistent with previous online payment or mobile payment studies (Johnson et al., 2018, Liu and Yi, 2017, Khalifa and Shen, 2008, Yang et al., 2012, Karjaluoto et al., 2010b).

The research revealed that perceived playfulness has a major positive impact on behavioral intention, implying that people think FRP is exciting and enjoyable as a payment method. The findings complement the findings of prior work (Wang et al., 2016, Maity and Dass, 2014) in the context of mobile advertising and entertainment. The use of FRP authenticates consumers within a few seconds, which is fascinating to the customers. Furthermore, at the POS, it is intriguing that the consumers do not carry mobile or cards. They scan the product barcode and pay with their face. The new features of FRP play a different role in users' minds because of users' intrinsic motivational factors such as hedonism and self-identity.

We have also found that the need for uniqueness has a substantial effect on the behavioral intention to use FRP in the present study. It means that users tend to use unique and attractive technology to enhance their social image and prestige in society. Our finding is in line with several earlier pieces of research (Venkatesh and Brown, 2001, Blazquez et al., 2020, Choi and Kim, 2016).

Initial trust was also found to have a significant impact on the intent of using FRP. This result is consistent with several previous m-commerce research studies (Kumar et al., 2018b, Kumar et al., 2018a, Karjaluoto et al., 2010a, Cao et al., 2018). The findings indicate that users who trust WeChat or Alipay security system have a high likelihood of using FRP service.

The results of the negative valence provide several interesting insights. First, perceived complexity had a non-significant influence on behavioral intention to use FRP. The potential explanation is that people are used to QR code payments in China. Users need to put a fingerprint or password in QR code payment, which is comparatively complex than FRP. The FRP payments are more comfortable to use than any other alternatives. Therefore, it makes sense that complexity had a non-significant role in influencing intention to use FRP. However, this result contradicts previous adoption research, which indicates that ease of use is a significant predictor of intention to use (Islam and Mäntymäki, 2011, Islam, 2015). As the relative advantage in this study was necessary, the effect of perceived complexity may be less influential.

Second, perceived risk (privacy and financial) significantly influences customers' behavioral intention to use FRP. This signifies an individual's apprehensions about security and privacy breaches associated with the use of biometric authentication technology, which eventually raises their negative attitude toward using this technology (Talwar et al., 2020). Consumers may fear that hackers can easily hack their accounts and complete FRP transactions (Johnson et al., 2018). It is in line with Slade et al. (2013), who say that everyone plays a role in the world of mobile payments, so security issues are omnipresent. The increased awareness of security breaches has made consumers more mindful of the risks associated with digital transactions (Cordray, 2014). Therefore, there is a higher chance of financial loss. Furthermore, FRP is operated by a third party that stores customers' personal information, which eventually raises consumers' hostile attitude toward using FRP for payment. However, our findings suggest that innovativeness attenuates the effect of perceived risk on intention to use FRP.

Finally, technophobia had significant influences on customers' intention to use FRP. This finding indicates that consumers' intention to use FRP significantly drops as they feel anxious, skeptical, and uncertain about using the FRP in payment. This result shows that the perception of technophobia is negatively associated with the acceptance of emerging technologies in the literature on technology adoption (Khasawneh, 2015, Sinkovics et al., 2002).

5.1. Theoretical Implications

We present several theoretical implications for these results. First, the study's outcomes provide more in-depth knowledge of the relative importance of positive and negative valence in determining FRP intention. This was necessary since most of the prior studies focused on the factors that influenced the adoption and acceptance of Fin-Tech or m-payment technology. In comparison, only little was known about the possible inhibitors that kept individuals from engaging in the digital payment system. In addition, it is the first empirical study utilizing the valence framework to study the FRP.

Second, the present research tries to show the moderating effect of personal innovativeness on the relationship between negative valence and behavioral intention. We found that the relationship between perceived risk and behavioral intention had an attenuating impact on personal innovation. This suggests that personal innovativeness is a mitigating factor in reducing the barrier of FRP adoption and use. To the best of our knowledge, no previous literature has investigated this

relationship. Therefore, our paper contributes to the technology adoption literature, specifically mobile payment, by empirically investigating the moderating effects of personal innovativeness (Talwar et al., 2020, Acker and Murthy, 2018, Qasim and Abu-Shanab, 2016).

Finally, these results are relevant to the new technologies (e.g., AI, biometrics, 3D sensing, and big data) incorporated into FRP, can make a substantial contribution to our understanding of technology acceptability in the new era of shopping, and can inspire scholars to conduct future research on the topic.

5.2 Practical Implications

Along with theoretical implications, this also proposes policy implications for practitioners. Our analysis suggested that FRP service providers should pay close attention to four factors (initial trust, perceived playfulness, relative advantage, and need for uniqueness) because they all have a clear and constructive effect on customers' behavioral intention. We encourage service providers to look for ways to promote initial trust in FRP services for their customers. Relative advantage has the most significant effect on the intention to use FRP services. Service providers should carefully examine the issues of relative advantages to ensure that their services and offers suit their customers' existing standards, desires, and lifestyles. Service providers could provide monetary incentives to entice new users. Offering new users discounts, coupons, or gifts may boost positive opinions of facial recognition payment. Such financial incentives have been shown to be beneficial in the early stages of implementing FRP in China, and they might also be used in other nations.

Perceived playfulness is also an important determinant of FRP services use. According to a study conducted by news portal Sina Technology, more than 60% of respondents believe they appear uglier in the camera used by Alipay's face recognition technology than they do in real life (Daily, 2019). Alipay added beauty filters (providing face-lifting and whitening effects, etc.) in the face-scanning system to address this problem. The number of users increased dramatically once the beauty filters were made available in retail stores; women increased by 123 percent, while males increased by 106 percent (Finance, 2019). As a result, organizations may considerably improve the user experience and enable customers to enjoy shopping to a greater extent in the future by minimizing system faults and increasing the efficiency and accuracy of recognition.

In dampening customers' FRP services usage choices, negative valences play an essential role. FRP service providers should do their utmost to reduce the expectations of privacy and financial

risk of customers. For example, Alipay already stated that the current technology cannot trick facial recognition payment no matter how realistic the photos are. Even if such a fraudulent case happens, Alipay will pay the victim in full through its insurance company. This kind of statement would build initial trust and remove the risk related to privacy and financial losses. Furthermore, consumers should have easier access to technical support and resources, encouraging them to utilize facial recognition for payment. For POS payment, more staff members can be assigned to provide technical support for new users, such as giving basic user introductions and tutorials.

6. Conclusions

The overarching goal of this paper was to enrich our understanding of users' reactions to using FRP in payment. We employed the valence framework and identified a number of positive and negative valence factors that may influence FRP use. The structural model results indicate that relative advantage (positive valence) and perceived risk (negative valence) are the two most influential predictors towards intention to use FRP. In addition, we found personal innovativeness moderates the relationship between perceived risk and behavioral intention to use FRP. Our work contributes to the understanding of both positively and negatively valence factors behind technology use intentions (Cenfetelli, 2004). The research model provides a more systematic way to explain users' perceptions by taking into account both positive and negative influences. With this approach, this study predicts dimensions that specifically influence behavioral intention to use FRP in payment.

7. Limitations and Future Directions

The current research acknowledged some limitations. First of all, our respondents are a small group of the Chinese population, so future studies should examine how different cultures and demographics influence FRP service usage. More generalizable results could be generated by a broad and diverse sample. Additionally, cross-cultural studies across different regions could be conducted to determine the cultural impact on technological acceptance. Second, most users are still in the early stages of adopting this new technology, and future studies may need to include a more diverse and larger, more extensive sample of users to capture a fuller user experience to better support the validity and reliability of the findings. Third, We did not separate the first time users and reusers. The service procedure provided by a first-time user and a person who revisits the same store is different for this service. The user flows for first-time users and returning users

of the FRP technology are unlike each other. Returning users can skip the procedure and use a more convenient and quick payment service. So future researchers may consider to segment their survey sample for findout why first users don't even reach reuse. Fourth, despite the authors' best effort to include all the significant variables in the study, they could not test all of the critical variables in the study. Future studies could explore new constructs related to facial recognition systems such as perceived system quality, perceived information quality (Gao and Waechter, 2017, Chen and Li, 2017). Finally, this research examines the effect of only a few positive valence and negative valence factors. The current study did not investigate the impact of environmental or situational variables. Cultural factors, government regulations, and promotional strategies could also enhance consumers' intention and future user behavior.

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