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Faculty of Business Economics

Master of Management

Master's thesis

An ageing population and quality of service

Antun Glumac

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization International Marketing Strategy

SUPERVISOR :
Prof. dr. Allard VAN RIEL

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1. Introduction

1.1 Business Economic Motivation

The rapid and widespread adoption of smartphones since their relatively recent introduction in the early 1990s can be attributed to a number of factors, including increasingly powerful hardware, innovative internet technologies, and sophisticated software and e-commerce platforms. As a result of these factors, and the smartphone's revolutionary impact on human interactions, both demand and adoption rates have grown exponentially, with an estimated 6.38 billion users projected globally by 2029 (Ash Turner, 2025). The increasing number of smartphone users makes mobile banking an increasingly important sales channel for financial institutions, but not all demographic groups might have an equal adoption rate.

It is not possible to give a single definition of "Older adults" that could be applied consistently and be useful in all contexts. Age can be defined biologically, socially, economically, or chronologically. The World Health Organization, in its technical report series, defined old age as starting chronologically at 60 years old, with the "old" old age starting at 80. (World Health Organization, 1989). At the beginning of 2024, there were about 2.3 million people aged 65 years or older in Belgium. This age group now makes up nearly 20% of the population, and the Belgian Federal Planning Bureau expects this share to exceed 25% by 2050 (Study Committee on Ageing, Yearly Report, 2025).

Elderly individuals are increasing as a share of the population, but are also increasingly economically important. Elderly individuals have lower income rates since most of them are retired. The replacement rate of income for Belgian pensioners is 55.7% (Dewilde & Raeymaeckers, 2008). Relative to other EU countries, the Belgian pension system is not particularly generous, but Belgian elderly have high outright home ownership rates at 74.2% and are thus income-poor but asset-rich, as both studies situate the explanation for this paradox in the level of assets, both financial and in terms of real estate, built up over the life course (De Decker & Dewilde, 2010).

According to the World Bank, the number of bank branches in Belgium has fallen from 57 branches per 100.000 people in 2004 to 26 per 100.000 in 2020 (World Bank, 2021). Competition and increasing costs are placing pressure on banks to reduce their brick-and-mortar footprint in order to stay competitive. The popularity of online banking is filling the gap that is left by the shrinking retail footprint. According to Febelfin (Febelfin, 2025), mobile banking subscriptions have grown from 1 million in 2013 to 12.9 million in 2023. The number of bank branches has fallen from 7138 to 3243 in the same period.

In the UK, only 49% of people aged 65 and older used online banking in 2020, while over 65% of people in other age groups were online banking users. Individuals older than 65 are beginning to segregate from younger age groups due to the accumulation of technological services. Hence, it is

vital to bridge this gap through effective interventions that would assist older people with digital financial services. A study done by Thomas et al. concluded that fear, lack of experience/knowledge, and interface issues were the main factors that act as barriers to older people's use of online financial services. Also, hidden costs such as time, effort, and money were revealed, corroborating that older people are losing many benefits from not using these services (Thomas et al., 2024).

Health problems, disabilities, and handicaps can prevent older adults from fully participating in work, school, housework, and other activities. These challenges can also create difficulties in using or manipulating technological devices. Research indicates that 28% of U.S. adults 65 and older report such limitations. Furthermore, seniors with disabilities are less likely to use digital assets like the internet, smartphones, and tablets compared to those without disabilities (Anderson & Perrin, 2017).

A study by Salam et al. showed that quality has a positive effect on mobile banking adoption. In the study of Croatian mobile banking users, the oldest age group was least demanding regarding the quality of the service (Orehovački et al., 2022). Given that this study did not find the lack of quality to be the reason for lower adoption, it is possible that other drivers and barriers play a role in mobile banking adoption. Lower usage of online banking by elderly individuals and their increasing economic importance require further research into evaluating their perceived value of mobile banking and factors restricting their usage.

1.2 Academic Motivation

Most past research investigating technology adoption regarding the use of mobile banking uses the Technology Acceptance Model(TAM) or Unified Theory of Acceptance(UTAUT), which primarily focuses on drivers of technology adoption instead of barriers that influence use. Unified Theory of Acceptance 2 (UTAUT2) was later developed, including more variables predicting technology use. These models were developed to model user attitudes toward technology. There is plenty of research on mobile banking adoption, while research on mobile banking adoption with a focus on the senior population is limited (Msweli & Mawela, 2020). Prior studies show that there is indeed low adoption of mobile banking among older consumers (Chaouali & Souiden, 2018; Msweli & Mawela, 2020). This research endeavors to rectify this by expanding a theoretical framework of technological acceptance, specifically focusing on the use of mobile banking among older individuals.

This research will look into two psychological barriers: 'Financial risk' (FR) and 'Tradition' (TR), and one physical barrier: 'Impaired vision' (IV). Financial risk can be described as the perceived possibility of incurring financial damages as a result of using a technology. Impaired vision can be defined as the state of an individual's ability to use their vision in order to perform daily tasks. The tradition barrier comes into play when an innovation is incompatible with an individual's existing values, past experience, and social norms (Ram & Sheth, 1989). Consumers can have habits that may be very

important to them, such as frequent use of a product or service over a long period, which might affect the adoption of substitute technology.

Consumers often experience doubts about innovation adoption in the form of risk. Perceived risks of fraud or propensity to make a large mistake might hinder the use of new technologies. The impaired vision of the elderly could affect their ability to interact with mobile devices and, therefore, affect adoption. Those in better physical condition may find mobile use more convenient and are more likely to use it more frequently. A paper studying the adoption of smart elderly care products found that older age individuals in better physical condition have a higher actual adoption of wearable technology (Qin & Li, 2024).

This study will test whether 'Cognitive age' (CA) moderates the effects that barriers have on the attitudes towards the technology of mobile banking. Chronological age is calculated based on the year of birth and is traditionally used for market segmentation. This approach routinely associates older people with negative clichés and lowers their ability to understand the market. Some researchers have begun to recognize that cognitive age, which refers to any self-perceived age other than the birth age, is a more authentic reflection of an individual's values and a better predictor of their consumption intentions and behaviors. Previous research has shown that there are differences between cognitively young (who feel younger than their age) and cognitively old (who feel older than their age) consumers in the intentions to use mobile banking (Chaouali & Souiden, 2018, p. 2).

1.3 Problem statement

Given that older consumers have lower rates of adoption of mobile banking technology, this research paper will attempt to find factors that contribute to that phenomenon. Three possible barriers have been chosen: 'Financial risk', 'Impaired vision', and 'Tradition'. This research will also test whether cognitive age serves as a moderator between the barriers and attitudes towards the use of mobile banking.

This paper tries to answer the following research question: To what extent do barriers affect the attitude towards adoption of mobile banking among older adults (50+) when analyzed using the UTAUT2 model?

RQ1: To what extent does financial risk negatively influence older consumers' attitudes towards adopting mobile banking applications, and does cognitive age moderate this relationship among users?

RQ2: To what extent does tradition negatively influence older consumers' attitudes towards adopting mobile banking applications, and does cognitive age moderate this relationship among users?

RQ3: To what extent does impaired vision negatively influence older consumers' attitudes towards adopting mobile banking applications, and does cognitive age moderate this relationship among users?

1.4 Contribution

This master's thesis contributes to the field of technology acceptance research by focusing on the under-researched area of barriers to mobile banking adoption among older adults. It expands the theoretical framework by incorporating physical barriers, specifically impaired vision, which is under-researched, alongside psychological barriers like financial risk and tradition, which are less explored in existing literature that usually focuses on factors of adoption rather than barriers. By examining these factors using the modified UTAUT2 model, this thesis will offer insights for financial companies aiming to enhance the accessibility of mobile banking services for older individuals.

1.5 Approach

The research will employ a quantitative approach, collecting data with a survey and applying statistical methods in order to test the hypothesis. The literature review will extensively examine existing research on the adoption of mobile banking and similar technologies that are relevant. Several technology acceptance models, such as the TAM, UTAUT, and UTAUT2, while focusing on the barriers that might prevent older consumers from adopting of technology. The quantitative phase will involve designing a structured questionnaire measuring responses that form constructs on the basis of the UTAUT2 model and the identified barriers, targeting individuals aged 50 and older. The collected data will be analyzed using descriptive statistics and linear regression related to UTAUT2 constructs.

There have been further expansions of the UTAUT2 model since its inception in 2012, with some of them naming themselves Unified Theory of Acceptance 3 (UTAUT3). The first expansion of the model, generally considered UTAUT3, was made in 2017 by adding personal innovativeness as a construct in the model (Farooq et al., 2017). Some other constructs were added to UTAUT3 versions of the model: behavior to adopt and recommend (Bhatnagr & Rajesh, 2024), technological anxiety (Ngusie et al., 2024). The UTAUT3 model is not formally published by the UTAUT (Venkatesh et al., 2003) or UTAUT2 (Venkatesh et al., 2012) authors. This master's thesis expands upon the UTAUT2 model by adding three additional constructs; it does not expand upon a version of UTAUT3 in order to limit the number of constructs. The model in this master's thesis already uses ten constructs; expanding that number further introduces issues with multicollinearity and increases the required sample size, while not contributing to providing an answer to the research question.

2. Literature review

This literature review has the goal to analyze and evaluate academic literature on Mobile banking and its acceptance among older individuals, with an emphasis on barriers to adoption of the technology, while focusing on the most recent research on the topic. The literature review will also show the challenges to the acceptance of innovation, as well as the barriers that have influenced its adoption.

As the mobile economy becomes more significant, the fundamental cause of the old age consumer's scepticism with regard to Mobile banking barriers to adoption remains mostly unexplored. The organisation of this literature review is as follows. Firstly, an overview of numerous models for technology adoption will be explored, following the past relevant research using the following models.

A systematic literature review of the Barriers and motivations of older adults in digital banking adoption, covering studies from January 2019 to June 2024 (Dizon & Ebardo, 2025), has found that previous research on the topic uses a number of technology adoption theories. The UTAUT appeared in five articles, the TAM was cited in three articles, while the Innovation Resistance Model was referenced in one article. This literature review corroborates the fact that research on the adoption barriers is not well-researched.

Mobile banking is of growing interest to financial professionals and researchers, as shown in the literature review by Souiden et al. (2021). Based on 76 selected studies published between 2005 and 2019, found that TAM and the UTAUT model were most used to research mobile banking adoption. The study breaks down research papers into those that have an attributes-based perspective, customer-based perspective, social influence-based perspective, trust-based perspective, and barriers-based perspective. Attributes-based was the most common approach, while barriers-based was the least common. One study on mobile banking defines potential barriers as: usage barrier (which "occurs when an innovation is incongruent with existing workflows, practices, or habits), value barrier (which "derives from an innovation's performance and monetary value compared to alternatives"), risk barrier (which is "the degree of risk inherent in an innovation"), tradition barrier (which "comes into play when an innovation is incompatible with an individual's existing values and past experience, as well as social norms"), and image barrier (which is about the "negative image of the innovation") (Laukkanen, 2016, p. 2433).

This master's thesis addresses the research gap by contributing to technology acceptance barrier research, focusing on the older population and a specific technology of mobile banking. Another barrier that is not well researched in the literature of technology adoption is physical barriers. Medical issues like bad eyesight, especially among the older population, could have an impact as a barrier to the adoption of technology such as mobile banking.

2.1 Technology Acceptance Model

Developed by Fred Davis in 1986, TAM is based on the Theory of Reasoned Action (Ajzen, 1985). and is designed to predict user behavior based on their attitudes toward technology. This model has been one of the most widely applied models of technology acceptance in information systems. According to the model, the two primary factors influencing an individual's intention to use new technology are perceived ease of use and perceived usefulness. The model reasons that in order to increase the use

of the technology, acceptance has to be achieved first. This could be measured by asking individuals about their future intentions to use a specific technology. The TAM model is based on the Theory of Reasoned Action and some constructs from the Theory of Planned Behavior (Ajzen et al., 1980). The TAM has been tested numerous times, and it has been applied to various technologies. This is a general model that tries to explain the factors that influence technology acceptance. Several limitations of the TAM model have been proposed. The model primarily focuses on individual-level factors, while other factors, like organisational support, social influence, and external barriers, are not part of the model (Legris et al., 2003).

A study predicting older adults' mobile payment adoption among old age individuals in Taiwan (Yang et al., 2023) used a modified TAM model, advancing it by adding theory of reasoned action, the diffusion of innovations, trust, and five aspects of perceived risk, to measure the factors that influence the behavioral intentions of older adults to use mobile payments. The study argues that most consumer barriers to using Mobile payments include a lack of trust and security, the complexity of the system, and the habit of paying in cash. The number of factors that affect the use of Mobile payment services among older adults, including functional aspects (e.g., perceived complexity, perceived incompatibility, and perceived cost), psychological aspects (e.g., lack of trust and technology anxiety), and risks (i.e., privacy risks, security risks, financial risks, and functional risks).

This study found that Performance and Financial risk have an effect on Trust, while Time, Privacy, and Psychological risks do not. Trust is also found to have a positive effect on the perceived ease of use and usefulness. Attitude was found to be an important influence on the Behavioral intention to use the technology. This study suggests that for older adults to have a higher level of trust in mobile payment, it is essential to ensure that service functions have the intended benefits and that the Financial losses incurred are reduced. This research is relevant for this Master's thesis because it shows that Financial risk has an effect on trust, which has an impact on the adoption of mobile payment among old age individuals, and that could also be a barrier towards the attitude of mobile banking, which is a different but similar financial product.

A Senior Technology Acceptance Model(STAM) is a modified version of TAM that was developed to specifically study technology acceptance among older individuals (Chen & Chan, 2014). The STAM builds upon the TAM. It significantly extends TAM by incorporating age-related characteristics that are particularly relevant to older adults' interaction with technology. These new constructs include health and ability characteristics, which encompass self-reported health conditions, cognitive ability, physical functioning (e.g., dexterity, vision, hearing), and social relationships. The idea is that declining physical and cognitive abilities, common in older age, directly impact technology usage. Gerontechnology Self-Efficacy: An older adult's belief in their own ability to successfully use gerontechnology. Gerontechnology Anxiety: The apprehension or discomfort an older adult feels when faced with the prospect of using gerontechnology. Facilitating Conditions: The objective environmental

factors that support or hinder the use of gerontechnology (e.g., availability of help, accessibility, financial resources, social influence). Gerontechnology can be defined as an interdisciplinary field linking existing and developing technologies to support "successful aging" and is a response to the aging of society and rapidly emerging new technologies (van Bronswijk et al., 2009).

The study found that the data strongly supported the proposed STAM and could explain a significant amount (around 68%) of the variance in the use of gerontechnology by older Hong Kong Chinese. This indicates its effectiveness in predicting acceptance. Crucially, the study highlighted that the newly added age-related characteristics were often better and stronger predictors of gerontechnology usage behavior than the conventional attitudinal factors like perceived usefulness and perceived ease of use. Gerontechnology Self-Efficacy and Gerontechnology Anxiety were particularly influential. Higher self-efficacy and lower anxiety led to greater acceptance. Health and Ability Characteristics (e.g., better health, cognitive ability, physical functioning) directly and positively impacted technology acceptance. Facilitating Conditions also played a direct and significant role, emphasizing the importance of support systems and accessible environments (Chen & Chan, 2014). This research is relevant for this master's thesis because it showed that self-reported health conditions, which include vision, have an effect on perceived usefulness and perceived ease of use, and therefore attitude towards use. This research used 16 different gerontechnology products and general services, while this thesis will focus on a specific consumer technology, mobile banking.

2.2 Unified Theory of Acceptance and Use of Technology

The Unified Theory of Acceptance and Use of Technology model is the extension of the TAM model (Venkatesh et al., 2003), and it is the most recent model that concerns technology acceptance behavior. It was developed by integrating constructs from eight prominent Information systems models. These models are: the Theory of Reasoned Action, the Technology Acceptance Model, the Theory of Planned Behavior, the Decomposed Theory of Planned Behavior, the Social Cognitive Theory, the Model of Personal Computer Utilization, the Motivational Model, and the Innovation Diffusion Theory. Various researchers have suggested that the UTAUT model provides a better understanding of technology adoption than other similar theories do. Four determinants are used to determine user behavioral intention (BI) to use a technology: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003).

A study in India tested perceived risk and trust influence on the adoption of mobile banking among younger Indian users using the UTAUT model (Kumar et al., 2023). Perceived risk and perceived trust were tested as variables affecting actual use and as moderating variables influencing the relationship between behavioral intention and actual use. The study used structural equation modelling in Amos, version 20.0, which performs Covariance-Based Structural Equation Modeling. Perceived risk was not

found to have an effect on actual use, while it did moderate the relationship between behavioral intention and actual use.

This study was performed on subjects between the ages of 19 and 30, which could explain why risk did not have an impact on the actual use of technology, such as mobile payment. Also, having perceived risk as a general variable instead of focusing on a specific form of risk might be a reason for the lack of influence on actual use. Perceived risk, having a moderating effect on behavioral intention, explains why a low level of risk corresponds to a high level of use of mobile banking, while a high level of risk results in a low actual use level. Therefore, the results indicated that despite perceived risk having no direct effect on the actual use, it negatively moderates the effect of behavioral intention. This master's thesis will test a subset of perceived risk, financial risk as a barrier to attitude towards mobile banking adoption amongst older consumers, expanding this study.

A pilot study titled "Developing a Model for Mobile Payment Adoption among Senior Citizens In Malaysia, a modified UTAUT model was used to explain drivers and barriers to the use of mobile payments among older consumers (Razali et al., 2024). Alongside usual UTAUT constructs, the study used perceived physical condition and technological anxiety as influences on behavioral intention and digital skills as an influence on effort expectancy and performance expectancy. The relationship between perceived physical condition and behavioral intention was found to have a weak path coefficient. This is relevant because this master's thesis will look at the subset of perceived physical condition, perceived visual impairment, and test whether it serves as a barrier to mobile banking adoption. Also, this pilot study was performed on a sample of only 30 subjects, which lowers the model's predictive validity.

An article studying mobile payment adoption in China researched the impact of mobile payment adoption on consumer behavior and transaction frequency (Xu et al., 2024). The study used the UTAUT model, where improved effort expectancy, social influence, and facilitating conditions have a positive impact on increasing the likelihood of technology use among consumers. When effort expectancy was examined among different age groups, there were differences in overall credit card transaction activities and activities through the offline and online channels. Participants were divided into four age groups: Millennials (1981 - 1996), Gen X (1965 - 1980), Boomers II (1955 - 1964), and Boomers I (1946 - 1954). Results of the study indicate that effort expectancy has an effect on mobile payment on overall credit card transaction activities, and activities through the offline and online channels are more significant for Millennials, Gen X, and Boomers II, who are the three youngest generations. However, these effects are generally not significant for Boomers I. This finding suggests that bank managers should prioritize facilitating the use of mobile payments among the older generation.(Xu et al., 2024, p. 30) This study is relevant because it points out that there are differences in age groups and their adoption of mobile payment solutions. This master's thesis will investigate the causes of the lower adoption.

2.3 Unified Theory of Acceptance and Use of Technology 2

In order to address deficiencies in the UTAUT model, Venkatesh et al. (2012) developed an enhanced version of UTAUT that involves three new elements: price value, hedonic motivation, and habit, each of which has a significant influence on the behavioral intention of users. The price that influences the choice of a new technology is referred to as price value. Habit describes the habitual behavior of the user with new technologies.

UTAUT2 was developed with the aim of understanding and predicting individuals' acceptance and use of technology. UTAUT2 has been widely used in various studies to examine the adoption and usage of different technologies. Therefore, this master's thesis will use UTAUT2 to investigate the primary factors influencing the attitude and behavioral intention to use mobile banking among older individuals.

A study examining mobile shopping behavior among older adults in China (Huang, 2023) used the UTAUT2 model while modifying a model by adding Utilitarianism, Anxiety, and Trust as variables influencing technology use intention.

All of the variables in the model had an effect on the Mobile shopping intention, with the exception of hedonic motivation and price value. Effort expectancy and Habit had the largest effect on the intention. Anxiety was the only barrier to usage to be tested, and it was found to have a negative effect on the Mobile shopping intention. This study establishes previous findings that the UTAUT2 model can be used to study technology adoption and applies it to older age customers, while extending the original model. This study is relevant for this master's thesis because it shows that the UTAUT2 model can be used to study technology adoption among older individuals in the context of a technology that is similar to mobile banking. Among several drivers of technology adoption, only one barrier, Anxiety, is measured as a part of this study, and this master's thesis will seek to expand on further barriers.

Another study expanded the UTAUT2 model in the context of mobile banking by including Security, Risk, and Trust as variables influencing intention to use mobile banking (Apau et al., 2025). This paper provides a more comprehensive framework for understanding the factors that influence the adoption and use of mobile banking services. Security, risk, and trust factors have been integrated into an existing UTAUT2 framework to enhance understanding of mobile banking adoption and use.

Another study leveraging the UTAUT2 model investigated intention to use e-commerce vs physical shopping in Portugal and Spain while testing numerous barriers to e-commerce adoptions, such as: Privacy, Switching costs, Perceived risk, and Technological fear (Higueras-Castillo et al., 2023). There

were differences in both adoption drivers and barriers between countries. Habit, trust, and effort expectancy were drivers in e-commerce adoption in Spain, while rust, facilitation conditions, and social influence and habit were drivers in Portugal. Regarding barriers, switching costs and perceived risk were hindering e-commerce adoption in Spain, while privacy and technophobia had an effect in Portugal. This study is relevant for this master's thesis because it identifies switching costs and perceived risk as the largest barriers to the adoption of digital technology, while showing that both drivers and barriers to adoption can vary between different populations. This master's thesis will look at barriers closely related to switching costs and perceived risk, that is ’Tradition’ and ’Financial risk’.

2.4 Innovation Resistance Theory (IRT)

Innovation Resistance Theory (IRT) was proposed in 1987 to explain why users do not adopt certain technologies (Ram, 1987). According to the model, there are two categories of barriers: functional barriers, for example, usage, value, and risk, and psychological barriers, for instance, tradition and image. The functional barrier is a type of barrier that consumers can experience when there is a change due to the usage of a new product or innovation. Psychological barriers are experienced when there is a conflict between existing values and behaviours and technological acceptance (Ram & Sheth, 1989).

Consumer adoption versus rejection decisions in seemingly similar service innovations (Laukkanen, 2016) was one of the first studies to apply IRT in the context of mobile banking. The study investigated five adoption barriers: usage, value, risk, tradition, and image. Also, three consumer demographics: gender, age, and income. Consumers were examined in three different categories: "non-adopters," "postponers," and "rejecters.” The results showed that the value barrier is the greatest impediment to mobile banking adoption, followed by the image barrier. Both gender and age significantly affect mobile banking adoption. The result of the study found that the odds of the youngest segment adopting mobile banking are 1.85 times greater than the odds of the mature segment adopting the service.

This study established that Innovation resistance theory can be applied in the context of mobile banking and that age has a significant effect on the adoption of this particular technology. However, the study does not answer why older individuals might be less likely to adopt this technology. A crucial takeaway from this study is that even innovations that appear similar on the surface, like the Internet and mobile banking, can face different sets of resistance factors. This highlights the importance of understanding the specific barriers relevant to each specific innovation. This master's thesis will further build on this research by incorporating two barriers from this research: Financial risk, that is a subset of risk, and Tradition, while adding another barrier: Impaired vision, while focusing on older consumers as a specific group.

Another study conducted in France (Chaouali & Souiden, 2018) investigated mobile banking resistance among older individuals, more specifically, on the basis of cognitive age as a moderator. This is one of the few studies focusing on technology barriers in the context of mobile banking among older age consumers. A multigroup analysis was conducted to compare the relationships between psychological and functional barriers. Subjects were divided into two groups, cognitively old (who feel older than their age) and cognitively young (who feel younger than their age), and compared the relationship between psychological barriers: tradition and image, and functional barriers: usage, value, and risk. The study's model suggests that cognitive age moderates the interrelationships between psychological and functional barriers as well as the effects of such barriers on mobile banking resistance. The strength of such a relationship increases as cognitive age increases.

The results of the study revealed significant variations in the group-specific path coefficients between cognitively old and cognitively young old age individuals. There were significant differences between these two groups. Such effects are stronger for those who are cognitively older. The results confirm the influence of tradition, image, usage, value, and risk barriers on consumer resistance as assumed in the innovation resistance literature. These results are consistent with previous findings on the effects of psychological barriers on functional barriers. Cognitive age was found to have a moderating effect on these relationships.

The results corroborate assumptions and empirical studies in the innovation resistance literature (Laukkanen, 2016) by providing strong additional evidence of the direct effects of all barriers on mobile banking resistance. This study further augments the resistance literature by exploring the effects of psychological barriers on functional barriers.

Another study, in the context of mobile payment technology acceptance among older individuals, expanded the IRT model by adding risk barriers alongside functional and psychological barriers. Privacy, Security, Financial, and Operational risk were added to the model and their effect on resistance to adoption of mobile payments. Stickiness to cash was used as a moderating variable between Resistance, Attitude towards mobile payments, and non-adoption intentions (Cham et al., 2022)

A study has found that all of the barriers contribute to the resistance to mobile payment technology. This study has also uncovered a significant impact of psychological barriers on the elderly’s resistance to mobile payments. Sticking to cash was also found to be a significant moderator in moderating relationships between variables. This research is relevant because it proves that there are several barriers to the adoption of technology similar to mobile banking among older consumers, including financial risk. This master's thesis will incorporate financial risk into the UTAUT2 model and test its impact in the context of mobile banking.

A study investigating how minor physical inconveniences can encourage the adoption of digital banking services and associated financial technologies found that customers affected by ATM closures, even if the nearest alternative ATM is only a short distance away (e.g., 100 meters), increase their usage of the bank's digital platform, including an increase in both the number and dollar amount of digital transactions (Choi & Loh, 2024). Changing customer behavior is used as a justification for downsizing physical branches. This study provides evidence that the causality can also run in the opposite direction: reducing physical access can actively encourage customers to adopt digital banking.

Study participants were split into three different groups regarding age: the first tercile with an average age of 26, the second tercile with an average age of 40, and the third tercile with an average age of 58. The study found that the increase in the number and the dollar amount of digital transactions as a result of the distance friction was the largest among the youngest group, followed by the middle group. The oldest group also shows an increase in digital transactions, but the effects are weaker compared to the two other younger groups. These results show that the small changes towards digital banking are more effective for the younger age groups compared to the older age groups. These findings are relevant for this master's thesis because they suggest the existence of age-related barriers that hinder the adoption of digital banking, and this research will try to specify the barriers with the most influence.

2.5 Research hypotheses

Hypotheses that are tested in this research paper are as follows.

Financial risk barrier relates to the level of financial risks a new technology entails because uncertainty is inherent in innovations, so there must be at least some level of perceived financial risk. Generally, risks may be categorized into functional, physical, economic, and social risks (Ram & Sheth, 1989). In the case of mobile banking, there may be some financial risks, as there are possibilities of making a mistake and security threats like having your account stolen. Older age individuals might have higher sensitivity to risk, which lowers their mobile banking adoption.
H1. Financial risk will negatively influence the attitude toward adopting mobile banking.
H1a. Cognitive age moderates the relationship between Financial risk and Attitude to adopt mobile banking, such that the effect would be stronger for cognitively older adults.

Traditional barriers to embracing new technologies stem from consumers' social norms and family and societal values. Regarding mobile banking, these barriers can arise if conducting transactions through this method deviates from consumers' established payment habits. Specifically, individuals accustomed to paying with cash may simply prefer this familiar approach over using mobile devices (Laukkanen, 2007). Older age individuals might have longer developed habits that limit their use of newer technology like mobile banking.

H2. Tradition will negatively influence the attitude toward adopting mobile banking.
H2a. Cognitive age moderates the relationship between tradition and attitude to adopt mobile banking, such that the effect would be stronger for cognitively older adults.

Deteriorating physical conditions, which include impaired vision that results from older age, might have an impact on the use of newer technology. One study cited in the literature review shows that lower physical condition among older adults had an effect on the acceptance of mobile payments by technology (Razali et al., 2024). Lower levels of vision and other senses as a result of aging might have a negative impact on technology adoption in the context of mobile banking among the older population.
H3. Impaired vision will negatively influence the attitude toward adopting mobile banking.
H3a. Cognitive age moderates the relationship between impaired vision and attitude to adopt mobile banking, such that the effect would be stronger for cognitively older adults.

2.6 Conceptual model

In this part, the conceptual model for this research will be presented. The modified UTAUT2 model will be used in this research. As described in the literature review, it is the most used model when it comes to studying the drivers of technology adoption, and it's the most comprehensive model. Previous research has shown that the UTAUT2 model can explain technology adoption, including mobile banking. This thesis will expand this model by adding barriers to adoption and then testing their impact on attitude towards mobile banking. Alongside the usual UTAUT2 constructs, three new constructs will be added: Physical condition, Tradition, and Financial risk. Financial risk and tradition have already been tested, as presented in the literature review, although no research exists on the use of these barriers in the specific context of mobile banking among elderly individuals using the UTAUT2 model. Additionally, a new barrier called impaired vision will be incorporated in order to test whether age-related physical deterioration has an effect on mobile banking adoption.

Instead of Behavioral intention, Attitude towards the use of mobile banking will be measured, cause of this is due to the sample size and scope of this master's thesis. Three additional constructs will be moderated for cognitive age in order to test if it is a moderating influence. The goal of this conceptual model is to attempt to give a practical answer to what barriers have an impact on mobile banking adoption, so a practical suggestion can be given to increase the usage of mobile banking among older consumers.

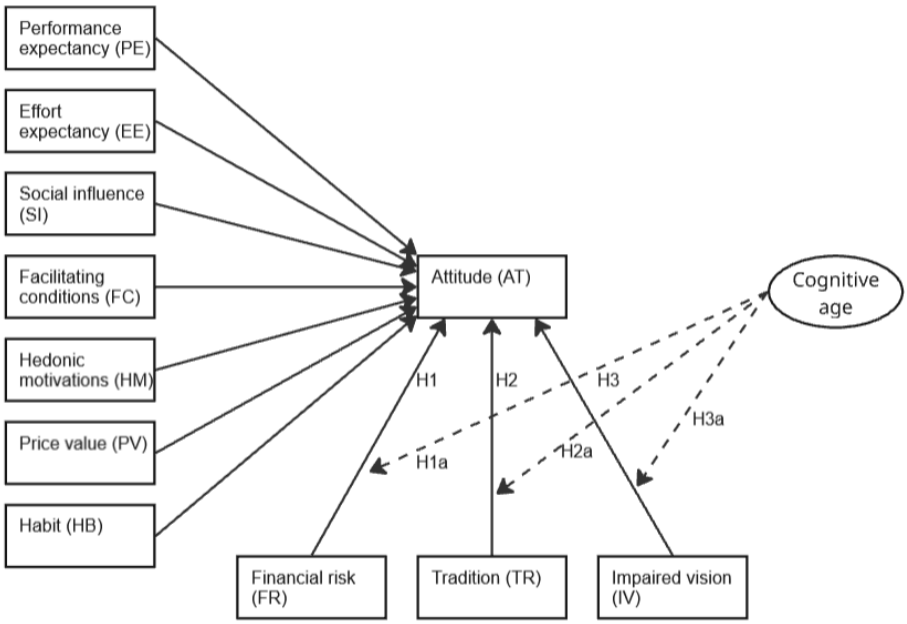

Figure 1 Conceptual model, Source: Author

3. Research design

3.1 Introduction

This chapter outlines the research design approach employed to address the research objectives and test the proposed hypotheses. A quantitative research design is used to test the hypothesis. This approach will allow for the collection of numerical data via a questionnaire from a representative sample, enabling statistical analysis to identify significant relationships.

This research is quantitative in nature, whose aim is to establish a cause-and-effect relationship between two or more variables, and this was done with the use of a questionnaire that was based on two brands and three brand extensions distributed to different participants.

The regression model will have "Attitude" as the dependent variable, while "Performance expectancy", "Effort Expectancy", "Social Influence", "Facilitating Conditions", "Hedonic Motivation", "Price Value", "Habit", "Financial Risk", "Tradition" and "Impaired vision" are the independent variables. "Financial Risk" x "Cognitive age," "Financial Risk" x "Cognitive age," and "Financial Risk" x "Cognitive age" are interaction terms moderating the relationship between dependent and independent variables.

The regression model is used to determine the relationship between the dependent variable and the independent variables. Moderating variables that influence the relationship between dependent and independent variables are present.

$$Y(AT)=\alpha+\beta1(PE)+\beta2(EE)+\beta3(SI)+\beta4(FC)+\beta5(HM)+\beta6(PV)+\beta7(PV)+\beta8(FR)+\beta9(TR)+\beta10(IV)+\beta11(FR*CA)+\beta12(TR*CA)+\beta13(IV*CA)+\epsilon$$

Where;

AT - Attitude

PE - Performance expectancy

EE - Effort expectancy

SI-Social Influence

FC- Facilitating Conditions

HM- Hedonic Motivation

PV - Price Value

HB -Habit

FR - Financial Risk

TR - Tradition

IV - Impaired Vision

CA - Cognitive Age

ε - Error term

3.2 Sampling

This study uses a random sampling approach by using two different avenues. One way of collecting data was through the Prolific platform, which is used to collect data for research purposes, and was done in the United Kingdom. Another data collection avenue was used by the researcher, using social media and a convenience sample. The convenience sampling method will be utilized due to the practical constraints, cost efficiency, and time limitations. This approach is used since it is expected that Prolific users have above-average digital skills for their age group, which reduces the sample's representativeness relative to the general population. Participants are aged 50 or older. This age cutoff was chosen so that age can be used as a moderator in a relationship and so that different age groups could be compared. While convenience sampling offers practicality, its generalizability to the entire population may be limited, and this will be acknowledged in the limitations section.

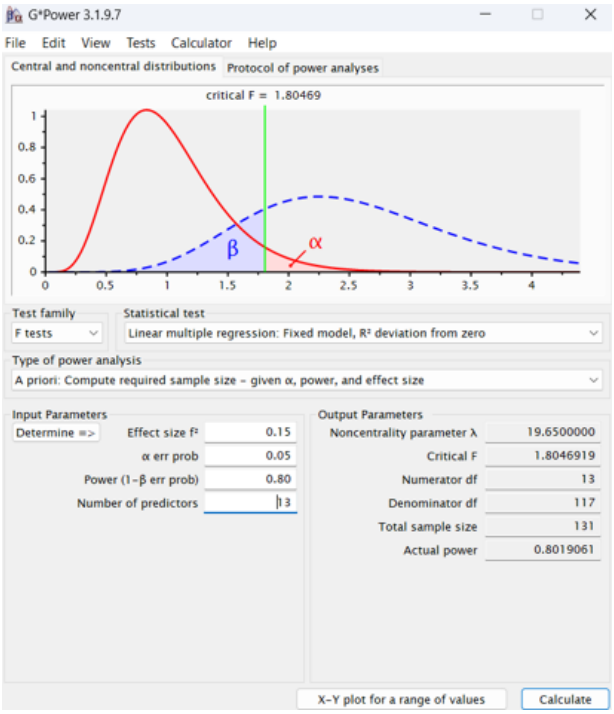

Figure 2 G-Power screenshot, Source: Autor

The G Power software program has been used in order to determine a minimum sample size. According to G Power analysis, at the confidence level of 95%, the minimum sample size is 131 with a statistical power of 0.80, margin error of 0.05%, effect size of 0.15, and the number of predictors is thirteen: Performance expectancy, Effort expectancy, Social influence, Facilitating conditions, Hedonic motivations, Price value, Habit, Financial risk, Tradition and Impaired vision, Financial riskXCognitive age, TraditionXCognitive age, Impaired VisionXCognitive age,.

3.3 Questionnaire design

This study employs a questionnaire in order to collect data. The questionnaire was developed by referencing previous literature in line with the study's topic. The survey will be conducted using the questionnaire distributed by Qualtrics. Questions use overstatement to encourage accurate responses relative to previous research that uses the same questions to measure different items. The Scales comprised 11 constructs, totaling 40 measurement items. Constructs and their respective associated measurement items are in the appendix. Measurement items have been validated by previous research and modified for the context of mobile banking and the use of overstatements in order to measure the correct response.

Original UTAUT2 constructs all use measurement items from the original study that defines the model (Venkatesh et al., 2012). Attitude is items were sourced from the Group buying repurchase intention study (Wang & Chou, 2014). Financial risk barrier measurement items were sourced from a study

researching the prediction of e-service adoption (Featherman & Pavlou, 2003). Tradition barrier items were sourced from a study researching barriers to mobile and online banking (Laukkanen, 2016) and a study on innovation resistance theory perspective on mobile payment solutions (Kaur et al., 2020). Impaired vision items were sourced from a study researching senior citizens' acceptance of information systems. The questionnaire utilized a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree), with the exception for questions regarding the construct cognitive age where the seven-point scale is used using the question: Please specify which of these decades you THINK you really belong to: 30 s 40 s 50 s 60 s 70 s 80 s 90 s.

Data will also be collected on the subjects' age, gender, education level, and frequency of use of mobile banking.

3.4 Data collection and organization

During the data collection process, 25 samples were collected by the researcher using social media, while 116 were collected by the Prolific platform. In total, there were 141 subjects surveyed. All of the questionnaires were filled out correctly, so it was not necessary to delete any responses for that reason. The Mahalanobis distance test was used to detect any multivariate outliers in the data set. Four responses were found to be outliers and were deleted, leaving 137 good responses. One variable used reverse scaling, and during this step, values on the Likert scale were reversed.

4. Results

4.1 Descriptive statistics

In this part of the thesis, descriptive statistics will be presented. Age ranges from 50 to 80, with a median of 66 years of age, which represents the average age of the survey taker.

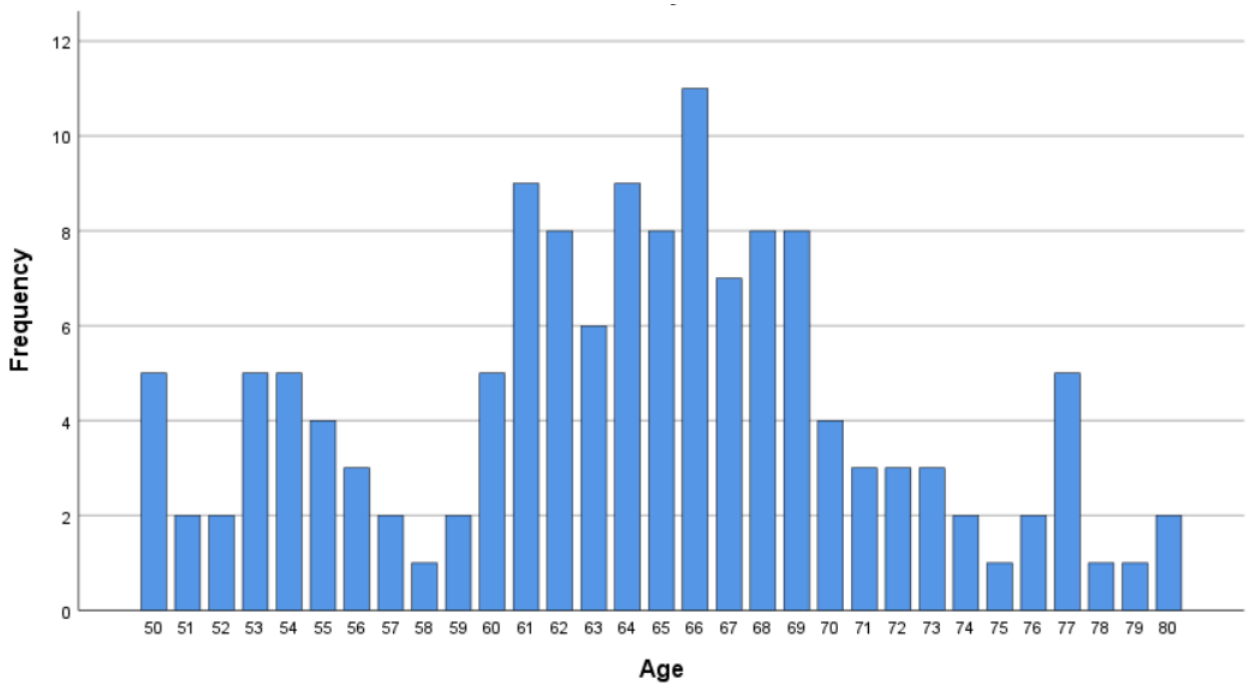

Figure 3 Age frequency

Figure 4 shows the education distribution among the participants of the study. Slightly over half of the subjects have a bachelor's degree or higher. This sample has higher rates of education compared to the population average, both in the United Kingdom and Croatia, where the study was conducted; this has to be taken into account when interpreting the results of the study.

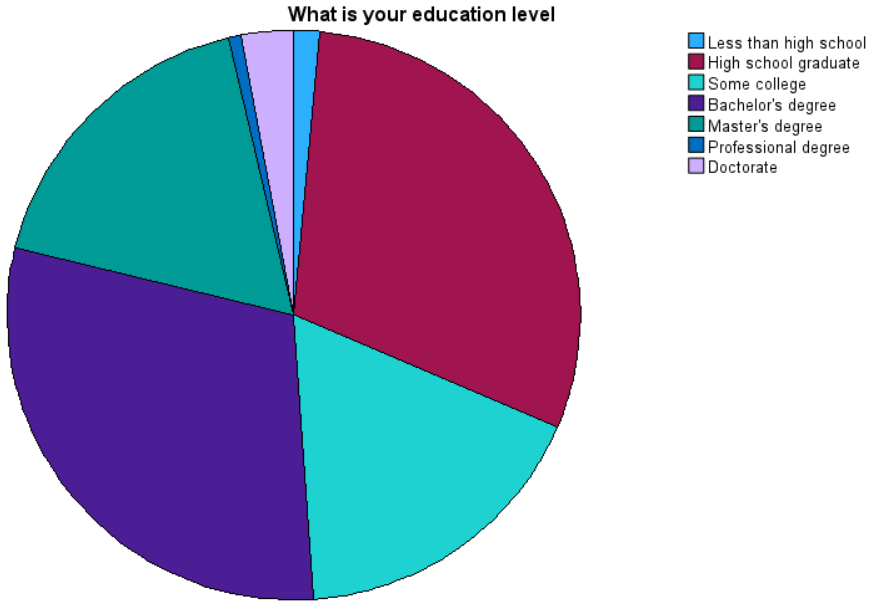

Figure 4 Education frequency

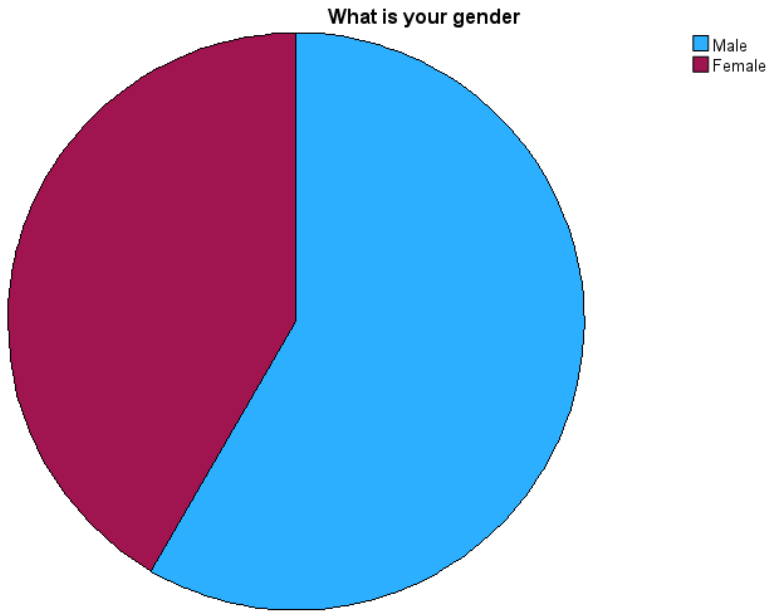

Figure 5 Gender frequency

The population is also more male than female, with 80 male and 57 female participants. No participants chose an option other than male or female.

4.2 Factor analysis

Factor analysis is a set of procedures for data reduction and summarization. In marketing research, there may be a large number of variables, most of which are correlated and which must be reduced to a manageable level. Relationships among sets of many interrelated variables are examined and represented in terms of a few underlying factors. Factor analysis can be used in the following three circumstances (Malhotra et al., 2017, p. 709).

1) To identify factors that explain correlations amongst the set of variables.
2) To identify a new, smaller set of uncorrelated variables to replace an original set of correlated variables
3) To identify a smaller set of salient variables from a more extensive set for use in subsequent multivariate analysis

This research paper has 44 variables that were used to measure 12 different constructs. Factor analysis is required to determine whether corresponding items fit into the constructs that they are supposed to measure.

Kaiser–Meyer–Olkin (KMO) is a measure of sampling adequacy. The KMO measures the appropriateness of factor analysis. High values indicate that factor analysis is appropriate. Values below 0.5 imply that factor analysis may not be appropriate. Bartlett's test of sphericity is a test statistic used to examine the hypothesis that the variables are uncorrelated (Malhotra et al., 2017, p. 712).

Confirmatory factor analysis is performed on the construct of cognitive age.

Table 1 KMO and Bartlett's Test of Cognitive Age Construct

KMO		0.828
Bartlett's Test of Sphericity	Sig.	<.001

Table 1 Shows that factor analysis is appropriate, while Table 2 shows that there is only one factor with an eigenvalue higher than one, which explains 73.512 percent of the variance. This concludes that all four items make up the construct.

Table 2 Total variance explained of the Cognitive age construct

	Initial Eigenvalues		
Factor	Total	% of Variance	Cumulative %
1	2.9409	73.512	73.512
2	0.416	10.473	83.985
3	0.346	8.651	92.636
4	0.295	7.364	100.00

Reliability analysis is also used to determine if there is internal consistency among items that construct a factor. When Cronbach's Alpha reliability test is performed on all four variables, it is sufficient at 0.645, suggesting that all four variables do form a factor together. When Cronbach's Alpha value is above 0.6, it generally indicates satisfactory internal consistency reliability (Malhotra et al., 2017, p. 360).

Table 3 Reliability Statistics of the construct Cognitive age

Cronbach's Alpha	N of Items
0,645	4

All of the twelve constructs used in the study passed confirmatory factor analysis and reliability statistics, and no items were dropped.

4.3 Correlation matrix

A correlation matrix is a table showing the correlation coefficients between several variables. Correlation measures how strong and in which direction two variables are linked. A weak correlation would have a correlation coefficient in the range of 0.1 to 0.29, a moderate positive correlation from 0.3 to 0.49, and a strong positive correlation from 0.5 to 1.0 (Pallant, 2007, p. 132). Table 4 shows a correlation matrix between different constructs that are a part of the conceptual model. Cognitive age and barriers that are made of Financial risk, Tradition, and Impaired vision have negative correlations with different constructs, while adoption drivers have positive correlations.

Table 4 Correlation matrix

		1	2	3	4	5	6	7	8	9	10	11	12
1 CA	Correlation	1											
2 PE	Correlation	-.275**	1										
3 EE	Correlation	-.359**	.820**	1									
4 SI	Correlation	-0.166	.572**	.477**	1								
5 FC	Correlation	-.304**	.754**	.883**	.528**	1							
6 HM	Correlation	-.170*	.660**	.565**	.481**	.574**	1						
7 PV	Correlation	-.172*	.582**	.636**	.428**	.695**	.439**	1					
8 HB	Correlation	-.235**	.839**	.773**	.514**	.725**	.740**	.598**	1				
9 AT	Correlation	-.291**	.914**	.865**	.545**	.828**	.688**	.667**	.874**	1			
10 FR	Correlation	.328**	-.606**	-.610**	-.318**	-.535**	-.468**	-.459**	-.554**	-.659**	1		
11 TR	Correlation	.206*	-.385**	-.512**	-.170*	-.433**	-.266**	-.410**	-.371**	-.452**	.539**	1	
12 IV	Correlation	0.156	-.464**	-.599**	-.192*	-.500**	-.181*	-.369**	-.357**	-.467**	.472**	.441**	1

5.4 Regression analysis

Regression analysis is a powerful and flexible procedure for analyzing associative relationships between a metric-dependent variable and one or more independent variables. It can be used in the following ways (Malhotra et al., 2017, p. 614).

1 To determine whether the independent variables explain a significant variation in the dependent variable: whether a relationship exists.

2 To determine how much of the variation in the dependent variable can be explained by the independent variables: strength of the relationship.

3 To determine the structure or form of the relationship: the mathematical equation relating The independent and dependent variables.

4 To predict the values of the dependent variable.

5 To control for other independent variables when evaluating the contributions of a specific variable or set of variables.

Table 5 shows R Square value, which is in this case is 0.916, suggesting that approximately 91.6% of the variance is explained. An adjusted R Square value of 0.908 suggests that approximately 90.8% of the variance is explained, accounting for the complexity of the model.

Table 5 Regression model summary

Model	R	R Square	Adjusted R Square
1	.957a	0.916	0.908

Table 6 shows the p-value is < .001, which means the regression model is statistically significant. The F-statistic is 103.74, which tests the overall significance of the regression model.

Table 6 Regression model ANOVA

Model		F	Sig.
1	Regression	103.748	<.001

Table 7 shows p-values and unstandardized regression coefficients of the regression model. Performance expectancy, facilitating conditions, and Habit have their p-values below 0.05, which suggests that the probability of these results being random is under 5%.

The standardized coefficient of PE is 0.412. For every one standard deviation increase in PE, AT is predicted to increase by 0.406 standard deviations, holding all other variables constant. This suggests that an increase in expected performance strengthens the likelihood of use of mobile banking. The standardized coefficient of FC is 0.144. For every one standard deviation increase in FC, AT is

predicted to increase by 0.144 standard deviations, holding all other variables constant. This suggests that an increase in conditions that facilitate the use of mobile banking strengthens the likelihood of use of mobile banking. The standardized coefficient of HB is 0.234. For every one standard deviation increase in HB, AT is predicted to increase by 0.234 standard deviations, holding all other variables constant. This suggests that an increase in habitual use of mobile banking strengthens the likelihood of use of mobile banking.

Table 7 Regression model coefficients and p-value

Model	Unstandardized coefficients B	Standardized Coefficients Beta	Sig.	VIF
(Constant)	0.182		0.682	
PE		0.412	0.000	5.116
EE		0.137	0.070	8.334
SI		-0.010	0.762	1.639
FC		0.144	0.022	5.664
HM		0.022	0.595	2.458
PV		0.067	0.079	2.124
HB		0.234	0.000	4.916
FR		-0.012	0.934	28.809
TR		-0.010	0.931	20.469
IV		-0.153	0.239	24.705
FRxCA		-0.141	0.470	55.429
TRxCA		0.013	0.934	36.702
IVxCA		0.228	0.136	33.865

High VIF values show that multicollinearity is a problem in the regression model. Multicollinearity is a state of high intercorrelation among independent variables. Virtually all multiple regression analyses done in marketing research involve predictors or independent variables that are related. Multicollinearity, however, arises when intercorrelations among the predictors are very high. Multicollinearity can result in several problems, including the following (Malhotra et al., 2017, p. 661):

1. The partial regression coefficients may not be estimated precisely. The standard errors are likely to be high.

2. The magnitudes, as well as the signs of the partial regression coefficients, may change from sample to sample.

3. It becomes difficult to assess the relative importance of the independent variables in explaining the variation in the dependent variable.

4. Predictor variables may be incorrectly included or removed in stepwise regression.

A variance inflation factor (VIF) detects multicollinearity in regression analysis. If VIF equals 1, it means the variables are not correlated. Values between 1 and 5 can be determined as moderately correlated. A VIF greater than five can be interpreted as a high correlation among variables.

High multicollinearity has to be addressed, especially for the interaction terms. That is done so with the use of the residual centering method. Residual centering involves a two-step regression process to create the centered variables. Residual values are calculated by running a linear regression with, for example, an interaction term, Financial risk x Cognitive age, as a dependent variable and Financial risk and Cognitive age as independent variables. Unstandardized residuals are used instead of interaction terms in the regression equation.

Table 8 Regression model coefficients and p-value with unstandardized residuals

Model	Unstandardized coefficients B	Standardized Coefficients Beta	Sig.	VIF
(Constant)	0.140		0.758	
PE		0.414	0.000	5.123
EE		0.126	0.092	8.091
SI		-0.010	0.754	1.638
FC		0.148	0.020	5.771
HM		0.024	0.563	2.454
PV		0.067	0.078	2.118
HB		0.238	0.000	4.944
FR		-0.106	0.006	2.076
TR		0,000	0.999	1.788
IV		0.039	0.284	1.899
FRxCA residuals		-0.020	0.583	1.885
TRxCA residuals		0.012	0.703	1.682
IVxCA residuals		0.047	0.139	1.473

In Table 8, linear regression with residually centered variables is presented, with their VIF sizes. VIF values above three can be considered high, while values over 10 are very high, indicating multicollinearity (Pallant, 2007, p. 156). Variables like PE, FC, and HB have high multicollinearity, while EE can be considered to have very high multicollinearity. Most importantly for the conclusion of this study, barriers to adoption, FR, TR, and IV do not have high multicollinearity, which does not impact the testing of the hypothesis.

This linear regression confirms that Performance expectancy, Facilitating conditions, and Habit have a positive relationship on Attitude, with the addition of Financial risk as a negative contributor to

Attitude. The standardized coefficient of FR is -0.148. A one standard deviation increase in FR is associated with a 0.106 standard deviation decrease in Great Attitude. This is the only significant negative predictor. Despite lowering VIF, Cognitive age does not moderate the relationship between barriers to adoption and Attitude.

First hypothesis H1 is supported. Financial risk does have a negative impact on the attitude towards adoption of mobile banking. Hypothesis H1a is rejected, because Cognitive age as a moderator in the relationship between was not found to be statistically significant. Hypothesis H2 is not supported, due to the high p-value of the construct Tradition in the model. Hypothesis H2a is also rejected. Cognitive age did not moderate the relationship between Tradition and Attitude due to a high p-value. Last hypothesis H3 was also not found to be supported. Impaired vision did not have a negative impact on attitude due to the high p-value; hypothesis H3a is rejected as well for the same reason.

5. Discussion

In this part of the paper, the results will be compared with previous research, and the results will be discussed. Only one of the barriers, Financial risk, was found to have a negative effect on attitude towards mobile banking use among older individuals. In previous studies, there have been different conclusions regarding the impact of risk when it comes to technology acceptance. However, it does seem that when it comes to older individuals, this and previous research point out that risk perception does have an effect on technology acceptance.

In previous research, tradition barrier or similar concepts had an effect on technology acceptance, unlike in this study. The reason for this could be that a UTAUT2 model with a lot of variables, like the one that was used in this study, cannot detect a smaller effect. The sampling strategy could have also played a role, considering that individuals participating in this study were more tech-savvy and educated than the general population.

The third hypothesis has not been tested well in previous literature. A deteriorating physical condition might not be a barrier to the adoption of a fairly simple technology like mobile banking for the general population. But still, it could be a barrier to certain parts of the population that are very old or suffer from disabilities. Further research should target specific segments to determine what physical conditions and to what extent mobile banking, or similar technologies, are adopted. Cognitive age was not found to be a moderator in the relationship between barriers and attitude. This is the first type of moderator to be used, so there are no specific previous studies to which to compare results.

Table 9 Total Comparison with previous literature

Hypothesis	Study results	Previous study results
H1	Supported	(Kumar et al., 2023)-Perceived risk did not have an impact on actual use - not supported Risk did not have an effect on usage intention - not supported (Chung & Liang, 2020) Risk did have an impact on resistance to mobile banking, more so on people with higher cognitive age – supported (Chaouali & Souiden, 2018) Risk, including financial risk, was found to have an impact on resistance to the adoption of mobile payment by non-elderly consumers – supported (Cham et al., 2022) Risk did have an effect on the intention of mobile payments among non-older age individuals – supported (Kaur et al., 2020)
H1a	Not supported	No good comparison
H2	Not supported	Tradition was not found to have an effect on use intention or intention to recommend – supported (Kaur et al., 2020) Stickiness to cash, which is similar to tradition, is found to moderate the relationship between users' resistance and their non-adoption intention of mobile payment - supported (Cham et al., 2022) The Tradition barrier negatively relates to Internet banking non-adopters' intention to use the innovation supported (Laukkanen, 2016)
H2a	Not supported	No good comparison
H3	Not supported	Self-reported health conditions were found to have an effect on the Usage behavior of gerontechnology acceptance by the elderly (Chen & Chan, 2014)
H3b	Not supported	No good comparison

5.1 Limitations and further research

The study has had some limitations. The first limitation would be a sampling strategy that relied on a convenience sample, which limits diversity in demographics in terms such as education, technological literacy, and geographic representation. Future research should expand sample diversity to include more diverse demographic and geographic samples to enhance the generalizability of findings.

Another limitation is the type of statistical test performed. This master's thesis used linear regression in order to determine the causal relationship between variables. Partial Least Squares Structural Equation Modeling is the most widely used method for this type of research, and this method is particularly well-suited for this research for several key reasons. Out of eleven studies that were part of the literature review, nine of them used PLS-SEM as part of their statistical analysis. This form of

analysis is very often used in the UTAUT2 model. PLS-SEM is a more advanced technique that allows you to test complex models with multiple relationships, including both direct and indirect effects. Additionally, PLS-SEM has significant abilities in handling complex research models with higher-order constructs (Hair et al., 2017). Linear regression was chosen due to the scope and complexity of this master's thesis

6. Conclusion

6.1 Theoretical contribution

This research is among the few to integrate the UTAUT2 model with IRT constructs like Financial risk and Tradition into one research model to explain attitudes towards mobile banking among older adults. It focuses on financial risk as a subset of perceived risk that most studies focus on as a variable in the model. Not all previous studies confirm perceived risk as a barrier to the adoption of mobile banking or similar technologies.

Another contribution is the addition of a completely new barrier, impaired vision, that tries to explain possible causes for the lower adoption of mobile banking among older consumers. Another contribution to the usage of cognitive age instead of standard age measurement. Age is often used as a moderator in UTAUT2 or similar technology acceptance models, but this is the first time the concept of cognitive age was used as a moderator in the context of barriers to technology adoption.

6.2 Managerial implications

Also, this study exhibits several practical implications for financial institutions and mobile banking application developers. This study tried to split the cause of lower acceptance of mobile banking into three different causes. Fear of causing financial damage, Previous habits that are a substitute for mobile banking, and lower visual ability. As financial risk was found to be the only variable influencing attitude toward use of mobile banking, it is advised to implement features that lower the perceived ability to make a mistake. Also, financial institutions should focus on messaging that creates a perception that mobile banking is equal to or even safer than traditional banking.

Previous research has shown that tradition-based factors do influence the acceptance of mobile banking and similar technologies, while this study does not. Sampling could be a reason for this since the selected sample is more educated and tech-savvy. Thirdly, vision impairment was not a contributing factor towards attitude. Although this could be the case for the general population, certain populations could still have accessibility issues when it comes to mobile banking, and financial institutions should address that issue.

References

Ajzen, I. (1985). From intentions to actions: *A theory of planned behavior. Action control: From cognition to behavior*/Springer.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. https://ci.nii.ac.jp/ncid/BA21965086

Anderson, M. & Perrin, A. (2017). Tech adoption climbed among adults. Pew research from https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2017/05/PI_2017.05.17_Older-Americans-Tech_FINAL.pdf

Apau, R., Titis, E., & Lallie, H. S. (2025). Towards a Better Understanding of Mobile Banking App Adoption and Use: Integrating Security, Risk, and Trust into UTAUT2. *Computers*, *14*(4), 144. https://doi.org/10.3390/computers14040144

Ash Turner (2025, July 7). Number of Mobile Phone & Smartphone Users from https://www.bankmycell.com/blog/how-many-phones-are-in-the-world

Bhatnagr, P., & Rajesh, A. (2023). Neobanking adoption – An integrated UTAUT-3, perceived risk and recommendation model. *South Asian Journal of Marketing*, *5*(2), 93–112. https://doi.org/10.1108/sajm-06-2022-0040

Cham, T., Cheah, J., Cheng, B., & Lim, X. (2021). I Am too old for this! Barriers contributing to the non-adoption of mobile payment. *International Journal of Bank Marketing*, *40*(5), 1017–1050. https://doi.org/10.1108/ijbm-06-2021-0283

Chaouali, W., & Souiden, N. (2018). The role of cognitive age in explaining mobile banking resistance among elderly people. *Journal of Retailing and Consumer Services*, *50*, 342–350. https://doi.org/10.1016/j.jretconser.2018.07.009

Chen, K., & Chan, A. H. S. (2014). Gerontechnology acceptance by elderly Hong Kong Chinese: a senior technology acceptance model (STAM). *Ergonomics*, *57*(5), 635–652. https://doi.org/10.1080/00140139.2014.895855

Choi, H., & Loh, R. K. (2023). Physical frictions and digital banking adoption. *Management Science*, *70*(10), 6597–6621. https://doi.org/10.1287/mnsc.2023.4972

Chung, K. C., & Liang, S. W. (2020). Understanding Factors Affecting innovation Resistance of mobile Payments in Taiwan: An Integrative perspective. *Mathematics*, *8*(10), 1841. https://doi.org/10.3390/math8101841

De Decker, P., & Dewilde, C. (2010). Home-ownership and asset-based welfare: the case of Belgium. *Journal of Housing and the Built Environment*, *25*(2), 243–262. https://doi.org/10.1007/s10901-010-9185-6

Dewilde, C., & Raeymaeckers, P. (2008). The trade-off between home-ownership and pensions: individual and institutional determinants of old-age poverty. *Ageing and Society*, *28*(6), 805–830. https://doi.org/10.1017/s0144686x08007277

Dizon, G., & Ebardo, R. (2025). Barriers and motivations of older adults in digital banking adoption: Recent findings, gaps, and future directions. *International Journal of Innovative Research and Scientific Studies*, *8*(3), 1959–1970. https://doi.org/10.53894/ijirss.v8i3.6929

Farooq, M. S., Salam, M., Jaafar, N., Fayolle, A., Ayupp, K., Radovic-Markovic, M., & Sajid, A. (2017). Acceptance and use of lecture capture system (LCS) in executive business studies. *Interactive Technology and Smart Education*, *14*(4), 329–348. https://doi.org/10.1108/itse-06-2016-0015

Febelfin (2025, July 7). Online and offline banking through consumers' eyes from https://febelfin.be/media/pages/publicaties/2024/online-en-offline-bankieren-door-de-ogen-van-de-consument/17c78013bf-1709648898/storytelling_online_and_offline_banking.pdf

Featherman, M. S., & Pavlou, P. A. (2003). Predicting e-services adoption: a perceived risk facets perspective. *International Journal of Human-Computer Studies*, *59*(4), 451–474. https://doi.org/10.1016/s1071-5819(03)00111-3

Hair, J., Hollingsworth, C. L., Randolph, A. B., & Chong, A. Y. L. (2017). An updated and expanded assessment of PLS-SEM in information systems research. *Industrial Management & Data Systems*, *117*(3), 442–458. https://doi.org/10.1108/imds-04-2016-0130

Higueras-Castillo, E., Liébana-Cabanillas, F. J., & Villarejo-Ramos, Á. F. (2023). Intention to use e-commerce vs physical shopping. Difference between consumers in the post-COVID era. *Journal of Business Research*, *157*, 113622. https://doi.org/10.1016/j.jbusres.2022.113622

Huang, T. (2023). Expanding the UTAUT2 framework to determine the drivers of mobile shopping behaviour among older adults. *PLoS ONE*, *18*(12), e0295581. https://doi.org/10.1371/journal.pone.0295581

Kaur, P., Dhir, A., Singh, N., Sahu, G., & Almotairi, M. (2020). An innovation resistance theory perspective on mobile payment solutions. *Journal of Retailing and Consumer Services*, *55*, 102059.https://doi.org/10.1016/j.jretconser.2020.102059

Kumar, R., Singh, R., Kumar, K., Khan, S., & Corvello, V. (2023). How Does Perceived Risk and Trust Affect Mobile Banking Adoption? Empirical Evidence from India. *Sustainability*, *15*(5), 4053. https://doi.org/10.3390/su15054053

Laukkanen, T. (2007). Internet vs mobile banking: comparing customer value perceptions. *Business process management journal*, *13*(6), 788-797.https://doi.org/10.1108/14637150710834550

Laukkanen, T. (2016). Consumer adoption versus rejection decisions in seemingly similar service innovations: The case of the Internet and mobile banking. *Journal of Business Research*, *69*(7), 2432–2439. https://doi.org/10.1016/j.jbusres.2016.01.013

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & management*, *40*(3), 191–204.https://doi.org/10.1016/S0378-7206(01)00143-4

Malhotra, N. K., Nunan, D., & Birks, D. F. (2017). *Marketing research*. Pearson UK.

Msweli, N. T., & Mawela, T. (2020). Enablers and barriers for mobile commerce and banking services among the elderly in developing countries: A systematic review. *Responsible Design, Implementation and Use of Information and Communication Technology*, *12067(March)*, 319–330.doi: 10.1007/978-3-030-45002-1_27.

Ngusie, H. S., Kassie, S. Y., Zemariam, A. B., Walle, A. D., Enyew, E. B., Kasaye, M. D., Seboka, B. T., & Mengiste, S. A. (2024). Understanding the predictors of health professionals' intention to use electronic health record system: extend and apply UTAUT3 model. *BMC Health Services Research*, *24*(1). https://doi.org/10.1186/s12913-024-11378-1

Orehovački, T., Blašković, L., & Kurevija, M. (2022). Evaluating the perceived quality of mobile banking applications in Croatia: An Empirical study. *Future Internet*, *15*(1), 8. https://doi.org/10.3390/fi15010008

Pallant, J. (2007). *SPSS survival manual : a step by step guide to data analysis using SPSS for Windows*. http://ci.nii.ac.jp/ncid/BA83963567

Qin, H., & Li, Q. (2024). Exploring factors influencing the adoption of smart elderly care products: An enhanced UTAUT model analysis of smart wearables. *Edelweiss Applied Science and Technology*, *8*(5). https://doi.org/10.55214/25768484.v8i5.1796

Ram, S. (1987). A model of innovation resistance. *ACR North American Advances*. https://acrwebsite.org/volumes/6688/volumes/v14/NA-14

Ram, S., & Sheth, J. N. (1989). Consumer Resistance to Innovations: The Marketing Problem and its solutions. *Journal of Consumer Marketing*, *6*(2), 5–14. https://doi.org/10.1108/eum0000000002542

Razali, R. S. (2024). Developing a Model for Mobile Payment Adoption among Senior Citizens in Malaysia: A Pilot Study. *Pakistan Journal of Life and Social Sciences (PJLSS)*, *22*(2). https://doi.org/10.57239/pjlss-2024-22.2.001083

Souiden, N., Ladhari, R., & Chaouali, W. (2021). Mobile banking adoption: a systematic review. *International Journal of Bank Marketing*, *39(2), 214–241.* https://doi.org/10.1108/IJBM-04-2020-0182

Federal Planning Bureau (2025). Study Committee on Ageing, Yearly Report from https://www.plan.be/sites/default/files/documents/FOR_VERG2025_13176_NL.pdf

Thomas, D., Chowdhury, G., & Ruthven, I. (2024). Are Older People Battling with Digital Financial Services? In *Lecture notes in computer science* (pp. 139–146). https://doi.org/10.1007/978-3-031-57850-2_11

Van Bronswijk, J., Bouma, H., Fozard, J., Kearns, W., Davison, G., & Tuan, P. (2009). Defining gerontechnology for R&D purposes. *Gerontechnology*, *8*(1). https://doi.org/10.4017/gt.2009.08.01.002.00

Venkatesh, N., Morris, N., Davis, N., & Davis, N. (2003). User acceptance of information Technology: toward a unified view. *MIS Quarterly*, *27*(3), 425. https://doi.org/10.2307/30036540

Venkatesh, N., Thong, N., & Xu, N. (2012). Consumer Acceptance and use of Information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly*, *36*(1), 157. https://doi.org/10.2307/41410412

Wang, E. S., & Chou, N. P. (2014). Consumer characteristics, social influence, and system factors on online Group-Buying repurchasing intention. *Journal of Electronic Commerce Research*, *15*(2), 119. http://www.jecr.org/sites/default/files/Paper3.pdf

World Bank, Number of Bank Branches for Belgium [DDAI02BEA643NWDB], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DDAI02BEA643NWDB, August 13, 2025.

World Health Organization. (1989, June 1). *World Health Organization Technical Report Series 779*. https://iris.who.int/bitstream/handle/10665/39521/WHO_TRS_779.pdf

Xu, Y., Ghose, A., & Xiao, B. (2023). Mobile Payment adoption: An Empirical Investigation of AliPay. *Information Systems Research*, *35*(2), 807–828. https://doi.org/10.1287/isre.2021.0156

Yang, C., Yang, S., & Chang, Y. (2023). Predicting Older Adults' mobile payment adoption: an extended TAM model. *International Journal of Environmental Research and Public Health*, *20*(2), 1391. https://doi.org/10.3390/ijerph20021391

APENDIX

Table 1.

Construct	Item	Original Measurement item	Measurement item	Source
Performance expectancy	PE1	I find mobile Internet useful in my daily life.	I find mobile banking very useful in my daily life.	Venkatesh et al., 2012
	PE2	Using mobile Internet increases my chances of achieving things that are important to me.	Using mobile banking greatly increases my chances of achieving tasks that are important to me.	Venkatesh et al., 2012
	PE3	Using mobile Internet helps me accomplish things more quickly.	Using mobile banking helps me a lot to accomplish things more quickly.	Venkatesh et al., 2012
	PE4	Using mobile Internet increases my productivity.	Using mobile banking greatly increases my productivity.	Venkatesh et al., 2012
Effort Expectancy	EE1	Learning how to use mobile Internet is easy for me.	Learning how to use mobile banking is very easy for me.	Venkatesh et al., 2012
	EE2	My interaction with mobile Internet is clear and understandable.	My interaction with mobile banking is very clear and understandable.	Venkatesh et al., 2012
	EE3	I find mobile Internet easy to use.	I find mobile banking very easy to use.	Venkatesh et al., 2012
	EE4	It is easy for me to become skillful at using mobile Internet.	It is very easy for me to become skillful at using mobile banking.	Venkatesh et al., 2012
Social Influence	SI1	People who are important to me think that I should use mobile Internet.	People who are very important to me think that I should use mobile banking.	Venkatesh et al., 2012
	SI2	People who influence my behavior think that I	People who influence my behavior think that	Venkatesh et al.,

		should use mobile Internet.	I should use mobile banking.	2012
	SI3	People whose opinions that I value prefer that I use mobile Internet.	People whose opinions that I value highly prefer that I use mobile banking.	Venkatesh et al., 2012
Facilitating Conditions	FC1	I have the resources necessary to use mobile Internet.	I have the resources necessary to use mobile banking.	Venkatesh et al., 2012
	FC2	I have the knowledge necessary to use mobile Internet.	I have the knowledge necessary to use mobile banking	Venkatesh et al., 2012
	FC3	Mobile Internet is compatible with other technologies I use.	Mobile banking is compatible with other technologies I use.	Venkatesh et al., 2012
	FC4	I can get help from others when I have difficulties using mobile Internet.	I can get help easily from others when I have difficulties using mobile banking.	Venkatesh et al., 2012
Hedonic Motivation	HM1	Using mobile Internet is fun.	Using mobile banking is very fun.	Venkatesh et al., 2012
	HM2	Using mobile Internet is enjoyable.	Using mobile banking is very enjoyable	Venkatesh et al., 2012
	HM3	Using mobile Internet is very entertaining.	Using mobile banking is very entertaining.	Venkatesh et al., 2012
Price Value	PV1	Mobile Internet is reasonably priced.	Mobile banking is very reasonably priced	Venkatesh et al., 2012
	PV2	Mobile Internet is a good value for the money.	Mobile banking is a very good value for the money.	Venkatesh et al., 2012
	PV3	At the current price, mobile Internet provides a good value.	At the current price, mobile banking provides a very good value	Venkatesh et al., 2012
Habit	HB1	The use of mobile Internet has become a habit for me.	The use of mobile banking has become a habit for me.	Venkatesh et al., 2012
	HB2	I am addicted to using the mobile Internet.	I am addicted to using mobile banking.	Venkatesh et al., 2012

	HB3	I must use mobile Internet.	I must use mobile banking.	Venkatesh et al., 2012
	HB4	Using mobile Internet has become natural to me.	Using mobile banking has become very natural to me.	Venkatesh et al., 2012
Attitude	AT1	I think using the OGB website is a good idea.	I think using mobile banking is a very good idea.	Wang & Chou, 2014
	AT2	I think using the OGB website is beneficial to me.	I think using mobile banking is very beneficial to me.	Wang & Chou, 2014
	AT3	I have positive perceptions of using the OGB website.	I have very positive perceptions of using mobile banking.	Wang & Chou, 2014
Financial Risk	FR1	There are likely chances to lose money if you use mobile banking.	What are the chances that you stand to lose money if you use the XXXX?	Featherman & Pavlou, 2003.
	FR2	Using mobile banking subjects your checking account to potential fraud	Using an Internet-bill-payment service subjects your checking account to potential fraud	Featherman & Pavlou, 2003.
	FR3	My signing up for and using mobile banking would lead to a financial loss for me.	My signing up for and using an XXXX would lead to a financial loss for me.	Featherman & Pavlou, 2003.
	FR4	Using a mobile banking service subjects your checking account to financial risk.	Using an Internet bill-payment service subjects your checking account to financial risk.	Featherman & Pavlou, 2003.
Tradition	TR1	Patronizing in the banking office and chatting with the teller is a nice occasion on a weekday.	Patronizing in the banking office and chatting with the teller is a nice occasion on a weekday.	Laukkanen, 2016
	TR2	I find self-service alternatives more pleasant than personal customer service. (Reverse scale)	I find self-service alternatives more pleasant than personal customer service. (Reverse scale)	Laukkanen, 2016
	TR3	I find it very difficult to contact the mobile banking customer service	I find it difficult to contact customer service at the MPS	Kaur et al., 2020 Or. (Laukkanen,

				2016)
	TR4	I find it very difficult to get some information about mobile banking use	I find it difficult to get some Information about MPS use	Kaur et al., 2020 Or. (Laukkanen, 2016)
Impaired vision	IV1	A problem with eyesight requires me to exert more effort to perform daily activities.	E.g. problem in hearing, speech, moving, and memory requires me to exert more effort in my daily activities.	Phang et al.,2006 Or. (McDowell and Newell 1996)
	IV2	A problem with eyesight limits the kind of activities that I can perform.	E.g. problem in hearing, speech, moving, and memory limits the kind of activities that I can perform.	Phang et al.,2006 Or. (McDowell and Newell 1996)
	IV3	A problem with eyesight causes me to have difficulty performing daily activities.	E.g. problem in hearing, speech, moving, and memory causes me to have difficulty performing daily activities.	Phang et al.,2006 Or. (McDowell and Newell 1996)
Cognitive age		Please specify which of these age decades you THINK you really belong to: 30s 40s 50s 60s 70s 80s 90s		Wei et al., 2013
	CG1	1. I feel as though I am in my	1. I feel as though I am in my …	Wei et al., 2013
	CG2	2. I look as though I am in my	2. I look as though I am in my …	Wei et al., 2013
	CG3	3. I do most things as though I were in my	3. I do most things as though I were in my …	Wei et al., 2013
	CG4	My interests are mostly those of a person in their	My interests are mostly those of a person in his/her …	Wei et al., 2013