

Factors determining the use of mobile devices to make Near Field Communication payments in South Africa

A research report submitted by

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February 2017

ABSTRACT

The South African industry is facing new competitive challenges when it comes to means of making payments. Banks and payment services providers are constantly working on innovative ways to assist customers in making payments. Technology plays an important role in this regard as means of making payments has evolved from cash to card transactions and electronic funds transfers. Factors such as the time it takes to make a payment at a point of sale, the security of the mechanism that is used to make the payment and usability of the technology are challenges that new payment technology needs to overcome for it to appeal to customers. A new means of making payments at a point of sale uses Near Field Communication (NFC) through mobile phones. This research focuses on individuals that pay for goods and services at point of sales and what factors would influence them to adopt this way of making payments. The customers selected to participate are currently banked with one of the big five banks in South Africa: ABSA, Standard Bank, First National Bank, Nedbank and Capitec.

A review of the literature on the adoption of technology by individuals highlighted three key drivers, which are: perceived usefulness, perceived ease of use and perceived security. The extent to which these affect the adoption of a new technology was evaluated by 84 respondents, which were asked to rate the importance of these drivers in terms of their adoption to the using their mobile devices to perform NFC payments at a point of sale. A linear analysis was used to analyse the results of the quantitative survey and determined the importance of each of the drivers that influence individuals to adopt new technology.

Individuals perceive NFC payments to be useful and easy to use but security came out as the most influential driver when it comes to individuals adopting the use of NFC through their mobile phones to make payments. Recommendations are made on the industry can be improved to influence the use of NFC payments at point of sales.

DECLARATION

I, Lethogonolo Mpofu, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Lethogonolo Mpofu



Signed at Pretoria

On the 28th day of MARCH 2017

DEDICATION

To my fiancé, Kgomotso Machuisa. Thanks for all the support.

ACKNOWLEDGEMENTS

Sincere thanks and appreciation goes to:

- Giuseppe Virgillito for his support and time off to work on my studies
- My fiancé, Kgomotso Machuisa, for all the support and understanding
- My parents, Mr John Mpofu and Mrs Stephina Mpofu for their encouragement
- Anthony Stacey for his guidance and boot camp arrangements
- Mike Mundy, my supervisor, for his encouragement and support and hard work
- My editor and proof reader Jacky Diack for all the hard work and guidance
- Mohanoe Mokhitli for providing a listening ear to ease the frustrations
- Syndicate members and classmates for sharing the fun times and the hard times
- Sandile Madikiza for guidance on approaching my studies
- A special thanks to all the respondents
- Diane Sankar and Sahil Mungar for assisting me with useful research material
- All my friends for their encouragement through this journey

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DEFINITION OF TERMS

Host Card Emulation (HCE) – A method of storing, managing and accessing data on a cloud instead of on a smartphone (Ozdenizci, Ozdenizci, Ok, & Karlidere, 2015).

Mobile Payments – Payment services that are performed using a portable electronic device such as smartphone or PDA (Investopedia, 1999).

Near Field Communication (NFC) – A short range radio frequency that allows two devices to connect to each other when brought into close proximity (Sixto, 2004).

Radio Frequency Identification (RFID) – A wireless technology that uses radio frequencies to connect two wireless devices (Kalapala, 2013)

Retail Banks – Banking services offered to individual customers (Mabunu, 2013).

Electronic Fund Transfer at Point of Sale (EFTPOS) – Paying for goods or services by transferring funds by means of electronic payment system, using payment cards at a point of sale. (eftpos, n.d.)

Secure Element (SE) – A chip that is embedded in the SIM card or the hardware of a smartphone and it emulates the contactless card (Marwaha, 2014).

Mobile Network Operator (MNO) – A company that provides wireless communication services for subscribers (Fendelman, 2017).

Host Card Emulation (HCE) – A mechanism that allows an external reader and a hosted application to perform card emulation transactions (Smart Card Alliance, 2015).

Point of Sale (POS) – A point where customers pay for goods and services (Ebrahimi, 2012).

CHAPTER 1: INTRODUCTION

The mobile device has evolved into a multifunctional computing device. This increased functionality has turned the phone into a personal assistant, keys or even a wallet. The wallet functionality of the phone may be used for payment of goods. This method of paying for goods using one's mobile device is known as mobile payments and it includes Electronic Fund Transfer at Point of Sale (EFTPOS) functionality that allows customers to pay for their goods at the merchant's Point-of-Sale (Viehland, 2007).

1.1 Purpose of the Study

The purpose of this research is to evaluate the main drivers for customers to adopt and use their mobile devices to perform payments using Near Field Communication (NFC) technology at retailers' Point-of-Sale in South Africa. The results may be used by South African banks in the design and development of better mobile payment systems. The marketing of these systems may also be improved by promoting an offer of real value to the customer.

1.2 Context of the Study

A mobile payment is considered to be any payment that is initiated or confirmed using a mobile device (Karnouskos, 2004). Mallat (2006) defines mobile payments as a process of transferring funds from the payer to a receiver by means of a mobile device, and makes it clear that there is a distinction between mobile payments and mobile banking services. Mobile payments include payments over the internet and smart cards, amongst others (Viehland, 2007). This study will however concentrate on the use of mobile phones to make payments at a Point-of-Sale using NFC.

NFC technology has been around for a while now. It dates back to 1983 (Milcarz, 2014; Viehland, 2007). NFC is a newer version of Radio Frequency Identification (RFID) but operates at a shorter distance than RFID, can be setup for two or one way communication, and its main feature is its security level that limits any interception possibilities (Kalapala, 2013). Most of its promises have not been realised in most parts of the world (Workgroup, 2014). NFC is effectively a short-range wireless

communication between two devices (Ozdenizci, 2015). It has been assumed for a long time that NFC would be the technology that would increase the scale of consumers using mobile payment services (Evensen & Kähler, 2014). NFC technology is available in smart phones and allows them to operate as smart cards by emulating smart card functionality for mobile payments, coupons, loyalty cards, identification and access control (Ozdenizci, 2015). The use of this technology in mobile banking potentially adds to the value that customers are increasingly expecting in return for the fees that they being charged (Mabunu, 2013).

The aim of this research is to look at the drivers that would promote the adoption of the use of mobile phones to make payments via NFC technology in South Africa even though there are other electronic means of payments available. Even though the term mobile payments may be used to refer to different scenarios, this study concentrates on paying for goods or services at a Point-of-Sale (POS) terminal. A review on the behavioural determinants that drive customers to use mobile banking concluded that the effects of perceived usefulness, ease of use, security and privacy are the major drivers of customer adoptability in the context of e-banking in Bangladesh (Jahangir & Begum, 2008). Another study concluded that perceived ease of use, perceived usefulness and trust (which results from structural assurances) were the factors affecting customer's attitudes towards mobile banking (Gu, Lee, & Suh, 2009). Amin (2007) also, suggests that perceived usefulness, perceived ease-of-use and perceived credibility were the factors that drove customers to use mobile credit cards in Malaysia. We shall therefore be looking at usefulness, ease of use and security as important drivers to the adoption of NFC payments in South Africa.

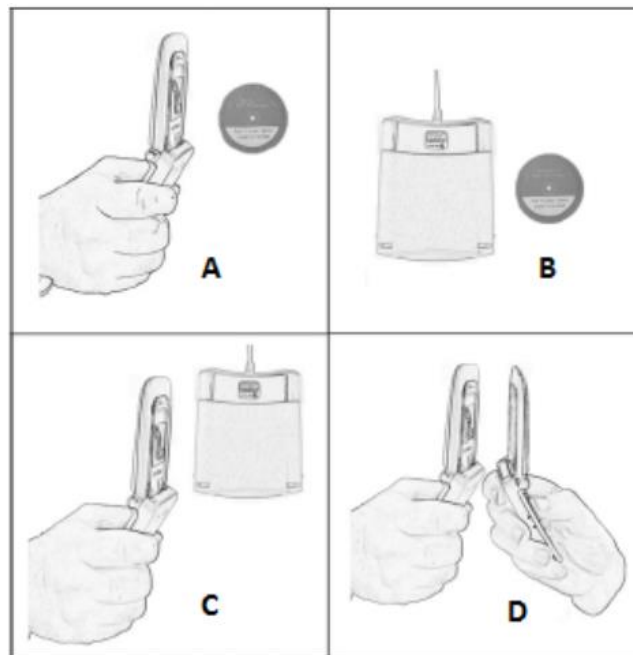
According to a presentation by Meeker (2015) at the Code Conference, there are 23 million smartphone users in South Africa. That is 47% population penetration. Smartphones are now the mini computers of the world and their powerful capabilities are being revealed as time goes by. This is a clearly good space for banks to play in and to provide services through smartphone usage (Meeker, 2015).

Imagine a sports fan entering the stadium by waving their smartphone next to a Point-of-Sale terminal to pay for their ticket. They touch their smartphone with a poster of their favourite player and the image is automatically downloaded as wallpaper. They then pay for snacks using coupons saved to their phone by simply tapping their device

on to the Point-of-Sale. This is the outlook that can be expected from harnessing and developing the power of NFC (Sixto, 2004). In the context of this study we shall be looking at the usage of NFC technology by a customer to make purchases at a retail business.

NFC is a technology that was developed by Philips and Sony in late 2002 and was adopted as the standard by Ecma International in December 2002, and thus is found in numerous devices. To connect using NFC a device transmits a low frequency radio-wave (13.56 MHz spectrum) and another device is required to be placed close enough to allow transfer of energy and data from one device to the other. NFC uses magnetic inductive coupling to transfer data, which is what makes it different to Bluetooth and Wi-Fi. Sixto (2004) mentions two types of NFC devices; active and passive. An active device is an NFC device that has an internal power supply, such as a smartphone. A passive device is an NFC device without an internal power supply, such as a contactless card. Figure 2 indicates that an NFC enabled phone or receiver is able to read an NFC tag (Figure 2; A and B), an NFC enabled phone and an NFC enabled reader can read each other (Figure 2; C) and that NFC enabled phones are able to transfer data between each other (Figure 2; D) (Halaweh, 2013). As stated previously, this study will be concentrating on payments made by NFC on a smartphone specifically, and thus the focus will therefore be on a specific category of active NFC device.

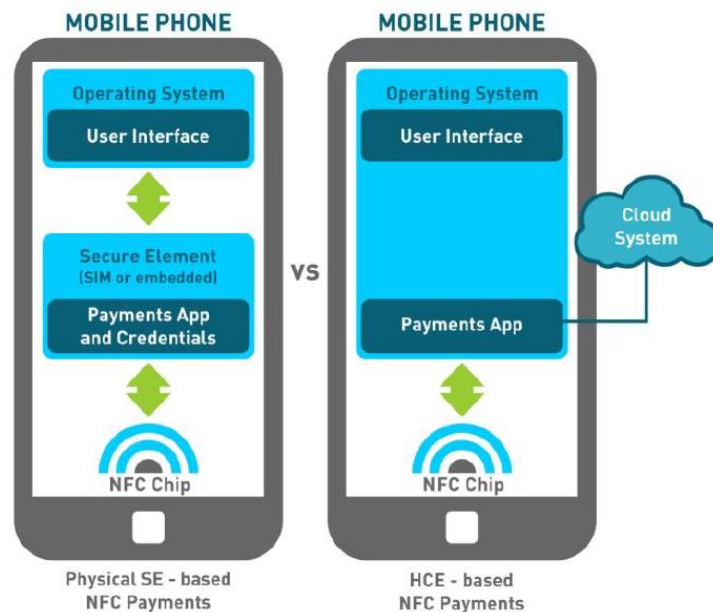
Figure 1: NFC Communications (Halaweh, 2013)



To be able to make payments using NFC, certain of the customer's financial credentials are needed and these are stored in a secure element (SE). There are a number of secure element architectures: SIM-centric, device-centric, SD-centric and Host Card Emulation (Ondrus, 2015). SIM-centric NFC uses Mobile Network Operators (MNO) to make payments. This is the less favoured means of payments because of its reliance on MNOs. The device-centric architecture allows for the customer's financial credentials to be stored on the actual device. This model is also not favoured because, even though it does not use the MNO, only big brands like Apple and Samsung are able to participate in the market, since they have the financial power to manufacture smartphones with the device-centric secure element stored on the motherboard of the phone itself. The concept of using Host Card Emulation (HCE) with NFC is different in the sense that the financial credentials may be stored either in a cloud or a secure location on the phone. The application resides in the operating system as the host and interacts directly with the NFC controller (Workgroup, 2014). HCE is currently available on Android 4.4 KitKat version and above, and Blackberry OS 10. Figure 1 below illustrates the difference between the physical secure element base and host card emulation based payments. This model does not favour the MNOs or the smartphone manufacturers. HCE is an alternative to the traditional NFC payment method even though it uses the same NFC technology and the mobile device

has to be NFC-enabled for the payment to be processed successfully (Workgroup, 2014).

Figure 2: Physical SE vs HCE (Workgroup, 2014)



Due to the financial nature of mobile payment transactions, security is always a concern to be considered, but especially in the context of mobile devices and applications. Mobile devices, mobile applications and private information need protection during a mobile payment transaction. In his research, Ashraf (2012) identifies threats to users, devices, applications and data governance. He concludes that there is an increase in fraud cases against mobile banking and so a thorough look at security is required when developing mobile payment applications.

1.3 Problem statement

1.3.1 Main problem

The research problem is to identify the main drivers and sub-drivers of customer adoption of NFC technology to make payments using their mobile phones at business

Point-of-Sales and evaluate the importance of security, ease-of-use and usefulness to the adoption of NFC payments through mobile phones.

1.3.2 Sub-problems

Sub-problem 1: The primary sub-problem is to evaluate the importance of perceived security, perceived ease-of-use and perceived usefulness to the adoption of NFC payments using a mobile phone by an individual.

Sub-problem 2: The secondary sub-problem is to evaluate how age affects the individual's perceived security, perceived ease-of-use and perceived usefulness of NFC payments using a mobile phone.

1.4 Significance of the Study

The study will assist in directing the design and development of NFC payments in South Africa. It identifies the drivers and sub-drivers that influence adoption of payments using NFC technology and evaluates the importance of these drivers and sub-drivers. The business environment is constantly changing and South African banks need to be constantly aligned with customers' wants and needs. Mobile payments should be convenient and secure, but there might be other important factors that drive the usage of NFC payments. These may be different to the drivers for other mobile payment functionalities.

There are several studies that have been conducted to look at mobile banking and the mobile payments ecosystem, but not in South Africa. For example, Evensen, Joachim (2014) analysed the Norwegian NFC payment business ecosystem and realised that the hindrance to establishing a sustainable Norwegian NFC payment ecosystem is the chicken-and-egg paradox where the consumer's adoption and the merchant's recruitments have been paralysing each other. This means that the merchants are awaiting the customer's demand for NFC payments while customers are waiting for the merchants to implement NFC Point-of-Sales in their businesses (Evensen, Joachim, 2014). A comprehensive understanding of the adoption factors to mobile payments for each customer will enable the adoption to go past the tipping point and reach critical mass (Lourens, 2015). In another study, Lourens (2015) used the Q-

methodology to look at retailers adoption to mobile payments in the Netherlands and found out that most of them follow the same wait-and-see approach that relies heavily on customer demand before they are enticed. That investigation indicates that the NFC mobile payment as an alternative has been limited to a niche market in the Netherlands (Lourens, 2015). While similar results were achieved in both European countries, these cannot automatically be applied to a South African market. Numerous social and economic factors in South Africa differ from those of Europe. Thus, this study must conduct research which considers the South African context of the mobile payment ecosystem.

This study focuses on NFC payments adoption in South Africa. Use and knowledge of the technology is new in South Africa. Additionally, there have not been a lot of studies on NFC mobile payments (Viehland, 2007), especially when it comes to the South African context, where the method of NFC payment has been limited to contactless card (McLeod, 2015). It is thus important to look at the factors that would drive customers to use NFC through their mobile devices to make payments in South Africa and to use a customer-centric approach when developing these systems. These drivers need to be managed based on their relative influence to the customer.

1.5 Delimitations of the study

This study is specific to South African customers. While the recommendations may be applicable in other countries, differences in customer profiles might need to be looked at before it can be applied to those countries. Similarly, this study is tailored to a South African market.

The focus of the study is on personal retail bank customers in South Africa that use current methods, such as cash, credit or debit card, to make payments at Point-of-Sale (POS) terminals. This ranges from entry level customers, many of whom have a low income and may be in possession of an entry level smartphone, to private banking customers, with high net-worth. Bank customers that do not have a smartphone are included in this study. The research sample will be split across customers from different banks.

The research will compose of banking customers across a vast range of ages to determine how age may affect perceived ease of use, security and usefulness of NFC payments in South Africa. Looking at age groups will give an idea of different customer preferences, which will provide better guidance to different customer needs.

1.6 Assumptions

The main assumption is that customers will be able to easily switch from a payment method that offers them less value to another payment method that offers more value. We would assume that customers will be informed about this new technology. It is also assumed that customers would have the same understanding of what each of the drivers mean.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

In the previous chapter the themes that will be covered in this study were discussed. The objectives, significance of the study and the delimitations were presented. As highlighted in the previous chapter, the main purpose of the study is to identify key drivers that affect customers in their decision to use mobile phones to make NFC payments instead of using traditional methods like cash, debit or credit card. There is not much research that has been conducted on this aspect of NFC. Aydin, Kun, and Ok (2010) mention that most of the NFC academic literature concentrates more on the science of its design than on the behavioural aspect.

In this chapter, the literature review will be looked at, which is an important part of the research process. It provides critical information that is useful in identifying knowledge gaps that should be permeated by the researcher (Webster & Watson, 2010). The literature concerning the problem presented above and factors that are used to formulate propositions for the topic that is being researched are discussed in this chapter.

NFC is a technology that allows communication between electronic devices when they are at proximity to each other (around 20 centimetres). Nokia was the first mobile phone that was NFC enabled and it was developed in 2006. A mobile phone that is NFC enabled is able to communicate with another electronic device that is NFC enabled (Halaweh, 2013).

A study by Massoth and Bingel (2009) has shown that NFC payments are 25% more efficient when compared to other mobile payment methods, such as Interactive Voice Response, Short Message Service, Wireless Application Protocol and One Time Password Generator. Although bank credit and debit cards that have the ability to use NFC payments are available in South Africa, the aim of this study is to specifically look at factors affecting the usage of active NFC payments which are made from a mobile phone at a Point-of-Sale.

A similar study was done by Viehland (2007) who used the Technology Acceptance Model (TAM) to assess how consumers in New Zealand would accept the use of their mobile phones to make payments at Point-of-Sales. He concluded that most customers would not use their mobile phones to make payments because of security concerns, especially those of confidentiality. The study was conducted at a point when the technology already existed in New Zealand (Viehland, 2007).

The adoption concepts identified must be considered in relation to the existing literature to determine the value of their deeper investigation as well which models would be applicable in determining their true significance. Most New Zealand customers were driven by convenience to use their mobile phones to make payments (Viehland, 2007). However, in this paper the drivers identified by Amin (2007) from a study conducted in Malaysia, which are suggested as perceived usefulness, perceived ease-of-use and perceived credibility, will all be considered in a South African context.

2.2. Mobile Phone NFC Payments in South Africa

World market developments are different and uneven in each country. There are countries that are more advanced than others when it comes to technology development (Ondrus & Pigneur, 2007). The use of mobile phones to do NFC payments is available in South Africa but only from a single bank. This is compounded by the unfortunate fact that there is not that much academic literature available for this subject due to the fact that this technology is still in its infant stages (Tan, Ooi, Chong, & Hew, 2014). There are countries like Japan and South Korea that have implemented successful NFC payments (Ondrus & Pigneur, 2007). The implementation of such payment methods has however not been successful in Europe and North America (Ondrus & Pigneur, 2007).

The use of mobile phones to do NFC payments has been limited to a niche market in the Netherlands due to the retailers not seeing the benefits of spending money on new NFC enabled equipment without knowing if it is what the customer needs and if it worth the cost (Lourens, 2015). Similarly, in Malaysia the use of mobile phones to do NFC payments is not widely used by consumers, even though it was implemented in 2010 (Tan, 2014). In Switzerland, the market is still immature and the payment method is limited to a niche market also (Ondrus & Pigneur, 2007). The research shows that

smart cards and contactless cards are performing quite well, but experts still believe that NFC will disrupt payments as we know them because of the continuing increase in mobile phone penetration.

Table 1 below indicates the mobile phone penetration in South Africa.

Table 1: Mobile phone penetration in South Africa (BusinessTech, 2013)

Criteria	Value
South African Population	51.8 million
Total mobile connections (active SIM Cards)	66.1 million
Total unique subscribers (people)	40.7 million
Mobile penetration	128%

Table 1 above indicates that there are 51.8 million individuals in South Africa, with a total of 66.1 million active mobile connections. This means that there are more active mobile devices in South Africa than there are people. The opportunity to use mobile devices to perform payments is increasing and currently results at a 128% penetration.

Below (Table 2) is the number of customers banked with at least one of the South African retail banks over two subsequent years.

Table 2: Customers per Bank in South Africa (BusinessTech, 2015)

Bank	Customers 2013/14	Customers 2014/15	Change
Standard Bank	10.4 million	11.1 million	6.7%
Absa	8.6 million	9.2 million	7.0%
FNB	7.6 million	7.3 million	-3.9%
Nedbank	6.7 million	7.1 million	6.0%
Capitec	5.8 million	6.2 million	6.9%

When looking at mobile phone users per bank (Table 2), the table above indicates that there is growth for every bank, except for FNB, which had a loss of 3.9%. All the other banks grew by around 7% in terms of their customers that use mobile phones. This year-on-year growth indicates to us that the platform to use mobile phones to perform NFC payments is becoming wider every year.

2.3. Theoretical Background

This study aims to determine the drivers and sub-drivers that influence customers' adoption to NFC payments using their mobile phones in South Africa. However, to determine this one must also review other payment methods and their adoption to some extent.

The use of debit cards was a revolutionary step, as stated by the Carow and Staten (1999) study, and customers still use and trust them to transact up to this point. Now there are debit cards that have the NFC enabled functionality that allows the customer to just wave their card over the Point-of-Sale device and the transaction is successfully

completed (McLeod, 2015). The trends in adoption of both payment types can be valuable considerations when considering adoption of a new payment method.

This study also considers a customer's age as a factor that may influence the likelihood of adopting this new way of making payments. Similarly, this factor and its effect on the adoption of other technologies may be significant. Renaud and Biljon (2008) used the Senior Technology Acceptance & Adaptation model to investigate the adoption of the elderly to mobile technology and their study concluded that elderly adults never fully accept the use of new technology. This was not however applied specifically to NFC payments by mobile device and in relation to the other adoption factors being considered in this study, nor does it review the South African market specifically. This study therefore investigates if the same applies to NFC payments using mobile devices in the South African context. The adoption by customers of the use credit cards to make payments took time (Ondrus, Lyytinen, & Pigneur, 2009). We might be looking at a similar scenario when it comes to this new form of making payments.

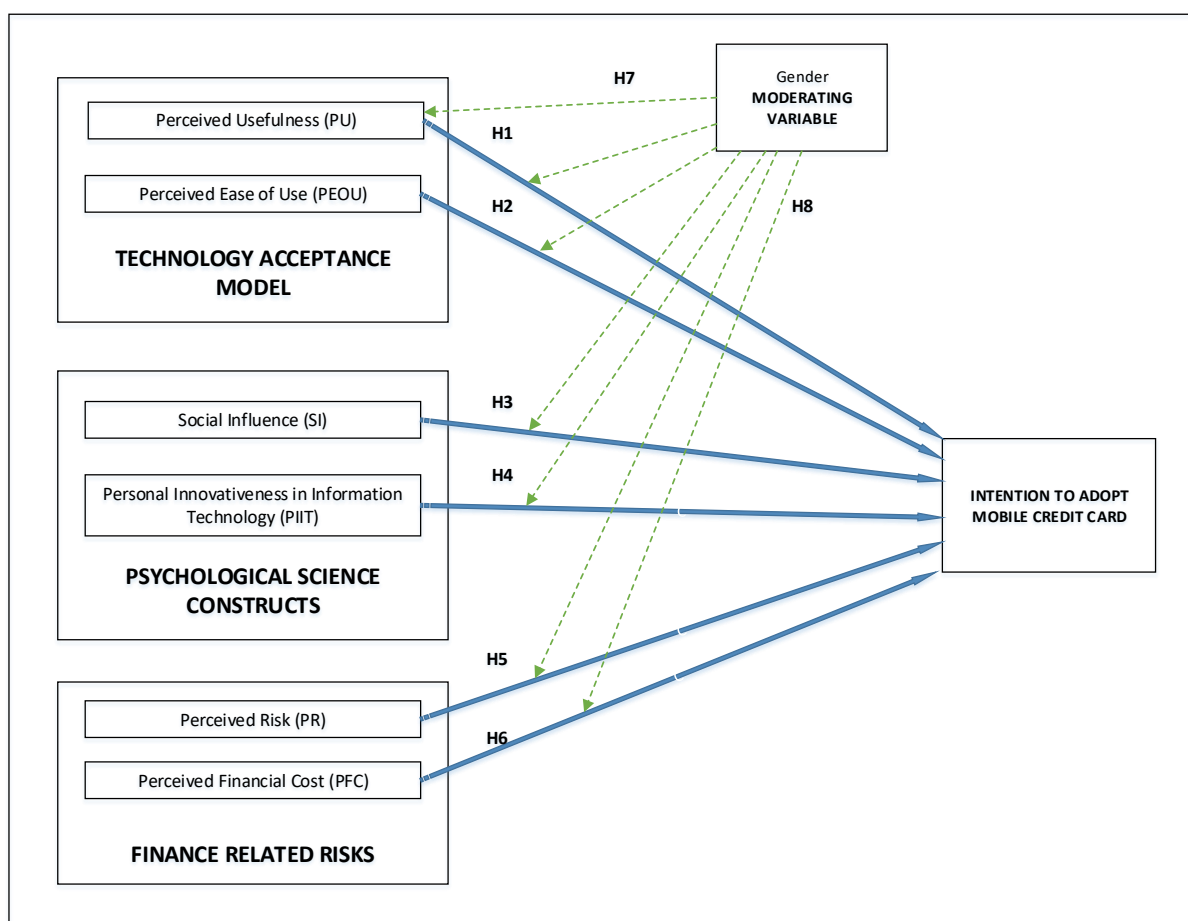
We must therefore ask what it is about this new payment technology that would make the user want to use it. It is this question that dictates the aim of this study; to evaluate what drivers would lead the customer to using NFC payments through their mobile phone even though there are other available means of payments.

The Technology Acceptance Model (TAM) is often used to determine if a new piece of technology will be adopted or not (Porter & Donthu, 2006). As a trusted approach, this model is an important consideration for a study of this nature.

The TAM method is the most widely applied theory when it comes to determining the adoption of new technologies by its users. It states that perceived usefulness and perceived ease of use influence attitudes toward new technology. This method can be used to predict whether individuals will use new technology that has been introduced, based on the technology's ease of use and usefulness as perceived by that individual (Davis, 1989). Perceived usefulness may be defined as a measure of how much an individual believes a particular system will assist them to enhance their job performance (Viehland, 2007). Perceived ease of use may be defined as a measure of how much an individual believes that using a particular system would be effortless (Viehland, 2007).

The original Technology Acceptance Model (TAM) concludes that the two factors that affect the adoption of technology by users are *Perceived Usefulness* and *Perceived Ease of Use* (Davis, 1989). This review will however consider factors that were used in the study by Tan (2014). The study used the Technology Acceptance Model (TAM) that has been modified to include four additional components: *Social Influence*, *Personal Innovativeness in Information Technology*, *Perceived Risk* and *Perceived Financial Cost*. These are considered with the original two: Perceived Usefulness and Perceived Ease of Use (Tan, 2014).

Figure 3: Modified TAM Research Framework (Tan, 2014)



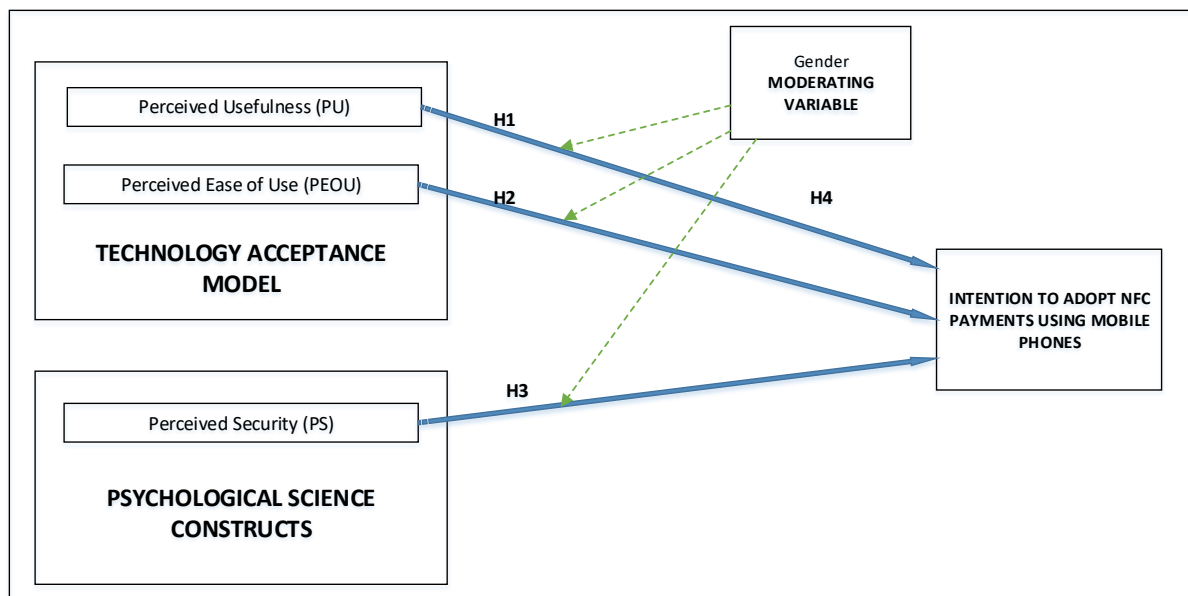
In their study Tan (2014) modified the TAM model (Figure 3) to include Perceived Risk, Social Influence, Personal Innovativeness in Information Technology and Perceived Financial Costs as additional factors that affect the adaption of technology. Gender was used as a moderating factor in the study. The study concluded that gender had

an influence only on Perceived Ease of Use (as a motivating factor for females) and Perceived Usefulness (as a motivating factor for males).

To conduct this study the modified TAM model of Tan (2014) will be adapted to be relevant to this study by including Perceived Risk as additional factor. It will be used together with a quantitative model to evaluate the adoption of NFC technology. Age will be used in the study as a moderating variable to evaluate how it affects the effects of Perceived Ease of Use, Perceived Usefulness and Perceived Security of NFC technology.

This study will make use of an adapted framework as shown in Figure 4 below:

Figure 4: Adopted Framework from Modified TAM



2.4. Factors influencing the Adoption of NFC Payments using mobile phones

There are drivers that influence the adoption of a new technology by customers or individuals. A study conducted by Ondrus and Pigneur (2007) through a focus group resulted in the following list of factors that affect the adoption of NFC payments. The results were then verified with several experts.

- **Ease of use** - The degree to which the individual believes that a system does not require any effort
- **Cost** - Include any cost related to using the technology (direct and indirect)
- **Reliability** - The individual should trust that the transaction will go through successfully as it involves finances
- **Market Acceptance** - The degree to which the individual is already willing to accept the technology
- **Security** - The extent to which the technology is secured
- **Flexibility** - Can the technology be used by many other applications?
- **Maturity** - The stage of development the technology is in
- **Speed** - How fast the technology is in making payments when compared to other means of payments
- **Scalability** - Is the payment method usable in large and small environments

Using the criteria above, Ondrus and Pigneur (2007) concluded that smart card and contactless cards were still being preferred when compared to making NFC payments using a mobile phone. The results are the same in a number of industries, which might be because the NFC technology is fairly new and there are developments that are still required (Ondrus & Pigneur, 2007).

2.4.1. Time Efficiency

According to a study done by Polasik (2013), paying with cash at a Point-of-Sale is faster than paying with a card, either magnetic strip or EMV. EMV stands for Europay, MasterCard and Visa, this is global standard that is used to authenticate chip-card transactions by using a computer chips. The closest competition to the cash payment method, when it comes to faster payments, is the NFC payment method, with contactless card or mobile phone. Currently, the fastest and preferred (by customers) payment method is the NFC contactless card payment, but noteworthy is that the payment method is used without printing a slip. Two time intervals affect the customer's satisfaction when buying goods at a retail store. Firstly, it is the queuing time and, secondly, it is the time it takes to conclude a transaction at the counter. These two factors also have a considerable impact on the retail store as well. In other words, faster payment methods have are advantageous for both the customer and the

merchant (Polasik, 2013). The longer the time spent by the customer in the queue, the more the cost to them and the merchant (Winder, 2005).

Table 3 below shows the results of a study that was done in Poland by Winder (2005), which shows that NFC mobile payments are, on average, faster (about 25%) than traditional Point-of-Sale payment methods when focusing on the consumer perspective.

Table 3: Duration purchase transactions (Winder, 2005)

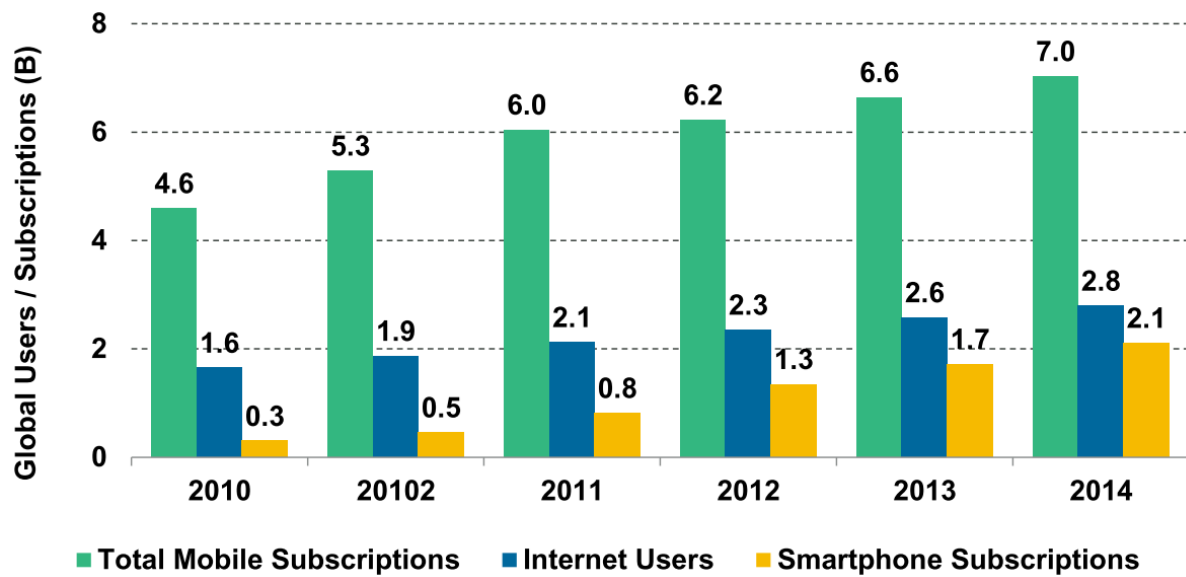
Payment instrument	Mean	Median	Minimum	Maximum	Standard Deviation	Sample size
The consumer perspective						
cash	39.61	33.32	4.75	244.35	25.35	2577
traditional card with signature	59.15	49.93	28.01	216.40	36.41	30
traditional card with PIN	56.29	48.30	29.21	155.18	22.43	186
contactless card - online	40.19	37.06	21.84	134.73	12.54	146
RFID mobile sticker	38.52	37.43	29.61	52.35	4.84	26
NFC mobile payment with PIN	38.95	39.01	32.64	43.75	3.06	14
remote mobile payment	68.16	58.76	38.26	165.64	28.44	52

Table 3 above indicates that cash is still one of the fastest way to make payments at point of sale, with a mean time of 39.61 seconds. NFC mobile payments are faster than cash, with a mean time of 38.95 seconds. NFC mobile payments are even faster than paying with a traditional card. It terms of giving customers a faster service, NFC payments using mobile phones would provide a better alternative to cash and card payments.

2.4.2. Smartphone Penetration

Estimates in a study by Du (2013) indicated that that there would be more than 150 million phones that have NFC capabilities by the year 2014 (Du, 2013). Figure 5 below, from Meeker (2015), shows evidence that there is still a growing global smart phone penetration, even though it might be slowing down slightly. This may be a positive sign that will improve the potential to use NFC payments through mobile phones.

Figure 5: Global smart phone penetration (Meeker, 2015)



With a total global mobile subscription of 7 Billion in 2014 (Figure 5), the acquisition of mobile phones by customers is increasing. The number of smartphone subscriptions form a small part of the total number of mobile subscriptions, at 2.1 Billion, but is it also on a year-on-year increase. This provides an opportunity for NFC payments through mobile phones.

The public's growing dependency on smart phones to make their lives easier is the major driving force behind the use of NFC (Du, 2013). A study done by Mehmood, Hassannezhad, and Abbas (2014) in Italy also indicates that NFC has the potential to saturate the market as a result of the increasing penetration of mobile phones. The study used a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis to produce the NFC strengths, which indicates mobile phone penetration as the most important factor. It also indicates that credit card payments are the main threat to NFC payments.

Figure 6: SWOT analysis of NFC adoption (Mehmood, 2014)

SWOT group	Group weight score	SWOT factors	Local weight score	Overall weight score
Strengths	0.477	S11: Penetration level of mobiles	0.418	0.1994
		S12: Economies of scale	0.210	0.1002
		S21: NFC compatible for use on mobiles	0.175	0.0835
		S22: Can be used for other functions	0.052	0.0248
		S31: Ubiquitous companions	0.045	0.0215
		S32: Faster and convenient	0.100	0.0477
Weaknesses	0.239	W11: Reduction in battery life	0.143	0.0342
		W21: Virus attacks or hacking	0.236	0.0564
		W22: Information misuse	0.374	0.0894
		W31: Phones with NFC cost more	0.112	0.0268
		W32: Infra-structure deployment costs	0.095	0.0227
		W33: Service costs	0.040	0.0096
Opportunities	0.198	O11: Innovative technology (Customer loyalty)	0.390	0.0772
		O12: First mover advantage	0.117	0.0232
		O21: Strategic partnerships	0.175	0.0347
		O22: Increase in customer interaction	0.318	0.0630
Threats	0.086	T11: Lack of business models	0.244	0.0210
		T12: Lack of laws and regulations	0.216	0.0186
		T13: Reluctance of change	0.137	0.0118
		T21: Competition with other technologies	0.403	0.0346

The compatibility of NFC technology on mobile phones is listed as a strength in Figure 6 above but the cost of mobile phones that are compatible with the NFC technology is listed as a weakness. The table above indicates to us that there is work that needs to be done in manufacturing cheaper mobile phones that are NFC compatible.

2.4.3. Cost

Du (2013) mentions that a customer would rather use their mobile device to make payments than withdraw money from an ATM, which may cost them a withdrawal fee. A study was conducted in Germany which looks at the customer's requirements of a payment system. Of the respondents 92% selected "none or low cost" as an approval criteria for mobile payments (Zenker, 2003). In New Zealand 61% of customers were opposed to paying any service fees for their mobile payment functionality (Viehland, 2007).

2.4.4. *Ease of Use*

Findings from a number of studies, including studies by Davis (1989) and Amin (2007), have confirmed the importance of ease of use as a factor that influences individuals' decision to use a particular system. Amin (2007) defines the customer's perceived ease of use as one of the fundamental elements of TAM and indicates that the more an individual believes that using a system will be effortless the more likely they are to use it.

2.5. Barriers to usage of NFC payments through mobile phones

2.5.1. *Business Model*

The reason why most western countries have not been successful at implementing NFC payments has not been scrutinised carefully. It seems it might be because the business model needs to be aligned with the environment in which this payment mechanism is being implemented, and most papers that have been published around NFC payments discuss technical issues (Ondrus, 2009). Osterwalder and Pigneur (2002) proposed a business model that should be used. This consisted of the value proposition that the product is offering to the market, the cost and revenue model, the target market and the infrastructure in which this model will be implemented should be aligned.

2.5.2. *Implementation*

Looking at the failed implementation of the NFC payments in Switzerland by PostFinance, it is indicative that it is a necessity to get buy in from both the merchants and the customers. The value proposition that was being offered was a secure and convenient means of paying for goods at merchant's stores. The payments method failed because the NFC payment was by means of a sticker that was attached to the back of the phone. Instead of implementing the solution for NFC enabled phones only, they decided to include phones that do not have NFC by putting an NFC readable sticker at the back of the phone (Ondrus, 2009).

2.5.3. Security

NFC payments have been implemented in New Zealand. Despite the enormous awareness, the payment method has only been adopted by a small number of customers. Even though they consider the payment method useful, easy to use and convenient, they are more concerned around its security (Viehland, 2007). As Antovski (2002) has mentioned, security has always been an issue from the start when it comes to M-commerce (Mobile Commerce). M-Commerce refers to the purchasing of goods using wireless handheld devices. So in order for NFC payments to succeed they must be secure, in reality and in the customer perception (Viehland, 2007). Four critical factors are mentioned by Nambiar, Lu, and Liang (2004) in their study. These are:

- **Authentication** - The parties participating in the payment transaction need to be verified and it must be confirmed that they are who they claim to be.
- **Confidentiality** - To ensure that only the parties involved (the reader and the sender) in the payment transaction can read the context of the message.
- **Integrity** - Ensuring that the message that has been sent by the sender is not altered before it is received by the receiver.
- **Repudiation** - A mechanism needs to be put in place to guarantee that the parties that were involved in a payment transaction cannot come back at a later stage and deny their involvement.

A study by Amin (2007), which was done in Malaysia, indicated that security and privacy are relevant customer considerations of NFC payments, even if they consider the payment method to be useful and easy to use.

2.5.4. NFC is an Emerging Technology

The NFC payment technology through mobile phones is currently available in Malaysia but it is only used by a few customers. Other customers may potentially be ignoring this technology. The reason for this may be because this technology is still in its early stages and users might not be familiar with it as yet (Amin, 2007). As also pointed out by Halaweh (2013), there is little research available for NFC and this technology has not received enough attention as yet.

2.5.5. Ethical Concerns

Dependency and vulnerability, privacy and also inequality have been raised as the main issues concerning the use of mobile phones to make NFC payments (Halaweh, 2013).

2.5.5.1. Dependency and vulnerability

Relevant factors which make dependency and vulnerability an ethical concern are:

- High dependency on mobile phones means that individuals will constantly be exposed to the radio waves emitted by the phone, which may affect the user's body in the long term or even cause cancer.
- The customer is given the option to communicate directly with the payment mechanism and this may lead to job losses because there would be no need for a cashier.
- Losing a phone may leave an individual in trouble if they are dependent on the use of NFC payments.
- Phone battery will be drained quicker, which may leave the user without any means to make payments.
- May increase irresponsible spending behaviour (Lourens, 2015).

2.5.5.2. Inequality

Relevant factors which raise inequality as an ethical concern are that:

- Users that can afford mobile phones that have NFC capabilities will experience a rapid payment system while others must take longer to make payments.
- Early adopters of the NFC payment system may see it as the best way of making payments because they may have more tech knowledge when compared to an ordinary individual (Halaweh, 2013).

2.5.5.3. Privacy

Privacy becomes a relevant ethical concern as a result of the use of mobile devices as a payment tool due to:

- Easier tracking of individuals by banks and telecommunication companies (Lourens, 2015).

2.6. Formulation of Propositions

The following research problems were presented in chapter 1:

Sub-problem 1: Evaluate the importance of perceived security, perceived ease-of-use and perceived usefulness to the adoption of NFC payments using a mobile phone by an individual.

Sub-problem 2: Evaluate how age affects the individual's perceived security, perceived ease-of-use and perceived usefulness of NFC payments using a mobile phone.

Perceived usefulness and perceived ease of use are the factors that Davis (1989) found, using the TAM model, to influence an individual when adopting a technology. The study concludes that an individual will be motivated to use a system if they perceive it to be useful or easy to use (Davis, 1989). A study from Canada has indicated that 34% of customers prefer to use their mobile devices to make payment instead of the traditional currency (Du, 2013). Based on the studies above, this study will assume that factors of perceived usefulness and ease of use will have the same effect on NFC payments.

Hypothesis 1:

- Individuals will adapt the use of NFC through their mobile devices to make payments at Point-of-Sale if they perceive the technology to be useful.

Hypothesis 2:

- Individuals will adapt the use of NFC through their mobile devices to make payments at Point-of-Sale if they perceive the technology to be easy to use.

Security is suggested by studies as a reason for individuals to not use a certain technology (Viehland, 2007). The study listed security as the second reason for New Zealand customers not to use their mobile phones to do NFC payments.

Table 4: Reasons for not using NFC payments (Viehland, 2007)

Dislike paying for service fees	61.0%
Proper security is probably lacking	30.2%
Easier to pay with cash	30.2%
Service is easy to use, but registration is too troublesome	29.4%
Try new technology later	14.7%
Don't want to change how things are usually done	11.0%
Do not like sending text messages	5.2%
Do not know how to send text messages	2.9%
Can't be bothered trying new things	2.2%

Table 4 above indicates to us that paying for service fees is the first reason why individuals do not use NFC payments, and this is followed by the security of using mobile phones to perform NFC payments. Individuals perceive the use NFC payments to not be secure enough. This indicates to us that the security of NFC payments plays a major role when individuals decide to use NFC payments.

Hypothesis 3:

- Individuals will adapt the use of NFC through their mobile devices to make payments at Point-of-Sale if they perceive the technology to be secure.

Renaud and Biljon (2008) used the Senior Technology Acceptance & Adoption Model (STAM) to look at the adoption of using mobile phones by the elderly and concluded that (1) the perceived usefulness and (2) the ease of learning and use influence the

use of technology by older individuals. A quantitative analysis of the data is needed to evaluate the effect of age on adopting NFC payments.

Hypothesis 4:

- The likelihood of Individuals adopting the use of NFC through their mobile devices to make payments at Point-of-Sales will decline with an increase in age.

These hypotheses, determined from the existing literature, will provide a starting point for answering the problem statement.

2.7. Conclusion of Literature Review

As covered in the literature review above, not enough research has been done on NFC payments due to its infancy. NFC payments through mobile phones have been implemented in several countries but they seem to only be successful in a few of them. This kind of payment method generally ends up being offered to and a niche market and thus is only being used by a small number of customers.

The usage of NFC technology to make payments in South Africa is currently applicable predominantly to payment via contactless card. NFC payments through the use of mobile devices is in its infancy in South Africa. It appears, as per most of the studies conducted in other countries that have implemented this payment mechanism, that South Africa might also follow the same route when it comes to the direction that this payment method might take.

It is clear from the review of existing literature that a closer study of the South African market and its potential to successfully adopt NFC Payments via mobile phone is needed. Such a study would leverage off the existing research and knowledge, but also offers the opportunity to address the problems raised in a new light and certainly in a society which has yet to be considered.

CHAPTER 3: RESEARCH METHODOLOGY

The research methodology that is followed to address the propositions presented in the literature review is described in this section.

3.1. Introduction

The first objective of this study is to identify the drivers and sub-drivers that influence individuals to use mobile phones to do NFC payments. The second objective of the study is to evaluate the importance of user's perceived security, perceived ease of use and perceived usefulness as the factors that motivate customer to adopt the use of mobile phones to do NFC payments. The fourth objective is to evaluate how age affects an individual's perception towards NFC payments security, ease of use and usefulness. These objectives will be achieved through using a quantitative approach. The data to the questions is collected using a questionnaire based survey.

3.2. Research Methodology

A quantitative approach is defined by Creswel (2003) as a process that captures a concept that can be represented in the form of numbers. This is done by creating precise measurements to capture the concept in question. The data that is collected requires analysis using a quantitative approach to determine the importance of perceived usefulness, perceived ease of use and perceived security in influencing the adoption of NFC payments using mobile phones, and to determine if these motivating factors are influenced by the age of the individual.

3.3. Research Design

The study is conducted by using data collected from a survey questionnaire. The questions are intended to evaluate the likely adoption of NFC payments, based on the factors mentioned above, by the individuals taking part in the study. The questionnaire is internet based as suggestion by Gosling, Vazire, Srivastava, and John (2004) that the quality of internet based questionnaires and traditional pen-and-paper methods are of the same standard.

3.4. Population and Sample

3.4.1. Population

The study collected data from many South African adults that have a transactional bank account or a credit card with at least one of the South African retail banks. Due to this being a study based on future adoption, the individuals do not have to be in possession of a smart phone that is NFC enabled. The ages of the population are reasonably spread across the customers that have bank accounts. The intention is to project the findings for a larger population.

3.4.2. Sample and Sampling Method

The sample is high and wide enough to be representative of the total adult population of South Africa that have a transactional bank account or a credit card with one of the South African retail banks. The sample consist of a wide range of ages. This sample includes a range of customers, varying from those with youth accounts to private bank clients, and in an age ranging from 18 to 51 years and above. The sample also includes banking customers that are currently using the NFC technology to make payments through contactless cards.

Microsoft Excel was used as a randomisation tool to select the individuals to participate in the survey. Individuals were selected from a base of business and social network contacts. The selected individuals were verified to make sure that it consists of both individuals that work at banks as well as those that do not, to eliminate any bias towards banking system knowledge.

The selected sample ranges across customers with varying levels of technological knowledge and usage levels. This include those that use digital platforms, like the internet, banking app and mobile phone banking to make payments, as well as those that currently do not use these platforms. The study is intended to provide future predictions so the motivating factors of individuals that do not use digital technology to make payments were taken into consideration.

3.5. Data Collection

Questionnaire were sent out to the targeted individuals. The questionnaire consisted of questions that require the respondents to rate the relative importance of ease-of-use, usefulness and security in relation to the adoption of using mobile phones to do NFC payments at Point-of-Sales. The questionnaire requires the respondent to enter their age to determine the age factor in the adoption of the new technology. The respondent are also asked to reveal the last time they made a payment using their debit or credit card to make certain that they are relevant to the study.

The questionnaire was tested with a small sample to make sure that its content is appropriate. Once validated, it was sent to the total selected sample. The selected individuals were contacted via an email which will have the link that should be selected to access the questionnaire.

Table 5 below lists the demographic fields that are required by the study.

Table 5: Respondents Demographics

Field	Description	Type
Age	The age of the customer	Interval
Gender	The gender of the customer	Nominal
Annual Income	The annual (gross) income of the customer	Interval
Use NFC Payments	Does the individual use contactless card or NFC through their mobile phone to transact	Y/N

Table 6 below informs us of the profile of respondents that were targeted and the number sampled.

Table 6: Profile of Respondents

Type of Respondent	Number of Respondents
Age 18 – 25	7
Age 26 – 30	20
Age 31 - 35	33
Age 36 – 40	9
Age 41 – 50	10
Age > 51	5

3.6. Research Instrument

A questionnaire will be used as a research instrument for this study. The questionnaire will be divided into the following sections:

- **Section 1** (Mobile phone usage) - The user's phone usage will be gathered in this section. Information about what they use their mobile phone for and how informed are they about mobile phone technology.
- **Section 2** (Banking habits) - This section is to find out if the individual uses electronic channels for banking and how comfortable and secure are they with their current payment methods.
- **Section 3** (NFC Payment factors of adoption) - The factors presented in the literature review will be addressed in this section. A 5-point scale will be used to gauge how the identified factors will influence their adoption of using NFC payments.
- **Section 4** (Demographics) - This section will be used to collect user's demographics such as age group, income and gender.

3.7. Data Analysis and Interpretation

A number of factors that have the possibility of influencing the adoption of NFC payments by individuals were identified in the literature review. Chau and Lai (2003) used the factor analysis approach for their study about the factors affecting the

adoption of internet banking. This suggests that the same approach will work for this study and should be applicable to a South African context.

3.8. Limitations of the Study

- The study will be limited to the South African context and is not to be interpreted elsewhere.
- The study will be limited to individuals that are from the ages of 18 to over 55 years.
- Only individuals that have a transactional account or credit card with one of the South African retail banks will be considered.

3.9. Validity and Reliability

3.8.1. External validity

It should be possible to generalise the results of the survey for a larger population and thus the validity of the questionnaire needs to be high.

3.8.2. Reliability

To ensure that the questionnaire is reliable, a pilot group will answer it twice during the testing phase to compare their first answers with the second set of answers. If there is little variance between the two sets of answers, then the questionnaire may be considered reliable.

CHAPTER 4: ANALYSIS AND PRESENTATION OF RESULTS

4.1. Introduction

In this chapter the results of the data collection will be presented. These results were collected using a survey, as stated in the previous chapter, and are presented in line with the specified quantitative research methodology.

4.2. Research results

The questionnaire was sent out to a group of 100 individuals that were selected randomly. The research was targeted at individuals that bank with at least one of the major 5 banks in South Africa.

Received respondent's data was cleaned to:

- Remove individuals that did not bank with any institution in South Africa, as this would mean that they are currently not using any relevant payment technology to the study and their questionnaire would thus not provide useful information.
- Excluded individuals that have not made any form of payment in the last six months to make sure that the information is current and relevant.
- Confirm that there are no individuals under the age of 18 years.

This resulted in a total number of 84 usable responses.

4.2.1. Demographics

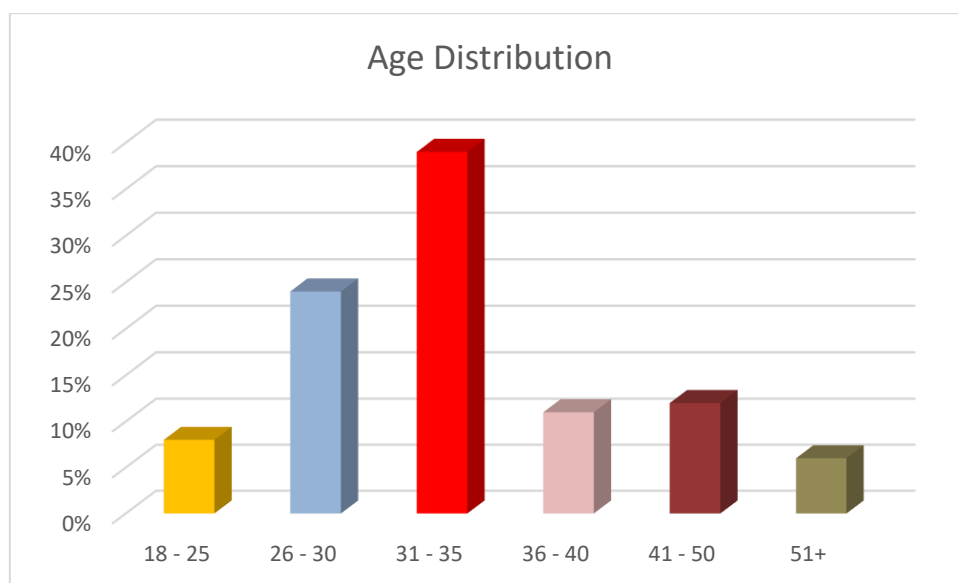
To gain insight into the age, gender, income and education level of the respondents, demographic information was collected. The information may be used to represent specific information and perception per cluster. However, the important demographic clusters that this research concentrates on are age and income. The overall rating of the entire sample relies on income and how the respondents are affected by age.

4.2.1.1. Age Distribution

The age distribution graph shows that majority of respondents fall in the 31 – 35 categories (39%). This is where majority of the active banked population lies and hence the high figure. The rest of the distribution is spread between the age groups as follows:

- 1) 26 – 30 age group that constitutes 24%
- 2) 41 – 50 age group that constitutes 12%
- 3) 36 – 40 age group that constitutes 11%
- 4) 18 – 25 age group that constitutes 8%
- 5) over 51 age group that constitutes 6%

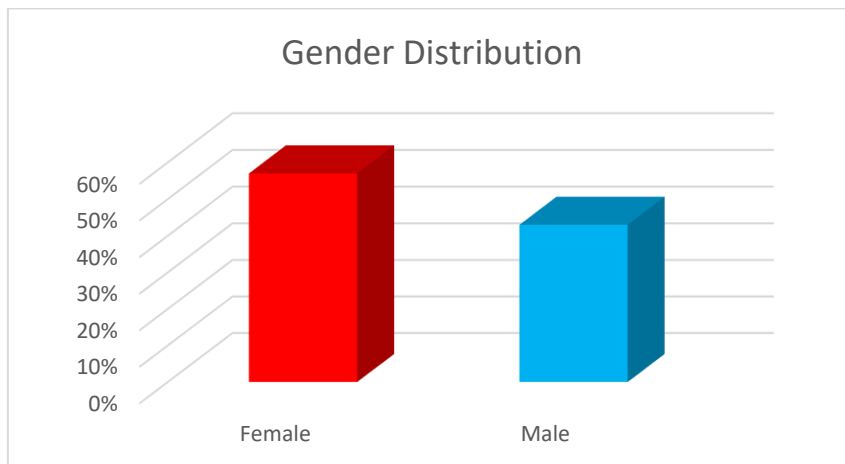
Figure 7: Age Distribution



4.2.1.2. Gender Distribution

The gender distribution is slightly tilted to the female side at 57% and the male at 43%.

Figure 8: Gender Distribution

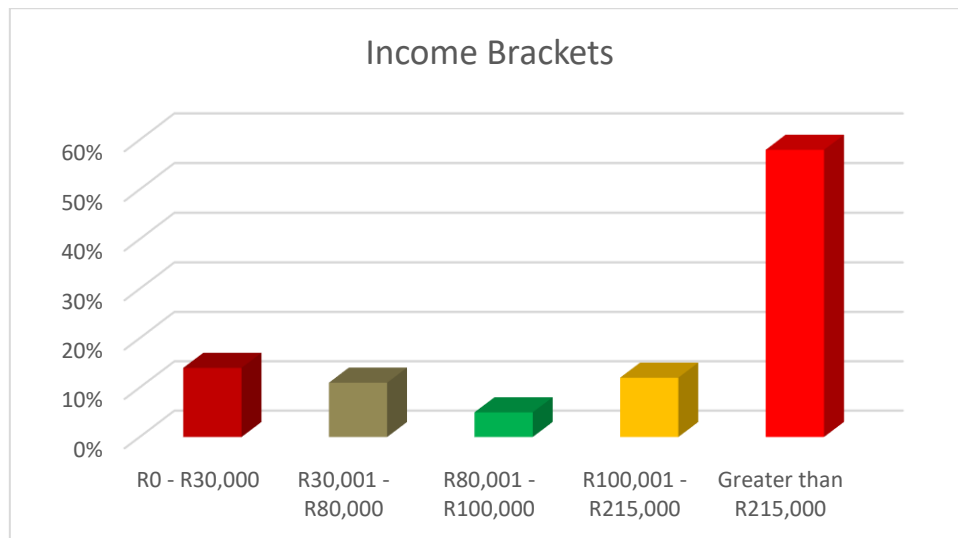


4.2.1.3. Income Bracket Distribution

Most the respondents lie in the “Greater than R215,000” income group, and constitute 58% of the survey group. This is followed by the R0 – R30,000 income group constituting 14%, then the R100,000 – R215,000 income group constituting 12%, thereafter the R30,000 – R80,000 income group constitutes 11% of the survey, followed by the R80,000 – R100,000 income group at 5%.

The collected income groups will assist in grouping the results into different salary clusters. This research will however concentrate on two salary groups, those earning below R100,000 and those earning above R100,000.

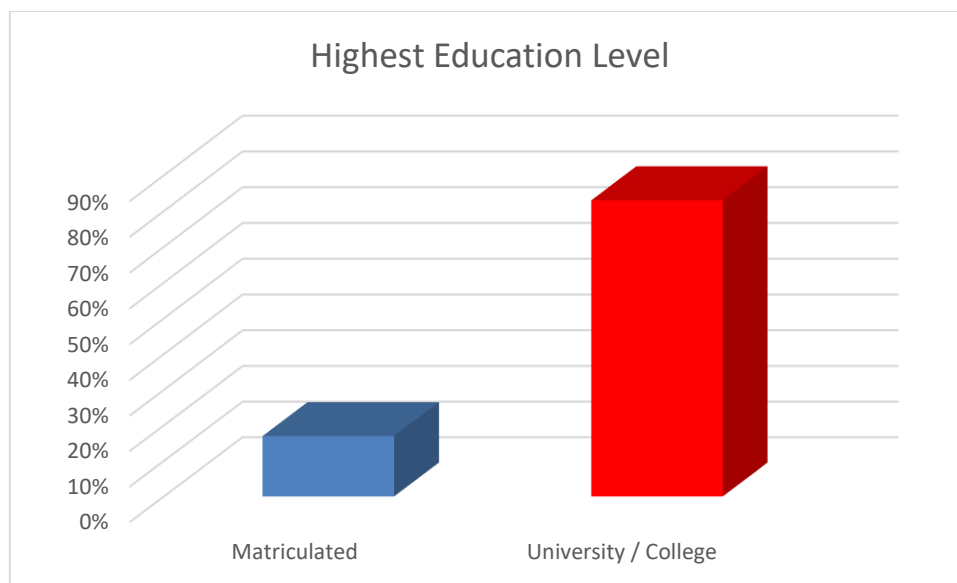
Figure 9: Income Brackets



4.2.1.4. *Highest Education Level*

Respondents fall into two education level categories, with 17% matriculated and 83% having been through university or college. The level of education should not have considerable impact on the research, but should be able to provide some indication as to whether it affects the level at which individuals perceive complexity.

Figure 10: Highest Education Level



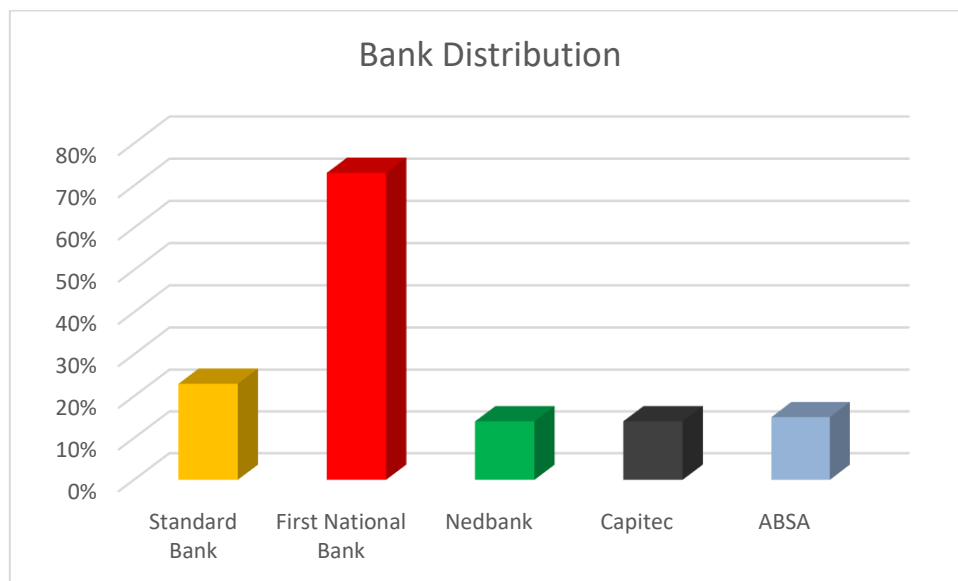
4.2.2. *General Banking*

The survey was used to collect some of the individual's banking behaviour in relation to the bank at which their accounts are held, what methods they use to make payments when they shop for goods and if they use mobile devices to make any kind of payments.

4.2.2.1. *Bank where accounts are held*

Respondents to the survey could select more than one bank. Most of the individual's accounts are held by First National Bank, which constitutes 73%. This number was followed by Standard bank, which constitutes 23%. The rest of the respondents were divided between ABSA, Capitec and Nedbank, which constitute 15%, 14% and 14% respectively.

Figure 11: Bank Distribution

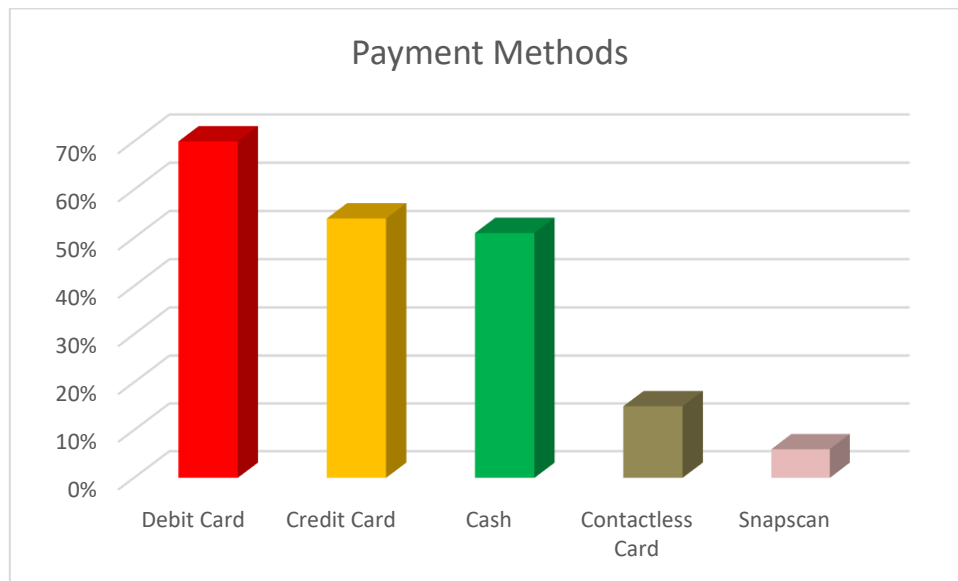


4.2.2.2. Payment Methods

Data about the respondents' preferred means of payment was collected. The data shows that a high percentage of respondents use their debit cards to make payments (70%). It is interesting to see the percentage of individuals that use their credit cards and cash to make payments is almost the same. While 54% of respondents use credit cards for payments, 51% use cash.

The newer means of payments share percentages of 15% for contactless card and 6% for Snapscan. This informs us that most people have not yet adopted these new means of making payments.

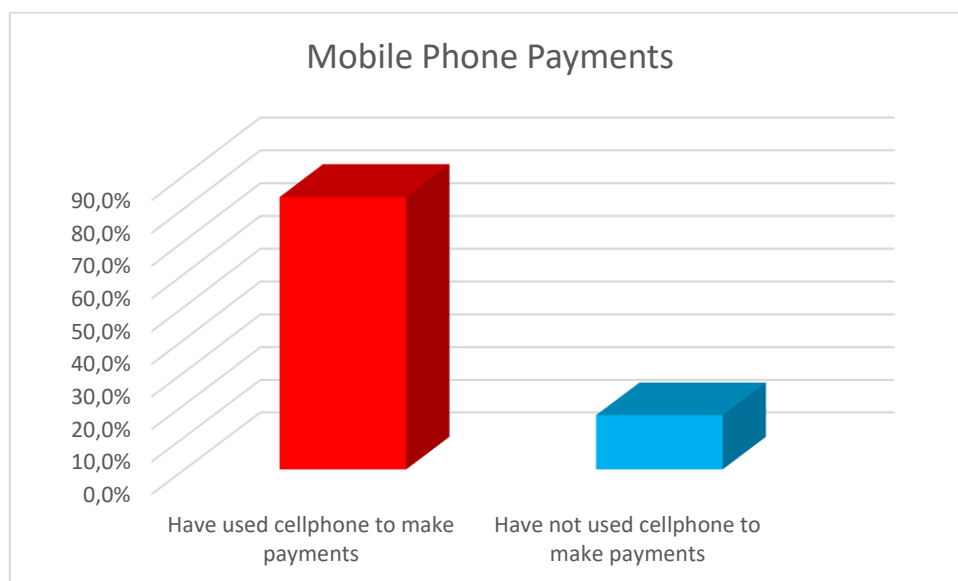
Figure 12: Payment Methods



4.2.2.3. Mobile Phone Payment Transactions

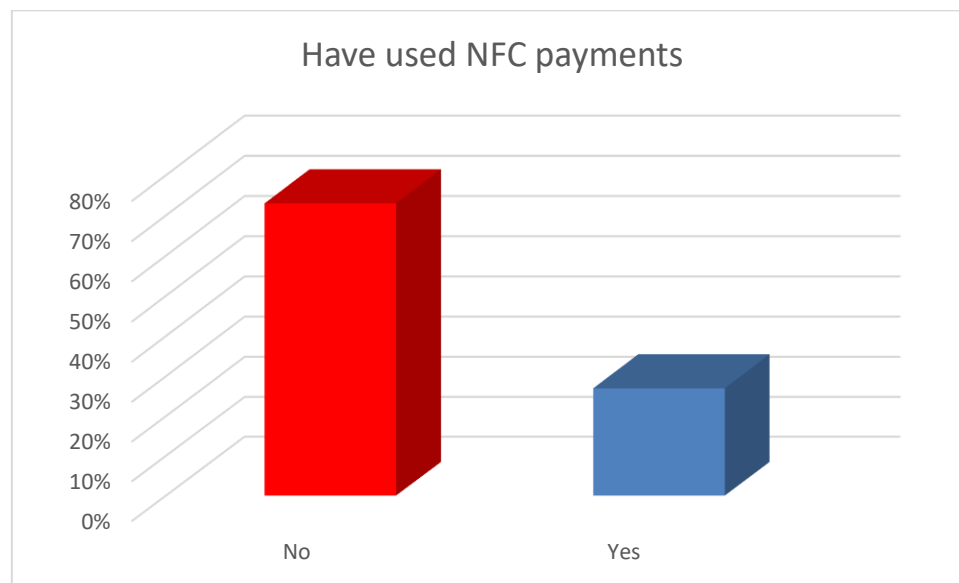
As part of the survey, we asked individuals if they utilised their mobile phones to perform payment transactions. A high percentage of individuals have performed some form of payment using their mobile phones (83.3%), while 16.7% have not used their mobile phones to make any kind of payment.

Figure 13: Mobile Phone Payments



The survey revealed that 27% of the respondents have used NFC payments, while 73% of the respondents have not used NFC to make payments.

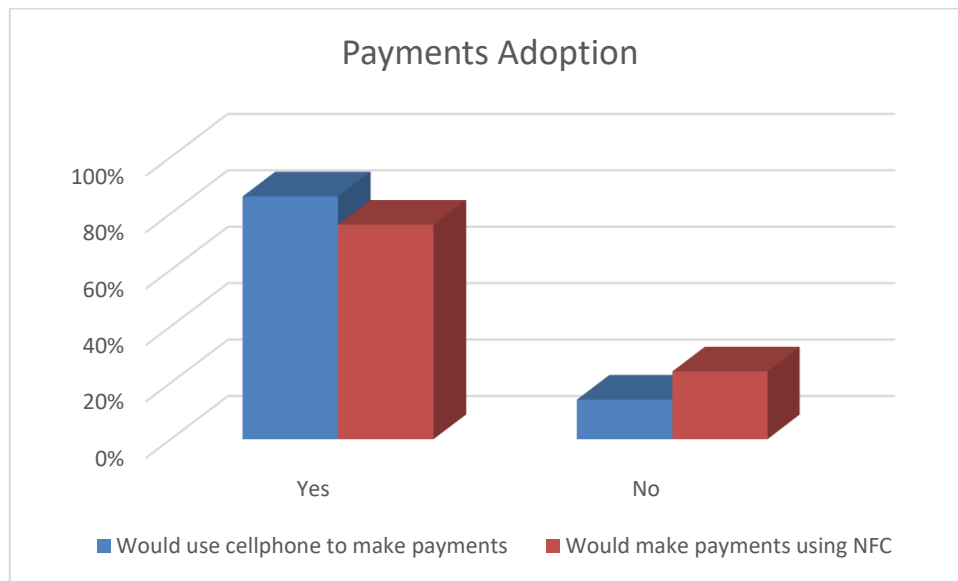
Figure 14: Individuals that have used NFC payments



When looking at the percentage of individuals that would use their mobile phones to make payments for the first time, and looking at whether they would make payments using NFC, the survey revealed that most of the respondents are interested in trying out these means of payments. Of the respondents, 86% state that they would perform a payment transaction using their mobile phone, while a slightly lesser percentage of 76% confirm that they would use their mobile phone to make NFC payments.

Of the respondents who have never used their devices to make payments, 14% will never use them to make payments. Of those who have never used their mobile phone to make payments, 24% will never use them to make payments.

Figure 15: Individuals that are willing to make payments using their mobile phones

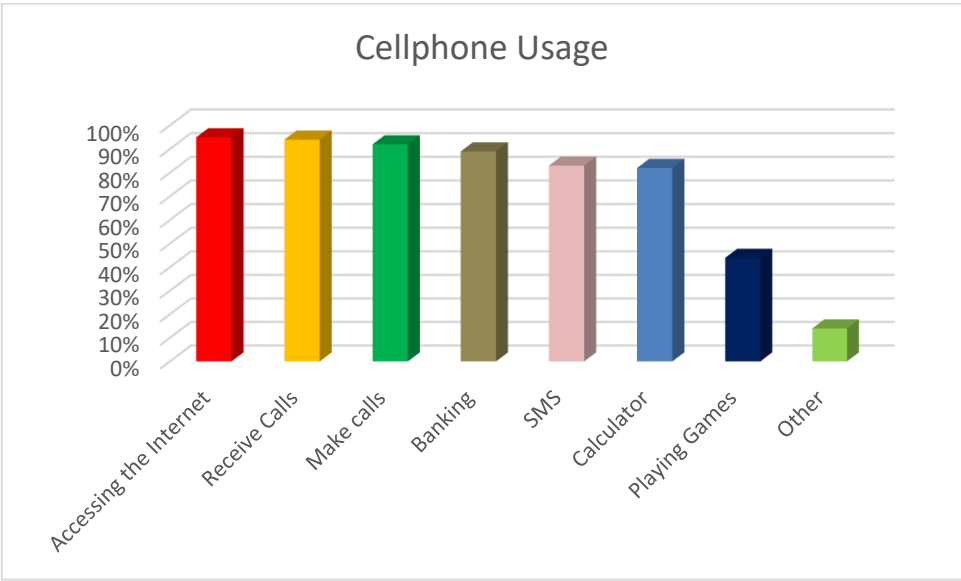


4.2.3. Mobile Phone Usage

The survey was also used to evaluate what the respondents used their mobile phones for on a day to day basis. The purpose of collecting this data was so that comparisons can be made between the behaviour of individuals and their phone usage. The recorded mobile phone usages are almost the same except for “Playing games” and “Other”. “Other” comprises of individuals that use their mobile phones for social media, reading, WhatsApp, music, movies, memos and maps.

The mobile phone usage response is divided into accessing the internet (95%), Receive Calls (94%), Make Calls (92%), Banking (89%), SMS (83%), Calculator (82%), Playing Games (44%) and Other (14%).

Figure 16: Mobile Phone Usage



4.2.4. Data Sharing

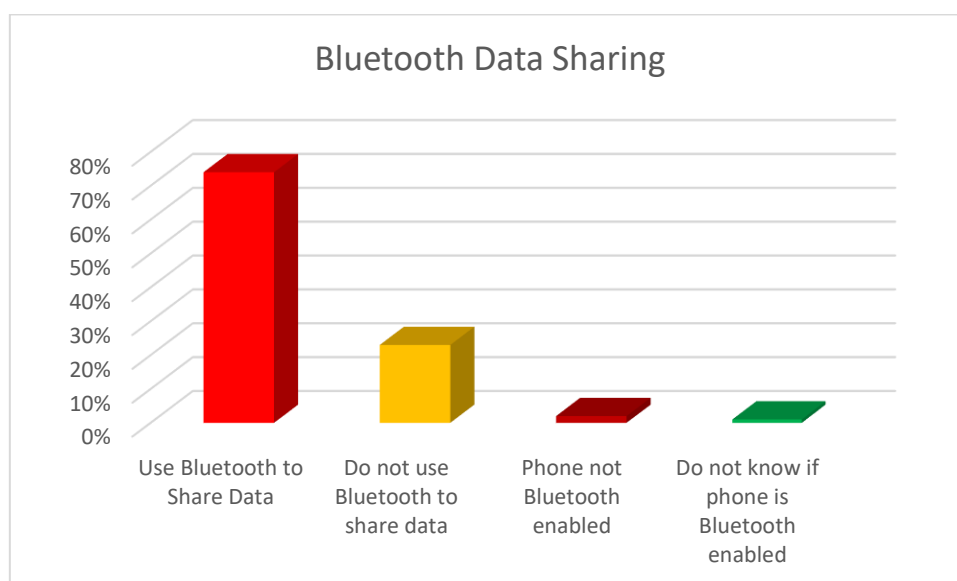
Since NFC is a means of sharing data, the survey looked at how comfortable individuals are with sharing information using NFC and Bluetooth. If individuals are comfortable with sharing data using NFC and Bluetooth, then they might be more comfortable sharing payment data using NFC.

4.2.4.1. Bluetooth Data Sharing

Most individuals have phones that are Bluetooth enabled and they use it to share information. Of the sample group 74% of individuals indicated that they do use Bluetooth to share data, while 23% do not use Bluetooth to share data.

Only 2% of respondents do not have phones that are Bluetooth enabled and 1% of the respondents do not know if their phones are Bluetooth enabled or not.

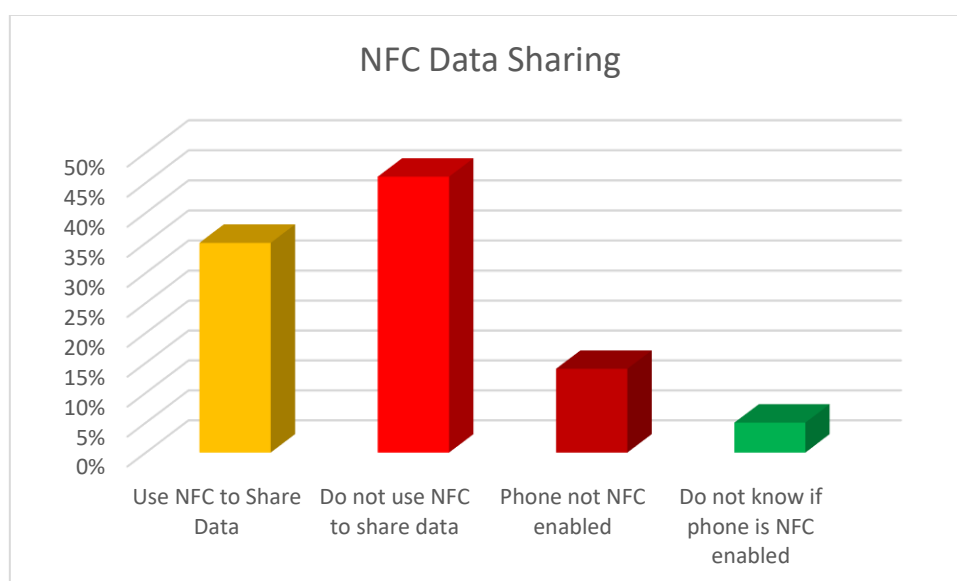
Figure 17: Individuals that use Bluetooth to share data



4.2.4.2. NFC Data Sharing

When compared to Bluetooth, most individuals do not use NFC to share data (46%). The percentage of individuals that use NFC to share data is 35%. The lower number of individuals that use NFC to share data might be affected by the higher percentage of phones that are not NFC enabled, which is at 14%, and the high percentage of individuals that do not know if their phone is NFC enabled, which is at 5%.

Figure 18: Individuals that use NFC to share data



4.2.4. Adoption Factors

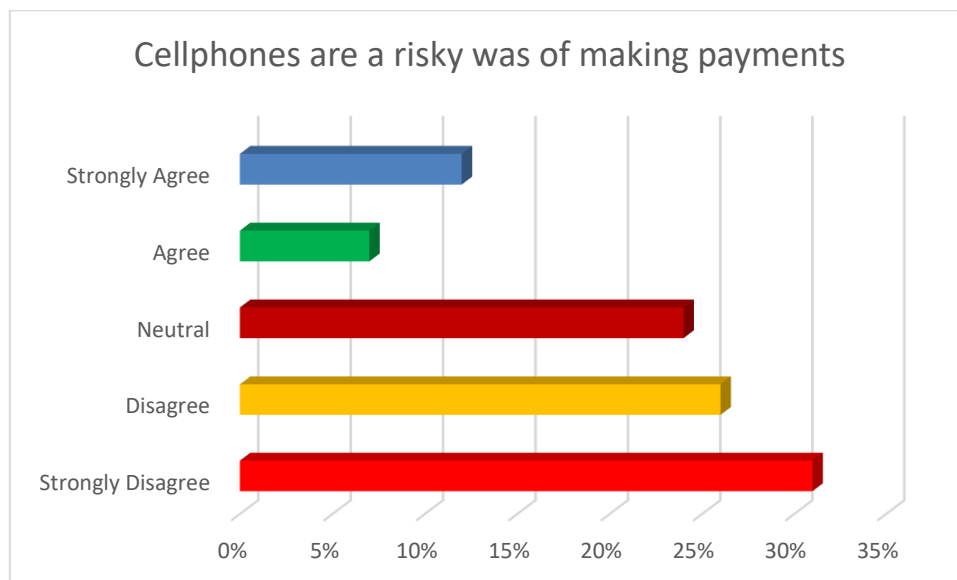
The study looks at six adoption factors that may influence whether individuals use their mobile phones to perform NFC payments.

4.2.4.1. Risk of Using Mobile Phones to Make Payments

The results show that most individuals (31%) strongly disagree with the statement that mobile phones are a risky way of making payments. The percentage of individuals that disagree with the statement (26%) is only slightly higher than that of individuals that are neutral about the riskiness of making payments using a mobile phone (24%). On the other hand, only 12% of individuals strongly agree that mobile phones are a risky way of making payment, and 7% agree with the statement.

On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, the respondents' average came to 3.57.

Figure 19: Mobile phones are a risky way of making payments



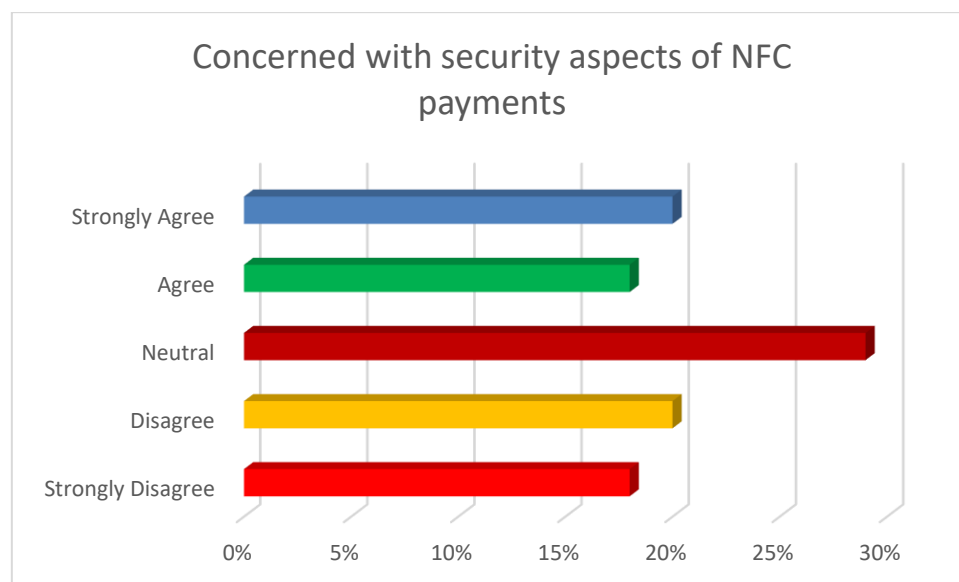
4.2.4.2. NFC Security Aspects

When respondents were asked if they are concerned about the security aspects of NFC payments, 29% of respondents responded as being neutral to the security

aspects of NFC payments. Percentages of respondents that strongly agree that they are concerned about the security aspects of NFC payments and those that disagree with the statement are the same at 20%. Individuals that agree that they are concerned about the security aspects of NFC payments and those that strongly agree that they are concerned about the security aspects of NFC payments each constitute 18%.

On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, the respondent's average came to 3.02.

Figure 20: Concerned with NFC payments security aspects

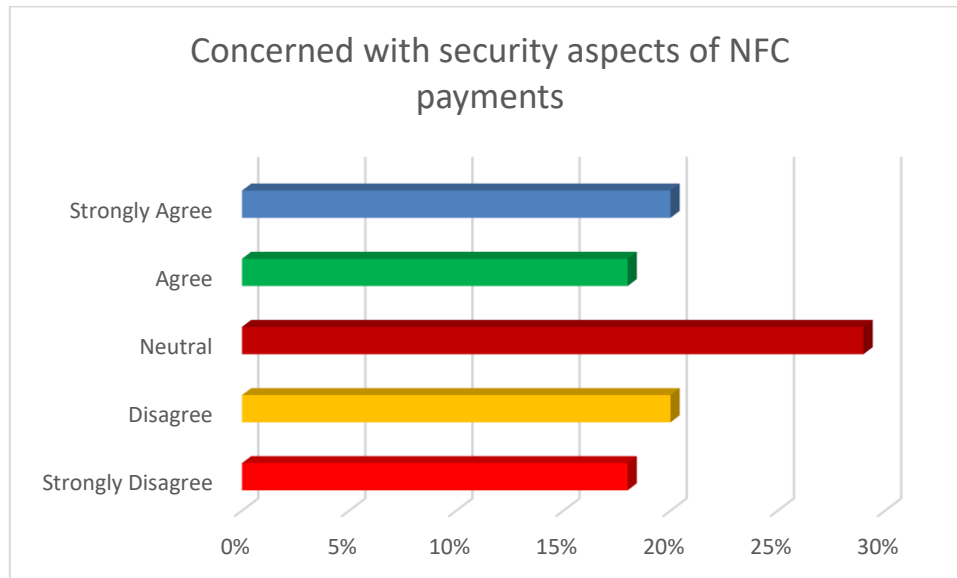


4.2.4.3. Tampering of payment transactions

The respondents were asked if they believe that their payment transactions may be tampered with if they use their mobile phones to perform NFC payments. The majority of the respondents were neutral about this question (42%), which may be due to a lack of knowledge about NFC payments because it is a new technology. This was followed by 18% of individuals that agree that information concerning their NFC payment transaction may be tampered with by others. Interestingly, both individuals that strongly disagree and those that strongly agree with the statement constitute the same percentage of 15%. Lastly, 10% of respondents disagree that NFC payment transaction may be tampered with by others.

On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, the respondent's average came to 2.92.

Figure 21: Concerned with tampering of payment information

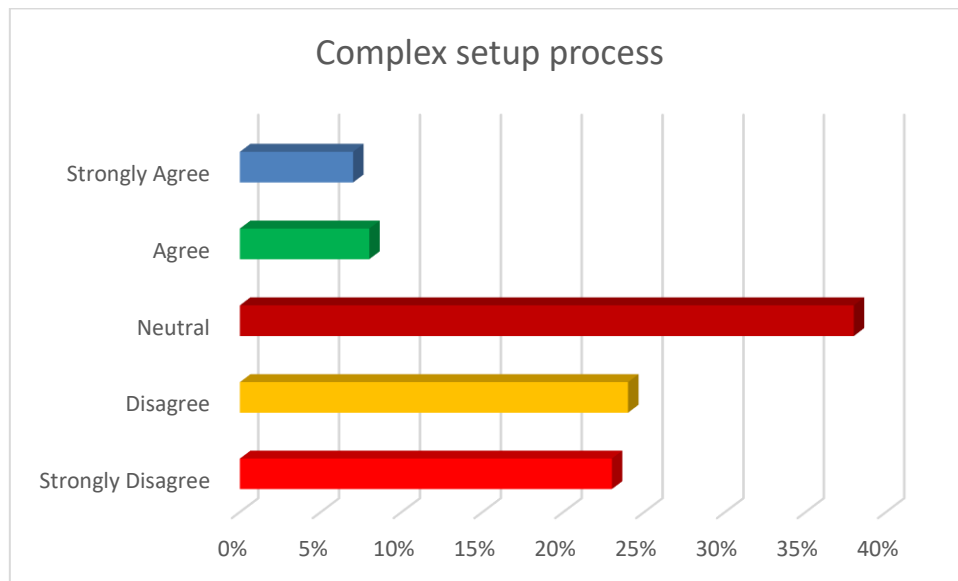


4.2.4.4. *NFC Payment Complex Setup Process*

When asked if the NFC payments setup process was complex, 38% of respondents were neutral. This might have been due to a lack of knowledge about the setup process for NFC payments. Percentages of individuals that strongly disagree and those that disagree that the NFC payment setup process is complex are almost the same, at 23% and 24% respectively. Individuals that strongly agree and those that agree constitute almost the same percentages also, at 7% and 8% respectively.

On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, the respondent's average came to 3.46.

Figure 22: Individuals that think NFC payments setup process is complex

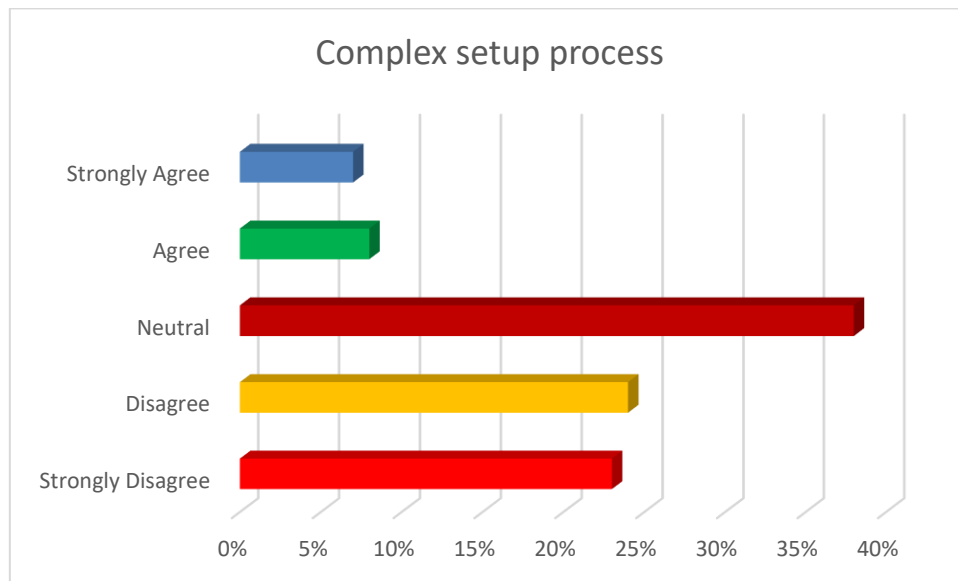


4.2.4.5. Risk of Losing One's Mobile Phone

The majority of the respondents were worried about losing their mobile phones, which may allow other people to gain access to their mobile phone and use it to make payments. This can be ascertained by the fact that 30% of the respondents agree with this statement, in addition to which a further 26% strongly agree. Individuals that are neutral constitute 21%. Those that strongly disagree and disagree with the statement constitute 11% and 12% respectively.

On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, the respondent's average came to 2.51.

Figure 23: Individuals that are concerned about losing their mobile phones

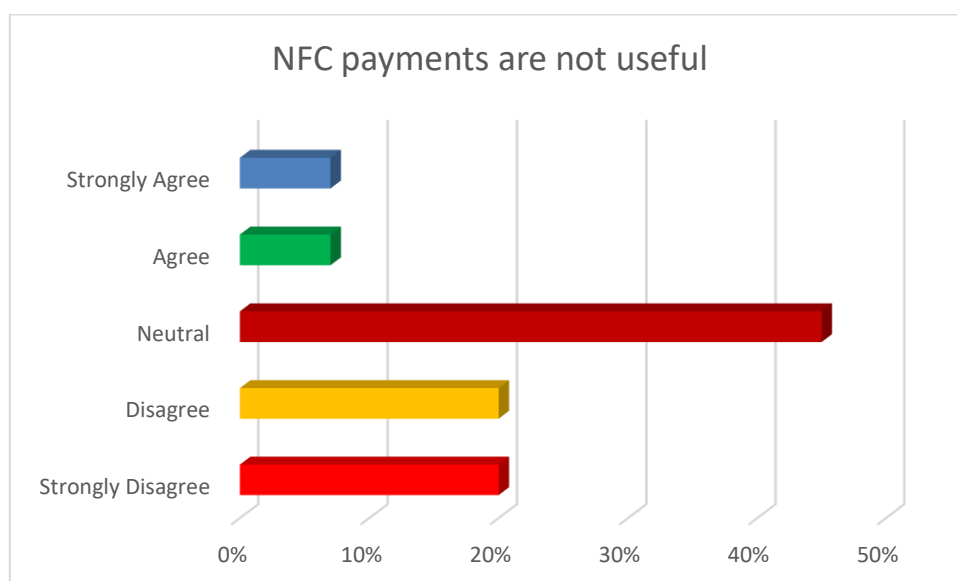


4.2.4.5. Usefulness of NFC Payments

The majority of the respondents were neutral about the usefulness of NFC Payments. These individuals constitute 45% of the sample group. This may be due to the fact that most people still use debit cards, credit cards and cash to make payments and do not necessarily see a need for NFC payments. Individuals that strongly disagree and those that disagree both constitute 20%. Individuals that strongly disagree and those that disagree both constitute 7%.

On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, the respondent's average came to 3.39.

Figure 24: Individuals that believe that NFC payments are not useful



4.3. Data Analysis

4.3.1. User Types

The mean for every adoption factor was calculated for three categories of users; individuals that currently use NFC payments, individuals that would potentially use NFC payments and individuals that would never use NFC payments. This will give an idea of how the different users perceive different usability and security factors. The results below show that individuals that are currently using NFC payments are less concerned about the security and they are the customer base that believes that NFC payments are useful.

On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, below are the means for all factors evaluated.

Table 7: Means per user categories

Factor	NFC User	NFC Potential User	Non-User
Mobile phones are a risky way of making payments	4.6	3.6	2.4
Concerned about the security aspects of NFC payments	4.1	3.1	1.9
Information concerning my payment transactions can be tampered with by others	3.6	3.0	2.1
NFC Payments require a complex setup process	4.3	3.3	2.9
I may lose my phone and risk someone getting access to make payments	3.0	2.6	1.8
NFC payments are not useful	4.0	3.2	3.1

4.3.2. Salary Groups

The mean per salary group categories was calculated. On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, below are the means for all factors evaluated.

Table 8: Behaviour mean per salary group

Factor	R0 – R30000	R30001 – R80000	R80001 – R100000	R100001 – R215000	Above R215000
Mobile phones are a risky way of making payments	3.6	3.3	2.0	3.9	3.7
Concerned about the security aspects of NFC payments	3.4	2.9	2.0	2.9	3.1
Information concerning my payment transactions can be tampered with by others	2.9	2.9	1.8	3.0	3.1
NFC Payments require a complex setup process	3.0	3.4	3.0	3.0	3.8
I may lose my phone and risk someone getting access to make payments	2.1	2.3	1.5	2.7	2.8
NFC payments are not useful	3.1	2.7	3.8	3.3	3.7

The data above can be used to derive the answer to the question that was posed in the previous chapters, pertaining to whether salary affects the perception of individuals towards NFC payments. Below is the total mean of individuals that earn below R100,000 per annum and those that earn above R100,000 per annum.

Table 9: Below and above R100,000 salary groups

Factor	Below R100000	Above R100000
Mobile phones are a risky way of making payments	3.0	4.0
Concerned about the security aspects of NFC payments	2.8	3.0
Information concerning my payment transactions can be tampered with by others	2.5	3.0
NFC Payments require a complex setup process	3.1	3.4
I may lose my phone and risk someone getting access to make payments	2.0	2.7
NFC payments are not useful	3.2	3.5

Individuals that earn more than R100,000 per annum scored more than individuals that earn less than R100,000 for all behaviours.

4.3.3. Age Groups

Analysis of the different age groups and how they affect the individual's perceptions was conducted. On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, below are the means for all factors evaluated per age group.

Table 10: Adoption Factors by Ae Group

Factor	18 – 25	26 – 30	31 – 35	36 – 40	41 - 50	51+
Mobile phones are a risky way of making payments	3.4	3.9	3.6	3.3	3.5	3.2
Concerned about the security aspects of NFC payments	3.3	2.9	3.1	3.0	3.0	2.6
Information concerning my payment transactions can be tampered with by others	2.7	2.6	2.8	3.3	3.2	2.0
NFC Payments require a complex setup process	3.4	3.3	3.5	3.8	3.5	3.5
I may lose my phone and risk someone getting access to make payments	1.7	2.4	2.6	3.1	2.3	1.8
NFC payments are not useful	3.1	3.3	3.4	3.4	2.9	2.8

4.3.4. Level of Education

The average score for the two levels of education was reviewed to ascertain if an individual's level of education affects how they perceive the different adoption factors.

On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, below are the means for all factors evaluated.

Table 11: Adoption Factors per Level of Education

Factor	Matriculated	University / College
Mobile phones are a risky way of making payments	3.4	3.6
Concerned about the security aspects of NFC payments	3.0	3.0
Information concerning my payment transactions can be tampered with by others	2.9	3.0
NFC Payments require a complex setup process	3.5	3.5
I may lose my phone and risk someone getting access to make payments	2.6	2.5
NFC payments are not useful	3.0	3.4

The data shows that there is no substantial difference between individuals that matriculated and those that have studied at university or college. The only substantial difference that we see is when they were asked about the usefulness of NFC payments, which averaged at 3.0 for matriculated individuals and 3.4 for university or college individuals.

4.3.5. Gender

The mean figures below look at the differences in male and female perceptions of the NFC payment adoption factors. On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, below are the means for all factors evaluated.

Table 12: Adoption Factors per Gender

Factor	Male	Female
Mobile phones are a risky way of making payments	3.7	3.5
Concerned about the security aspects of NFC payments	3.3	2.8
Information concerning my payment transactions can be tampered with by others	3.1	2.8
NFC Payments require a complex setup process	3.7	3.4
I may lose my phone and risk someone getting access to make payments	2.7	2.4
NFC payments are not useful	3.4	3.4

5.3.6. Individual Banks

Individual banks were looked at to determine how factors are averaged across the different banks.

On a scale of 1 – 5, where 1 is strongly agree, 3 is neutral and 5 is strongly disagree, below are the means for all factors evaluated.

Table 13: Adoption factors per Bank

Factor	Standard Bank	ABSA	Nedbank	FNB	Capitec
Mobile phones are a risky way of making payments	3.6	3.5	3.6	3.6	3.8
Concerned about the security aspects of NFC payments	3.2	3.5	3.0	3.7	5.0
Information concerning my payment transactions can be tampered with by others	2.9	3.0	3.3	5.0	2.9
NFC Payments require a complex setup process	3.6	3.7	5.0	3.7	3.4
I may lose my phone and risk someone getting access to make payments	3.0	5.0	2.4	2.3	2.8
NFC payments are not useful	5.0	3.6	3.4	3.4	3.5

4.4. Hypothesis Analysis

In the section below we look at the data presented above in relation to the hypotheses that have been discussed in the previous chapter.

4.4.1. Hypothesis 1:

- Individuals will adopt the use of NFC through their mobile devices to make payments at Point-of-Sale if they perceive the technology to be useful.

To give an indication of whether individuals that perceive NFC payment technology to be useful are more likely to use it, individuals that have used NFC to make payments and those that have not used NFC to make payments were asked if they think NFC payments are not useful.

The mean of the scale of 1 to 5, where 1 is strongly agree and 5 is strongly disagree, have been recorded in the table below.

Table 14: Are NFC payments useful

Individual's Behaviour	NFC Payments are not useful (Mean)
Have not used NFC payments but would use NFC payments	3.2
Have not used NFC payments and would not use NFC payments	3.1
Have used NFC payments	4.0

The values above indicate that individuals that have never used their mobile phones to make NFC payments are more likely to be neutral about how useful the technology is. Even if they may intend using the technology for the first time, their decision does not seem to be driven by its perceived usefulness. It is important to take note that the individuals do not disagree with the statement that NFC payments are useful and their response is slightly on the disagreement side.

However, the results indicate that individuals that have used the technology before do perceive it to be useful. This implies that the perceived usefulness factor of a technology affects its adoption only if the individual has had a chance to use the technology. The perceived usefulness factor does not seem to affect the individual's adoption to a technology if that individual has not been exposed to use of the technology. Individuals that have never used the technology and don't intend to use the technology only scored 0.1 less than those that have not used the technology but intended to use it sometime in the future.

4.4.2. Hypothesis 2:

- Individuals will adopt the use of NFC through their mobile devices to make payments at Point-of-Sale if they perceive the technology to be easy to use.

The calculated mean below indicates that an individual who considered the NFC payments setup process to be complex are less likely to use NFC payments when compared to individuals that do not agree that to setup NFC payments on a mobile device is complex.

The mean of the scale of 1 to 5, where 1 is strongly agree and 5 is strongly disagree, have been recorded in the table below.

Table 15: Complexity of NFC payments setup process

Individual's Behaviour	NFC Payments require a complex setup process (Mean)
Have not used NFC payments but would use NFC payments	3.3
Have not used NFC payments and would not use NFC payments	2.9
Have used NFC payments	4.3

The values in the table above indicates that individuals that have not used NFC payments but intend to use the technology in the future scored higher than individuals that have not used the technology and do not intend to use it in the future. This indicates that individuals that have not used the technology but intend to use it in the future disagree more with the statement than those that have not used the technology and do not intend using it in the future.

Individuals that have used the technology scored higher than the other two groups. This shows that the individuals that scored higher, towards the disagreement side, are more likely to adopt the technology than those that scored lower. This also indicates that the perception of the set-up process and its level of difficulty is relevant to whether customers would adopt the technology.

4.4.3. Hypothesis 3:

- Individuals will adopt the use of NFC through their mobile devices to make payments at Point-of-Sale if they perceive the technology to be secure.

Individuals were asked about NFC payments security concerns to determine if they would adopt the use of NFC payments if they perceived it to be secure. The mean scores were compared between individuals that have not used NFC payments but they would use the technology in the future, individuals that have never used NFC

payments and would not use them in the future, and those that have used NFC payments.

The mean of the scale of 1 to 5, where 1 is strongly agree and 5 is strongly disagree, have been recorded in the table below.

Table 16: Concerned about security aspects of NFC payments

Individual's Behaviour	I'm concerned about the security aspects of NFC payments (Mean)
Have not used NFC payments but would use NFC payments	3.1
Have not used NFC payments and would not use NFC payments	1.9
Have used NFC payments	4.1

The values above indicate that individuals that have not used NFC payments but are willing to adopt the technology scored higher than those that are not willing to adopt the technology. This means that they disagree with the statement that they are concerned about the security aspects of NFC payments.

It is indicated that the individuals that are not willing to use their mobile phones for NFC payments scored less than individuals that are currently using NFC payments. Individuals that use their mobile device to perform NFC payments are less concerned about NFC payments security aspects.

When individuals were asked if they think mobile phones are a risky way of making payments, the scores received below indicate the same results as the security concerns above. Individuals that have not used NFC payments but are willing to use them in the future scored more than those that would not use them, indicating that they do not agree with the statement that mobile phones are a risky way of making payments. Individuals that are currently using the technology scored higher than those that would use it in the future, which means that they strongly disagree with the statement.

Table 17: Mobile phones are a risky way of making payments

Individual's Behaviour	Mobile phones are a risky way of making payments (Mean)
Have not used NFC payments but would use NFC payments	3.6
Have not used NFC payments and would not use NFC payments	2.4
Have used NFC payments	4.6

4.4.4. Hypothesis 4

- The likelihood of individuals adopting the use of NFC through their mobile devices to make payments at Point-of-Sales will decline with an increase in age.

The mean of the scale of 1 to 5, where 1 is strongly agree and 5 is strongly disagree, have been recorded in the table below.

The table below indicate the percentages of three types of individuals, those that have not used NFC payments but are willing to use the technology in the future, those that have not used the technology and are not intending to use it and those that have used the technology. These figures are grouped by age to see if higher age groups are less likely to adopt the technology.

Table 18: NFC payments adoption by age group

Age Range	Would use the Technology	Would not use the Technology	Uses the technology
18 – 25	42.9%	14.3%	42.9%
26 – 30	55%	15%	30%
31 – 35	51.5%	15.2%	33.3%
36 – 40	33.3%	66.7%	0%
41 – 50	50%	20%	30%
51+	40%	60%	0%

The values above indicate that the decline in NFC payments adoption is not consistent with age. We have instances where a younger group of individuals have a lower percentage of adopting the technology than an older group of individuals.

CHAPTER 5: DISCUSSION AND ANALYSIS

5.1. Introduction

Results presented in the previous chapter are analysed and discussed in this chapter. To give context to the customers that were used in the research, their demographics will be discussed first. The factors that influence the adoption of NFC technology will follow. Hypothesis 1, hypothesis 2 will be discussed with relation to the Technology Acceptance Model. Hypothesis 3 will be discussed in relation to the modified Technology Acceptance Model and hypothesis 4 will be discussed at the end regarding hypothesis 1, hypothesis 2 and hypothesis 3 to illustrate its impact on each of them as a moderating factor.

The Technology Acceptance Model states that perceived usefulness and perceived ease of use influence attitude towards new technology and this method can predict if an individual will use a technology based on how they perceive it to be useful and easy to use (Davis, 1989).

5.2. Demographic Profile of Respondents

The sampling of respondents was random and looked at the banked population from 18 to 55 years and across gender and race. The income brackets were separated into different segments even though the study will be concentrating on individuals that earn below R100 001 per annum and those that earn above R100 000 per annum. The study is constituted by 29.8% of respondents that earn anything from R0 to R100,000 and 70.2% of respondents that earn above R100,000.

The respondents' ages ranged from 18 years to above 51 years. Most respondents' age ranged from 31 years – 35 years at 39%. This figure is followed by age range of 26 years – 30 years at 24%. Then followed by the 41 years – 50 years at 12%, 36 years – 40 years at 11%, 18 years – 25 years at 8% and 6% of respondents were above 51 years.

5.3. Perceived Usefulness

5.3.1. Adopters

The usefulness of a technology is considered to be one of the factors that affect an individual's adoption to that technology (Davis, 1989). The results indicate that the 41 respondents that have not used their mobile devices to perform NFC payments, but would use their mobile devices to perform NFC payments in the future, scored a mean of 3.2 when asked if they thought NFC payments were not useful. The score of 3.2 indicates that they slightly disagree with this statement and perceive NFC payments to be useful. These results prove that individuals are more likely to use a technology when they perceive it to be useful.

5.3.2. Non-Adopters

When looking at the 23 respondents that have used NFC payments, they scored a mean of 4.0, which means they disagree with the statement, when they were asked if they think NFC payments are not useful. This indicates that they have adopted the use of their mobile payments to perform NFC payments because they consider them to be useful.

On the other hand, the 20 respondents that have not used their mobile devices to perform NFC payments and would not use their mobile devices to perform NFC payment in the future scored a mean of 3.1 when they were asked if NFC payments are not useful. This means that even though they might slightly disagree with the statement, the perceived usefulness of the technology is not enough for them adopt it, which means there might be other factors that are influencing them to not adopt the technology.

5.3.3. Conclusion

It is evident that individuals will use a technology if they perceive it to be useful but the results also indicate that even if individuals perceive a technology to be useful, it does not necessarily mean they will use that technology. This might be driven by other factors that are countering the usefulness of that technology.

5.4. Perceived Ease of Use

5.4.1. Adopters

The Technology Acceptance Model states that individuals will adopt a technology if they perceive it to be easy to use (Davis, 1989). The 41 respondents that have indicated that they have not used their mobile devices to perform NFC payments but they would do so in the future resulted in a mean score of 3.3 when they were asked if they think that NFC payments require a complex setup process.

This indicates that they disagree with the statement. These respondents think that the NFC payments setup process is not complex. This perception has an influence in their decision to adopt the use of their mobile devices to perform NFC payments. The results are in line with the Technology Acceptance Model.

5.4.2. Non-Adopters

The 20 respondents that have not used their mobile devices to perform NFC payments scored a mean of 2.9 when they were asked if NFC payments require a complex setup process. It is evident that individuals that have not used their mobile devices to perform NFC payments and are not intending to do so in the future perceive NFC setup process to be complex in some way. The results indicate that individuals may not adopt a technology if they consider it to be complex to use.

5.4.3. Current Users

Individuals that have used their mobile devices to perform NFC payments scored a mean of 4.3 if asked if NFC payments require a complex setup process. This shows that the individuals that have used the technology strongly disagree with the statement.

5.4.4. Conclusion

Referring to the Technology Acceptance Model, the indication is clear that individuals would use their mobile devices for NFC payments if they perceive it to be easy to use.

The results also indicate that individuals that do not use NFC payments and do not intend to do so in the future agree that NFC payments are complex to use.

5.5. Perceived Security

5.5.1. Adopters

Tan et al. (2014) modified the Technology Acceptance Model to include security in his study. The same model will be used to determine the influence of security when it comes to the adoption of NFC payments using mobile devices. Respondents that have never used their mobile devices to perform NFC payments but intend to use their mobile devices to perform NFC payments in the future had a mean score of 3.6 when they were asked if they thought mobile phones were a risky way of making payments.

This indicates that they disagree with the statement and they do not think mobile phones are a risky way of making payments. These users also had a mean score of 3.1 when they were asked if they are concerned about the security aspects of NFC payments. These results indicate that individuals that have never used their mobile devices to perform NFC payments but intend to do so in the future are not concerned about the security aspects of NFC payments.

5.5.2. Non-Adopters

Individuals that have never used their mobile devices to perform NFC payments and are not intending to do so in the future had a mean score of 2.4 when asked if they thought mobile phones were a risky way of making payments. The mean score indicates to us that these individuals agree with the statement and perceive mobile phones to be a risky way of making payments. These individuals also had a mean of 1.9 when they were asked if they are concerned about security aspects of NFC payments. This score indicates that users that have never used their mobile devices to perform NFC payments and do not intend to use their mobile devices to do so in the future are concerned about the security aspects of NFC payments.

5.5.3. Current Users

Individuals that are currently using their mobile devices to perform NFC payments responded with a mean score of 4.6 when they were asked if they thought mobile phones are a risky way of making payments. This score indicates that they strongly disagree with the statement and they do not think mobile phones are a risky way of making payments. These individuals that are currently using their mobile devices to perform NFC payments also responded with a mean score of 4.1 when they were asked if they were concerned about the security aspects of NFC payments. This score indicates that these individuals disagree with the statement and they are not concerned about the security aspects of NFC payments.

5.5.4. Conclusion

The results indicate that security is an important factor when it comes to the adoption of technology. Individuals that perceive a technology to be risky will have a less adoption than those that do not perceive it to be risky. Individuals that do not perceive a technology to be risky will adopt the technology.

5.5. Age Factor

The adopted Technology Acceptance Model by Tan et al. (2014) will be used to determine the effects that age has on the perceived usefulness, perceived ease of use and perceived risk of using a technology.

5.5.1. Adopters

The results above indicate that the highest percentage of an age group that has not used their mobile devices to perform NFC payments but are intending to use this technology in the future falls in the age range 26 – 30 at 55%, followed by age group 31 – 35 at 51.5% then age group 41 – 50 at 50%. This indicates to us that the adoption of a new technology does not necessarily decline with age. It seems there are certain instances in an individual's age when their behaviour towards technology changes. The interest of using this new technology of age group 36 – 40 is lower than both age

groups 41 – 50 and 51+. Age group 36 – 40 has the lowest percentage of individuals that have not used the NFC technology but are interested in using it in the future.

5.5.2. *Non-Adopters*

When looking at age groups of individuals that have not used their mobile devices to perform NFC payments and are not interested in using this technology, the results indicate that the highest percentage of these individuals fall in the age group 36 – 40 at 66.7%, followed by age group 51+ at 60% then age group 41 – 50 at 20%. Instead of age group 51+ having the lowest percentage of individuals that are not interested in using NFC payments. The results indicate that most of the respondents that belong in the age group 36 – 40 are the ones that are not interested in using NFC payments. The statement that the adoption to technology decreases with age holds true but with an exception to age group 36 – 40.

5.5.3. *Current Users*

Majority of individuals that are currently using their mobile devices to perform NFC payments fall in the age group 18 – 25 at 42.9%, followed by the age group 31 – 35 at 33.3% the age group 26 – 30 and 41 – 50 at 30%. The results indicate that the lowest age group, 18 – 25, has already adopted to using this new technology when compared to the highest age group of 51+. The statement that technology adoption declines with age would hold true, with an exception to age group 36 – 40.

5.5.4. *Conclusion*

When looking purely at the effects of age on the adoption of a new technology we see that the lower age groups have already used the NFC technology. These results are not completely in line with hypothesis 4, which states that an individual's adoption to technology will decline with an increase in age. The reason for this conclusion being the age group 36 – 40, none of which has had the opportunity to use NFC payments through their mobile devices.

Individuals that have a high potential of adopting NFC payments through their mobile devices fall in the 26 – 30 age group. The results do not show any trend when it comes

to individuals that have not used their mobile devices to perform NFC payments but intend to do so in the future.

Age group 36 – 40 indicate the highest percentage of individuals that have not used NFC payments through their mobile devices and do not intend to use the technology in the future. The results trend indicates that the statement that technology adoption declines with age holds true but with exception to age group 36 – 40. In conclusion, when looking only at age, the adoption of technology does decrease with age but with an exception to age group 36 – 40. There seems to be a behaviour change that individuals in this age group experience, which affects their perception towards technology.

5.6. Moderating Factor

In this section age is looked at as a moderating factor to hypothesis 1, hypothesis 2 and hypothesis 3. The results should indicate how age affects each of these adoption factors.

5.6.1. Perceived Usefulness

A total mean score of 3.4 was returned by the respondents when they were asked if they perceive NFC payments using their mobile devices to not be useful. This result shows that individuals disagree with the statement and perceive NFC payments using their mobile devices to be useful. The table below indicates how the different age groups responded to this statement.

Table 19: Age Factor on Perceived Usefulness

Age Group	Perceived Usefulness (Mean)
18 – 25	3.1
26 – 30	3.3
31 – 35	3.4
36 – 40	3.4
41 -50	2.9
51+	2.8

The table above indicates that age groups 41 – 50 and 51+ agree with the statement that NFC payments are not useful. The two age groups scored a mean of 2.9 and 2.8 respectively. When compared to all the other age groups, whom do not agree with the statement and perceive the technology to be useful, it is evident that older individuals that are above the age of 41 are less likely to adopt the use of their mobile devices to perform NFC payments based on perceived usefulness. The results indicate that the adoption to the use of NFC payments declines with an increase with age with respect to the technology's perceived usefulness.

5.6.2. Perceived Ease of Use

Respondents were asked if they perceive the setup process for NFC payments using their mobile phones to be complex and they scored a mean of 3.5, which indicates that they do not agree with the statement and they perceive the setup process to not be complex. The table below indicates how this mean is affected by the different age groups.

Table 20: Age Factor on Perceived Ease of Use

Age Group	Perceived Ease of Use (Mean)
18 – 25	3.4
26 – 30	3.3
31 – 35	3.5
36 – 40	3.8
41 -50	3.5
51+	3.5

The values indicate to us that all age groups disagree with the statement that the setup process for NFC payments using their mobile devices is complex. Age does not have a factor in the adoption of NFC payments using mobile devices in terms of perceived ease of use. Respondents from all age groups will adopt NFC technology for its perceived ease of use.

5.6.3. Perceived Security

The collected data indicate that respondents are concerned about the security aspects of using their mobile devices to perform NFC payments. Respondents scored a mean of 2.9 when they were asked if they were concerned about the security aspects of NFC payments, indicating that they agree with the statement. The table below indicates how the different age groups responded to the statement.

Table 21: Age Factor on Perceived Security

Age Group	Perceived Security (Mean)
18 – 25	3.3
26 – 30	2.9
31 – 35	3.1
36 – 40	3.0
41 -50	3.0
51+	2.6

The data indicates that age groups 26 – 30 and 51+ scored a mean of 2.9 and 2.6 respectfully. The adoption to the use of mobile devices to perform NFC payments in terms of its perceived security does not constantly decline with age but the results are indicative that individuals 51 and above are less likely to adopt the technology than any other group due to security concerns.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

Main conclusions and recommendations are presented in this chapter. When reviewing the results of the survey certain conclusions can be reached. These in turn allow recommendations to be made from the resulting research report. A comprehensive conclusion of the study can be drawn up by reviewing each hypothesis. The resulting recommendations can be made to the major banks and any other entity that is involved in the provision of payment systems. The chapter will be concluded by making suggestions for further research.

6.2. Summary of Findings

6.2.1. Hypothesis 1

Individuals will adopt the use of NFC through their mobile devices to make payments at point of sale if they perceive the technology to be useful.

Hypothesis 1 was answered by combining literature review and data from a questionnaire. One of the main drivers of technology adoption, as declared by the Technology Acceptance Model (TAM), is perceived usefulness Tan (2014). The results indicate that individuals that are intending to use their mobile devices to perform NFC payments find NFC payments to be useful. Individuals that are currently using their mobile devices to perform NFC payments also perceive the technology to be useful. This study confirms the hypothesis that individuals will adopt a technology if they perceive it to be useful.

The respondents to this study perceive the use of mobile devices to perform NFC payments to be useful so this means they are more likely to adopt to the use of the technology to make payments. NFC payments are not at the same usage level as the use of cash and debit or credit cards when it comes to speed, especially in an event that an individual needs to enter their pin when making a purchase.

The data collected from the respondents show that most of the individuals that have not used a mobile device to perform NFC payments, and are not intending to use the technology, do not perceive it to be useful.

6.2.2. Hypothesis 2

Individuals will adopt the use of NFC through their mobile devices to make payments at point of sale if they perceive the technology to be easy to use.

The literature review and data from a questionnaire was combined to answer hypothesis 2. Ease of use is one of the most important drivers for the adoption of technology by individuals as per the Technology Acceptance Model (TAM) Tan (2014). The data from the questionnaire indicates that individuals that have never used their mobile devices to perform NFC payments but are willing to try this technology in the future perceive the technology to be easy to use.

The results also indicate that individuals that are currently using mobile phones to perform NFC payments, perceive NFC technology to be easy to use. Thus, the study confirms that individuals will adopt a technology if they perceive that technology to be easy to use.

When looking at how South Africans will adopt the use of mobile devices to perform NFC payments, the study indicates that South African Individuals consider the use of their mobile devices to perform NFC payments to be easy to use. This means that South African individuals are more likely to adopt the use of their mobile devices to pay for goods and services using through NFC payments at point of sales.

6.2.3. Hypothesis 3

Individuals will adopt the use of NFC through their mobile devices to make payments at point of sale if they perceive the technology to be secure.

Tan (2014) modified the Technology Acceptance Model to include security as one of the main drivers for adoption to a new technology. The modified TAM was used together with data from a questionnaire to answer hypothesis 3. The study revealed that individuals that will adopt the use of their mobile devices to perform NFC payments are individuals that perceive the technology to be secure.

This study confirms the findings of the modified TAM which indicates that individuals will use a technology if they perceive it to be secure. Most of the respondents that perceive the use of their mobile devices to perform NFC payments to be secure, to a certain extent, are willing to use the technology instead of cash and credit cards.

Though the respondents indicated that they do think that the use of mobile devices to perform NFC payments is a secure means of making payments, they do not strongly agree with its secureness. This conclusion is made judging by the mean score portrayed by the results. Security seems to be the biggest hindrance to individuals adopting the use of their mobile devices to pay for their goods and services through NFC payments at point of sales.

6.2.4. Hypothesis 4

The likelihood of Individuals adopting the use of NFC through their mobile devices to make payments at point of sales will decline with an increase in age.

The use of the Senior Technology Acceptance Model (STAM) in a study by Renaud and Biljon (2008) concluded that older individuals are affected more by the perceived usefulness and perceived ease of use when it comes to the adoption of a technology. The literature review and the data gathered from a questionnaire was used to answer this question by including age as a moderating factor.

This study does not conclusively confirm that the effect of age on the perceived usefulness of NFC technology and the perceived ease of use of the NFC technology constantly increases or decrease with age.

When it comes to the effect of age on the factors affecting the adoption of a technology, this study indicates that the older the individuals the more they find the use of their mobile devices to perform NFC payments less secure. Respondents from Age groups 18 – 25 and 51+ are affected more by the chance that they may lose their mobile phone, which may in turn give whomever finds their mobile phone a chance to use it to make payments through NFC.

The respondents to this study indicate that individuals above the age of 41 are more concerned about the security of NFC payments, than respondents whom are less than 41 of age, and this means they were less likely to adopt to the use of this technology.

6.3. Recommendations

The value of the perceived usefulness and perceived ease of use of technology are very important customer factors when it comes to the adoption of a technology. To maximise the use of NFC payments, banks and providers of payment facilities need to understand the relative impact of these drivers and how they are affected by the customer's age. The security of NFC payments is an important factor and it needs to be focused on. The following aspects should be taken into consideration:

6.3.1. Usefulness of NFC Payment Technology

Making NFC payments using mobile devices is still considered by customers as a backup option to cash and debit cards. A study by (Smets, 2011) indicates that the main aim of customer loyalty is to retain customers. Using NFC to store customer's loyalty cards will reduce the customer's wallets and increase the usefulness of NFC. This will encourage customers to adopt the NFC technology, which will in turn increase the adoption to NFC payments using their mobile devices.

6.3.2. Promotion of NFC Technology to increase knowledge

Individuals need to be informed about NFC payments and how the technology can be useful to every individual who has a bank account. Knowledge about NFC will increase customer demand mobile devices that have NFC capabilities. When more individuals start using their mobile devices for NFC payments, then this might encourage more merchants to accommodate NFC payments.

6.3.3. Discounted NFC purchases to increase usage

Since this is a new technology, offering discounts for goods paid for by using NFC should encourage individuals to use their mobile devices to perform NFC payments. Once the customer sees how useful the technology is they should be persuaded to adopt it. Rewarding the customers could be a way to get them involved in the usage of NFC payments.

6.3.4. Ease of Use is linked to Adoption

The setup process and the usage of NFC payments using a mobile device should be easy. Individuals are more likely to use the technology if it is easy to use. The NFC setup process should be automatic and should be done when the user registers themselves to use a mobile phone app with such capabilities. The user should just be asked to confirm the registration.

6.3.5. Improve NFC payments security awareness

Security concern is one of the important factors of technology adoption. This means that banks and payment services providers should make customers aware of the measures involved in making sure that NFC payments are secure. The improvement in security should be communicated in a language that an ordinary user can understand. The potential user needs to feel that their money and transactions are secure when they use the technology.

6.3.6. *Increase availability of NFC Point of Sales*

Increasing the availability of NFC payment point of sales will encourage individuals to use the technology. Currently there is a lack of NFC point of sales availability at merchants' stores and this makes the payment method unreliable. Individuals might be left stranded without any means of making payments. The availability of NFC payment point of sales devices will give customers peace of mind knowing that they will be able to pay for their goods no matter which merchant they went to.

6.3.7. *Cheaper NFC compatible mobile phones*

Accessibility of cheap mobile phones that have NFC capabilities would be beneficial to the usage of NFC by individuals. This would also increase awareness of the NFC technology and what functions it can be used for. When an increased number of individuals have access to the NFC technology, its usage would increase and its perceived usefulness would increase, which in turn would increase its adoption.

6.4. Concluding Remarks

User adoption to a new technology is determined by perceived ease of use, perceived usefulness and perceived security of that technology. These are the same factors that will affect the adoption of NFC payments using mobile devices for making payments for goods and services at point of sales.

The most important factor that would influence the use of NFC to make payments is perceived security. Most individuals would not use NFC payments through mobile devices if they perceive it to be unsecure or if there is a possibility for someone else to gain access to their payment transaction. Advancements in NFC payments security will encourage more individuals to adopt NFC payments in South Africa.

Perceived usefulness and perceived ease of use are important factors that would influence the use of NFC payments and good news is that means of making payments using NFC through mobile phones is perceived to be useful and perceived to be easy to use.

Accessibility to mobile devices that are NFC enabled remains a challenge because these phones are more expensive than phones that are not NFC enabled. A reduction in cost for NFC enabled mobile devices would encourage an increase in NFC payments usage.

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Appendix A

Questionnaire Questions

1 → What is your age?*

☐ A 18 - 25	☐ B 26 - 30	☐ C 31 - 35	☐ D 36 - 40
☐ E 41 - 50	☐ F 51+		

2 → What is your gender?*

☐ A Female	☐ B Male
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3 → What is your highest level of education?*

☐ A Did not finish school	☐ B Matriculated
☐ C University / College	☐ D Other

4 → What is your annual salary?*

☐ A R0 - R30,000	☐ B R30,001 - R80,000
☐ C R80,001 - R100,000	☐ D R100,001 - R215,000
☐ E Greater than R215,000	

5 → What do you use your cellphone for?*

For "Other" please use a comma to separate uses that are more than one.

Choose as many as you like

☐ A To receive calls	☐ B To make calls
☐ C SMS	☐ D Accessing the internet
☐ E Banking	☐ F Playing Games
☐ G Calculator	☐ H I don't have a cellphone
☐ I Other	

6 → Is your phone NFC enabled? If so, do you ever use NFC to share data?*

NFC (near field communication) is the technology that allows two devices—like your phone and a payments terminal—to talk to each other when they're close together. NFC allows contactless payments by tapping a phone on a point of sale device.

☐ A Yes	☐ B No
☐ C My phone is not NFC enabled	☐ D I don't know

7 → Is your phone Bluetooth enabled? if so, do you ever use Bluetooth to share data?*

☐ A	Yes
☐ B	No
☐ C	My phone is not Bluetooth enabled
☐ D	I don't know

8 → Which bank do you currently use? (You may choose more than one option)?*

Choose as many as you like

☐ A	Standard Bank	☐ B	ABSA
☐ C	Nedbank	☐ D	First National Bank
☐ E	Other		

9 → Which of the following methods do you use to make payments at retail stores?*

Choose as many as you like

☐ A	Cash	☐ B	Debit Card
☐ C	Credit Card	☐ D	Contactless Card
☐ E	Snapscan		

10 → Have you ever performed a payment transaction using a cellphone?*

☐ Y	Yes
☐ N	No

11 → If no, would you ever perform a payment transaction using a cellphone?

☐ Y	Yes
☐ N	No

12 → Have you ever used your phone to perform NFC payments?*

NFC (near field communication) is the technology that allows two devices—like your phone and a **payments** terminal—to talk to each other when they're close together. **NFC** allows contactless payments by tapping a phone on a point of sale device.

☐ Y	Yes
☐ N	No

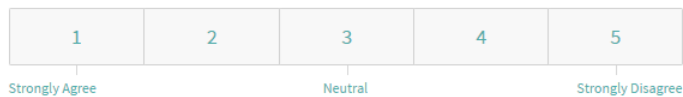
13 → If no, would you ever use your phone to perform NFC payments?

☒ Yes

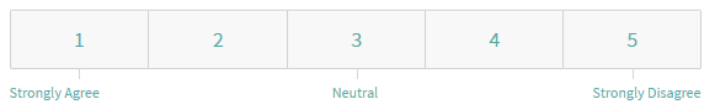
☐ No

14 → I'm less likely to use NFC to make payments because...

a. Cellphones are a risky way of making payments^{*}



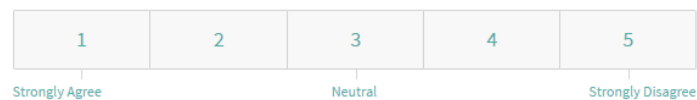
b. I am concerned about the security aspects of NFC payments^{*}



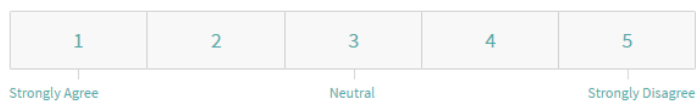
c. Information concerning my payment transactions can be tampered with by others^{*}



d. NFC Payments require a complex setup process^{*}



e. I may loose my phone and risk someone getting access to make payments^{*}



f. NFC Payments are not useful^{*}

