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Unveiling the Influence of Technology Anxiety on Facial Recognition Payment: Does the Golden Age Citizen Adopt the Payment with their Face?

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ABSTRACT

This study examines the moderating role of technology anxiety (TA) in the relationship between trust, satisfaction, and the intention to use facial recognition payment (FRP), focusing on the senior citizens in Tangshan City, China. With the latest development of China's cashless society, FRP has been widely adopted among young generation due to its convenience and security. However, senior citizen users face significant psychological barriers due to technology anxiety as mentioned by many studies. The research integrates the framework of Belief-Attitude-Intention (B-A-I) framework and the Technology-Organization-Environment-Individual (TOE-I) to propose a theoretical model and develop research hypotheses, with a focus on analysing how technology anxiety moderates the relationship between attitudes and behavioural intentions, specifically on senior citizen users. At the theoretical level, this study expands the theoretical perspective of biometric payment system adoption research by introducing technology anxiety as a moderating variable. At the practical level, the findings provide reference for policymakers and businesses to design elderly-friendly digital payment solutions, suggesting targeted interventions (e.g., digital literacy training) to reduce technology anxiety and promote the adoption of emerging payment technologies among the elderly. Suggestion will be made to improve the adoption level of FRP among the golden age citizen.

Keywords: Facial Recognition Payment (FRP), Technology Anxiety, Senior Citizens, Technology Adoption, Moderating Variable
JEL Classifications: M15, O33, D83

1. INTRODUCTION

China has emerged as a global leader in adopting innovative payment systems, driven by the rapid growth of financial technology. By 2019, third-party payment platforms like Alipay and WeChat Pay dominated China's payment market, accounting for 90% of transactions and accelerating the country's transition toward a cashless society (Li et al., 2019; Zhong and Moon, 2022). The concept of a cashless society, first proposed by Alvin Toffler in 1980, has become a reality in China, primarily through mobile payment technologies like Alipay and WeChat Pay (Alibaba-Group, 2020). Corporate giants like Tencent and Alibaba have taken the lead in China, driving the widespread adoption of FRP and reshaping the landscape of mobile payment methods. However, despite its promises, the ascent of FRP has given rise to unexpected challenges and vulnerabilities. These challenges stem from the critical importance and security associated with biometric data. The use of facial recognition technology (FRT) without individuals' explicit consent or for questionable purposes has raised ethical and societal controversy (Lai and Rau, 2021).

In 2017, Alipay piloted FRP at a KFC outlet in Hangzhou, marking the beginning of widespread offline adoption (Zhong and Moon, 2022). By late 2018, Alipay launched its FRP terminal, Dragonfly, followed by WeChat Pay's Frog and UnionPay's FRP system (Shiau et al., 2023). These advancements have made FRP a popular

choice in supermarkets, convenience stores, shopping malls, and vending machines, with over 495 million users in 2021—more than one-third of China's population (iiMedia, 2019; Tang, 2022). For instance, Lao Dongyan, a Chinese law professor, vehemently voiced her opposition to the implementation of facial recognition technology as she entered her residential community, advocating for more stringent oversight of such systems (Ding, 2019).

The mobile payment market is steadily growing, and the application prospects for 3D facial recognition are promising. Compared to QR code scanning and bank card payments, facial recognition payment is more convenient, eliminating the need to enter passwords or scan with a phone. It is not only efficient and user-friendly but also ensures unique identity verification, effectively meeting the fundamental needs of customers (Tianyi and Xianying, 2024). Currently, a significant transformation has taken place in the landscape of payment systems and facial recognition technology is finding applications in the field of mobile payments, where it is being employed to enhance security and streamline user authentication processes. Face recognition, leveraging the prominent physiological characteristics (e.g., fingerprints, palmprints, voice, and facial dynamics) of users, effectively captures and processes their facial information through biometric identification systems (Maity et al., 2020).

China has witnessed the rapid emergence of facial recognition payment (FRP) as a distinctive element in the realm of mobile payments over the past decade (Liu et al., 2021). Since the launch of the digital RMB pilot in December 2022, Tangshan City has been included as a key focus in Hebei Province's 14th 5-year Plan, making it one of the first regions in China to expand the pilot program. As of September 2023, Tangshan has opened 857,700 personal wallets and 43,000 corporate wallets, with 81,000 merchant stores accepting digital RMB payments, reaching a total transaction volume of 340 million yuan. The pilot covers various scenarios, including shopping mall consumption, public utility payments, and payroll distribution (e.g., over 2 million yuan in salaries issued by municipal financial units) (Tangshan Reformation, 2023). Additionally, institutions such as Tangshan Bank have expanded payroll distribution and fiscal appropriation scenarios by directly connecting to the systems of Industrial and Commercial Bank of China (ICBC), China Construction Bank (CCB), and other banks (Tangshan Bank, 2024). As a pioneer in the e-CNY pilot program, Tangshan City's merchant coverage (81,000 stores) aligns with the national trend of FRP technology adoption (Tangshan Reformation, 2023; Zhiwei, 2021), demonstrating a strong foundation for technology implementation.

Despite its technological potential, the adoption of facial recognition payment (FRP) is hindered by psychological barriers, particularly technology anxiety (TA), which is a multidimensional construct encompassing concerns about unfamiliar interfaces and data privacy risks. This issue is evident in Tangshan, where 28% of residents are over the age of 60 and experience heightened TA due to limited digital literacy (Tangshan Civil Affairs Bureau, 2024). Such findings align with Lee and Coughlin (2015)'s assertion that aging populations face challenges in adopting new technologies due to stagnated learning curves and resistance to change. In response, Tangshan has implemented the "Digital Elderly Assistance" programs, emphasizing the need for targeted digital literacy initiatives to mitigate TA and facilitate technology adoption among older adults (Tangshan Civil Affairs Bureau, 2024).

However, a literature review revealed a scarcity of empirical studies investigating the moderators on intention to use FRP (Gao et al., 2023). Since senior citizens represent one demographic group significantly impacted by the digital divide, research has highlighted their tendency to encounter heightened anxiety when engaging with information and communication technologies (ICT) (Wagner et al., 2010). Powell (2013) observed a notable positive correlation between age and computer-related anxiety among adult populations in the 2000s, indicating that seniors are particularly susceptible to technological apprehension. Guo et al. (2013) further supported this notion, suggesting that senior citizens tend to exhibit higher levels of technology anxiety compared to their younger counterparts, which can partly be attributed to differences in educational background and computer literacy. The fundamental procedure of employing facial recognition payment entails a customer gazing at the camera and handling the FRP device publicly, akin to an integrated context where technology anxiety could be exacerbated.

In social cognitive theory, anxiety is a major cause of negative emotions that can make a person less likely to engage in an activity. According to Compeau et al. (1999), this occurs because individuals experiencing emotional upheaval may lose faith in their ability to complete a task, thereby diminishing their likelihood of achieving their goals.

There are two main types of anxiety: Trait anxiety and state anxiety (Igbaria and Iivari, 1995). Trait anxiety refers to persistently negative feelings about specific external stimuli or events, reflecting an individual's inherent disposition. In contrast, state anxiety is a temporary emotional response triggered by specific external factors or events (Gilbert et al., 2003; Saadé and Kira, 2006).

Consumer variances and situational elements have the potential to moderate the connections between attitudes and intention (Dabholkar and Bagozzi, 2002). In offline facial recognition payment situations, senior citizens are required to scan their faces in front of a device, with or without assistance from cashiers, which serves as a stimulus or situation triggering technology anxiety among them.

This research examines the moderating role of technology anxiety between attitude and intention to use FRP. Celik (2016) suggested that senior citizens tend to exhibit high levels of computer anxiety and resistance to adopting new information technology. Moreover, technology anxiety was found to have a negative moderating effect on effort expectancy and behavioral willingness to use technology. For instance, Steele et al. (2009) discussed participants' concerns about technology anxiety in relation to a wireless sensor network. Steele et al. (2009) and Cimperman et al. (2013) reported that computer anxiety negatively moderated the impact of effort

expectancy for seniors using home telehealth services. Yang and Forney (2013) implied that consumers who have high anxiety about using mobile shopping are more significantly influenced by the opinions of other referents in adopting mobile shopping. Thus, this research addresses the following research questions:

RQ1. Does technology anxiety moderate the relationship between trust and intention to use?

RQ2. Does technology anxiety moderate the relationship between satisfaction and intention to use?

2. LITERATURE REVIEW

Technology anxiety has emerged as a critical barrier in the adoption of digital technologies, especially among elderly populations. This section reviews the theoretical and empirical foundations relevant to technology anxiety and its influence on user behavior. First, the concept of technology anxiety is clarified by tracing its evolution from early notions of computer anxiety. Second, key empirical studies are summarized to highlight the significant negative impact of technology anxiety on technology adoption. Third, the Belief-Attitude-Intention (B-A-I) framework is presented to explain the psychological mechanisms through which anxiety moderates the attitude-intention link. Finally, the Technology-Organization-Environment-Individual (TOE-I) framework is introduced to contextualize technology adoption at the individual level, extending traditional organizational adoption models. These discussions form the basis for understanding the moderating role of technology anxiety in the adoption of facial recognition payment systems among senior citizens.

2.1. Overview of Technology Anxiety

The anxiety refers to excessive timidity in using computers, negative comments against computers and information science, attempts to reduce the amount of time spent using computers, and even the avoidance of computers in the place where they are located (Doronina, 1995). Furthermore, computer anxiety was first mentioned with the popularity and widespread adoption of computers. Later, as technology advanced, more researchers began using the term "technology anxiety." At the first stage, with the popularity and widespread adoption of computers, Chu et al. (2009) defined computer anxiety as the fear or apprehension individuals feel when they use computers or when they consider the possibility of computer use. Ellis and Allaire (1999), Wild et al. (2012) and Czaja et al. (2006) did not provide a definition of computer anxiety, while Bozionelos (2001) defined computer anxiety as: Negative emotions and cognitions evoked in actual or imaginary interaction with computer-based technology. It has the nature of a trait that predisposes individuals toward a state of psychological distress in situations that involve encounters with computers. Behavioral manifestations of computer anxiety include: (1) Avoidance of computers and the general areas where computers are located. (2) excessive caution with computers. (3) negative remarks about computers. (4) attempts to cut short the necessary use of computers (Maurer and Simonson, 1984).

With the diversification of technology forms (such as smartphones, the internet of things, and artificial intelligence), the focus of anxiety has expanded from a single computer to all digital technologies. Anxiety about computers has generalized and extended to technology anxiety. Maurer and Simonson (1984) stated that technology anxiety (TA) focuses on a user's state of mind regarding general technology tools, whereas computer anxiety is more narrowly focused on anxiety related to personal computer usage. TA specifically concerns the user's perception of their ability and willingness to use technology-related tools. Hoque and Sorwar (2017) adopted this definition in his research. Maurer and Simonson (1984) believed technology anxiety and computer anxiety are similar: "The research emphasis has been anxiety related to personal computers, yet what has been learned can easily be extended to apply to anxiety in relation to technological tools in general." Likewise, in Hasan and Ahmed (2010)'s study on computer anxiety, which defined it as discomfort and fear of using technology, to explain technology anxiety. It is showing that these two studies using the term "computer anxiety" and "technology anxiety" interchangeably. While Talukder et al. (2020) switched the term to technology anxiety.

2.2. Empirical Studies on Technology Anxiety

Technology anxiety has been widely studied in the context of technology adoption among elderly populations. Several empirical studies have explored its impact on adoption behavior, often identifying it as a significant inhibitor.

Hoque and Sorwar (2017) examined the adoption of mobile technology among elderly individuals in Dhaka, Bangladesh, using an extended UTAUT model. Their findings indicate that technology anxiety, along with resistance to change, negatively moderates adoption. Similarly, Talukder et al. (2020) investigated wearable healthcare technology (WHT) adoption among elderly individuals in China, confirming that technology anxiety serves as a negative predictor of adoption.

Further research by Deng et al. (2014) analyzed mobile health service adoption in China among middle-aged and older residents. Their study revealed that technology anxiety, along with other factors, influenced adoption intention, particularly among older users. Talukder et al. (2021) extended this line of research by examining the continued use of wearable health technology in China and found that technology anxiety significantly hindered continued usage.

Jeng et al. (2022) explored the adoption of Smart Health Wearable Devices (SHWD) in Taiwan, incorporating technology anxiety as a moderating factor in an extended TAM framework. Their results indicate that technology anxiety weakens the relationship between attitude and intention, highlighting its role as a barrier to adoption.

Beyond Asia, Lee et al. (2020) investigated ICT use, eHealth literacy, and social capital among older adults in low-income urban areas in the United States and South Korea. Their study found that U.S. respondents exhibited higher levels of technophobia, potentially due to structural barriers such as limited ICT access and training. However, they also cited previous research suggesting that interventions such as tutorials can help reduce technology anxiety, indicating that it is a modifiable factor.

Overall, these empirical studies consistently highlight the negative impact of technology anxiety on technology adoption and continued use among elderly populations. The findings emphasize the need for targeted interventions to reduce anxiety and facilitate smoother adoption processes. Table 1 presents selected empirical studies on technology anxiety.

2.3. Belief-Attitude-Intention (B-A-I) Framework

Fishbein and Ajzen (1975) established that individual behavior is systematically shaped through a hierarchical cognitive structure comprising beliefs, attitudes, and behavioral intentions. Beck (1979) empirically validated this chain, demonstrating that beliefs predict attitudes, which in turn determine behavioral intentions. Madrigal (2001) further elaborated that the B-A-I framework provides a structured model for explaining how individuals form specific behavioral decisions. Within this framework, beliefs are categorized into descriptive (derived from direct observation) and inferential (formed through reasoning) types (Fishbein and Ajzen, 1975). Attitudes reflect an individual's affective evaluation of a behavior, encompassing both positive and negative valences (Ajzen, 2014; Shih, 2004; Van der Pligt et al., 1997). Behavioral intention acts as the proximal determinant of actual behavior, representing the subjective likelihood of performing an action (Bagozzi et al., 1989).

Compeau and Higgins (1995) posits that anxiety disrupts individuals' self-efficacy and emotional stability, which in turn affects their behavioral intentions. In the context of facial recognition payment, technology anxiety can undermine senior citizens' confidence in their ability to use the technology effectively, thereby weakening the positive relationship between attitude (e.g., satisfaction, trust) and intention to use. By positioning technology anxiety as a moderator between attitude and intention to use, It is aligned with the B-A-I framework's emphasis on the interplay between emotional states and behavioral outcomes (Fishbein and Ajzen, 1977). Technology anxiety is a situational emotional response triggered by the use of new or complex technologies. It primarily influences users' affective responses (attitudes) rather than their cognitive evaluations (beliefs). For instance, users with high technology anxiety may experience reduced satisfaction or trust in a technology, even if they perceive it as useful or easy to use. Given its affective nature, technology anxiety is more likely to moderate the relationship between attitudes (e.g., satisfaction) and intentions (e.g., intention to use), as it directly impacts how users emotionally evaluate the technology.

Consumer differences and situational factors can moderate the relationships between attitudes and intentions (Dabholkar and Bagozzi, 2002). In facial recognition payment scenarios, senior citizens are required to scan their faces in front of a device, often without assistance from cashiers. This situation serves as a stimulus that triggers technology anxiety among them. For senior citizens, who may already exhibit high levels of computer anxiety and resistance to adopting new technologies (Celik, 2016), this anxiety can significantly influence their attitudes and intentions. Existing literature supports the moderating role of technology anxiety in the attitude-intention relationship. For example, Celik (2016) found that senior citizens tend to exhibit high levels of computer anxiety, which negatively impacts their willingness to adopt new technologies. Steele et al. (2009) and Cimperman et al. (2013) reported that technology anxiety negatively moderates the impact of effort expectancy on seniors' willingness to use

Table 1: Selected empirical studies of technology anxiety

Author and year	State/sample	Research area/model	Key findings
Hoque and Sorwar (2017)	Dhaka, Bangladesh (n=274 elderly aged ≥60)	Extended UTAUT model	Technology anxiety and resistance to change negatively moderating adoption
Deng et al. (2014)	China (Wuhan); 424 residents aged ≥40 (218 middle-aged, 206 older)	Mobile health service adoption; Integrated model	Older users: Perceived value, attitude, perceived behavior control, technology anxiety, and self-actualization need affected intention
Talukder et al. (2021)	China (Wuhan, Xinyu, Ningbo); 295 elderly (≥65 years) with prior WHT experience	Wearable health technology (WHT) continued use; Enablers and Inhibitors model	Inhibitors: Inertia (β=−0.115*) and technology anxiety (β=−0.226**) negatively affected use
Talukder et al. (2020)	Wuhan, China (325 elderly ≥60)	Wearable Healthcare Technology (WHT) adoption; Extended UTAUT2 with additional constructs (resistance to change, technology anxiety, self-actualization)	Technology anxiety, resistance to change functions as Negative predictors
Jeng et al. (2022)	Taiwan (166 elderly ≥60)	Smart Health Wearable Devices (SHWD) adoption; Extended TAM with technology readiness, Interactivity, and Technology anxiety as moderator	Negative moderator: Technology anxiety weakens attitude-intention linkage (β=−0.191)
Lee et al. (2020)	US (n=113) and South Korea (n=104) older adults from low-income urban areas	ICT use, eHealth literacy, Social Capital	US respondents exhibited higher technophobia, potentially linked to lower baseline ICT access and structural barriers (e.g., lack of training). Interventions (e.g., tutorials) reduced technophobia in prior studies (cited: Lee et al., 2020), suggesting anxiety is modifiable through education.

home telehealth services. Yang and Forney (2013) demonstrated that consumers with high anxiety about using mobile shopping are more significantly influenced by others' opinions, further highlighting the role of anxiety in shaping behavioral intentions. These studies provide a strong foundation for positioning technology anxiety as a moderator between attitude and intention.

2.4. Technology-Organization-Environment-Individual (TOE-I) Framework

The technology-organization-environment (TOE) framework, initially developed by Tornatzky et al. (1990), provides a comprehensive model for predicting consumer adoption of electronic commerce (e-commerce) by considering three key dimensions: technology, organization, and environment. Due to its flexibility and context-sensitive nature, the TOE framework has been widely utilized to identify the critical determinants influencing the adoption of innovative technologies across various domains (Amelina et al., 2016; Kuan and Chau, 2001; Mousavi and Demirkan, 2013). Its strong theoretical foundation and extensive empirical validation have established it as a reliable framework in the field of information systems (IS) research (Oliveira and Martins, 2011). Over time, scholars have refined and expanded the framework, further enhancing its applicability and theoretical robustness (Awa et al., 2015).

Despite its strengths, the original TOE framework has certain limitations, particularly in addressing complex adoption behaviors. One key critique is its primary focus on the organizational level, making it less suitable for analyzing technology adoption at the individual level (Wang and Lai, 2014; Yuan et al., 2019). To address this limitation, researchers have suggested integrating individual-level factors to improve the framework's explanatory power (Premkumar, 2003; Yuan et al., 2019). Several studies have demonstrated that individual characteristics, including those of employees, corporate decision-makers, and consumers, significantly influence technology adoption decisions (Ahmadi et al., 2017; Awa et al., 2017; Hueske et al., 2015; Wang and Lai, 2014). Recognizing the importance of individual perceptions in decision-making processes, scholars have progressively incorporated personal-level variables into the TOE model.

Building on this refinement, alternative frameworks have been proposed to better capture individual adoption behaviors. For instance, Jiang et al. (2010) introduced the technological-personal-environmental framework to analyze individual-level technology acceptance. Similarly, Hunafa et al. (2017) applied this model to examine users' intention to adopt mobile payment systems, while Handayani et al. (2017) developed the human-technological-organizational framework to explore the adoption of hospital information systems. These extensions underscore the growing recognition of individual perceptions as a crucial component in understanding technology adoption.

In the context of offline facial recognition payment systems, this study adopts an extended TOE-I framework (Shiau et al., 2023), which integrates the technological, environmental, organizational, and individual dimensions. Within this framework, key perceived factors that shape adoption decisions are identified as salient beliefs. Specifically, convenience reflects users' perceptions of the technological benefits of facial recognition payment, while familiarity is shaped by prior experiences with offline merchants. Social support captures the influence of family, friends or community on adoption, whereas perceived privacy risk represents individual concerns regarding security and data protection. By incorporating these dimensions, this study provides a more nuanced understanding of the factors driving the adoption of facial recognition payment systems in offline settings.

3. THEORETICAL FRAMEWORK AND HYPOTHESES

This chapter presents the theoretical framework grounded in the Belief-Attitude-Intention (B-A-I) model, focusing on the moderating role of technology anxiety between user attitudes and the intention to use facial recognition payment systems. A conceptual model is developed to illustrate the key relationships among constructs, followed by the formulation of hypotheses. Drawing from prior literature, technology anxiety is recognized as a psychological barrier that can diminish users' affective responses and behavioral intentions, particularly among senior citizens facing unfamiliar digital technologies. It is hypothesized that technology anxiety weakens the positive influence of trust and satisfaction on the intention to use offline facial recognition payment systems.

3.1. Theoretical Framework

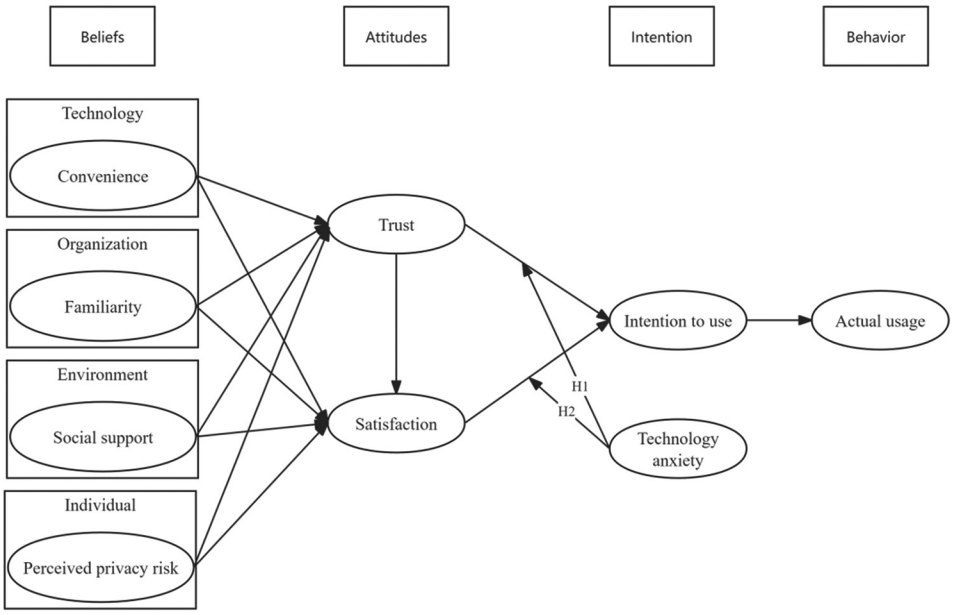
Based on insights from prior literature, this study presents a research framework illustrated in Figure 1. The focal variable is the actual usage, while convenience, familiarity, social support, perceived privacy risk serves as independent variable. Trust, and satisfaction serve as attitudes, both are the following consequences of beliefs, also the antecedents of intention to use, the intention to use serve as the antecedent of actual usage. However, the hypothesized connections are not straightforward; the link between attitudes (trust and satisfaction) and intention to use is moderated by technology anxiety.

3.2. Hypotheses Development

Simonson et al. (1987) defined technology anxiety as an individual's apprehension, or even fear, when she/he is faced with the possibility of using technologies. i.e., whether older adults could accept and smoothly operate and comfortably use innovative technology against negative psychological perception of nervousness, fear, and self-doubt when learning new skills (Jeng et al., 2022). Huang et al. (2022) reported that Mobile technology anxiety would moderate the link between attitude toward mobile learning and mobile learning continuance intention.

Specifically, college students with higher levels of mobile technology anxiety are likely to have a weaker relationship between attitude toward mobile learning and mobile learning continuance intention than those with lower levels of mobile technology anxiety. In the context of mobile shopping, Yang and Forney (2013) indicated that consumers with a high level of technology anxiety rely more on social influence in the use of mobile shopping than consumers with a low level of technology

Figure 1: Research framework



Source: Fishbein and Ajzen (1975)

anxiety. Hence, technology anxiety may also moderate senior citizens intention to use facial recognition payment. On this basis, the following hypotheses are deposited:

H_1. The effect of trust on the intention to use an offline facial recognition payment system is negatively moderated by technology anxiety.

H_2. The effect of satisfaction on the intention to use an offline facial recognition payment system is negatively moderated by technology anxiety.

4. RESEARCH METHODOLOGY

In general, this study is using quantitative methodology for the attainment of research objectives, as quantitative research methodology will provide help in validation of the relationship among the variables of study for generalizability generalizability (Polit and Beck, 2010). Methodology used for validation is includes expert validation and constructs validation. According to Sekaran and Bougie (2016), content validity refers to the agreement among the professionals that the items are designed accurately and adequately measure the variable. Meanwhile, construct validity refers to the degree to which the items have been operationalised consistent with underlying theory.

In this study, content validity and construct validity will be used the expertise opinion (industrial and academic expertise). In detail, the un-structure interview will be applied, by using 5 expertise's in the area of technology anxiety and facial recognition payment which 3 persons for industrial expertise and 4 persons for academia expertise.

4.1. Measurements

In this current work, technology anxiety refers to an individual's feelings of apprehension or fear when confronted with the prospect of using technologies (Simonson et al., 1987). Similar to self-efficacy, technology anxiety pertains to users' overall perceptions regarding the use of technology (Venkatesh, 2000). The researcher selected Hoque and Sorwar (2017)'s 4 - item Technology Anxiety measurements as the final measurement of technology.

Table 2: Items representing technology anxiety adapted from (Hoque and Sorwar, 2017)

No	Items
1	Using FRP services would make me very nervous.
2	Using FRP services would make me worried.
3	Using FRP services may make me feel uncomfortable.
4	Using FRP services may make me feel uneasy and confused.

This can be attributed to its sufficient composite reliability: 0.8990, where the factor loadings of four items span from 0.8118 to 0.8383, along with an average variance extracted (AVE) value of 0.6899, and this measurements' Cronbach's alpha value is 0.8506. The measurement scale is based on a five - point Likert - scale, whereas: 5 = Strongly Agree; 4 = Agree; 3 = Neither Agree nor Disagree (Neutral); 2 = Disagree; 1 = Strongly Disagree. The items are illustrated in Table 2.

4.2. Reliability Test

After confirming the validity of the questionnaire, the researcher then evaluated the internal reliability of the improved instrument utilized in this study. Reliability, according to Kothari (2004), refers to the degree of accuracy and precision exhibited by a measuring process. In order to assess this, the inter-item consistency of all characteristics being examined was carefully examined. The instrument's reliability was evaluated using Cronbach's Alpha coefficient, which is considered outstanding if it surpasses 0.90, good if it is about 0.80, acceptable if it is around 0.70, and dubious if it is about 0.60. Values that fall below 0.60 are considered unsatisfactory and of low quality (Zikmund et al., 2000).

Table 3: Technology anxiety' Cronbach's alpha values

Items	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
TA_1	8.96	14.698	0.893	0.921
TA_2	8.94	14.596	0.857	0.931
TA_3	9.15	14.048	0.850	0.934
TA_4	9.13	13.933	0.876	0.925
Overall scale	-	-	-	0.945

Hence, a total of 101 responses were collected from the participants to evaluate the internal consistency of the refined questionnaire. Using SPSS 27, the measurements of all constructs were analyzed. Table 3 presents a summary of the reliability outcomes, demonstrating satisfactory internal consistency for all constructs examined.

5. DISCUSSION

This chapter presents the key theoretical and practical implications derived from the study's findings. By examining the factors influencing senior citizens' adoption of facial recognition payment (FRP), the study offers valuable insights that contribute to both academic understanding and real-world application. The following sections elaborate on these implications.

5.1. Theoretical Implications

First, this study finds enrichment of theoretical frameworks by integrating the belief-attitude-intention (BAI) and technology-organization-environment-individual (TOE-I) frameworks to explore the psychological mechanisms underlying senior citizens' adoption of FRP. While these frameworks have been widely used in technology adoption studies (Khan et al., 2021; Kwabena et al., 2021; Liu et al., 2022; Sun et al., 2022; Yuan et al., 2019), their application to the context of facial recognition payment, particularly among senior citizens, is limited. By incorporating social support as a key belief within the environmental dimension of the TOE-I framework, this study extends the theoretical boundaries of the model. Additionally, technology anxiety as a moderator between attitudes (trust and satisfaction) and intention to use FRP addresses a critical gap in the literature on facial recognition payment adoption. This study thus provides a more nuanced understanding of how situational and psychological factors interact to influence technology adoption among older adults.

Second, this research also has contribution to the literature on technology anxiety: While technology anxiety has been studied in many contexts (Jeng et al., 2022; Li, 2024; Man et al., 2024; Ngafeeson et al., 2024), its role as a moderator in the adoption of biometric payment systems, particularly among senior citizens, has not been thoroughly examined. This study contributes to the literature by demonstrating how technology anxiety influences the relationship between trust, satisfaction, and intention to use FRP. By doing so, it provides a deeper understanding of the barriers that senior citizens face when adopting advanced technologies, thereby enriching the theoretical research on technology anxiety and its impact on behavioral intentions.

5.2. Practical Implications

Firstly, this study can be guidance for policymakers and government agencies who promoting digital inclusion among senior citizens. By identifying the key factors that influence older adults' adoption of FRP, this research can inform the development of targeted policies and initiatives aimed at reducing the digital divide. For example, the study's findings could be used to design training programs that address technology anxiety and improve seniors' familiarity with facial recognition payment systems. Additionally, the results could guide the implementation of regulatory measures to enhance the security and privacy of biometric payment systems, thereby increasing trust and satisfaction among older users.

Secondly, this research provides implications for financial institutions and retailers. As senior citizens represent a substantial consumer base with considerable financial resources (Lee and Coughlin, 2015), understanding the factors that influence their adoption of FRP can help businesses tailor their strategies to better serve this demographic group. For instance, the study's findings could inform the design of user-friendly FRP systems that minimize technology anxiety and maximize convenience for older adults. Retailers could also use the insights from this research to create marketing campaigns that emphasize the convenience and security of FRP, thereby encouraging greater adoption among senior citizens.

6. CONCLUSION

This study explored the moderating role of technology anxiety (TA) in the relationship between attitudes (trust and satisfaction) and the intention to use facial recognition payment (FRP) among senior citizens in Tangshan, China. By integrating the Belief-Attitude-Intention (B-A-I) framework and the extended Technology-Organization-Environment-Individual (TOE-I) framework, the research provided a comprehensive understanding of the psychological and situational factors influencing FRP adoption among older adults. The findings revealed that technology anxiety significantly moderates the relationship between trust, satisfaction, and intention to use FRP, highlighting its role as a critical barrier to adoption for this demographic.

The theoretical contributions of this study are twofold. First, it enriched existing frameworks by incorporating technology anxiety as a moderator, addressing a gap in the literature on biometric payment systems. Second, it extended the application of the TOE-I framework to individual-level adoption, particularly for senior citizens, by emphasizing the interplay between emotional states and behavioral outcomes. These insights offer a nuanced

perspective on how psychological barriers, such as TA, can disrupt the cognitive pathways leading to technology adoption.

Practically, the findings provide actionable implications for policymakers, financial institutions, and retailers. For policymakers, the study underscores the need for targeted digital literacy programs, such as Tangshan's "Digital Elderly Assistance" initiative, to mitigate technology anxiety and promote inclusive digital payment systems. Financial institutions and retailers can leverage these insights to design user-friendly FRP interfaces and marketing strategies that emphasize security and convenience, thereby fostering trust and satisfaction among senior users.

Despite its contributions, this study has limitations. The focus on Tangshan may limit the generalizability of the findings to other regions with different socioeconomic or technological contexts. Future research could expand the geographical scope and incorporate longitudinal data to assess the long-term effects of interventions aimed at reducing technology anxiety. Additionally, exploring the role of other moderators, such as social support or cultural factors, could further enhance the understanding of FRP adoption among diverse elderly populations.

In conclusion, this study advances the theoretical and practical discourse on technology adoption by elucidating the critical role of technology anxiety in shaping senior citizens' behavioral intentions. By addressing these barriers, stakeholders can facilitate the transition toward a cashless society while ensuring inclusivity for all age groups.

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