The role of mobile phone skills in the usage of mobile financial services in a developing country

THE ROLE OF MOBILE PHONE SKILLS IN THE USAGE OF MOBILE FINANCIAL SERVICES IN A DEVELOPING COUNTRY

Rebecca Isabella Kiconco

This is an output from the project Changing the Mindset of Ugandan Entrepreneurs [grant number W 08.370.102], which is part of the research agenda of the Knowledge Platform on Inclusive Development Policies and funded by the Netherlands Ministry of Foreign Affairs through NWO-WOTRO.

A catalogue record is available from the Eindhoven University of Technology Library.

ISBN: 978-94-6423-087-1
Keywords: Mobile phone skills, mobile money, developing countries

Cover design: Wycliff Bamulanzeki
Printed by: ProefschriftMaken.nl

The role of mobile phone skills in the usage of mobile financial services in a developing country

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Technische Universiteit Eindhoven,
op gezag van de rector magnificus prof.dr.ir. F.P.T. Baaijens,
voor een commissie aangewezen door het College voor Promoties,
in het openbaar te verdedigen op dinsdag 5 januari 2021 om 16:00 uur

door

Rebecca Isabella Kiconco
Kabale, Oeganda

Dit proefschrift is goedgekeurd door de promotoren en de samenstelling van de promotiecommissie is als volgt:

voorzitter:	prof.dr. I.E.J. Heynderickx
1e promotor:	prof.dr. C.C.P. Snijders
copromotor(en):	dr. G. Rooks
leden:	prof.dr. M. Dekker (Universiteit Leiden)
	prof.dr. E.J. Nijssen
	prof.dr.ir.ing. R.N.A. Bekkers
	prof.dr.ir. E. Nillesen (Maastricht University)
adviseur(s):	dr. J.I. Höffken

Het onderzoek of ontwerp dat in dit proefschrift wordt beschreven is uitgevoerd in overeenstemming met de TU/e Gedragscode Wetenschapsbeoefening.

To my beloved parents,
Johnson . K and Irene T. M. Bitarabeho.
For cultivating the value of continuous learning and discovery within me.

And to my husband Arthur.
For your invaluable and unwavering support.

Summary

The role of mobile phone skills in the usage of mobile financial services in a developing country

"Mobile money," a technology that allows people to receive, store and spend money using a basic mobile phone, is a well-established alternative for taking care of financial business in many developing countries. This technology allows those without standard bank accounts to transfer money and do business with others too far away to deal with directly. Sometimes, mobile money transactions are carried out at a point of sale (e.g., retail shopping). Nevertheless, adoption rates are still relatively low, and the use of the system for those who have it is rather low as well. How can this be? Recent anecdotal findings point to a lack of skills to use mobile financial services as a probable cause for the above problem. In developing countries where the advent of certain technologies is still relatively new, the first step in ensuring technology adoption should be assessing whether the targeted users can use the innovation. In these unique contexts, more so the rural communities which are characterized by low levels of literacy, the skills of intended users need to be given priority. The role skills play in the adoption and the use of mobile money technologies has mostly been ignored. This premise forms the basis for the research in this thesis.

This research work aims to gain insights into the adoption and usage gap of mobile money using a skills perspective. For this purpose, three major questions were investigated: [1] what role do skills play in the adoption of mobile money, [2] which factors determine who is more likely to have mobile money skills, and [3] can skill learning occur within social networks and if so, what influences this transfer of skills? Building on existing literature, three studies were undertaken in Uganda, using an improved methodology to measure actual mobile money and mobile phone skills.

Based on the premise that skills in using technology as an adoption and usage driver are mostly understudied and yet very important in developing country contexts, Chapter 2 is constructed. In reiteration, existing literature points to skills playing a pivotal role in the use of mobile technologies, but the findings remain primarily anecdotal. This section provides empirical evidence that offers a deeper understanding of adoption, use, and breadth of use (variety of services) of mobile money technology from a skills perspective. The research also innovatively measures skills using a newly developed test to assess existing skills. Unlike commonly used self-assessments or perceptions of skill level, this test can gauge participants' mobile phone skill level. Hypotheses were tested using a sample of 208 individuals from an urban location in Central Uganda. Findings reveal that a marginal increase in mobile phone skills has a strong effect on the odds of adopting mobile money but a less substantial effect on the extent to which the functionalities of

the mobile money application are used. On the other hand, English literacy does not influence both adoption and the magnitude of services individuals use. The contribution of chapter 2 is the addition to literature a skills perspective to adoption and use of mobile-related applications, more so in developing country contexts.

Chapter 3 recognizes that though an extensive proliferation of mobile phones exists in several developing countries, usage statistics of essential applications, for instance, mobile money is still low. Given the previous chapter results showing that skills are vital for usage, this section develops explicitly a framework to identify who is likely to have mobile phone skills. To understand who is likely to have mobile phone skills, this research explores different individual level and social network factors. Using a sample of 525 respondents from rural Uganda, earlier findings that mobile money use is mainly dependent on mobile phone skills are confirmed. Furthermore, results show that older people are less likely to possess mobile phone skills. Additionally, more substantial incomes, better education, higher cognitive motivation, being of the male gender, and the presence of more peer adopters in one's network predict mobile phone skills' possession. Moreover, density and network size do not influence mobile phone skills. The chapter's contribution is the provision of a deeper understanding of the antecedents of mobile phone skills possession.

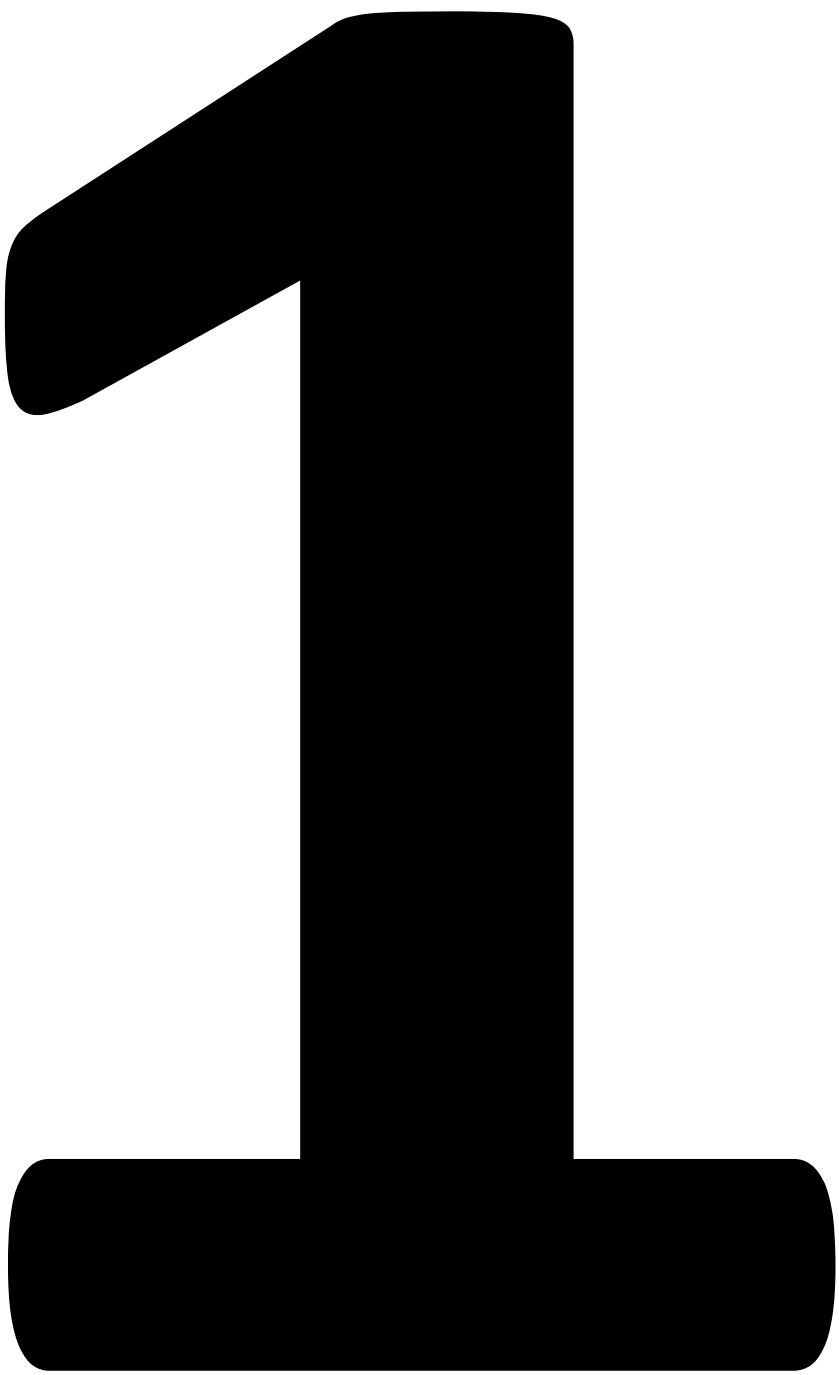
In chapter 4, a pertinent arises: how can and how do people acquire and learn skills? This section focuses on learning as a process of searching and developing skills within a relationship between a person and one of his or her social contacts. Social network factors and individual attributes of the parties within the relationship are hypothesized to influence learning. Two studies are presented, using two similar primary data collections. In the first study, an urban sample is selected; the second sample is from a rural location. Generically, urban locations are characterized by above-average education levels, and as can be expected, the rural area, a considerably less educated populace. Within these two different locations, social networks' vitality in mobile money skills acquisition can be aptly studied. A field-study of learning mobile money skills using a sample of the Ugandan population is presented. The study sample consists of 208 inhabitants from an urban area and 526 inhabitants from a rural area. The data shows that learning is better explained by social network characteristics compared to attributes of the individual in both studies. In particular, individuals profit from people in their network if those network connections are skillful, regardless of how skilled the learner is. Our results suggest that learning happens at an accelerated rate in networks that consist of skilled people on top of this direct learning effect. Comparing the rural and urban samples, we find that network effects are more substantial in rural areas relative to the urban area. The results further reveal that individuals with higher education and better mobile phone skills are less dependent on their networks in learning how to use mobile money. Chapter 4 contributes to literature

insights into which network ties are resourceful for technology skill learning and under what circumstances these dynamics may change.

Chapter 5 presents a synthesis of the thesis's findings. Furthermore, relevant implications arising from the studies are discussed. Chapter 5 specifies suggestions pertinent to the mobile money space, and by extension, to other mobile technologies in the developing world. Additionally, contributions to theory, literature, and areas for future research are highlighted. Overall, the thesis provides strong evidence for the importance of skills in predicting mobile financial services' adoption and use. Findings point to large skill inequalities within rural communities in developing countries, with older people being seriously disadvantaged. Higher incomes, better education, higher cognitive motivation, being male, and the presence of more peer adopters in one's network disposes one to possess such skills more likely. The studies also find evidence for learning skills within social relationships in networks that have skills to leverage. The effects are more substantial in rural areas than urban areas, pointing to the dependence on skilled others in communities characterized by higher levels of illiteracy.

Long-term and short-term solutions can be recommended from the above findings. Whereas existing mobile financial technologies can be modified to older persons' capabilities, new technologies' development should also consider a user-centric approach by taking the potential users' skills level into account while maintaining a low price. Additionally, there is a need to invest in mobile phone interfaces for basic phones that are easier to read, comprehend and use, so that more extensive parts of the population have access to mobile money in a way that fits their particular situation.

Contents



Chapter 1

General Introduction

Introduction

A mobile financial service, known as mobile money, is an application that allows users to store, send, and receive money over a basic or smartphone. In other words, mobile money is an electronic wallet or 'a bank in your pocket.' Mobile money has transformed the lives of many in Sub-Saharan Africa. Whereas previously in developing countries inhabitants had to physically carry and transport cash, nowadays using a mobile phone for transacting and payment is possible. For instance, Jacqueline Belony, 20 years old, relays: "I can have a problem with my child, and I don't have money in my hands. I don't want to break the safe; there are plenty of people at the house, I don't want to break the safe in front of people. But I can leave with my phone, and go to any doctor." While another, Pauline Michel, 47 years, says: "Keeping money on the phone is better because people don't know your business." The above are some of the stories related by users of mobile money in Haiti [(1)]. Among the livelihood changes mobile money brings about, the ease of transferring money from urban migrants back to rural areas, privacy and convenience are highlighted above. In as much as the above accounts are from Haiti, the benefits relayed are crucial for users in Uganda as well. Similarly, these gains stretch beyond Uganda and Haiti to encompass countries with related human development indices which are commonly grouped among developing countries. In particular, countries characterized by low life expectancy and low literacy levels fall within this category.

While there are many apparent benefits of using mobile money, it can be problematic as well. A while ago, I, together with my family, drove up to a gas/petrol station on a Monday morning to find an inattentive attendant – Judith. On inquiring as to what was preoccupying her mind, Judith related a story where she had remitted money (150,000 Uganda Shillings equivalent to approximately 35 euros) to her mother. The latter was living in a rural area (Karamoja), about 549 kilometers from the city. Judith used the mobile money application to transfer money to her mother's mobile wallet. However, Judith's mother did not know how to use the app, and therefore, Judith's cousins, who lived with the mother, helped her withdraw the money from an agent. The problem was, the cousins kept 70 percent of the money, and gave Judith's mother only 30 percent. Judith had discovered this by asking her mother how much money she had received from her cousins via the mobile phone voice communication.

Judith's problem highlights some challenges of mobile money use that arise from a lack of skills to use a mobile phone. Not only was Judith's mother unable to know how much money was on her mobile money account, but she also lacked the skills to make the withdrawal herself as well. This problem is not uncommon. Many individuals find themselves in similar circumstances, especially in rural areas, more so, regarding using mobile applications (Wyche, Simiyu, & Othieno, 2016; Wyche & Steinfield, 2016).

The above illustrates that mobile money is a promising innovation, yet its diffusion can be problematic. The diffusion problem is also seen from the low adoption rates in some developing countries, especially in sub-Saharan Africa (Alleman & Rappoport, 2010;

Nkwede & Agha, 2017). In this thesis, I argue that the lack of mobile phone and mobile money skills is a significant hindrance to the diffusion of mobile money. I will focus on three major questions to structure the thesis: (1) what role do skills play in the adoption of mobile money, (2) which factors determine who is more likely to have mobile money skills, and (3) can skill learning occur within social networks and if so, what influences this transfer of skills? In this chapter, a sketch of the necessary background into the studies is provided. Furthermore, the thesis is situated within the existing literature.

1.1 The advent of mobile phones in Africa

Mobile phones have extended from a mere medium of communication through voice and text to a technological tool that hosts applications that span a wide range of sectors. These include education, health care, governance, agriculture, transport, and finance, to mention but a few. For instance, mobile phones are used to mitigate information asymmetries in the agricultural sector (regarding weather, market prices, best practice resources), which improves the bargaining power of farmers (Ghosh, 2016; Oluwatayo, 2013). In locations with inadequate infrastructure such as poor roads and undependable postal services, mobile phones can substitute for travel, allow quicker and easier access to information on prices, and enable farmers and traders to reach broader markets through applications such as "MFarm" in Kenya and "Jaguza" in Uganda. Mobile phones boost entrepreneurship by allowing more efficient financial transactions and generally ease business transactions (Asongu, Nwachukwu, & Orim, 2017). The "uber" application has changed the face of public transportation in Uganda and other African countries (Henama & Sifolo, 2017; Inoue, 2019). In short, in developing countries, mobile-phone-based agricultural guidance, health care access, transportation convenience, and ease of money transfer could provide enormous economic and developmental benefits. [(2)]

In tandem with this broad application of mobile phone technology, the upsurge and proliferation of mobile phones in developing countries is described as "*one of the most remarkable technology stories of the past decade*" (Donner & Tellez, 2008). By 2006, the number of mobile phone users in developing countries surpassed users in developed countries (Ivatury & Pickens, 2006). It was expected that by the end of 2012, most communities in sub-Saharan Africa (SSA) would have mobile phone coverage except for a handful of countries (Asongu, 2013). Indeed, coverage by mobile network operators is abundant in most of SSA, with 44 percent of the population owning a mobile phone, according to the 2019 Global System for Mobile Communications report on sub-Saharan Africa [(3)]. However, the above statistics are potentially higher because data collection in this diverse region (SSA) is challenging, which often requires face to face interaction with individuals.

1.2 Mobile money applications on mobile phones

The number of mobile phone users has long exceeded the number of people with bank accounts across the world (Tobbin, 2012). Thus, it is no surprise that applications for mobile money are ubiquitous. Mobile money is an application that facilitates access and utilization of digital cash, using the mobile phone (Gencer, 2011). Mobile money enables users to create a virtual account into which funds can be deposited, and transfers made without using a formal banking system. The cash value of these funds can also be securely withdrawn from agents who are usually ubiquitous kiosks or grocery stores. On this basis, mobile money is not only a substitute for formal banking services, but it is also a means through which people without formal financial accounts can access financial services. The birth of mobile money in Africa started with the M-PESA service, launched in 2007 by Vodafone, in Kenya, as a partnership between Faulu Kenya, a local microfinance institution (MFI) and Safaricom (Hughes & Lonie, 2007). M-PESA means "mobile money" in Swahili. After its success in Kenya, mobile money found its way to other emerging economies, including India, Afghanistan, Tanzania, and Uganda, to mention but a few. In different countries, however, mobile money is attached to other code names, many of which represent telecom company operators, such as Airtel money and MTN money in Uganda. Similarly, we find M-Kesh in Mozambique, Zap in Niger, M-Paisa in Afghanistan, Patym and Mobikwik in India, bKash, and UKash in Bangladesh, SnapScan and Zapper in South Africa, Easy-Paisa in Pakistan, and Splash in Sierra Leone. All the above are code names for various mobile money systems, all of which allow the same basic service: to be able to store and transfer money without a bank account.

Typically, an individual registers or opens an account with a telecom service agent and deposits cash onto the mobile wallet account. A deposit of an equivalent amount of digital funds is made and immediately electronically reflected on the account. The active user can now execute transactions using these electronic funds via a mobile interface. The mobile money system is text-based, and notifications of transactions take place through the Short Message Service (SMS). A simple illustration of a mobile money transaction is shown in figure 1 below. Here, you can visually observe the steps a registered user takes to remit 50,000 Ugandan shillings – approximately 12 euros to another user, as payment for rent using a conventional mobile money interface). The mobile money application makes it possible to, for example: make payments, send money from a digital account on a mobile phone to another mobile money account, and to purchase prepaid telephone credit or internet data for oneself or another person's mobile phone. Except for changing money from electronic to cash or vice versa, the transactions do not need an intermediary (telecom service provider agent).

In Ugandan telecom companies, synergies with formal financial institutions have facilitated interoperability so that one can also transact over one's bank account using mobile money (GSMA, 2015). Interoperability at the telecom company network-level facilitating transfers across different mobile money network companies exists as well.

Mobile telephony is now a widely diffused technology and no longer creates an obstacle to mobile money adoption (Peruta, 2018). Mobile networks reach about 90 percent of the population in developing countries (Salazar, 2018). The ubiquity of mobile networks ensures that mobile-based solutions are readily available to many. At the end of 2015, mobile money was available in more than 90 countries with 270 service providers. Estimates are that about 1.9 billion individuals in the developing world access mobile money services (Global System for Mobile Communications, 2016), and more than half of these services are in sub-Saharan Africa.

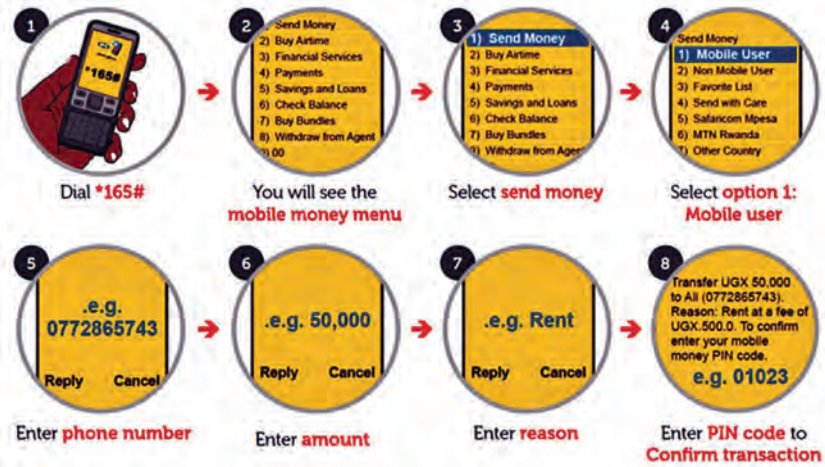


Figure 1. Illustration of steps in executing a mobile money transaction. *Source:* Training materials developed by the researcher under the project "Changing the mindset of Ugandan entrepreneurs: From Muppets to Gazelles," for field training of rural women entrepreneurs.

1.3 Mobile money in Action

Transferring money in the conventional sense seems simple when we think of deposits and transfers into and between bank accounts, the issuing of cheques, telegraphic transfers, or money orders. However, the above mechanisms require formal institutional structures such as banks, postal networks, or at the very least, money transfer companies such as MoneyGram or Western Union (Sander, Mukwana, & Millinga, 2001). More than 60 percent of the sub-Saharan Africans reside in rural communities where formal financial institutions do not find it profitable to locate (Lashitew, van Tulder, & Liasse, 2019). In many rural locations within developing countries, banks are virtually nonexistent. In the large trading centers where formal financial institutions usually locate, accessibility in terms of distance, cost of transacting, and financial literacy to make use of these services still pose a significant hindrance.

Before the year 2000, urban-rural remittances were primarily effected through semi-formal or completely informal means. Cash transfer conduits mainly took the form of family members, family friends, registered mail, and money order transfer service through

the post office (Wambalaba & Machoka, 2012). The above methods were mainly used for smaller amounts of money. To transfer more substantial sums of money, individuals would transport the cash on their own by private or public means of transport. In principle, though not many options were available, these existing mechanisms were marred by inefficiency, tardiness, unreliability, and considerable risk (Hughes & Lonie, 2007). In due course, with the arrival of more formalized money transfer systems, microfinance institutions, MoneyGram and Western Union emerged to tap into far to reach areas. Still, the latter is often accessible only in the large trading centers in rural areas. Besides, they are expensive, and often "elitist" (Sander et al., 2001; Wambalaba & Machoka, 2012).

With the advent of the mobile phone, developing a mobile money application curbs the above inefficiencies and reduce risks associated with cash transfers (Hughes & Lonie, 2007). Mobile money can, therefore, provide financial inclusiveness to even the poorest of the poor as long as they own or have access to a mobile phone. Individuals who formerly had no access to formal financial services (mainly situated in rural, far to reach areas) now have a convenient and inclusive financial, technological solution that did not involve the complexities associated with formal financial institutions.

The inclusiveness of mobile money stretches beyond the boundaries of the intended users (poorest of the poor) to encompass the middle class and elite living in urban areas who have bank accounts (Jack & Suri, 2011). Uganda's 2016 third annual financial inclusion report [(4)] reveals that mobile money is comparatively used more in urban areas (53%) than in rural areas (24%). It is used more by males (38%) than by females (25%) and is more prevalent among persons above (57%) than for persons below the poverty line (21%). These statistics reflect that the intended users (the poor) are either not adopting the technology or are still lagging. This situation further echoes either a state of unawareness or a lack of skills to use mobile money technology. The movement from access to usage necessitates the presence of knowledge on "how to use" mobile money technology (Salazar, 2018). This thesis delves into the above perspective. First, I will examine available adoption studies on mobile money specific to developing countries to identify the gaps in addressing adoption and use.

1.4 Adoption of mobile money: a literature review

The rise and impact of mobile money have drawn the attention of academic scholars. In the last decade, a large body of papers has been published about the adoption and use of mobile money. Within this body of research work, different perspectives have been brought to the fore. Notably, explaining mobile money adoption using perception-based models, for instance, the Technology Acceptance Model and related models. Other scholars use social network theories, demographic attributes, regulatory frameworks, social-cultural, and social-economic constructs, or a combination of models, to explain the use of mobile money. In the following section, I discuss the literature about the above approaches.

1.4.1 Models explaining the acceptance of mobile money

Eighty percent of the mobile money studies use some variant of an "attitude model" to explain mobile money acceptance (Abhipsa, Rahul, Tejaswini, & Raghav, 2019). One typically used framework is the Technology Acceptance Model (TAM) which is adapted from the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1977) and the Theory of Planned Behavior (TPB) (Ajzen, 1991). In brief, the TRA affords that the use of mobile money is explained by intentions, where these intentions, in turn, are shaped by attitudes and subjective norms towards mobile money. Though TRA is generic to understanding human behavioral actions, TAM explicitly provides insight into information systems' acceptance (Mathieson, Peacock, & Chin, 2001), which fits nicely in the mobile money context. TAM affords that, a decision to use mobile money stems from one's intentions, which in turn are determined by beliefs about mobile money (Davis, 1989; Lubua & Semlambo, 2017; Nkwede & Agha, 2017; Tobbin & Kuwornu, 2011). Therefore, according to TAM, if one perceives mobile money to be both useful and easy to use, the likelihood that one intends to use it and subsequently adopt it increase.

Though TAM is parsimonious and has strong empirical support for its overall explanatory power (Mathieson et al., 2001; Yousafzai, Foxall, & Pallister, 2010), it takes a narrow focal point on the technological characteristics. This narrow focus ignores external influences such as social influences, selfregulation, personal resources such as a person's perceived selfefficacy, perceived trust, and perceived financial implications (Bagozzi, 2007; Davis, Bagozzi, & Warshaw, 1989; Luarn & Lin, 2005). TAM is limited as well because it assumes that no hindrances prevent an individual from using technology if he or she chooses to (Bagozzi, 2007). In later sections within this chapter, I argue that in developing countries, particularly Uganda, hindrances such as literacy and technological skills to use mobile and comparable applications should be considered in adoption.

Similarly, the classical theory of diffusion of innovations (DOI) is used in literature to explain mobile money diffusion (Mahfuz & Saha, 2015; Narteh, Mahmoud, & Amoh, 2017; Everett M. Rogers, 1995; Tobbin, 2009). DOI proposes that an individual's discernment of specific characteristics of innovation determines whether one does or does not make a decision to adopt. DOI, therefore, suggests that the relative advantage, complexity, compatibility, observability, and trialability of mobile money influence mobile money adoption. As is the case for TAM, DOI is limited since it ignores an individual's resources or social support to use mobile money.

1.4.2 Extensions of TAM

Modified TAM models stretch beyond the technological perceptions of an individual. TAM2, for instance, incorporates the influence of one's social system and cognitive relevance of technology to the predictors of adoption (Venkatesh & Davis, 2000). Literature is scanty on the use of TAM2 in mobile money settings. However, the Unified Theory of Acceptance and Use of Technology theory (UTAUT) is a TAM extended theory that features in mobile

money adoption studies (Mugambe, 2017; Venkatesh, Morris, Davis, & Davis, 2003). UTAUT. Using UTAUT, one would argue that higher performance expectancy, low effort expectancy, more social influence, and presence of facilitating conditions do influence intention to use positively, and this intention subsequently increases the odds of adopting mobile money.

In a more context-specific study on mobile financial technology, TAM was extended to include a trust-based construct (perceived credibility), and two resource-based predictors (perceived cost and perceived self-efficacy) (Luarn & Lin, 2005). The extension to include the above constructs accounts for TAM's limitations that assume; (1) no barriers to usage and (2) the lack of consideration for trust in the model, given that technology can be affected by security and privacy concerns. This extension of TAM could be one of the most featured in mobile money literature, though it is usually applied together with other theories, for instance, DOI (Baganzi, 2017; Lubua & Semlambo, 2017; Mahfuz & Saha, 2015; Nkwede & Agha, 2017). Table 1 below provides an overview of empirical studies on the adoption and use of mobile money in developing countries, with an emphasis on the theoretical underpinnings which reflect the general trend in the current literature.

Scholars have sometimes integrated the DOI with TAM in investigating mobile money adoption (Narteh et al., 2017; Osei-Assibey, 2015; Tobbin & Kuwornu, 2011). The argument for integrating TAM and DOI is that the predictors in both models are incredibly similar and supplement one another. For instance, similarities can be drawn between relative advantage and perceived usefulness, or complexity, and perceived ease of use. In most cases, though, the outcome measure in these studies is usually "intention of use" (Narteh et al., 2017; Osei-Assibey, 2015; Tobbin & Kuwornu, 2011) and only sometimes actual adoption (Nkwede & Agha, 2017). (see table 1.1)

The influence of various predictors on mobile money adoption is inconsistent within many of these studies. For the most part, perceived usefulness has a positive effect on intention (Ali & Dhaha, 2014; Narteh et al., 2017; Nkwede & Agha, 2017; Tobbin, 2009), yet outliers exist where studies find no effects (Mahfuz & Saha, 2015). Similarly, whereas several studies find perceived financial costs to be uninfluential (Lubua & Semlambo, 2017; Micheni, Lule, & Muketha, 2013; Nkwede & Agha, 2017), other research finds costs to be relevant (Humbani & Wiese, 2017; Narteh et al., 2017). I argue that the above inconsistencies reflect that the context within which technology is placed matters. Perception-based models extend our understanding of mobile money adoption. Nonetheless, these models are not extensive enough concerning developing country contexts (Abhipsa et al., 2019; Dahlberg, Guo, & Ondrus, 2015). For instance, adoption within low literate communities entails more than perceptions of ease of use, usefulness, cost, or trust.

The issue of actual capabilities or skills to use technology would be essential in low literate communities. I make the above issue clearer in later sections of this chapter. In the following paragraphs, I highlight a few mobile money adoption paradigms in the literature that are not perception-based.

Table 1.1. Sample of mobile money adoption and use studies in developing countries.

No	Author's	Theoretical model	Outcome measure	Method	Sample	Results	Country
1	Ngugi, Pelowski, & Ogembo (2010)	Social-cultural constructs	adoption	Case study - survey	67 users of M-Pesa	Large unbanked population, wide availability of mobile phones and innovativeness of communities promote adoption.	Kenya
2	Tobin (2009)	TAM extended, DOI	Intention to use	Quantitative	288 individuals	Perceived ease of use, perceived usefulness, perceived trust, trialability positively influence intention. Perceived risk negatively affects intention.	Ghana
3	Lubua & Semlambo (2017)	TAM modified: perceived relevance of cost; perceived financial benefit; comfortability with transaction steps; Quality of user support	Intention to use	Quantitative	110 business owners	Perceived financial benefit and comfortability predict intention to use. Perceived relevance of cost does not predict intention.	Tanzania
4	Nkwede & Agha (2017)	DOI, TAM extended	Adoption	Quantitative	344 mobile money users	Trialability, compatibility, perceived trust, peou, pu, awareness, relative advantage predict adoption. Perceived financial cost does not influence adoption.	Nigeria
5	Mahfuz & Saha (2015)	TAM extended, DOI	Intention to use	Quantitative	251 individuals	Peou, perceived trust predict intention. Pu and trialability do not predict intention. Perceived risk and transaction cost did not pass validity tests.	Bangla-desh
6	Maradung (2013)	Demographics	Use	Quantitative	190 users and nonusers	Being young, male, and employed increases the likelihood of use. Education, income, and having a bank account do not predict use.	Botswana
7	Murendo, Wollni, de Brauw, & Mugabi (2018)	SLT, SRT, Granovetter's theory of weak ties	Adoption	Quantitative	477 rural households	More adopters in the network increase the likelihood of adoption. More weak ties and more educated contacts do not influence adoption	Uganda
8	Baganzi & Lau W. K. (2017)	Trust and risk perceptions' model	Intention to adopt	Quantitative	438 mobile money users	Perceived risk, performance expectancy, and structural assurance predict intention to adopt. Trust belief does not influence intention to adopt.	Uganda
9	Sayid, Heights, & Echchabi (2012)	TAM extended	Attitude and Intention	Quantitative	100 users	Perceived usefulness and security positively influence attitude. Social influence and perceived usefulness positively influence intention to adopt. Perceived ease of use, perceived risk, and social influence do not influence attitudes. Further, attitude does not predict intention.	Somalia

10	Humbani & Wiese (2017)	Technology readiness framework	Adoption	Quantitative	416 online participants	Convenience and compatibility positively influence adoption. Insecurity, perceived cost, and perceived risk negatively affect adoption. Optimism, innovativeness, and discomfort do not influence adoption.	South Africa
11	Micheni, Lule, & Muketha, (2013)	Transaction cost and facilitating conditions	Intention to adopt	Quantitative	250 individuals	Facilitating conditions positively influence intention to adopt. Transaction costs do not influence adoption.	Kenya
12	Mugambe (2017)	UTAUT2	Intention to use	Quantitative	321 registered users	Social influence, habit, and facilitating conditions have significant effects on intention to use. Price value, hedonic motivation, effort expectancy did not have any effect on intention to use.	Uganda
13	Ali & Dhaha (2014)	TAM extended	Intention to adopt	Quantitative	414 university students	Perceived usefulness, perceived ease of use, and perceived trust predict intention to adopt. Perceived risk is not a predictor of intention.	Somalia
14	Narteh, Mahmoud & Amoh, (2017)	TAM, DOI	Intention to use	Quantitative	300 mobile money users	Perceived ease of use, perceived usefulness, perceived trust, perceived cost, social influence, and complexity predict intention. Relative advantage and perceived risk do not predict intention.	Ghana
15	Osei-Assibey (2015)	DOI, TAM extended & Demographics	Intention to adopt a) traders b) collectors	Quantitative	172 market traders; 90 susu collectors; 1 focus group	a) Trialability, awareness, compatibility, presence of susu collectors, and education predicted intention to adopt of traders. b) Perceived risk, education, relative advantage, and age predicted intention of susu collectors to adopt. Perceived risk and perceived trust negatively influenced intention.	Ghana
16	Otieno, Liyala, Odongo & Abeka (2016)	Exploratory perceptions model	Use and adoption	Ethnography	48 participants	Challenges affecting adoption and use include a) Lack of national identification b) Few mobile money agents with inadequate cash and e-float. c) Lack of information on how to access and operate certain features of mobile money d) Language barrier	Kenya

TAM = Technology Acceptance Model; DOI = Innovation for Diffusion Theory; SLT = Social Learning Theory; SRT = Social Resources Theory; UTAUT =Unified Theory of Acceptance and Use of Technology; pu = Perceived usefulness; peou =Perceived ease of use.

1.5 Limitations of existing models in explaining the adoption and use of mobile money

The adoption of mobile money in sub-Saharan Africa has received substantial research attention. One significant drift in the literature is the use of "intention to adopt or intention to use" as outcome measures (see table 1.1). The common usage of intention, although understandable from a practical standpoint, illustrates a conceptualization gap in the literature. Actual adoption or actual use, which is accounted for in terms of both adoption rates and statistics, has mostly been ignored (Abhipsa et al., 2019).

More importantly, one's intention to use mobile money does not automatically guarantee adoption and use. Having an intention is only a first step toward the decision to use. Still, intention can potentially become overshadowed by a multitude of implementation problems that need solving to ensure actual adoption (Gollwitzer & Brandstätter, 1997). One crucial issue is deficiencies of skills to use mobile money that prevents persons from translating an intention into adoption (Alampay, 2009). If one does not have skills, the intention is useless to the adoption action. Therefore, intentions used as proxies for adoption in technology adoption research, are not an accurate reflection of reality, especially in the developing world context. Consequently, I argue that intention as a standalone outcome cannot provide a comprehensive picture of mobile money adoption and use in developing countries.

Secondly, the use of perceptions and perception-based models is limited in explaining mobile money adoption. Limitations exist because perceptions per se might not help in driving adoption rates up. Yet, developing countries are focused more on finding practical ways to drive up financial inclusion through ubiquitous applications like mobile money. I do not disregard the insights provided by perception-based models. However, these models add little new understanding of adoption, use, and barriers to adoption in developing countries (Dahlberg et al., 2015; Dahlberg, Mallat, Ondrus, & Zmijewska, 2008). There is a need to move past the use of TAM and UTUAT models in explaining the adoption of mobile money and shift to addressing actual barriers, for instance, skills insufficiencies in developing countries. I argue that a deeper understanding of skills can provide practical solutions on how to propel mobile money adoption rates further, something which perceptions cannot do.

Commonly used adoption models are further limited in as far as their replicability to new contexts is concerned. We can deduce this in two ways: practically and through research. From a practical standpoint, mobile money systems have snowballed in some developing countries but failed in many others and the reasons why are not clear (Evans & Pirchio, 2014; Nkwede & Agha, 2017). Secondly, studies to assess the replicability of successful adoption models in other countries echo a lack of consistency in the effects of variables (Flores-Roux & Mariscal, 2010). The above deductions imply that contexts are unique to the extent that different countries might indeed have different mobile money adoption drivers. Thus, we cannot expect fairly general models to have similar

effects when applied at face value in new contexts. Therefore, the wholesale application of adoption models advanced from developed countries is limited in application to developing countries. Given the limitations discussed above, I will focus on actual use and actual skills in this thesis.

1.6 The need to consider skills in the adoption and usage of technology

At the outset of mobile money introduction in developing countries, Alleman & Rappoport, (2010) predicted explosive growth given the vast market potential in these emerging markets and the wide availability of communications services. Nine years later, the reality is far from explosive in many countries, more so in sub-Saharan Africa. In Uganda specifically, only 35 percent of the population in Uganda was using mobile money in the year 2014, according to the World Bank [(5)] indicators. Subsequently, in 2016, Uganda recorded an increase in mobile money adopters from 35 percent (2014) to 48 percent (2016), according to the Financial Inclusion Report [(6)]. The above statistics are still below par.

The low adoption rates are not due to a lack of access to the necessary infrastructure. Service providers are ubiquitous even in the remotest far to reach areas with 90 percent of the population in developing countries having access (Salazar, 2018). The fact that mobile money systems have been established in many developing countries, yet the use is limited, leads one to speculate that the obstacles to the technology's adoption in most countries are not being investigated in sufficient depth (Albuquerque, Diniz, & Cernev, 2016).

A few studies indicate that barriers such as skills to operate technology are critical in using mobile money applications (Alampay, 2009; Medhi, Ratan, & Toyama, 2009; Wyche & Steinfield, 2016). Yet, no empirical evidence has been put forward. Looking at the literature, I can conclude that the major weakness of mobile money adoption studies is that most are about intentions and not actual use. As previously discussed, intentions might not translate into use due to the presence of hindrances, for instance, skills deficiencies to use technology.

Skills as a problem of diffusion and use have not been studied. Skills are of significant importance to develop implementation intentions (development and execution of plans to use mobile money) (Gollwitzer & Brandstätter, 1997). In developing countries, vast inequalities in literacy, access, and use of technology still exist, and not everyone can operate a mobile phone (Dodson, Sterling, & Bennett, 2013; Wyche & Steinfield, 2016). Furthermore, the English language (common to text-based applications such as mobile money), though widely used in many countries, and integrated into the education system, is not native to many countries in sub- Saharan Africa (Negash, 2011). Therefore, skills as a component of adoption become an essential consideration.

As part of preliminary field studies for this thesis, I briefly tested for mobile money usability under a lab setting with a specific focus on skills regarding "how to do," using the

mobile money platform. The results highlight that multiple factors drive usage. Among these are skills (technical know-how or experience with a mobile handset), social support (the presence of peers to carry out transactions on behalf of individuals who do not know how to use the application), the relevance of services and literacy. This bundle of factors provides a stepping stone in devising practical solutions to increase the use of mobile money and other related mobile applications.

1.6.1 Skills: a literature review

Skills in the mobile money context are defined as the capability of people to use mobile money, consisting of informal financial skills and SMS related skills. Users and potential users of mobile-based applications in developing countries are constrained by one deficiency or another to effectively use mobile phones to achieve their goals (Medhi et al., 2011; Medhi, Ratan, et al., 2009; Wyche & Steinfield, 2016). Challenges arise from the difficulty in using mobile interfaces and the deeply embedded menu structures on mobile phones. Hence, it is necessary to consider the skills of users and potential users of mobile payment technology (Alampay & Bala, 2010b; Donner & Tellez, 2008).

Mobile money uses a text-based design through short message service (SMS). The design of the mobile phone and the mobile money application introduces skills into the equation of adoption and use. An ethnographic m-payment study by Medhi, Gautama, & Toyama (2009) with 90 subjects from 4 developing countries puts this in perspective. Text-based designs were less preferred to voice calls, and more operational assistance was required in the use of the mobile payment application. The preference of voice-over text arises as a result of low literacy levels. Text-based applications introduce literacy barriers that are initially not there because individuals majorly acquire phones for voice communications (Burrell & Oreglia, 2015). The literacy barrier is amplified for those living in remote areas in many developing countries (Gebremichael and Jackson, 2006; Johora and Maria, 2015). Yet, mobile money is more valuable to this segment of the population, for they often face more considerable challenges than most in accessing financial services (Tuz & May, 2015). Although mobile phones have diffused substantially in developing countries, the mobile phone as a technology to do anything else than call is still a recent innovation in many communities.

Similarly, individuals do experience difficulty in retrieving SMS messages as this phone feature can be unfamiliar (Katusiime & Pinkwart, 2016). Indeed, a lack of knowledge in SMS texting functionality does negatively influence adoption (Osei-Assibey, 2015). The issue of SMS functionality is just one of the aspects of using mobile money. There are many other issues on phone functionality that feature in mobile money transactions other than SMS. In using mobile money, other aspects of using the mobile phone arise, such as the identification of symbols, notably # and *. This is not obvious. Memorization of a short code to access applications is not innate to many; keypads of feature phones are reported to be overcrowded and awkward, sometimes requiring several taps for a single

character rendering it easy to make mistakes (Wyche & Steinfield, 2016). In extreme cases, differences between lower and uppercase letters confuse illiterate individuals who can misidentify the letters for different alphabets on the mobile keypad (Dodson et al., 2013). If one uses a basic phone, the ability to switch from symbols to numbers, or letters to numbers is vital as well. Many feature phones have buttons that share letters with symbols or numbers.

What complicates matters further is that the academic literature often uses an unfortunate methodology to operationalizing skills in general. Many studies use self-assessment in measuring skills. As a result, the underlying construct is likely to be erroneously represented. A case in point is a study that tested skills to use mobile money using self-reported SMS-communication skills in the Philippines, with items such as, "indicate whether you know how to use mobile money or not." The mobile money application in the Philippines uses an SMS-based service available on any mobile phone with an SMS feature. The study surprisingly found that although 99 percent of the respondents reported being knowledgeable in using SMS, 56 percent stated that the primary reason for not using mobile money was that "they do not know how to use the service" (Alampay & Bala, 2010). The findings show that self-assessment measures can be flawed to the extent that one could have skills but is not aware because he or she has not used the service before, and therefore it becomes a case of lack of awareness. Such flawed data cannot be obtained if actual skills are tested. The issue in the Philippines study could have been one of lack of awareness or low levels of self-efficacy and not a lack of skills per se. In other instances, respondents can overestimate the skills level during self-assessment due to social desirability. Thus, self-assessment and perceptions can be misleading as measures of skills. In addition to flawed measurement, skill-related studies remain primarily anecdotal.

In conclusion, the premise of this thesis revolves around providing a deeper understanding of the role that *actual skills* play in adoption (*actual use*) and how relevant skills can be acquired. This thesis will further allow for the development of a framework or yardstick against which a skilled person can be identified. These elements are critical not only in the advancement of adoption and related research but also for progressing knowledge about the drivers of financial inclusion, which is a vital development agenda in developing countries.

1.7 Context scope and why it matters.

The research in this thesis is done in Uganda, which is categorized as a developing country under the human development indices (rank of 159 out of 189 countries). Core to the definition of a developing country is the issue of literacy, specifically low education levels. This thesis delves deeper into a more detailed analysis of context via rural and urban segregation. Whereas literacy in developing countries is generally low, literacy differences between rural and urban locations are large as well (Gebremichael and Jackson, 2006;

Johora and Maria, 2015). I argue that the issue of actual capabilities or skills to use technology is essential in low literate communities. Furthermore, the findings from this thesis can be generalized to the extent that other developing countries have similar levels of human development. I make the above issue clearer in later sections of this thesis.

1.8 Thesis outline

In developing countries where the advent of certain technologies is still relatively new, the first step in ensuring the adoption of technology should be assessing whether the targeted users can use the innovation. In these unique contexts, more so the rural communities which are characterized by low levels of literacy, the skills of intended users need to be given priority. The role skills play in the adoption, and the use of technologies such as mobile money has mostly been ignored. This premise forms the basis for the research in this thesis. In this thesis, four chapters are presented that provide an in-depth exploration of whether skills are essential in the adoption and use of mobile money, who potentially has these skills, and how skills can be acquired through social networks. The last chapter is a synthesis of the findings, highlighting the implications of the thesis.

Chapter 2 is based on the premise that skills in the use of technology as an adoption and usage driver is mostly understudied and yet very important in developing country contexts. In reiteration, existing literature points to skills playing a pivotal role in the use of mobile technologies, but the findings remain primarily anecdotal. This section provides empirical evidence that offers a deeper understanding of adoption, use, and breadth of use (variety of services) of mobile money technology from a skills perspective. The research also innovatively measures skills using a newly developed test to assess actual skills. Unlike commonly used selfassessments or perceptions of skill level, this test can accurately gauge the mobile phone skill level of participants.

Chapter 3 follows from findings in Chapter 2 that indeed, skills are of great significance in the use of mobile money. Therefore, the question arises: how can and do people acquire and learn skills? The focus in this section is on learning as a process of searching and acquiring skills within a relationship between a person and one of his or her social contacts. Social network factors, as well as individual attributes of the parties within the relationship, are hypothesized to influence learning. Two studies are presented, using two similar primary data collections. In the first study, an urban sample is selected; the second sample is from a rural location. Generically, urban locations are characterized by above-average education levels, and as can be expected, the rural area, a considerably less educated populace. Within these two different locations, the vitality of social networks in mobile money skills acquisition can be aptly studied.

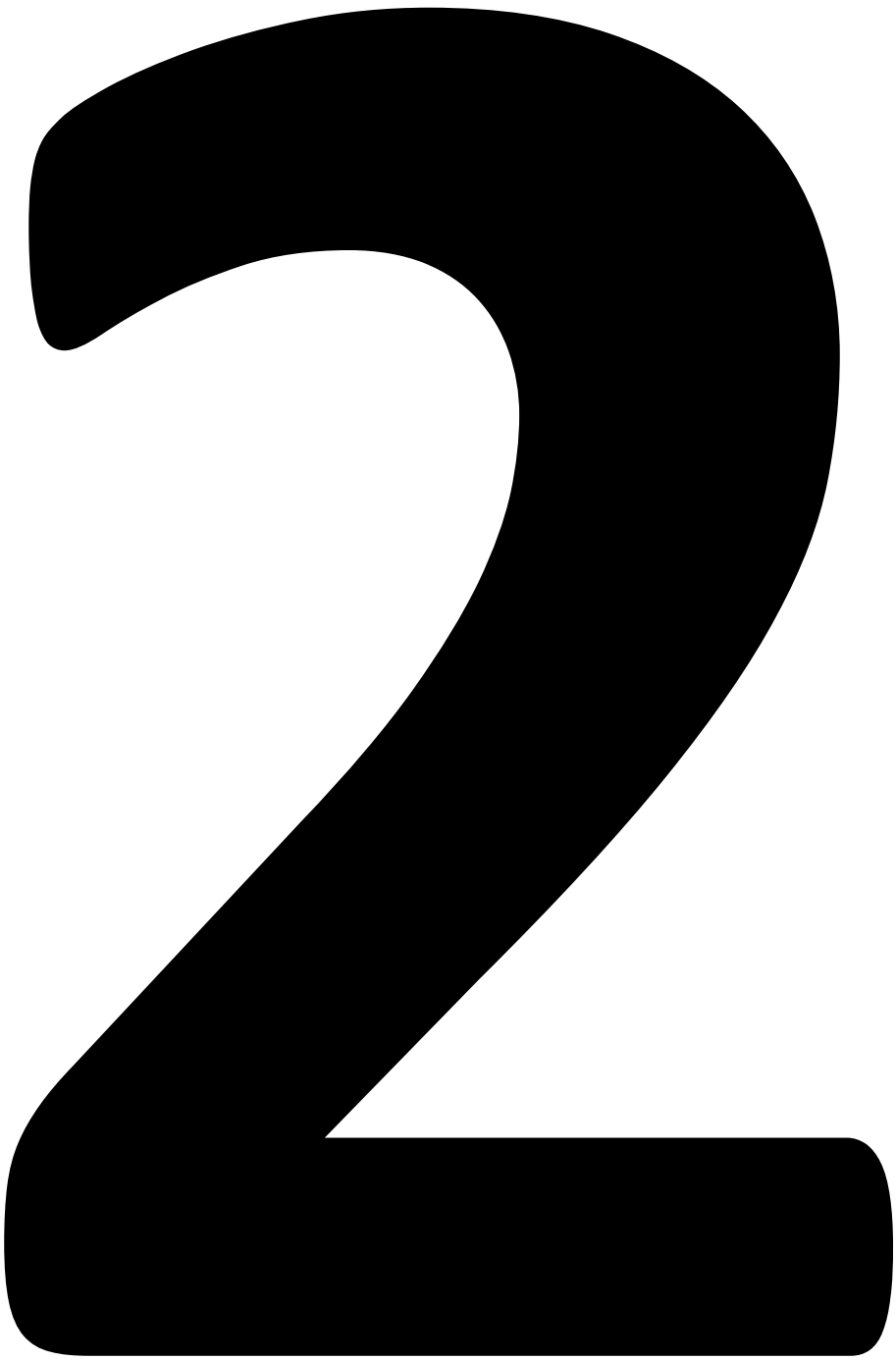
Chapter 4 recognizes that though an extensive proliferation of mobile phones exists in several developing countries, usage statistics of essential applications, for instance, mobile money is still low. Given the previous chapter results showing that skills are vital

for usage, this section develops explicitly a framework to identify who is likely to have mobile phone skills.

Chapter 5 presents a synthesis of the thesis's findings. Furthermore, relevant implications arising from the studies are discussed. Chapter 5 specifies suggestions pertinent to the mobile money space, and by extension, to other mobile technologies in the developing world. Additionally, contributions to theory, literature, and areas for future research are highlighted.

References

1. https://www.gsma.com/mobilefordevelopment/wpcontent/uploads/2012/06/mercycorps2.pdf
2. https://enterpriseresilienceblog.typepad.com/enterprise_resilience_man/2009/11/page/2/
3. https://www.gsma.com/r/mobileeconomy/sub-saharan-africa/
4. http://finclusion.org/uploads/file/reports/InterMedia%20FII%20Wave%203%20Findings%20Uganda.pdf
5. http://datatopics.worldbank.org/financialinclusion/country/uganda
6. http://finclusion.org/uploads/file/reports/InterMedia%20FII%20Wave%203%20Findings%



Chapter 2

A skills perspective on the adoption and use of mobile money services in Uganda

This chapter appeared as Kiconco, R. I., Rooks, G., Solano, G., & Matzat, U. (2019). A skills perspective on the adoption and use of mobile money services in Uganda. Information Development, 35(5), 724-738. doi:10.1177/0266666918788908

In this chapter, 1 investigate how cognitive resources, namely, mobile phone skills and English literacy, influence the use of mobile financial services. The hypotheses are tested using a sample of 208 individuals from an urban location in Central Uganda. Actual mobile phone skills are measured using a newly developed scale. The results show that a marginal increase in mobile phone skills has a strong effect on the odds of adopting mobile money, but a less strong effect on the extent to which the functionalities of the mobile money application are used. On the other hand, English literacy has no influence on both adoption and the magnitude of services individuals use.

2.1 Introduction

Following the rapid diffusion of mobile phones in Africa, the impact of mobile technology can be found in various domains. Mobile phones in developing countries have been associated with: job creation and entrepreneurship (Afutu-Kotey et al., 2017; Asongu et al., 2017); access to credit facilities for small businesses leading to growth (Asongu and Odhiambo, 2017); income redistribution among the poor and gender income equality (Asongu, 2015); good governance, both politically and economically (Asongu and Nwachukwu, 2016); higher productivity in agriculture (Issahaku et al., 2017); as well as financial inclusion (Peruta, 2017). In this paper, we pay particular attention to mobile technology in the financial inclusion realm with an emphasis on understanding the role that cognitive resources play in adoption and use.

Financial inclusion is a situation within which individuals have access to financial services tailored to their needs (Peruta, 2017). In general, developing countries post poor financial inclusion demographics (Zins and Weill, 2016). People in developing countries face many challenges and constraints in access to finances and financial services (see, for example, Solano and Rooks, 2018). Mobile financial services have taken center stage in improving financial inclusion in many developing countries (De Albuquerque et al., 2016; Donovan, 2012; Kikulwe et al., 2014; Murendo et al., 2018; Nyeko et al., 2014). The use of mobile financial services by the unbanked has been recognized as one of the best opportunities for economic growth, poverty alleviation, and establishing financial security in developing countries (Mothobi and Grzybowski, 2017; Peruta, 2017). The most popular mobile-based financial service in these countries is 'mobile money.' Mobile money is a mobile-based platform that allows individuals to make financial transactions using cell phone technology (Jack and Suri, 2011; Murendo et al., 2018).

The first mobile phone-based money transfer system (M-PESA) that allowed individuals to deposit, send, and withdraw funds using their cell phones was introduced in Kenya in the year 2007 (Donovan, 2011; Etim, 2014; Jack and Suri, 2011). ('M' for mobile, 'pesa' is Swahili for money) With limited access to formal financial institutions, the aim of this platform was to extend and include the 'poorest of the poor' in the financial circle (Peruta, 2017). M-PESA has since then grown rapidly, spilling over into neighboring states

under disparate code names by telecom providers and is widely viewed as a success story to be emulated across the developing world (Donovan, 2012). Extending financial services to the unbanked, mobile money improves productivity while lowering the cost of transactions (Aron, 2015; Jack and Suri, 2011; Peruta, 2017). Focusing on Uganda, there is evidence that mobile money has improved rural household incomes through remittances from urban areas (Kikulwe et al., 2014; Munyegera and Matsumoto, 2016). In other countries, mobile money has generated employment opportunities and created a platform on which other businesses grow (Kendall et al., 2012). Moreover, since access to mobile money funds is safeguarded by the use of personal identification numbers (PIN codes), mobile money provides a secure method of savings for rural populations who have limited access to formal financial institutions and face risks caused by traditional means of money transfer and saving (Duncombe and Boateng, 2009; Jack and Suri, 2011; Kikulwe et al., 2014).

Despite the increasing number of people adopting it, mobile money is still far from being widespread (Etim, 2014; Global System for Mobile Communications, 2015, 2016b). According to the World Bank [(1)] indicators, only 35% of the population in Uganda was using mobile money in the year 2014. Subsequently, the 2016 financial inclusion report on Uganda [(2)] reflected an increase in mobile money adopters from 35% (2014) to 48% (2016). This report categorizes mobile money *non-users* as primarily *poor and less educated* with limited access to technology, and a lack of requisite skills as their biggest barriers. These encumbrances, however, are not tested empirically and have remained anecdotal findings.

To use mobile money, individuals need certain skills. Given that mobile money platforms operate on mobile phone technology, and predominantly function using the English language, it is expected that before one can appreciate and efficiently use mobile money services, one has to possess at least basic technical mobile phone skills and linguistic abilities. In developing countries, where the digital divide is still a challenge, and large inequalities in literacy, access, and use of technology exist (Alampay and Bala, 2010; Gebremichael and Jackson, 2006; Medhi et al., 2011), not everyone can operate a mobile phone. Also, the English language, though widely used formally and integrated into the education system, is not native to many countries, even more so in sub-Saharan Africa (Negash, 2011).

2.1.1 Research objectives

Dahlberg, Guo, and Ondrus (2015) called for more innovative context-specific constructs and approaches into mobile payment research. In line with this call, we add to the literature a new perspective on the adoption of mobile technology by highlighting the importance of skills in the decision to use mobile money. In this study, we also focus not only on the adoption decision (whether one uses it or not) but also on what we term *variety of use of* mobile money services. We define 'variety of use' as the extent to which

individuals exploit the different functionalities of the mobile money application. Previous studies that were exploring the variety of use in other domains model this concept as a complex behavior that involves higher cognitive effort and points to the importance of studying this notion more thoroughly (Leary et al., 2014; Shih and Venkatesh, 2004). Nevertheless, what remains unclear are the factors that hinder or support variety of use of mobile money services.

Specifically, the research objectives for this study are:

1. To examine the effect of mobile phone skills and English proficiency on mobile money adoption.
2. To assess the influence of mobile phone skills and English proficiency on variety of use of mobile money services.

The remainder of the article is structured as follows. The literature review in the next section provides a background to previous literature on mobile money adoption, theories on the relevance of skills in mobile money studies, and the research hypotheses. Following the literature section, is the methodology used in this study. A discussion advances the results section. Finally, we present the implications arising from the findings.

2.2 Literature review

Mobile money refers to a repository of electronic money operated via mobile phones (De Albuquerque et al., 2016). Mobile money provides an integrated platform that eases financial transactions in the form of a one-stop center. In other words, given its ubiquitous nature, mobile money facilitates transactions over a wide range of sectors. Mobile money has been extensively applied in many domains, including business, finance, health, agriculture, and education. In Uganda, telecom companies have partnered with banks to synchronize both banking and mobile financial services. With continuous evolution, mobile money facilitates financial transactions encompassing mobile and bank account balance checks, deposits and withdrawals, goods and service payments, purchase of prepaid mobile phone credit, and money transfers (Hughes and Lonie, 2007). Lately, mobile money also enables bank transfers, savings in groups, personal savings, and access to credit (Gencer, 2011; Global System for Mobile Communications, 2015). A recent literature review shows that most mobile payment adoption studies investigate adoption with specific theoretical backgrounds. Commonly used models include the Technology Acceptance Model (TAM); the Unified Theory of Acceptance and Use of Technology (UTAUT); Task-Technology Fit (TTF); Theory of Reasoned Action (TRA); the Theory of Planned Behavior (TPB) and Diffusion of Innovation theory (DOI) (Dahlberg et al., 2015). The growing body of research surrounding the drivers and constraints in adoption of mobile money in developing countries encompasses cost (Jack and Suri, 2011); perceived ease of use and perceived usefulness (Etim, 2014; Tobbin, 2012); social network effects

(Kikulwe et al., 2014; Murendo et al., 2018; Okello Candiya Bongomin et al., 2018); access to formal banking institutions (Peruta, 2017); technology anxiety (Lee and Warkentin, 2004) and complexity, trialability, age and gender (Faqih and Jaradat, 2015; Nyeko et al., 2014).

These studies notwithstanding, researchers have not systematically studied the influence of skills on adoption and use. Thus, there is good reason to study how skills influence mobile money use. In line with Dahlberg, Guo, and Ondrus's (2015) call to study mobile technology adoption as a dynamically evolving service in different contexts, Wyche and Steinfield (2016) investigated, in a qualitative study, why farmers in Kenya are not able to use cell phones. Their study reveals barriers created by a lack of skills in the use of mobile technology. The respondents in the study were challenged by phone functions such as texting, and they were unable to comprehend the English language used in the mobile phone menus. Hence, in a developing country, basic skills and competencies could be a significant predictor of mobile money use.

Mobile money is used by literate, semi-literate and illiterate persons, and is particularly widespread among people who cannot easily access financial services in the formal sector (Donovan, 2012; Jack and Suri, 2011; Kendall et al., 2012). This segment of the population is characterized by low literacy levels (Medhi et al., 2011). Previous research shows that illiterate populations avoid complex functions, and primarily use phones for making calls, because their knowledge of the mobile phone is limited (Chipchase, 2005; Lippert and Forman, 2005). Furthermore, they use a mobile phone with minimal reading and comprehension abilities of what they are doing (Wyche and Steinfield, 2016). Their skill levels to efficiently use a mobile phone are low. Skills refer to technical know-how to operate a given technology. Mobile phone skills refer to the technical skills and know-how to operate a mobile phone, for instance, texting, comprehending texts, menu functions of a mobile phone (Alampay and Bala, 2010; Wyche and Steinfield, 2016). Besides, more technically related skills are required, such as scrolling and hierarchical navigation, soft-key mapping, numeric input, and understanding technical language (Medhi et al., 2011). There is broad consensus among scholars that technological know-how is an essential factor in the use of technology (Alampay and Bala, 2010; Irura and Munjiru, 2013; Lippert and Forman, 2005; Morawczynski, 2011).

To be able to use mobile money effectively, one needs to be in a position to operate a mobile phone. Mobile phone functions used for services such as loading prepaid credit, subscribing to monthly data or credit plans, checking credit balances, to mention but a few, follow the same pattern as mobile money functions. For example, in the context of mobile money, a synchronized access code used across two major mobile networks in Uganda is *165#. Once input, this code processes the main set of mobile money options, which will then provide a menu that appears on the handset for subsequent selection of the required mobile money service.

The mechanism behind using mobile money requires the use of such codes and following sequential instructions to execute transactions. Hence, we argue that having

prior mobile phone skills will influence the extent to which an individual can use mobile money. Previous experience with technologies promotes the use and adoption of mobile money (Schierz et al., 2010; Wei and Zhang, 2008). For example, Schierz et al. (2010), while studying individual behavior patterns, found that prior experience was instrumental in the adoption of mobile payment systems in Germany. Previous experience gained from using a mobile phone will enable a smoother transition into how to use mobile money. Correspondingly, fully exploiting, and effectively utilizing a technology necessitates having the required skills to operate a technology (Shen et al., 2010). Not only will prior experience with a mobile phone enable individuals to use mobile money, but it will also provide opportunities to explore the more complicated functionalities of the technology system (Lippert and Forman, 2005).

In developing countries where literacy levels are relatively low (Alampay and Bala, 2010; Medhi et al., 2011), it is prudent to consider English literacy constraints in the adoption of mobile financial technology. Previous studies have argued and shown that low literacy users find it hard to complete tasks in the English based user-interfaces (Medhi et al., 2009, 2011). Taking the case of M-PESA, in Kenya, some users not fluent in English had difficulty reading text portions of receipts from the mobile money transactions. However, they could identify the numerical values (Donovan, 2012). Further still, recent qualitative research by Wyche and Steinfield (2016) found that English menus embedded within the mobile money application posed a barrier for illiterate users. Not only did the language limit interactivity with the system, but it also sat a blockade to accessing the technology. The above literature underscores the importance of both abilities and literacy in facilitating the operation of the mobile money application.

Correspondingly, if one faces a barricade in using mobile money due to the English language barrier, the attempt to explore various services offered will be limited. We argue that individuals who can read English will be able to explore the variety of mobile money services and, therefore, will be more likely to use them. This reasoning follows from findings in Wyche and Steinfield (2016) that depict that technology embedded with the English language is challenging to operate for persons with low literacy. Furthermore, in their study on the use of the internet, Lissitsa and Chachashvili-Bolotin (2014) found that proficiency in English facilitated variety of use of the Internet.

2.2.1 Study hypotheses

H1 The higher the mobile phone skills an individual possesses, the more likely that (s)he adopts mobile money.

H2 The higher the mobile phone skills an individual possesses, the larger the variety of mobile money services (s)he will use.

H3 Having proficiency in English will positively influence the adoption of mobile money.

H4 Proficiency in English will positively influence variety of mobile money services use.

2.3 Method

To test our hypotheses, we make use of data that was collected via a survey in May 2015. Wakiso district was purposively selected because it is the largest district by population in Uganda. Wakiso has a population that is 13% [3] higher than the capital city Kampala, and it has a highly urbanized and accessible population. The survey location was selected using a multistage sampling procedure. In Uganda, urban districts are divided into municipalities, divisions, wards, and cells or sub-wards. Randomization was used to select Entebbe out of the major administrative units in Wakiso. Similarly, one division within the municipality chosen, one ward within the chosen division, and finally a list of sub-wards. From this list, the first five sub-wards were randomly selected for the data collection (one can think of a sub-ward as a village). Within each of the five sub-wards, systematic sampling of 50 households was done based on the sub-ward's population leading to a total of 250 sampled households. Based on the list of registered homes provided by the sub-ward's local council chairperson, the n^{th} household was selected for an interview. For instance, in the Nakiwogo sub-ward that had 576 registered households, every 11^{th} household (576/50) was selected for participation. Within eachhousehold, one respondent was selected. Typically, the person who opened the door was asked to participate. If the person was under the age of 16, the research assistant asked whether an adult was present.

In total, 47 of the 250 initially sampled households refused or could not participate in the study. The response rate was quite high (81.2%). Some of the reasons for non-cooperation were the fact that the household head was not around, and the potential participant was not authorized to talk to strangers, a lack of time on the respondent's part, or being busy at the moment of the interview. If a household was found to have no individual to interview or a non-cooperative individual, then the next-door household was considered for an interview.

The face-to-face interviews were conducted by six trained Ugandan interviewers who visited participants' homes and collected all information using the Survey Gizmo tool (Survey Gizmo, 2006) on tablet computers. The interviewers were selected and trained for a day and a half in the use of the tablet computers that were used to collect the responses, the objectives of the data collection, and general techniques for managing interviews. All interviewers were M.Sc. students who had previous experience with conducting social scientific research. At the end of the data collection, a total of 249 interviews were finalized. Unfortunately, some interviews were lost because of a problem with intermittent internet access. All in all, 41 surveys were lost or not usable. The final number of valid observations is 208.

2.3.1 Measures

The development of the survey included a back-and-forth process with pre-testing of the questionnaire to construct scales and evaluate whether or not items were reliable and valid in the Ugandan context (pre-tests were done on the street with mobile money users,

typically ten users). Initially, self-perception scales were developed to test for variables such as mobile phone skills. However, they were prone to social desirability. Therefore, the decision was made to focus on abilities rather than self-perception. This process took approximately two weeks. The instrument was available in both English and the local language - Luganda (the main spoken language in Central Uganda) to ensure that questions were standardized and not ambiguous.

2.3.1.1 Dependent variables

2.3.1.1.1 Mobile money adoption

Mobile money adoption is a measurement of whether one uses or does not use the technology. The variable Mobile Money Adoption is a single item measure based upon the question "do you currently use mobile money?" that was asked to participants of the study, with the possible answers being "yes" and "no."

2.3.1.1.2 Variety of use of mobile money

The variety of use was measured based on the different services available on mobile money platforms in Uganda at the time of the data collection. If respondents indicated that they used mobile money, then they were subsequently asked whether they used the following services: buy airtime ("buying airtime" refers to the purchase of prepaid mobile credit to make use of a cell phone); receive money; send money; deposit / withdraw money, store / save money; pay for goods / receive payment for goods; pay for bills, pay school fees; and transfer money to/from a bank account.

2.3.1.2 Independent variables

2.3.1.2.1 Mobile phone skills development of the measurement instrument

To test the participant's actual mobile phone skills, a 12-item scale was developed based on the Actual Digital Skills questionnaire developed by the European Computer Driving License (ECDL) in their 2009 report on digital literacy (ECDL, 2009). The instrument focuses on personal computer skills and includes questions such as "Which of the following is a portable storage device?" and "Where would you click to attach a file to an email?" The version developed for this study focuses on mobile phone skills, with questions about hardware functionality, for instance, "Which of these is most likely failing if your phone loses power quickly?" Additionally, software-related questions are included; for example, "if you want to send a picture from your phone to a friend, which of these systems does not allow you to do that?" Questions had varying degrees of difficulty. All items had five possible options, one of which is correct. Participants had the option to say they do not know the correct answer (this option minimized guesswork). At the end of the survey, all answers were recoded to 'correct' or 'incorrect' (*see Appendix I for details)*. The scale development commenced with a pilot of ten data points. No issues were identified in both flow and clarity; therefore, no modifications were done. The reliability of the instrument was checked using a Mokken scale analysis.

2.3.1.2.2 English literacy

English literacy was measured using a 4-point Likert scale. Respondents' were asked, "How well can you read in English?" Response categories were 'Not at all, A little, Good, and Very Good.'

2.3.1.3 Control variables

Several variables are included to control for possible confounding effects. These variables were selected based on the existing literature on mobile money adoption. Mallat (2007) indicates that network externalities can have a positive effect on the adoption of mobile money services, depending on whether or not the system is perceived as having enough users. The existence of network externalities implies that when more peers adopt mobile money, the utility of adopting and using mobile money is increasing for an individual as well.

2.3.1.3.1 Peer adoption

A common survey method in social network research is the so-called name-generator method (Marsden, 1990), which has been extensively used in developing countries (for example, Rooks, Klyver, and Sserwanga, 2016; Solano and Rooks, 2018). In this method, respondents are asked to list people with whom they interacted in a particular period. In this study, respondents were asked, 'Looking back over the last six months – list the people with whom you discussed important matters? Think of people in your family, in your work, your friends, and so forth. It can be anyone who you have talked recently and whose opinion you consider to be important'. The interviewer then noted the names of these contacts. After obtaining the list of names, the participant was questioned about specific characteristics of each contact he or she named. The variable *network size* is the number of contacts mentioned in the name generator.

A common practice when using name-generators is the limitation of the maximum number of contacts, to cope with time constraints in a survey while maintaining measurement precision and minimizing measurement bias (Sosa, 2011). For this study, the name-generator was limited to a maximum of ten names.

For each contact mentioned in the name-generator, we asked respondents 'does [*contact name*] use mobile money?' Possible responses included, 'yes; no; and I don't know.' Based on the information gathered, we calculated #peer adopters as the number of contacts in a network of whom the respondent knows that they use mobile money.

2.3.1.3.2 Demographic variables

Income influences have been shown to sustain the use of mobile technology (Crabbe et al., 2009). Mobile money is a financial service; therefore, users with a higher income are expected to have a stronger need to use the system and in more varied ways. Income was measured by asking the question, "What is your current average monthly income?" To control for social desirability and provide for privacy, the participant was not asked

to provide the exact amount, but was given the following categories: 0-100,000 UGX; 100,001-250,000 UGX; 250,001-500,000 UGX; 500,001-1,000,000 UGX; 1,000,001-2,000,000 UGX; > 2,000,000 UGX. The exchange rate is 1 dollar to 3,629 Uganda shillings (UGX) using the current exchange rate from Bank of Uganda [4].

Finally, we included three other demographic variables in our analysis, Age, Gender, and whether one has a bank account or not. We included them as control variables to test whether our hypotheses would hold in the presence of these influences.

2.4 Results

2.4.1 Mokken scaling results - Variety of use of mobile money services

We tested the scalability of the mobile money service items with Mokken scale analysis, a non-parametric item-response model (Gillespie et al., 1987). A Mokken scale can be seen as a probabilistic version of Guttman scaling (Van Schuur, 2003). Survey items of a binary nature (yes or no items) form a Guttman scale if the items can be arranged in a way that; when an answer to an item of a higher rank-order is one (or yes), then responses to items of a lower rankorder are likely to be one (or yes) as well. The resulting rank order arranges the items from "functionalities that are used by few users" to "functionalities that are used by many users." If these usage forms constitute a Mokken scale, then users who pursue the more difficult activities are likely also to pursue easier activities. In our case, this implies that if the user transfers money from/to a bank account", which does not happen often, then this user will likely pay bills with mobile money as well. The result of a Mokken scale analysis is a hierarchy of use, which together constitutes a scale, indicated by a measure of homogeneity for the scale (H), a measure of fit for each item (Hi), and reliability score (ρ). In our Mokken scale analysis, one item, "send money," had to be excluded, since it was not scalable. In the final scale, the H coefficients of all items are larger than .40, which is the standard threshold for the inclusion of items. The overall H-value of the scale is 0.45, which suggests a medium-strong scale. We checked whether model assumptions were met and found no violation of the model assumptions. All calculations were carried out using the software MSPWIN version 5.0 (Molenaar and Sijtsma, 2000). The *variety of use* variable thus consists of a score ranging from zero (no adoption) to six (all six usage forms are utilized). Table 2.1 presents the result of the Mokken scaling for a scale measuring the variety of use of mobile money.

Table 2.1. Results of mokken scaling for variety of mobile money use items.

Mobile Money Service Item	The proportion of Respondents pursuing an activity	Hi coefficient
Receive Money	91%	0.45
Deposit Money	85%	0.41
Buy Airtime	73%	0.45
Pay Bills	29%	0.42
Pay Goods	20%	0.46
Bank Transfers	6%	0.59
Scale H		0.45
Scale p		0.61

Table 2.1 shows that receiving money is very common, with 91% of the participants. Many users treat mobile money as a wallet, depositing money for a short while (85%). Buying airtime for mobile phone use (prepaid phone credit) is also common (73%). Less common are the functionalities to pay for goods and bills (20% and 29% respectively). Even less common is the use of mobile money for bank transfers (6%). The final measure of the *variety of use* is the sum of the different services used for mobile money in Uganda at the time of the data collection.

2.4.2 Mokken scaling results - Mobile phone skills

The validity and reliability of the instrument were once again checked using Mokken scale analysis. (for an explanation of the Mokken model see above) Test items 7, 2, and 11 were not scalable; therefore, they were excluded. The mobile phone skills variable thus consists of a score ranging from zero (no skills) to nine (high skills). Table 2.2 presents the result of the Mokken scaling for mobile phone skills. The final scale is strong and reliable, with an H-value of 0.50.

Table 2.2. Results of mokken scaling for the mobile phone skills test item.

Test item	The proportion of respondents that answered correctly	Hi coefficient
Sim card	96%	0.45
Hash button	94%	0.69
Space button	83%	0.64
Bluetooth symbol	72%	0.61
Sim pin-code	49%	0.37
Send pictures from phone mechanism	45%	0.40
Connection of mobile phone to computer	19%	0.54
iTunes and Google Play	14%	0.56
Voicemail	9%	0.37
Scale H		0.50
Scale p		0.72

Table 2.2 shows that identification of a sim card, hash and space buttons, as well as knowledge regarding which part of a phone needs attention if it loses power quickly, are the questions that were correctly answered the most, with 96%, 94%, 83%, and 82% respectively. Less known functionalities include what a PUK code is, the use of iTunes and Google play, Voicemail services, and knowledge on 3G technology with 16%, 14%, 9%, and 2%, respectively. Since the test items "Battery," "PUK code," and "3G Technology" were not scalable, we excluded these test items. The final measure of mobile phone skills is the sum of the different correct answers given by an individual. The *mobile phone skills* variable thus consists of a score ranging from zero (no skills) to nine (high skills).

2.4.3 Descriptive statistics

Table 2.3 shows that 54% of the respondents were women and the average age of the respondents is 36 years. The average monthly income is 326,322 Ugandan shillings, which are approximately 90 United States dollars at the current exchange rate. (1 dollar to 3,629 Uganda shillings) On average, respondents know 50% of the functionalities on their phones, and 84% of the respondents use mobile money. Those that adopted mobile money use, on average, 50% of the services provided. This generally literate sample can read English with an above-average number of 11 years spent at school. The average number of contacts per respondent is 5. Further, within an individual's network, about four people, on average, use mobile money, and 51% of the sample have a bank account.

Table 2.3. Mean and standard deviation of study variables (N= Number of Observations).

Variable	N	Mean	Standard deviation	Range
Adoption of Mobile Money	208	0.84	0.36	0-1
Variety of Mobile money use	166	3.13	1.14	1-6
Mobile phone skills	208	4.78	1.85	1-9
English literacy	208	1.85	1.01	0-3
Number of peer adopters	208	4.07	2.30	0-10
Network size	208	5.84	2.39	0-10
Age	208	36.29	12.72	18-75
Gender (Female 1/Male 0)	208	0.54	0.49	0-1
Income	208	326,322	442,723	50,000-2,000,000 (UGX)
Education in years	208	11.7	3.65	0-15
Having a bank account	208	0.51	0.50	0-1

Table 2.4 shows that the adoption of mobile money and variety of use have the same correlates. Therefore, an increase in mobile phone skills, English literacy, number of peer adopters, education, and having a bank account may influence an increase in mobile money adoption and variety of use.

The preliminary findings indicate a state of inequality in access and use of mobile money technology. The younger generation, individuals who are more educated, those with access to formal financial institutions (banks), and the male gender are in an advantaged position to utilize mobile money technology. Also, we observed high correlations, particularly between English literacy and Education in the number of years spent in school (0.70), prompting the testing for multicollinearity among independent variables in our subsequent analyses. The Variance Inflation Factors were all ≤ 2.50 with a mean-variance inflation factor of 1.72, indicating the absence of multicollinearity.

Table 2.4. Correlation table.

	Variable	1	2	3	4	5	6	7	8	9	10
1	Adoption of mobile money	1.00									
2	Variety of mobile money use	n/a	1.00								
3	Mobile phone skills	0.43**	0.27**	1.00							
4	English Literacy	0.35**	0.31**	0.45**	x 1.00						
5	Number of peer adopters	0.30**	0.26**	0.30**	0.30**	1.00					
6	Network size	0.06	0.11	0.20*	0.19*	0.70**	1.00				
7	Age	0.03	-0.01	0.36**	-0.03	-0.06	0.00	1.00			
8	Being female	-0.07	-0.11	-0.28	-0.14	-0.18*	-0.13*	-0.03	1.00		
9	Income	0.11	0.31**	0.18*	0.33**	0.11	0.04	-0.23**	-0.21*	1.00	
10	Education in years	0.38**	0.29**	0.52**	0.70**	0.37**	0.24**	0.02	-0.16*	0.33**	1.00
11	Having a bank account	0.23**	0.30**	0.26**	0.48**	0.26**	0.17*	0.25**	-0.12	0.42**	0.42**

*p<0.05; **p<0.001

2.4.4 Adoption of mobile money analysis

Table 2.5 shows the logistic regression results predicting mobile money adoption. Models 1 and 2, run independently with each having one of the two main predictors (English literacy and mobile phone skills), indicate that mobile phone skills are the only significant predictor of the two. ($\beta = 0.75$ [4.10], $p < 0.001$). Model 3 includes both predictors, and it supports the above finding. Therefore, we conclude that whereas hypothesis 1 is supported, hypothesis 3 is not supported by our data.

Based on a model with only the significant predictors of mobile money adoption (namely; mobile phone skills, number of peer adopters, and network size), we estimated the probability that a person with a certain level of mobile phone skills will adopt mobile money. To do this, we use 10 cases, where the mobile phone skill levels are varied based on the Mokken scale analysis reported earlier (0 - 9), and the number of adopters and network size is held at the sample mean of four (4) and five (5) respectively.

The predictive probabilities in figure 1 show that the difference between a person who has zero skills and a person with low skills (0 vs. 3) is almost 49 percentage points (0.74-0.25). Compare this to the difference between medium-skilled and low skilled respondents (3 vs. 6) of 20% (0.96- 0.74). This indicates that helping individuals at the beginning of a mobile phone acquisition to acquire basic (low skills) such as, 'what do the buttons on your phone represent'; 'where to locate the hash button on your phone,' can have a drastic effect on the use of mobilebased applications. The latter impact is more considerable than helping low skilled persons upskill to medium-skills. Increasing a medium level of mobile phone skills to a higher level does not seem to have much relevance to the adoption of mobile money, as seen by the low increment in probabilities of adoption (0.96 to 0.99).

Table 2.5. Logistic regression analysis of mobile money adoption (unstandardized coefficients, z-values between brackets and odds ratios).

Independent Variables	Model 1	Model 2	Model 3	Odds ratios Model 3
Mobile phone skills	-	0.75 (4.10)**	0.75 (4.02)**	2.12
English literacy	0.50 (1.49)	-	0.43 (1.17)	1.54
Number of peer adopters	0.60 (3.88)**	0.55 (3.40)**	0.55 (3.36)**	1.74
Network size	-0.39 (3.16)**	-0.46 (3.41)**	-0.48 (3.38)**	0.61
Age	-0.01 (1.00)	0.02 (1.15)	0.02 (1.21)	1.02
Being female	-0.10 (0.22)	0.44 (0.82)	0.35 (0.65)	1.43
Income	-2.07e-07 (0.27)	-1.84e-07 (0.23)	-2.72e-07 (0.32)	1
Education in years	0.09 (1.29)	0.054 (0.75)	-0.01 (0.06)	0.99
Having a bank account	0.61 (1.01)	0.44 (0.67)	0.21 (0.31)	1.23
Intercept	0.55 (0.53)	-3.05 (2.16)*	-2.90 (2.02)	
Pseudo R	0.27	0.38	0.39	
Number of Observations	208	208	208	208

*p<0.05; **p<0.001.

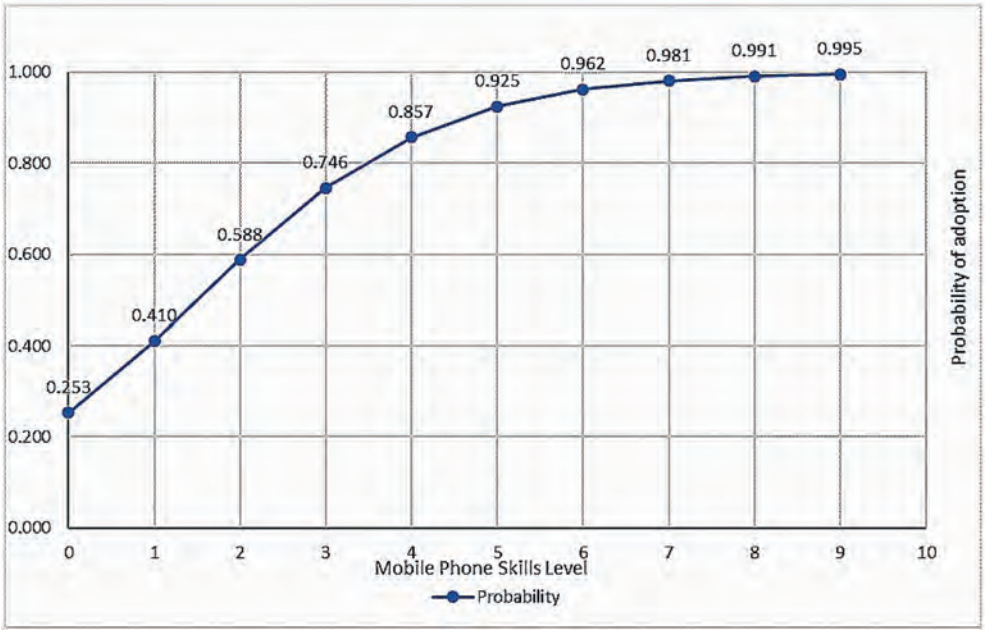


Figure 2.1. Probability of adopting mobile money at different mobile phone skills levels.

2.4.5 Variety of mobile money use analysis

The linear regression results predicting the variety of use of mobile money are presented in Table 2.6. Distinctions between the explained variance of each of the two main predictors are shown in Models 4 and 5, similar to the results in Table 2.5. Model 6, which contains all the constructs, shows that neither mobile phone skills nor English literacy predict the variety of use of mobile money, (β = 0.08, t =1.46, p>0.05); (β = 0.15, t =1.30, p>0.05) therefore H2 and H4 are not supported by the data.

Table 2.6. Linear regression analysis of variety of mobile money use, conditional on use (unstandardized coefficients, t-values between brackets).

Independent Variables	Model 4	Model 5	Model 6
Mobile phone skills	-	0.08 (1.51)	0.08 (1.46)
English literacy	0.16 (1.35)	-	0.15 (1.30)
Number of peer adopters	0.14 (2.56)*	0.13 (2.29)*	0.13 (2.37)*
Network size	-0.07 (1.37)	-0.06 (1.20)	-0.06 (1.25)
Age	0.01 (1.47)	0.01 (0.54)	0.01 (0.45)
Being female	0.01 (0.05)	0.06 (0.35)	0.07 (0.43)
Income	4.94e-07 (2.46)*	4.94e-07 (2.47)*	4.78e-07 (2.38)
Education in years	0.02 (0.59)	0.03 (0.93)	0.01 (0.11)
Having a bank account	0.31 (1.61)	0.35 (1.85)	0.29 (1.46)
Intercept	-18.44 (1.32)	-7.19 (0.44)	-5.79 (0.35)
R^2	0.22	0.22	0.23
Number of Observations	166	166	166

*p<0.05; **p<0.001

Furthermore, model 6 shows that the number of peer adopters in an individual's network positively influences the variety of use (β = 0.13, t=2.37, p<0.05). Hence, the higher the number of contacts an individual has that use mobile money, the more likely that the person will also use many services of the mobile money platform. Mobile phones are used primarily among one's network, and therefore, it is not surprising that mobile money transactions, too, seem to rotate within individual networks. Not only do networks present occasions to learn about mobile money services, but they also provide opportunities to execute various transactions because you possess a network that understands and uses the technology.

In summary, this article presents the results of research conducted in a developing economy context, namely, urban Uganda. By presenting the case of urban Uganda, the contribution of this paper is twofold. First, we analyze skills as determinants of the adoption of mobile financial technology, consistent with earlier suggestions in the literature. Secondly, we extend existing studies by also investigating determinants of

variety of use. Thus, we not only focus on the adoption decision in isolation but also study how people use it. Our results show that mobile phone skills are indeed an essential driver in the adoption of mobile financial technology in Uganda. In contrast, the importance of English language skills is much smaller or non-existing. These results could be pertinent to Ugandan policymakers and other developing economies faced with the dilemma of low adoption rates of mobile money. Through providing a basis to create relevant solutions tailored to improving mobile phone skills, the uptake of mobile money services can be improved. The results also show that it is pertinent to include users and their capabilities in the development of mobile technology services (Dahlberg, Guo, and Ondrus, 2015).

By extension, findings from this study can be used by policymakers to model relevant and appropriate interventions that focus on the intended user's skill level in other mobile technology domains fostering governance, employment generation, reduction of income inequality, and poverty alleviation. These are all positive mobile technology effects that have been highlighted in the literature (Afutu-Kotey et al., 2017; Asongu, 2015; Asongu et al., 2018; Issahaku et al., 2017).

2.5 Discussion

This article advances research on the adoption and use of mobile phone applications in developing countries by focusing on the skills of individuals, specifically mobile phone skills and English literacy. We argued that skills would affect adoption and use in two ways, namely; [1] the higher the mobile phone skills an individual has, the more likely the individual will adopt and make use of the various services offered by mobile money; [2] the higher the English language proficiency of an individual, the more likely s(he) will adopt mobile money and use more services offered by the technology.

The findings corroborate that individuals who are skilled at using a mobile phone will find it easier to operate mobile money technology. More so, in developing economies where the ubiquity of mobile phones is rising (De Albuquerque et al., 2016), and illiteracy levels are still high (Gebremichael and Jackson, 2006; Global System for Mobile Communications, 2016a; Matotay and Furuholt, 2010; West, 2012). Thus, skills are an essential consideration in the use of mobile financial technology products. There is a need for policymakers to enhance skills and, subsequently, adoption and usability of the technology for financial inclusion.

This study is the first to systematically demonstrate the importance of basic mobile phone skills in the use of mobile financial services in a developing country. Our results provide empirical corroboration of previous non-empirical speculation of the importance of skills in technology adoption (Alampay and Bala, 2010; Donovan, 2012; Medhi et al., 2009; Tobbin, 2012; Wyche and Steinfield, 2016). Though the above studies provided a platform on which this study is based, our research is different from the above studies as we develop a measurement scale to test actual mobile phone skills and consider these in relation to the actual usage of mobile money services in a developing country context.

Findings show that though mobile phone skills are important for initial adoption, they are not relevant for the subsequent use of other services over the same platform. Mobile money transactions follow an identical format; therefore, if an individual learns how to carry out one transaction, it is highly likely that transfer learning will occur, and one can follow sequential instructions to execute other transactions. This could explain why mobile phone skills are not crucial for variety of use.

Somewhat surprisingly, English language proficiency showed a positive trend, though not significant for the adoption of mobile money. Mobile money is a predominantly English- based platform. Therefore, it was expected that persons endowed with more skills regarding English literacy would be better suited to use this particular technology. However, our findings show that this is not the case.

Our analysis suggests an explanation of this result. Further quantitative analysis using the covariates, specifically, social influence, reveals that individuals can execute transactions possibly through social networks that provide tech-support regarding awareness, information provision, and actual hands-on facilitation. Murendo et al. (2018) confirmed the above reasoning. In other words, relatives, friends, and acquaintances of less tech-savvy mobile money users assist in using mobile money, either by using it on their behalf (proxy use) or through teaching them how to use it. The above phenomenon could explain why English proficiency might not be a requirement to use mobile money.

Anecdotal evidence from previously mentioned studies (Donovan, 2012; Medhi et al., 2009) and our fieldwork (informal qualitative inquiry carried out after the interviews), further support the above findings. This anecdotal evidence showed that illiterate individuals find mobile technology solutions through constant repetition, trial, and error and not necessarily through understanding the underlying dynamics. For example, individuals may have the ability to complete a transaction but may lack the capacity to comprehend the confirmation message received after that from the service providers (Wyche and Steinfield, 2016). Similarly, the use of mobile money agents as intermediaries in the transaction process facilitates low literate users to carry out transactions.

Notwithstanding the above social support, mobile money is a financial tool where access is by "secret codes," commonly referred to as PIN (Personal Identification Numbers) codes. Therefore, the risk of fraud arising from third party assistance and support through proxy use is imminent. Thus, it is pertinent that individuals can operate the technology on their own. Arguably, skills can be derived from social networks (Cross and Cummings, 2004; Kikulwe et al., 2014; Kreindler and Young, 2014; Murendo et al., 2018) and future studies being undertaken by the researchers will shed more light on the mechanisms through which individuals acquire mobile money skills through their social networks.

This article has some limitations. The study was cross-sectional, and because it was constrained by resources, it focused on an urban sample. The urban sample depicted an aboveaverage level of literacy, though this could explain the irrelevancy of English literacy in explaining adoption and use in this study. It would be more enriching if a rural sample

where illiteracy largely affects the population segment was used to investigate further the effect of skills on the use of mobile money. Future research should look into the dynamics of skills and their role in technology use between these two different settings.

Similarly, given that cross-sectional data is used, the only thing the study holds is correlations. What remains unclear is which predictor variables here might be endogenous and which variables were omitted. Future studies can explore a randomized experimental approach to determine causality.

In addition, to use mobile money, one needs mobile money skills. These are the direct skills to use the technology. However, to acquire these skills, an individual needs to know how to operate a mobile phone. In this study, we used mobile phone skills as a precursor to using mobile money. It would be prudent to test and measure mobile money skills and further examine whether these two skills are different from one another. Future research could focus on exploring the differences and effects of these two skills on the use of mobile money technology.

2.6 Implications

Skills are an integral part of the adoption process of mobile financial technology. The practical implications emerging from our study indicate the need for policymakers to promote skills and literacy for the adoption and use of technology. We live in a digital world, and the inequality in who can access and use digital technology is wider in developing economies (Aron, 2015; Wei and Zhang, 2008). With clear evidence from this study, individuals with access to skills, literacy, and income are in advantaged positions for the adoption of mobile money. Though these indicator constructs are positive, this status quo defeats the original purpose of the mobile money innovation, which was to include the "poorest of the poor" in the financial circle. It is thus of vital importance to mitigate the causes of this inequality and find solutions to reduce this divide.

It is pertinent to target specific technology needs of users through assessing their skill levels. With the surging move to use of technology in the financial domain, financial education and literacy have received consensus as instruments to enable the poor better understand and utilize financial products such as mobile money (Carpena et al., 2015). However, at the root of the problem is not the intention or structure of the education campaigns, but the failure to observe the cause of ineffectiveness in the education programs (Kaiser and Menkhoff, 2017). This study sheds light on one of the sources of ineffective education campaigns—the lack of prior skills. "A teachable moment" as described by Miller et al. (2015) can be adopted by assessing skill levels of individuals, determined using the measurement scale developed in studies such as this, to assess cognitive limitations and give contextualized and relevant training that maximizes the behavioral change in a target group.

Social networks are a source of change-agents. Additionally, policymakers should initiate and foster social network activities in various population segments to create

focus groups for mobile money adoption and diffusion. They also could identify opinion leaders who could then act as change agents in smaller communities. Future research can build on our findings by elaborating on the network perspective and applying other perspectives that take into account the effects of social influences and the broader social context for explaining the adoption of mobile money and other important innovations. Also, similar research needs to be repeated in other African countries to find out whether network characteristics matter there as well.

There is a need for usability studies on mobile financial technology. In respect of financial inclusion technology products and service providers and the wider technology community, the findings provide information on user behavior in developing economies. Debatably, there is a general impression that attitudes towards using technology are stimulated by numerous factors. However, this study clearly shows that in developing countries, adoption and continued use of technology is majorly a function of requisite skills to operate the technology. As these mobile technology solutions advance, systems and services providers should consider not only the additional value of their technology but also how practical it is for an individual to use. Usability studies should be a prudent requirement for the release of new technology to the market more so in emerging countries.

References

1. This chapter appeared as Kiconco, R. I., Rooks, G., Solano, G., & Matzat, U. (2019). A skills perspective on the adoption and use of mobile money services in Uganda. Information Development, 35(5), 724-738. doi:10.1177/0266666918788908
2. http://datatopics.worldbank.org/financialinclusion/country/uganda
3. http://finclusion.org/uploads/file/reports/InterMedia%20FII%20Wave%203%20Findings%
4. http://www.statoids.com/uug.html
5. https://www.bou.or.ug/bou/collateral/exchange rates.html

Chapter 3

Skills to use mobile money within rural communities in developing countries: who has them?

In a bid to understand who is likely to have mobile phone skills, this chapter explores different individual level and social network factors. Using a sample of 525 respondents from rural Uganda, earlier findings that mobile money use is indeed largely dependent on mobile phone skills are confirmed. The results further show that older people are less likely to possess mobile phone skills. Additionally, more substantial incomes, better education, higher cognitive motivation, being of the male gender, and the presence of more peer adopters in one's network predict mobile phone skills. Moreover, density and network size do not influence mobile phone skills.

3.1 Introduction

Mobile money is a financial tool that enables users to make and receive payments using their mobile phone devices (Gosavi, 2015). Nowadays, mobile money in Africa is used by about 1 in 10 Africans.[1] It is adopted across commerce, health care, education, taxation, agriculture, and other sectors (Donovan, 2012). Mobile money has impacted societies both at the individual level and at the national level by decreasing inequality and promoting economic growth (Demirgüç-Kunt, A., Honohan & Beck, 2008). In many developing countries, mobile money technology has dramatically impacted economic development; specifically, financial inclusion (Economides & Jeziorski, 2017; Holloway, Naizi, & Rouse, 2017).

Notwithstanding the usefulness of mobile money, the per capita usage of mobile money technology is still wanting, particularly in the rural areas (El-Zoghbi, 2018; Global System for Mobile Communications, 2016; McKay & Kaffenberger, 2013; Nkwede & Agha, 2017). This is somewhat unexpected since the necessary infrastructural systems are in place. In other words, the telecom network operators that run the mobile money transfer system are ubiquitous, even in the remotest areas in many developing countries. Additionally, mobile phones are increasingly accessible to lower-income groups (Rashid & Elder, 2009). The above suggests that the limited use of mobile money is not about access but usability. Although many people in developing countries use mobile phones in their daily lives, relatively few use mobile money, while those who use it are often marginal users. For instance, in Uganda (geographical context of our paper), statistics show that 43 percent of the adult population have registered mobile money accounts, yet only 38 percent are active[2].

Given the importance and impact of mobile money use, researchers have tried to uncover the determinants of mobile money use in developing countries. A primary research focus has been on intentions to adopt mobile money (Baganzi, 2017; Lubua & Semlambo, 2017; Mahfuz & Saha, 2015; Nkwede & Agha, 2017; Sayid, Heights, & Echchabi, 2012; Tobbin, 2009). A recent meta-analysis found that intentions to adopt are best explained by performance expectations, trust, attitudes, and perceived risk (Baptista & Oliveira, 2016). Though sound theory backs intention as a proxy measure for use, the construct's ability

to capture actual adoption is questioned (Abhipsa et al., 2019). Accordingly, Szajna, (1996) finds that intentions have significant effects on self-reported usage but not on actual usage (Szajna, 1996), a situation that undermines the practical impact of using intention-based models. Indeed, subjective or selfreported measures of use (i.e., use inferred from a respondent's intention) have to been found to have little similarity to actual use (Straub, Limayem, & Karahanna-Evaristo, 1995; Szajna, 1996; Yousafzai et al., 2010).

Recently, researchers shifted the focus from intention to actual use (Kiconco, Rooks, Solano, & Matzat, 2018). Kiconco et al., (2018) found that having skills was a much stronger predictor of actual use than performance expectations. An individual that expects mobile money to be useful, and intends to use it, still needs the skills to implement this intention (Gollwitzer, 1999; Kiconco et al., 2018). As Gollwitzer, (1999) argues, moving from intention to successful attainment of behaviour requires that problems associated with inertia are solved first. Consequently, learning and acquiring technical competencies in using a mobile phone is critical (Kaaira & Schueth, 2018; Medhi et al., 2011). More so in developing countries where illiteracy levels are high in rural communities, and the mobile phone is still a recent technology among this populace. In this environment, performance expectancy is a low priority condition in comparison to skills in determining the use of technology.

Not much is known about the distribution of digital skills among individuals in developing countries. The literature does provide indications of who is likely to be skilled. Using mobile phones for text messages is problematic where language barriers exist, while some prefer voice messages because of complete illiteracy (Arvila, Fischer, Keskinen, & Nieminen, 2018; Dodson et al., 2013; Wyche & Steinfield, 2016). Further, mobile phone users are considerably wealthier than others in a given population, tend to be male, and are better educated (Blumenstock & Eagle, 2010). Similar observations are made by Burrell & Oreglia, (2015) in Uganda. The authors state that using SMS-based market information services introduces literacy barriers and conclude that this situation blocks access by the poorer and the least educated people. As Dodson, Sterling, & Bennett, (2013) note, "ownership of a mobile phone does not lead to de facto use of SMS or text-based features."

This paper aims to contribute to the literature by exploring the factors that are associated with distribution and hence, inequality of skills to use mobile money in rural Uganda. We use a multi-level approach taking into account psychological, sociological, and economic perspectives on skills and their distribution. We carried out a large-scale systematic survey using face to face interviews. To measure skills, we make use of a measurement instrument that tests actual digital skills (Kiconco et al., 2018; Kiconco, Rooks, & Snijders, 2019). A limitation of existing scales to measure skills, for instance, digital skills, is that researchers rely on self-assessment of skills. In other words, respondents are asked to respond on a five Likert scale how confident they are about their competences to operate, for example, a computer. Items such as: "I know how to adjust privacy settings" or "I know how to install apps on a mobile device" (Alexander van Deursen, Helsper, & Eynon,

2014) are typically used. The results of this self-assessment often yield data not reflective of reality (Alampay, 2009).

In the remainder of the article, we present the theoretical framework deriving hypotheses in the next section, followed by the methods, and results. We then present the discussion of our results in light of extant literature and end with a conclusion.

3.2 Theoretical Framework

In this study, we aim to explain variation in mobile phone skills using a multi-level approach. We argue that having skills will be a function of opportunities and incentives to acquire skills, as well as the presence of the motivation to learn about this technology (and technology in general). In our model, variation in skills is hypothesized to be associated with factors that reside on the one hand at the individual level, and on the other hand, at the network level. On the individual level, we distinguish between factors that affect the opportunity for learning skills, motivation to learn skills, and general competencies that affect learning of skills. In particular, our foci are age, education, gender, income, and need for cognition. On the network level, we distinguish between factors that affect opportunities and motivation to learn mobile phone skills; specifically, the density of the network, and the number of peer adopters (other network members that adopted mobile money as well).

3.2.1 Individual-level

3.2.1.1 Age

In the use of mobile-based services, age is an essential factor to consider (Oluwatayo, 2013), because different age groups have varied needs, interests, and capabilities while considering, and using mobile applications (Gurtner, Reinhardt, & Soyez, 2014). However, the findings are mixed. On the one hand, age is positively associated with ownership and easier access to a mobile phone within rural communities in Africa (Blumenstock & Eagle, 2010; Penard, Poussing, Yebe, & ELlla, 2012). Access is attributed to the accessibility of economic resources to acquire and maintain a mobile phone. Older people are more suited to own and maintain a cell phone. In cases of loss due to theft, technical difficulties, or having to sell off the phone to earn money (Steinfield, Wyche, Cai, & Chiwasa, 2015), the older persons will find it easier to replace a handset because they usually have a source of income or employment.

On the other hand, a study in 17 African countries found that age did not affect mobile phone usage (Chabossou, Christoph, Matthias, & Zahonogo, 2009). These findings suggest that although older people may own mobile phones, this does not necessarily result in more usage (Dodson et al., 2013; Rashid & Elder, 2009; Wyche & Steinfield, 2016). With recent findings from Kiconco *et al*., (2018) indicating that some individuals use mobile phone applications on behalf of others due to deficiencies in skills, older persons in the rural area may be disadvantaged to learn how to use a mobile phone.

Biljon & Kotzé, (2008)'s study reveals that older people acquire mobile phones for specific purposes, in particular, security and building relationships, unlike their younger counterparts who stretch usage to include entertainment. Young people thus have more opportunities to spend more time exploring the functionalities of the phone and learn how to use it. Additionally, though older persons are not a homogenous group, in general, older people as a population segment tend to experience poor vision and suffer illiteracy challenges in using mobile interfaces (Matthew Kam, 2009; van Biljon & Renaud, 2016). These barriers are rampant in rural societies among the older generation that is less educated and generally less tech-savvy. Therefore, we argue that;
H1 – The older a person is, the more likely that s(he) has lower mobile phone skills.

3.2.1.2 Education

In developing countries, primary education emphasizes literacy. Reading and writing are the foundation for learning how to use a mobile phone (El-Zoghbi, 2018; Otieno, Liyala, Odongo, & Abeka, 2016; Tuz & May, 2015). Furthermore, primary education, such as numeracy, is essential for using financial applications on mobile phones, for instance, mobile money. Several studies have shown that having little or no formal education is a challenge in itself while operating a mobile phone (Dodson et al., 2013; Medhi et al., 2011; Wyche & Steinfield, 2016). While having an education is associated with mobile phone usage (Chabossou et al., 2009; Frias-Martinez & Virseda, 2012).

To be able to operate mobile phones, one needs to be able to identify characters, letters, numerals, which are the essence of many mobile applications' functionality (Dodson et al., 2013; Katusiime & Pinkwart, 2016; Medhi et al., 2011). The above is critical for feature mobile handsets that are designed with buttons, each having several characters. Several mobile phone operations are carried out via text which entails various cognitive tasks such as memorization and recall of Unstructured Supplementary Service Data (USSD) access codes, typing using numerical and figure-based keys, reading pre-set instructions and selecting personal choices or directives to effect desired outcomes (Burrell & Oreglia, 2015; Wyche & Steinfield, 2016). Therefore, primary education provides one with an opportunity and incentive to use a mobile phone and thus becomes essential to acquiring skills. Thus
H2 – The higher the education level one has, the more likely that one has mobile phone skills

3.2.1.3 Gender

All factors considered, Gillwald, Milek, & Stork, (2010) found that gender did not affect mobile phone usage in 17 African countries. This finding is not surprising. During the inception phase, men are more likely to be early adopters, but with the proliferation of mobile phones, the gap between women and men is narrowed (Penard et al., 2012). However, there is a caveat to this general finding in Gillwald et al., (2010). The authors note that due to cultural norms and practices, less mobility, and access to income, rural

women are often marginalized from information technology gadgets than rural men. Generally, available evidence suggests that for many women, phone access is limited by male control, which is often shaped by the suspicions of women's usage (Porter, 2012).

Therefore, in examining Gillwald et al., (2010)'s findings, we should be mindful of the contextual issues. An environment and cultural context that promotes hierarchy still abound in many rural communities in many developing countries (Holloway et al., 2017; Katengeza, Okello, & Jambo, 2011). As a consequence, women are usually excluded from asset access. In reference, Scott et al., (2004) found that women in Ghana, Botswana, and Uganda were less likely to own a mobile phone within rural communities. Current studies show that many rural households own a mobile phone, though in most cases, it is shared (Blumenstock & Eagle, 2010; Burrell, 2010; Dodson et al., 2013; Donner, 2009). Shared access means that more than one person uses the same mobile phone. However, this mobile phone is usually in possession of the family head, typically, a male figure (Melhem, Morrell, & Tandon, 2009) (husband, father, uncle, brother, or grandfather) who essentially has priority over its usage. Studies show that the household head determines how much time women spend on the mobile phone and supervise what they use it for (Dodson et al., 2013; Masuki et al., 2010).

Besides, research into gender access in rural areas shows that men predominantly own and actively use mobile phones compared to women (Frias-Martinez, Frias-Martinez, & Oliver, 2010; Gillwald et al., 2010; Mehrotra, Nguyen, Blumenstock, & Mohan, 2012; Steinfield et al., 2015). Similarly, the household head usually controls the income (Holloway et al., 2017; United Nations, 2015) and thus will most probably handle most of the transactions related to the mobile phone. Women are further disadvantaged through lack of access to employment, and education which are necessary for mobile phone usage (Dodson et al., 2013; Gillwald et al., 2010). Consequently, we suggest that females will face shortages in opportunities to learn how to use a mobile phone due to limited exposure and contextual barriers.

H3 – Males in rural regions in developing countries are more likely to have higher mobile phone skills

3.2.1.4 Income

Income has been shown to influence access, use, and sustained use of any technology (Peruta, 2017; Crabbe et al., 2009; Dijk, 2006). Notably, studies associate higher incomes with higher usage of mobile phones among rural communities in Africa (Chabossou et al., 2009; Donner, 2009; Steinfield et al., 2015) and lower incomes a barrier to access and adoption (Rashid & Elder, 2009). A mobile phone usually causes a drain on one's financial resources; this occurs at a faster rate among the poorer households as they often live from hand to mouth with little or no savings at all. Some payments related to maintaining a mobile phone include prepaid credit, data or internet costs, costs associated with mobile money transactions, maintenance costs for peripherals such as detachable batteries.

In rural areas, one needs to factor in unconventional outlays such as travel to charge mobile phone batteries at a cost in small trading centres where power or electricity can be found (Donner, 2009). This issue, in particular, will render usage at a minimum as one will not want to drain their battery from continuous use and thus only use the phone when necessary. Therefore, learning is inevitably hampered. This is also tied to findings that remittances through mobile money are, in most cases, initiated by relatives in urban areas (Murendo, Wollni, de Brauw, & Mugabi, 2018). Thus, in rural communities, there are more recipients than initiators of mobilebased transactions rendering usage limited.

Individuals with income will find mobile phone applications useful, for instance, mobile money, which can ease their day to day transactions and money transfers for personal and business-related purposes. Similarly, higher usage, which is a form of continuous practice in using a mobile phone, is tied to income (Blumenstock & Eagle, 2010). In the same way, individuals who dispose of their phones in rural areas usually do so to earn some money (Steinfield et al., 2015). In sum, we expect that individuals who have employment or any other form of income will not only have the opportunity but will also be incentivized to access, sustain and use a mobile phone and in this way. Such individuals are better placed to learn how to use mobile technology.

H4 – The higher one's income is, the more likely that one will have mobile phone skills.

3.2.1.5 Need for Cognition

The personality attribute, the need for cognition, is defined as a dispositional difference in individuals' cognitive motivation (Fleischhauer et al., 2010). Whereas some individuals possess moderately little motivation for cognitive tasks, others regularly involve themselves and enjoy these activities. Individuals high in need for cognition exert more effort in searching for information, are more persistent and possess adaptive problem-solving abilities (Nair & Ramnarayan, 2000; Verplanken, Hazenberg, & Palenéwen, 1992). The need for cognition has also been associated with reasoning and deep learning activities (Cazan & Indreica, 2014; Rudolph, Greiff, Strobel, & Preckel, 2018), which are necessary skills in recognizing patterns and sequences in goal achievement. Further, these skills reflect a type of self-regulated behaviour. Therefore, learning for an individual with a high need for cognition is self-directed.

In rural communities where literacy levels are rather low, and exposure to technology is still relatively new (Burrell, 2010; Gillwald et al., 2010; Melhem et al., 2009; Rashid & Elder, 2009), the use of a mobile phone is still a daunting task to many. However, despite these challenges, some individuals have displayed extreme ingenuity and perseverance to overcome complex interfaces and literacy issues to use mobile phones (Smyth, Kumar, Medhi, & Toyama, 2010). This is likely due to the higher exertion of cognitive motivation. Thus, we expect that individuals with higher cognitive motivation will more likely learn how to use a mobile phone through devising pragmatic ways to use a mobile phone despite low capabilities. Therefore, we argue that;

H5 – The higher one's need for cognition is, the more likely that they will have mobile phone skills

3.2.2 Social networks

An important factor in learning of skills is social networks (Alampay, 2009; Kiconco et al., 2019; Paredes & Shing, 2012), more so, through others who have similar skills. We distinguish between factors that affect opportunities and motivation to learn mobile phone skills: the number of other network members that adopted mobile money as well and the density of the network.

3.2.2.1 Number of peer adopters

Social support through peer adopters presents opportunities for learning. Peer adopters are the social contacts within one's network that use mobile money. Peer adopters play a role in honing one's skill level on the premise that contacts in that category can use a mobile phone. Through continuous social interaction, peers can stimulate social learning through observation and imitation (Penard et al., 2012).

Research has also found that a social network is one of the drivers that influence the use of a mobile phone (Biljon & Kotzé, 2008), hence the more contacts in one's network that use a mobile phone, the more likely that one is to use it. Furthermore, individuals have been found to depend on others who are using technology to find positive effects and adopt the same as a result (Arvila et al., 2018; Bandiera & Rasul, 2006). Within the network, too, one has access to technical support in using technology, and avenues for learning are more readily available (Kiconco, Rooks & Snijders, 2019). The mobile phone is an interactive technology that facilitates communication between individuals. Hence, having more individuals with whom to interact with via this medium is an incentive to continuously use the mobile phone and, in the process, gain and sharpen one's skills. Thus, we argue that associating with peer adopters propels learning.

H6 – The higher the number of peer adopters one has, the more likely that one has mobile phone skills

3.2.2.2 Density

Density refers to the extent to which one's social contacts are tied to one another (Feld, 1981). A dense network provides a shared sense of identity, shared norms, trust, and reciprocity, which in turn offers a quick flow of information and exchange of knowledge (Burt, 2004). We expect that there will be more learning (to use a mobile phone) overall in a dense network because of hastened sharing of knowledge and a culture that promotes embracing similar norms (Uzzi, 1996). This is likely because of the possibility that contacts in a dense network know the same information is quite high (Paredes & Shing, 2012). Therefore, individuals in dense networks can quickly get socially influenced by their peers

to adopt behaviors and technologies by extension (Kohler, Behrman, & Watkins, 2001). Hence, we argue that if one has a dense network, the opportunities and incentives of learning how to use a mobile phone through these contacts will rise.
H7 – The denser one's network is, the more likely that one has mobile phone skills

3.3 Method

To test our hypotheses, we make use of a large-scale survey of inhabitants Nakaseke, a rural district in Central Uganda. To collect data, we made use of face to face interviews. The data was collected in September of 2017. Rural districts in Uganda are administratively subdivided into counties, which in turn are composed of sub-counties. Sub-counties are divided into parishes. A parish is a composition of villages, which are the smallest administrative unit of a rural district. Using multistage sampling, the following villages in the district were randomly selected. Bugala, Kalagala, Kamusayi, Kanyale, Kibale, Kikwata, Kivule, Kyambogo, Kyamutakasa, Kykuumango, Lukabala, Mulungi'omi, Nakasseta, and Ssanze.

A professional translator was employed to translate English questions into the local language. A team composed of five experienced interviewers were trained for four days. In training, the interviewers learned about the goal of the research; the meaning of the scales in the instrument to ensure standardized interpretation in the field; and the use of the data collection software – "QuestionPro[3]. " Following the training, the interviewers performed a pilot with each collecting ten responses along the streets of Kyaliwajala town (the location of the training). The pilot was carried out in order to check for any ambiguities or malfunctions in the data collection software system. Similarly, the pilot tested whether the respondents were able to comprehend the questions in the instrument. No significant issues were found.

The Local Council Chairpersons of each village were informed in advance on which day we would visiting their respective villages. Residents within the villages were approached by their local Chairpersons, who then invited them to assemble at a central location in the village in preparation for the interviews on specific days. This was necessary as a chairperson's introduction of researchers (strangers to the village) carries much weight in terms of response rate. Additionally, households in villages are scattered by long distances, and many a time, residents are busy in their gardens, so the likelihood of finding no one at home increases. To mitigate this, we asked the chairpersons to assist with mobilization. Participation was voluntary. In total, 526 responses were collected with a response rate of 97 percent. This number (526) excludes 13 incomplete questionnaires that could not be used in the analysis. We tested for interviewer effects and found none.

3.3.1 Measures

3.3.1.1 Mobile phone skills

We measured the actual skills a respondent possesses using a knowledge test on mobile phone functionalities (Kiconco et al., 2018). This test was developed based on the Actual Digital Skills questionnaire (ECDL, 2009). The mobile phone skills test is composed of twelve (12) questions that focus on hardware and software functionalities and span different levels of toughness. Each question had five options to select from, of which one was correct. Participants were encouraged to desist from guesswork. To minimize the guesswork, an option to say they did not know the correct answer was provided among the five options. The final coding included a score of either correct or not correct for each question item. The items were tested for scalability using item response theory (De Boeck & Wilson, 2004). To be more specific, we used the one-parameter logistic model in Stata's IRT module (Kondratek, 2016). Item responses are either correct or not. The items are assumed to be equally discriminating between persons, but the difficulty of items is assumed to vary (some items are more challenging to answer in general than others). Our results indicate that all items were scalable. The scale as a whole also appropriately discriminated between people who had high and low mobile phone skills). The overall discrimination parameter was 1.95. Typically, a discrimination parameter greater than 1.70 is considered high (Baker, 2001).

3.3.1.2 Need for cognition

A five (5) item scale adapted from Cacioppo, Petty, & Chuan, (1984) with a Likert ranging from strongly agree to disagree strongly was used to measure an individual's tendency to engage in or enjoy effortful cognitive endeavours. The scale was tested for internal consistency, and one item dropped. The final scale was found to be highly reliable (4 items; $\alpha = .83$).

3.3.1.3 Demographics

Respondents were asked to report about their age, gender, education status, average monthly income, employment status, whether or not they possessed a bank account and their literacy levels.

To get social network data from which we derive the variables: peer adopters, density, and network size, we used a name generator (P. V. Marsden, 1990). The name generator has produced reliable social network data when used in Ugandan rural settings (Rooks, Szirmai, & Sserwanga, 2012; Rooks, Klyver, & Sserwanga, 2016; Solano & Rooks, 2018). Using the name generator, respondents were requested to provide names of contacts whom they had interacted with over the last six (6) months regarding important matters. These contacts were not limited to kin and thus could also include peers, colleagues, and friends. This list of contacts provided was then used as a basis for further questions

regarding specific attributes of each contact. The possible number of contacts provided was limited to ten (10) names due to time constraints.

3.3.1.4 Network size

Network size is the number of contacts given by the respondent.

3.3.1.5 Peer adopters

Respondents were asked whether each of the contact persons mentioned used the mobile money service. This question had three (3) possible responses – "yes; no, or I do not know." Based on these responses, peer adopters were calculated as the number of contacts in a respondent's network that use mobile money.

3.3.1.6 Density

This construct denotes the sum of the ties that exist in a respondent's network relative to the sum of maximum possible ties if all contacts are connected (West, Barron, Dowsett, & Newton, 1999). Among the follow-up questions to the respondent regarding his/her contacts, was whether each person in the network was connected to any of the other persons mentioned (tie). Possible responses were "yes I do" and "no, I do not." Using these responses, the density of a respondent's network was calculated as the number of ties observed divided by the total number of possible ties.

3.4 Results

3.4.1 Descriptive statistics

The following section provides the first insight into the attributes of users and non-users of mobile money. The study focuses on understanding factors that increase the likelihood of learning how to use a mobile phone given that one resides in a rural area with a view to increasing mobile money usage. One place to start is looking into users and non-users of mobile money and the differences between these two groups, more so concerning issues such as mobile phone skills, among others. We first make a distinction based on a critical feature, namely, mobile money use (who uses and who does not use mobile money). The sample consists of 525 respondents, of which 362 use mobile money, and 164 are non-users. Using t-tests (assuming unequal variances), we examine whether there are bivariate differences concerning our study variables amongst the two groups. We calculate Cohen's d estimate for the effect size of the significant differences (J. Cohen, 1992). Table 3.1 shows the results.

Table 3.1. T-test results comparing users and non-users of mobile money: Mean and standard deviation of study variables.

	Mobile money users		***Mobile money nonusers***	
	Number of Observation = *361*		**Number of observations = *163***	
Variable	*Mean*	*SD*	*Mean*	*SD*
Skills Mobile money skills	6.24	2.98	3.01	3.26
Mobile phone skills	5.21	2.16	4.15	2.05
Demographics Income	1.93	1.03	1.46	0.77
Education	2.34	0.67	2.08	0.65
Gender (female)	0.38	0.48	0.52	0.50
Age	36.80	12.70	37.82	16.78
Identified regulation	4.47	0.44	n/a	n/a
External regulation - norms	-0.08	0.57	n/a	n/a
External regulation - incentives	4.33	0.41	n/a	n/a
Personality Need for cognition	2.65	0.99	2.37	0.74
Social Network Characteristics Density	0.87	0.21	0.89	0.21
Density	0.87	0.21	0.89	0.21
Number of peer adopters	3.85	2.28	2.82	2.11

*ρ<0.05; **ρ<0.001.

As can be seen in table 3.1, mobile money users have higher mobile phone skills (M_{users} = 5.21; $M_{non\text{-}users}$ = 4.15), and this difference is statistically significant (t = -5.37, ρ <0.001). Besides, this effect size is medium, according to Cohen, (1992), only second to employment with d = -0.50. This finding is in line with expectations since mobile phone skills have previously been found to increase the odds of adoption of mobile money (Kiconco et al., 2018).

We also expected to find gender differences between users and non-users and we do find significant differences by gender (M_{users} = 0.38; $M_{non\text{-}users}$ = 0.52; t = 3.13, ρ < 0.05). Scholars have pointed at the disadvantaged position females have in accessing financial services and technology in developing countries; therefore, it is no surprise that we observe a similar trend (Gichuki & Mulu-Mutuku, 2018; Holloway et al., 2017; McKay & Kaffenberger, 2013; Osabuohien & Karakara, 2018). The effect size, however, is of low magnitude with d = 0.29. This finding is a positive indication that the differences between genders in accessing financial technology in rural areas are narrowing.

There are many significant differences between the users and non-users of mobile money. Users have higher income (M_{users} = 1.93; $M_{non\text{-}users}$ = 1.46; t = -5.29, ρ < 0.001), are better educated (M_{users} = 2.34; $M_{non\text{-}users}$ = 2.09; t = -3.95, ρ < 0.001), are more often employed (M_{users} = 0.95; $M_{non\text{-}users}$ = 0.66; t = -5.17, ρ < 0.001), more often have a bank account M_{users} = 0.11; $M_{non\text{-}users}$ = 0.33; t = -3.76, ρ < 0.001), have higher literacy levels (Musers = 0.28;

$M_{non\text{-}users}$ = -0.04; t = -3.43, ρ < 0.001), have a higher need for cognition (Musers = 2.65; $M_{non\text{-}users}$ = 2.37; t = -3.36, ρ < 0.001), their connections are more likely to use mobile money as well. Mobile money users are slightly younger than non-users, however, the difference is not large enough to be statistically significant (t = 0.99, ρ < 0.05). A similar observation is made for differences in density in social networks between both groups (M_{users} = 0.87; $M_{non\text{-}users}$ = 0.89; t = 0.74, ρ > 0.05).

Most differences discussed above are of medium effect size, although a few are quite large: employment status, income, and mobile phone skills rank strongest (d = 0.51; 0.50; 0.50 respectively). Interestingly, gender differences are not that large (d = 0.29). This finding is a positive indication that the differences between genders in accessing financial technology in rural areas are narrowing. In conclusion, it is prudent to say that mobile money users tend to have a higher social, economic status and have developed cognitive drive. In further describing the data, we explore the associations between constructs in the study using correlations.

Table 3.2. Correlations between study variables.

	Variable	1	2	3	4	5	6	7	8	9	10	11
1	Mobile phone skills	1.00										
2	Need for cognition	0.19**	1.00									
3	Density	-0.08*	-0.03	1.00								
4	Number of adopters	0.25**	0.09*	0.004	1.00							
5	Income	0.27**	0.11*	-0.07	0.29**	1.00						
6	Education	0.50**	0.10*	-0.08	0.15**	0.21**	1.00					
7	Gender	-0.16**	-0.23**	0.05	0.001	-0.16**	-0.06	1.00				
8	Age	-0.48**	-0.06	0.09*	-0.01	0.03	-0.33**	0.07	1.00			
9	Employ-ment status	0.19**	0.06	-0.07	0.16**	0.38**	0.16**	-0.21**	-0.06	1.00		
10	Bank Account	0.07	0.12*	-0.08	0.07	0.26**	0.16**	-0.09*	0.12*	0.21**	1.00	
11	Use mobile money	0.22**	0.12*	-0.03	0.21**	0.22**	0.17**	-0.14*	-0.04	0.23**	0.13*	1.00
12	Literacy	0.47**	0.18**	-0.05	0.20**	0.26**	0.65**	-0.08	-0.23	0.16	0.22	0.14

*p<0.05; **p<0.001.

We use the results of the above correlations in table 3.2 to test for multicollinearity between all study constructs. We observe moderately high correlations between age and mobile phone skills (r = -.48), mobile phone skills and literacy (r = .47), literacy and employment status, and income (r = .38). However, the test shows all variance inflation factors are < 1.88 and have a meanvariance inflation factor of 1.28, depicting the absence of multicollinearity.

3.4.2 Preliminary analysis

This section is about our first research question: do mobile phone skills explain mobile money use? First, we seek to understand the factors that explain the likelihood that an individual residing in a rural area in Uganda uses mobile money. The preceding will shed light on which factors are essential in the use of mobile money. In doing so, we can best understand the role of mobile phone skills play in the adoption and use of mobile money. We use logistic regression models in this part of the analysis. Additionally, we calculate the effect size (in percentage) to estimate the explanatory strength of the significant constructs.

Table 3.3. Logistic regression of mobile money use (unstandardized coefficients, z-values between brackets).

Independent variables	Model 1	Model 2	Odds Ratio (model 1)	Effect size (margin in %)
Mobile phone skills	0.38 (2.40)*	0.39 (2.46)*	1.46	32.8
Need for cognition	0.17 (1.52)	0.17 (1.50)	1.19	
Density	-0.02 (-0.03)	-0.02 (-0.05)	1.00	
Number of adopters	0.16 (2.96)*	0.15 (2.74)*	1.17	22.4
Income	0.23 (1.68)	0.21 (1.51)	1.26	
Education	0.31 (1.50)	0.30 (1.41)	1.37	
Gender	-0.26 (-1.21)	-0.23 (-1.06)	0.77	
Age	0.01 (1.12)	0.01 (1.09)	1.00	
Employment status	0.46 (2.43)*		1.59	15.5
Self-employed		0.61 (2.41)*		
Employed		0.80 (2.00)*		
Bank Account	0.83 (1.59)	0.84 (1.60)	2.30	
Network Size	-0.10 (-1.23)	-0.10 (-1.19)	0.91	
Literacy	-0.12 (-0.87)	-0.09 (-0.70)	0.89	
Intercept	1.19 (-1.26)	-1.18 (-1.25)		
Pseudo R^2	0.12	0.12		
Observations	525	525		

*ρ<0.05; **ρ<0.001

Note: The effect size column is based on model 1 results.

Table 3.3 shows the results from models 1 and 2. The difference between the two models is that model 1 considers employment status as a single construct whereas, in model 2, we create a dummy variable for this construct (reference category being no form of employment). The results from models 1 and 2 are similar. Having higher mobile phone skills, a more significant number of adopters, and being self-employed or employed increases the likelihood that one adopts mobile money. Further, considering the strength of these constructs in explaining use, we observe that mobile phone skills with an explanatory predictive margin of 32.8 percent of mobile money use, have the most substantial effect size. Therefore, it is the strongest predictor of mobile money use. The above finding corroborates findings from Kiconco et al., (2018), though we focus on a rural sample.

Considering all the variables in model 2, we find no gender effects on mobile money use. This finding is surprising since, in rural areas, we expected that females are typically disadvantaged in not only accessing mobile phones but also in using mobile money (Blumenstock & Eagle, 2010; Burrell, 2010; Melhem et al., 2009; Wyche et al., 2016). We additionally tested a model without mobile phone skills (not tabulated) to find out whether the gender effect was being drowned out by mobile phone skills. The model produces similar findings (no gender differences) except for income and education being marginally significant in predicting use. Moreover, we tested and found no interaction effects between gender and other constructs. Consequently, with this data, it is prudent to conclude that no specific gender is more likely to use mobile money. Based on the R^2 of the two models, we see similar quantities of explained variance ($R^2 = 0.11$).

3.4.3 Main Analysis

3.4.3.1 Who has mobile phone skills?

Given the above findings where mobile phone skills do indeed remarkably explain use, the following section will elucidate on the second research question: what factors determine who is more likely to learn how to use a mobile phone? The results of the analysis shown in Table 3.4 form the basis for testing the hypotheses of this study. Table 3.4 lays out four models with unstandardized coefficients and an extra column of standardized coefficients based on model 3 to indicate the explanatory weight of each significant construct relative to other variables in the model. We start the analysis with a model based on individual-level factors in model 1 and proceed to add social network constructs in model 2. Subsequently, model 3 includes all variables, including covariates.

Table 3.4. Multiple linear regression predicting mobile phone skills (models 1-4, unstandardized coefficients with t-values in brackets).

	Model 1	**Model 2**	**Model 3**	**Model 3 β**
Age	-0.02 (-10.58)**	-0.02 (-10.76)**	-0.02 (-10.32)**	0.36
Education	0.43 (8.99)**	0.41 (8.63)**	0.28 (4.82)**	0.21
Gender	-0.10 (-1.66)	-0.12 (-1.91)	-0.14 (-2.16)*	0.08
Income	0.17 (5.51)**	0.13 (4.15)**	0.12 (3.65)**	0.14
Need for cognition	0.09 (3.03)*	0.08 (2.75)*	0.07 (2.31)*	0.08
Number of peer adopters		0.05 (3.45)*	0.05 (3.51)**	0.14
Density		-0.05 (-0.39)	-0.06 (-0.47)	
Employment status				
Self-employed			-0.08 (-1.08)	
Employed			0.12 (1.08)	
Network size			0.01 (0.63)	
Literacy			0.14 (3.56)**	0.16
Intercept	-0.58 (-3.34)	-0.70 (-2.89)	-0.32 (-1.25)	
R^2	0.43	0.45	0.47	
Number of observations	525	525	525	

*p<0.05; **p<0.001

Note: In model 4, we tested that the effects did not arise due to differences in the villages which were sampled. We created a dummy variable using the villages and found that there are no differences between the villages.

The results show that individual-level factors alone (model 1), explain 43% of the variation in mobile phone skills. We find that age explains the greater part of the variation in mobile phone skills with a standardized regression coefficient of -0.38 (not shown in table). Additionally, we tested a model without the age predictor, and found a mobile phone skill explained variance of 30%. Specifically, model 1 demonstrates that, the older one is, the lower the mobile phone skills one will have ($\beta = -0.02$, $t = -10.58$, $\rho < 0.001$), as education levels rise, so do mobile phone skills ($\beta = 0.43$, $t = 8.99$, $\rho < 0.001$). The higher the income one earns, the more one's mobile phone skills increase ($\beta = 0.17$, $t = 5.51$, $\rho < 0.001$). Finally, a unit increase in the need for cognition will result in a 0.09 increase in mobile phone skills, and this finding is significant at $\rho < 0.05$. The above four findings remain directionally consistent throughout all the models. Therefore, it is prudent to conclude that the data support hypotheses 1, 2, 4 and 5. From the same model, we observe that on average, there is no significant difference between males and females regarding which gender has higher mobile phone skills ($\beta = -0.10$, $t = -1.66$, $\rho > 0.05$).

Model 2 incorporates social network variables, and the results show that the higher the number of peer adopters one has in their network, the more likely one is to have mobile phone skills ($\beta = 0.05$, $t = 3.45$, $\rho < 0.001$). The trend of this relationship remains

the same in model 3 as well; thus, the data supports hypothesis 6. However, the results suggest that denser networks inhibit mobile phone skills, but this finding is not significant (β = -0.05, t = -0.39, $\rho > 0.1$). Hence hypotheses 7 is not supported by the data. Model 2 shows an incremental explanatory power of the model of 2 per cent (R2 = .45 compared to R2 = .43). Likewise, in model 2, gender differences remain non-significant.

Model 3 has the highest explained variance (R2 = .47). In this model, we combine all regressors and find that in addition to relationships previously derived, literacy predicts mobile phone skills. In contrast to models 1 and 2, in model 3, we find a small, slightly significant effect of gender, with males possessing more skills. Males are thus more likely to have mobile phone skills compared to women (β = -0.14, t = -2.16, $\rho < 0.05$). To state this effect prudently, we can say the data seems to support hypothesis 3.

We also find that employment status does not predict mobile phone skills. An explanation could be that employment status moderately correlates with income, r = .38, $\rho < 0.001$ (table 3.2). Using models excluding either of the two (income or employment status), albeit not shown in the table, yields significant results for each. This suggests that part of the variance explained by income is attributable to employment status for income derives from productive activity. Further, in model 3, we find no effects for possessing a bank account on one's ability to use a mobile phone.

3.5 Discussion

Skills are an essential barrier to adopting and using mobile money. In this research, we set out to investigate the distribution of mobile money skills. Using a recent large-scale survey of 525 rural Ugandans using face to face interviews, we constructed an empirical model explaining almost 50% of the variance in mobile money skills. Findings show that there are significant inequalities in terms of age, education, income, and gender. Further still, individuals in rural Uganda who have few social network ties that adopted mobile money are most likely to have lower skills, and individuals with low cognitive motivation are less likely to have high mobile phone skills.

In the preliminary analysis, data showed that mobile phone skills do explain the use of mobile money. This finding supports earlier studies that show that difficulties in using mobile phones or a lack of skills have posed challenges for the adoption of mobile-based applications more so in rural areas in developing countries (Dodson et al., 2013; Medhi et al., 2011; Mimbi, Bankole, & Kyobe, 2011; Wyche & Steinfield, 2016). About the factors that determine who is more likely to learn how to use a mobile phone in the rural area, the data supported six of the seven hypotheses. It is interesting to note that the most vital determinant of whether one learns to use a phone or not in the rural area is age. The younger generation is more likely to learn than older people.

Considering that the average age for this study was 37 years, with 227 of 525 participants registering 38 and above years in age, defining old age might not be far from

30 years and older (Biljon & Kotzé, 2008). Scholarly work on usage on mobile phones in developing countries has either found no effects (Chabossou et al., 2009) or positive effects (Biljon & Kotzé, 2008; Blumenstock & Eagle, 2010; Penard et al., 2012) for the age factor. Nevertheless, as a contribution of this study, we can add to the literature an essential finding that having the resources to access technology or even owning a mobile phone (commonly found among the older generation) does not equate to possessing the skills to use one. Older people in rural areas though not homogenous, face challenges in using technology because of literacy problems. Therefore, there is a need to further look into age-related issues to usability and how older persons' acquisition of skills to use mobile phones can be effectively achieved.

Also, the presence of social support creates free-riding on the skills of younger social ties that can operate the mobile phone on behalf of older persons. For instance, qualitative interviews carried out during the study reveal that some illiterate individuals who owned mobile phones but had literate family members used them as proxies to execute mobile money transactions on their behalf. Furthermore, these individuals mainly used mobile phones personally for voice communications because this necessitated fewer skills and entailed only two functions; receiving and making a call. Previous studies provide similar findings (Burrell, 2010a; Medhi et al., 2011; Steinfield et al., 2015). Age cannot be altered or manipulated in a bid to increase skills. Therefore, interventions geared towards creating more user-friendly interfaces that are not textbased or that do not require high cognitive effort and skills could be explored in a bid to increase the direct usage of mobile phone applications by older people.

In another related study undertaken by the researchers, we found situations that can clearly explain this. Researchers undertook an exploratory qualitative inquiry into the usability of mobile money over the mobile phone in a rural area within Uganda, as part of a more extensive study. Preliminary findings revealed that some individuals who possessed low mobile phone skills manifested proactiveness in learning. This group found 'survival' means of using the platform regardless of their apparent lack of comprehension of the interface language. For instance, instead of having to recall the USSD *165#, which grants one access to the mobile money menu, individuals saved the USSD code as a contact in the phonebook. In this way, they did not have to memorize the code each time they needed to transact. We also encountered individuals with similar skill levels who exerted no effort and, as a result, were not able to use the mobile phone and relied heavily on peers for proxy use. The latter could have had low cognitive motivation relative to the former. This showed that whereas some people were able to find solutions to their limitations in creative ways, others were not proactive. Through such processes, individuals can practice on their own how to use and navigate the functionalities of a mobile phone and eventually achieve their goals.

Given that we found effects on the need for cognition, we further wanted to test whether cognitive motivation affects mobile phone skills through peer adopters. This

proposal is based on Anderson, (2008)'s findings that information benefits attained through social networks were stronger for cognitively motivated individuals. Thus, we anticipated that more cognitively motivated individuals would more learn more through their peer adopters than less motivated individuals. Our data found no support for this. Possibly, individuals with a higher need for cognition in rural areas are less dependent on their peer adopters. Our data do not permit us to make any conclusion on this matter. More research is warranted.

Regarding social network effects, our findings reveal that in rural areas, having more peer adopters is advantageous in learning to operate a mobile phone. There are three plausible explanations for this. One, more peer adopters increases the opportunities to access support in learning how to use a mobile phone through tapping into the technical know-how of one's contacts. Secondly, the odds of learning how to use a mobile phone through social influence (learning through observation and imitation associated with positive effects) and peer motivation (Arvila et al., 2018; Bandiera & Rasul, 2006; Golub & Sadler, 2016) are increased. Thirdly, peer adopters could act as an interactive network where mobile money exchange takes place or even SMS and text exchange. In the process, this serves as a practice ground for individuals to use mobile phones, which subsequently increases skill level.

On the other hand, we did not find any effects for density on mobile phone skills. Given that dense networks typically characterize rural communities and our data provides this evidence, we expected that learning would be smoother through dense networks (Uzzi, 1996). However, density in itself might not be sufficient for transfer learning of skills. Perhaps skills should be embedded within the network first for transfer to take place within dense networks (Kohler et al., 2001). Therefore, we further tested a proposition that the number of peer adopters (a proxy for information) would moderate the relationship between density and mobile phone skills (not shown in the results table). The data found no support for this interaction effect. Kohler et al., (2001) explains that the transfer of information within dense networks might not lead to enhanced learning if sources of information share the same social links among themselves. Perhaps learning to use a mobile phone through social ties is best suited on a one to one basis or peer interaction (dyadic effect) and not a network effect. More research needs to be done on this.

This study is limited by the nature of data given that it is cross-sectional. Thus, only correlations can hold. It therefore remains unclear which predictor variables here might be endogenous and which variables were omitted. Future studies can explore a randomized experimental approach to determine causality.

3.6 Conclusion

Mobile money technology has a high impact on economic development and financial inclusion in many developing countries. Mobile money is especially critical for people living in rural areas who have little or no access to financial services. Despite the bright and optimistic outlook of this technology and the wide proliferation of mobile phones in many developing countries, usage statistics are still low. A significant usage barrier identified by literature is a lack of skills to use a mobile phone. Therefore, the inhibitor is not access related but a skills quandary. This research lays a foundation for deriving effect solutions to improve skills in rural areas by identifying the factors that determine who is more likely to learn how to use a mobile phone and who is not through a theoretical framework comprising individual level and social network factors. The findings from this study suggest that older people are less likely to have skills. Further, mobile phone skills are primarily predicted by more substantial incomes, better education, male gender, higher cognitive motivation, and more social ties who use mobile phones to execute mobile money transactions.

References

1. https://www.gsma.com/r/wp-content/uploads/2019/05/GSMA-State-of-the-Industry-Report-on-Mobile-Money- 2018.pdf
2. http://finclusion.org/uploads/file/uganda-wave-5-report_final.pdf
3. https://www.questionpro.com/

Chapter 4

Learning mobile money in social networks: comparing a rural and urban region in Uganda

This chapter appeared as Kiconco, R. I., Rooks, G., & Snijders, C. (2020). Learning mobile money in social networks: Comparing a rural and urban region in Uganda. *Computers in Human Behavior*, *103*, 214-225. doi: 10.1016/j.chb.2019.09.005

Previous research shows that mobile financial services help to improve people's lives in developing countries. Recent studies suggest that the lack of skills to use mobile devices is a substantial barrier in the adoption and diffusion of mobile financial services. How inhabitants of developing countries learn skills is largely unknown. In this chapter, a field-study of learning mobile money skills is presented using a sample of the Ugandan population. The study sample consists of 208 inhabitants from an urban area and 526 inhabitants from a rural area. The data shows that in both studies, learning is better explained by social network characteristics compared to attributes of the individual. In particular, individuals profit from people in their network if those network connections are skillful, regardless of how skilled the learner is. The results suggest that on top of this direct learning effect, learning happens at an accelerated rate in networks that consist of skilled people. Comparing the rural and urban samples, I find that network effects are more substantial in the rural area relative to the urban area. The results further reveal that individuals with higher education and better mobile phone skills are less dependent on their networks in learning how to use mobile money.

4.1 Introduction

Mobile financial services are beneficial to individuals, households, communities, and businesses in developing countries (Munyegera & Matsumoto, 2016; Gosavi, 2018; Donner & Tellez, 2008; Gencer, 2011; Kendall et al., 2012). Mobile money technology has had a positive economic impact in developing countries through facilitating agricultural commercialization and thereby boosting household incomes (Kirui et al., 2013, Jack & Suri, 2014; Kikulwe, Fischer & Qaim, 2014). Additionally, mobile money has provided access to financial products in areas with poor infrastructure (Mbiti & Weil, 2016; Mothobi & Grzybowski, 2017). Other documented benefits of mobile money are women empowerment (Global System for Mobile Communications, 2016; Holloway, Naizi, & Rouse, 2017), accomplishing poverty reduction and rural development (Islam et al., 2017; Suri, 2017; Vong, Jeff, & Song, 2012) and amelioration of crime-related financial risk (Economides & Jeziorski, 2017).

Nevertheless, many people in developing countries have not yet adopted mobile money technology. Global System for Mobile Communications (2016) abbreviated GSMA reports that more than 2 billion people across the world still lack access to any form of financial service. Mobile money benefits depend to some extent on its widespread use. In countries such as Ethiopia and Nigeria, significant gains from mobile money are not evident because they have not fully embraced the mobile money technology (El-Zoghbi, 2018; Nkwede & Agha, 2017). Given the unbeatable benefits of mobile money, it is essential to understand the issues in this technology's adoption. Numerous factors have been studied in an attempt to understand mobile money adoption. This body of research includes effects relating to perceived ease of use and perceived usefulness (Etim,

2014; Mahfuz & Saha, 2015; Sayid, Heights, & Echchabi, 2012; Tobbin & Kuwornu, 2011); social networks (Conrad, Wollni, Alan, & Mugabi, 2017; Kikulwe et al., 2014; Okello Candiya Bongomin, Ntayi, Munene, & Malinga, 2018); cost of transactions (Jack & Suri, 2011); access to other forms of financial services (Peruta, 2017), and demographics and cultural aspects (Faqih & Jaradat, 2015).

Recently, researchers suggest that cognitive abilities and skills are of critical importance in the use of mobile money services in developing countries (Kiconco, Rooks, Solano, & Matzat, 2018). Mobile phone skills are a prerequisite for the use of mobile money to the extent that a marginal increase in mobile phone skills has a strong effect on the use of mobile money (Kiconco et al., 2018). The issue of skills to use mobile money was brought to light by Alampay, (2009) in a discussion on promoting access to digital technologies for the bottom of the pyramid in the Philippines. Alampay (2009) states that "M-money services require SMS-related skills, as well as informal financial skills similar to receiving or sending remittances through the usual platforms." Other scholars have also described skills to use mobile money as abilities to use SMS (Short Message Service, or text message), stemming from prior skills of the user such as literacy, understanding of hierarchical menus, and quick decision making (Medhi, Gautama, & Toyama, 2009). However, no empirical findings arose from these studies, and there is almost no evidence of mobile money skills research.

Possessing skills to operate mobile technology is especially critical in developing countries where the use of mobile applications is still problematic, and illiteracy levels are high (Gebremichael & Jackson, 2006; Otieno *et al.*, 2016; El-Zoghbi, 2018; Johora & Maria, 2015; Wyche & Steinfield, 2016). A better understanding of the factors that can enhance the acquisition of mobile phone and mobile money skills will help create more effective policies on how to promote direct and efficient use of various mobile technologies. This line of research is of specific relevance to many developing countries that are grappling with the challenge of increasing the adoption of mobile money (Evans & Pirchio, 2014; Nkwede & Agha, 2017). This then begs the question: if having skills is vital in driving mobile money adoption, how can and do people acquire skills?

In contrast to the dearth of research on mobile money skills in developing countries, there is extensive literature on the concept of "digital skills." In attempts to understand how digital skills are acquired, researchers suggested avenues such as learning in school (Zhong, 2011), through social contacts (van Deursen & van Dijk, 2010), and learning using the 'do-it-yourself approach' (Ferro, Helbig, & Gil-Garcia, 2011; Matzat & Sadowski, 2012). In this article, we explore whether and how people acquire mobile money skills through social networks in rural and urban areas. Learning through social contacts is an essential way for users to deal with the complexity of new technology (Behrman, Kohler, & Watkins, 2002; Lindstrom & Muñoz- Franco, 2005; Rogers, 2003; Bandiera & Rasul, 2006). Observation, imitation, hands-on experience, and direct tech-support are some of the

social learning mechanisms (Golub & Sadler, 2016; Lindstrom & Muñoz-Franco, 2005; Young, 2009).

In this article, we focus on learning as the process of searching and acquiring mobile money skills within a relationship between a person and one of his or her social contacts. We investigate social learning by two studies, using two similar primary data collections. In the first study, we use a sample selected in an urban location; the other sample is from a rural location. The urban location is characterized by above-average education levels, and as can be expected, the rural area has a considerably less educated community. Within these two different locations, we will get a picture of the dynamism of social networks in mobile money skills acquisition. The rest of the paper is organized as follows: We first present a literature review that forms the basis for the general hypotheses investigated in both studies one and two. We then present the studies. Next, we compare results from both studies with a focus on the differences in effect sizes. Finally, the paper offers a general discussion and conclusion.

4.2 Literature Review

4.2.1 Learning in social networks

Within a social network of relations, individuals learn through observation, imitation, hands-on experience, tech-support, and learning by doing (Golub & Sadler, 2016; Paredes & Shing, 2012; Bandiera & Rasul, 2006). Through observation, individuals learn through mimicking or copying the actions or behavior of others (Thorndike, 1898). This implies that individuals have visual and practical opportunities through their social ties for continuous practice to learn how to execute transactions over mobile technologies. Lave & Wenger (1991) suggested that skills may be acquired in a context that usually involves the practical use of those skills, in what is commonly known as "learning by doing." Thus, through continuous interactions, one's social network can be a source of technological support. Individuals can ask for practical guidance on how to complete mobile money tasks, the meaning of a confirmatory transaction message received after that, which buttons to press on the mobile phone when initiating transactions, to mention but a few (Alampay, 2009). This support within social situations fosters the development of skills (Paredes & Shing, 2012).

4.2.2 Cognitive abilities in a dyad

A dyad is the smallest network possible and consists of a group of two people – ego and alter[1] (Wellman & Wortley, 1990). Independently, both ego and alter can contribute to the successful acquisition of mobile money skills by ego. Whereas ego's cognitive abilities support the absorption and transfer of old skills into a new area, alter's cognitive capacities provide the necessary knowledge and skills that facilitate the above processes. We elaborate on this in the following section.

Mobile money is an application that operates over a mobile phone. Mobile phone skills are known to influence one's ability to use mobile money (Kiconco et al., 2018). Basic knowledge of how a mobile phone is operated can make a substantial difference in one's ability to use mobile money (Wyche & Steinfield, 2016; Alampay, 2009). Thus, the information base an individual has at his or her disposal about similar technology is essential for technology use decisions (Bandiera & Rasul, 2006). Possession of prior related knowledge and experience on how to operate a mobile phone allows ego to recognize the value of mobile money, assimilate it, and apply it. Therefore, we argue that if ego has (more) mobile phone skills, they will (more) easily learn how to operate mobile financial services from alters (Shih & Venkatesh, 2004).

H1 - The higher the mobile phone skills of ego, the more likely that they will learn how to use mobile money services from alter.

Having an education endows an individual with the cognitive capacity to learn a task or activity with ease (Cohen & Levinthal, 1990; Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013), more so if the new task is in the language learned previously. In the Ugandan context, the education system is English based. The mobile money application is embedded with English menus and instructions. English menus situate educated people in an advantaged position in learning how to use it. Besides, higher educated persons are more active in seeking and searching for information (Conrad et al., 2017). Thus, we argue that if ego is better educated, they will easily acquire mobile money skills from alter, given that mobile money technology works in the English language.

H2 - The higher the education level of ego, the more likely that they will learn how to use mobile money from alter.

Learning in a dyad is not only dependent on the cognitive abilities of ego, but also characteristics of ego's contacts. Acquisition of knowledge in a social network is established through access to the technical know-how and competencies of social contacts (Inkpen & Tsang, 2005). Individuals also tend to turn to more experienced others for information and tech-support (Borgatti & Cross, 2003). Thus, we hypothesize that having access to skilled alters in one's network will promote learning.

H3 - The higher the mobile money skills of alter, the more likely that ego will learn how to use mobile money.

4.2.3 Relational properties

Individuals who are close to each other are emotionally invested in each other's welfare (Reagans & McEvily, 2003). The actions of close friends are generally more informative and provide more guidance than those of strangers due to the increase in specificity and richness of knowledge transfer (Uzzi & Lancaster, 2003). Closer friends are more likely to know the knowledge needs of ego, and hence can be more effective in transferring skills to ego. Close ties possess the ability to determine each other's needs appropriately.

Therefore, close alter ties can easily sieve ego's requirements to ensure that the needs of ego match knowledge required (Allen & Eby, 2003; Uzzi, 1997; Uzzi & Lancaster, 2003).

Therefore, close ties are well suited to transfer mobile financial skills not only because they understand the learning needs of ego better, but also, they can be trusted by ego to act with their best interests in mind (Uzzi & Lancaster, 2003). Mobile money as a financial tool presents some risks associated with the theft of personal secret access codes and subsequent loss of funds or monies (Wyche, Simiyu, & Othieno, 2016). Safety thus becomes paramount not only in knowledge transfer but also in the execution of transactions.

Also, close ties present better opportunities for learning since they are easily accessible by ego (Cross, Parker, Prusak, & Borgatti, 2001). The level of emotional attachment, commitment, and reciprocity expected in a relationship, in turn, provides alter with the motivation to provide assistance and support in terms of exchange of knowledge on mobile money operations (Inkpen & Tsang, 2005).

H4 - The stronger the tie between alter and ego, the more likely that ego will learn how to use mobile money from alter.

4.2.4 Structural properties of ego's network

A dense ego network is a network in which many of ego's social contacts know each other. This characteristic of a network promotes the free flow of information on a wide range of issues within the network itself (Haythornthwaite & Laat, 2010; Paredes & Shing, 2012). Dense networks are often associated with high levels of trust between individuals (Coleman, 1990) and the promotion of fine-grained information exchange (Uzzi, 1996). The bond of trust and togetherness in such a network will quicken the pace at which those that are not yet conversant get knowledge and skills regarding mobile financial services.

Perhaps more importantly, within a dyad, alter's need to maintain a cooperative attitude and an excellent reputation within the network will provide the impetus for ego to trust an alter in the transfer of mobile financial skills (Reagans & McEvily, 2003). That is, given the obligations, need for reciprocity, and expectations of the network, as well as the necessity to identify with others in the group, an alter will be compelled to upskill the less skilled egos within a dyad.

H5 - The denser the network of ego, the more likely that ego will acquire mobile money skills from alter.

4.2.5 The strength of a tie as a moderator

Previously, we hypothesized that access to skilled alters will have a positive effect on mobile money learning (Inkpen & Tsang, 2005). We suggest that the strength of a tie will modify this effect. The positive effect of skill on learning will be more substantial when more trust exists between ego and alter. Given that mobile money is a financial tool, many a time people have reported fraud (Mudiri, 2013). Such cases arise from different

loopholes, one being, seeking usage assistance from others, and in the process being defrauded by these same parties. In learning from social contacts, therefore, we assume that precautions will be taken by ego to the extent that learning from skilled alters will be higher when ties are closer.

H6 - The relationship between skills of alter and learning of ego will be moderated by the strength of a tie.

4.3 Study 1: the urban sample

4.3.1 Method

We collected data in May 2015 in the Wakiso district in central Uganda. A district is an administrative division managed by the local government. Wakiso was purposely selected for the present study because it is the largest district by population in the country. We employed multistage sampling. Given the stratified nature of the country, urban districts are divided into municipalities, divisions, wards, and cells or sub-wards. We randomly selected one municipality (Entebbe municipality) within Wakiso district. Within the selected municipality, we randomly selected one division (Division A). Within the selected division, we randomly selected one ward (Central ward), and finally, a list of sub-wards was selected. Using this list, five sub-wards were randomly selected for the data collection (Kitaasa, Post Office, Nakasamba, Nakiwogo, and Nsamizi).

In each sub-ward, 50 participants were systematically sampled using a list of the subward's residents, which was provided by the sub-ward's register in the local council's custody. Given the number of households of each sub-ward, the nth household was selected for an interview in order collect the 50 cases required (for instance, Nakiwogo had 576 households in total; therefore every 11th household [576/50] was selected for the interview, whereas in Nakasamba, there were 100 households; therefore, every 2nd household [100/2] was considered). A sample of 250 households resulted from the five sub-wards.

The data collection instrument was honed by a back and forth process with pilot tests. A preliminary version was tested by the researchers in different areas of Kampala through approaching twenty (20) individuals in total, who accepted to participate. We were checking for the reliability and validity of questions in the Ugandan context as well as the flow and structure of the instrument. Upon modifying and finalizing the instrument, six (6) experienced interviewers were selected and trained for two (2) days in using the online survey tool (survey gizmo), the contents of the survey, and the objectives of the study. Additionally, the instrument was jointly translated into the local language (Luganda) by the team guided by a professional translator. This was to ensure the standardization of the instrument content while in the field. Interviews were conducted in a language most comfortable for the respondent.

One respondent was selected from each household for a face to face interview, and typically, this would be the adult that was first met at the house. The criterion for participation was that the person should be at least 16 years. The response rate was 84.1% (249 out of 296). Forty-seven of the initially sampled households refused to participate. In non-cooperative households, the reasons for non-cooperation were a lack of time and lack of authorization to talk to strangers by household heads. In these instances, the next-door household was considered for an interview. Ultimately, 249 interviews were completed. Unfortunately, 41 of the respondent interviews were lost due to unreliable internet access since data collection was done online using survey gizmo. We tested for interviewer effects and found no significant differences. The final number of valid observations is, therefore, 208.

4.3.1.1 Measures

4.3.1.1.1 Social network variables

To collect social network data, we used a so-called "name-generator," a common survey method in social network research. Participants were asked: 'Looking back over the last six months – who are the people with whom you have discussed important matters? Think of people in your family, at work, or friends, etcetera. It can be anyone with whom you talked recently and whose opinion you consider to be important' (Burt, 1984). The interviewer then made a note of the contact names. Though some scholars consider 30 listed contacts as the maximum names a respondent should give (Manfreda, Vehovar, & Hlebec, 2004), usually the network size that is subjected to follow up questions or name interpreters is typically limited to a manageable size [typically five contacts (Burt, 1984; Eagle & Proeschold-bell, 2015)]. Network size asked for is also dependent on the number of name interpreters, time, and the need to minimize fatigue and burdening the respondent with many questions (Marsden, 1990). For purposes of the present study, the name-generator was limited to a maximum of ten names who were asked follow-up questions. Limiting the number is a standard way to cope with time constraints in a survey while maintaining measurement precision and minimizing measurement bias (Marsden, 1990; Sosa, 2011). We realize that a complete network with information on connections between contacts would yield much more intricate data. However, this research was already stretched in breadth and width given that alteri were ten per ego and data was collected about ego, alters and alter connection to ego. Furthermore, given that we sought information about learning and the underlying mechanisms under which knowledge transfer takes place, we chose to focus on the content of a tie (alter-ego relationship), we note that on average an interview took 45 minutes per respondent.

4.3.1.1.2 Dependent Variable - Learning/Knowledge transfer

Instead of measuring the outcome of the transfer, we focused on the process or conduits that infer this transfer. The respondents were first asked, "*Has [alter name] ever helped*

you to use mobile money?". The former question, if answered "*yes*," implied a knowledge exchange relation to which five additional questions were queried about the nature of the exchange. *Specifically, (1) Has [alter name] helped you to understand a message from the system? (2) Has [alter name] helped you to send information to the system? (3) Have you asked [alter name] about Mobile Money? (4) Has [alter name] told you about the things you can do with mobile money?* The above questions captured knowledge transfer through observation, possible imitation, information seeking, awareness creation, and hands-on tech support, which are all channels through which learning can take place in a social context (Golub & Sadler, 2016; Lindstrom & Muñoz-Franco, 2005; Young, 2009).

4.3.1.1.3 Independent Variables

4.3.1.1.3.1 Mobile money skills at alter-level

We relied on the respondents to evaluate the mobile money skills of alters, consistent with earlier research (Borgatti & Cross, 2003; Reagans & McEvily, 2003; Sosa, 2011). Respondents were asked, "*How good is [alter name] with mobile money?*" to which there were four possible answers as indicators of the skill level of alter (not so good, good, very good, and I do not know).

4.3.1.1.3.2 Mobile phone skills at Ego–level

Mobile phone skills were assessed using a multiple-choice test of twelve question items about the functionality and operability of a mobile phone with varying levels of difficulty (Kiconco et al., 2018). Each question had five answer options, of which only one was correct, including an option for not knowing the answer. The latter helped minimize 'guesswork' which would bias the actual skills an individual has. Using Rasch modeling, only 9 question items qualified for consideration in the mobile phone skills scale.

4.3.1.1.3.3 Education: Ego-level

This was measured using a one-item question asked to the respondents on their education status, "*What is your highest achieved level of education?*". Answer scale ranged from 'no education at all' to 'postgraduate' in line with the education structure in Uganda. The level of education was proxied by the number of years of schooling (Peruta, 2017).

4.3.1.1.3.4 The strength of ties: Dyadic-level

Marsden & Campbell (1984) find that a measure of closeness is the best indicator of the strength of ties. Hence, we used one item to assess– the strength of the relationship "*How close are you with [alter name]?*". We used a 3-point scale with responses 'Not so close, close and very close.'

4.3.1.1.3.5 Density

Density is defined as the number of ties that exist in a network relative to the number of ties that could exist if all alters were connected (West, Barron, Dowsett, & Newton, 1999). We operationalized density as the proportion of existing ties mentioned by ego to the total possible ties in ego network.

4.3.1.1.4 Other measures

4.3.1.1.4.1 Proxy use

We used an identifier to capture proxy use by alters. The respondents were first asked, "*Has [alter name] ever helped you to use mobile money?*" Those that answered yes to the above were asked follow up questions to ascertain the nature of the support provided. In total, five different ways in which help could be provided by alters were outlined. Four of these have been discussed under the learning measurement (dependent variable). The 5th question which captured proxy use is: "*Does [alter name] use mobile money on your behalf?*" We isolated respondents that answered 'yes' to the above question and 'no' to all the other four questions. These respondents exclusively used mobile money through alters.

4.3.1.1.5 Covariates

4.3.1.1.5.1 Network size

The variable *network size* is the number of alters or contacts mentioned in the name generator by ego. Furthermore, demographic variables including *age, gender (of both ego and alters), and income* were measured. These constructs influence one's ability to use technologies within a social network framework. (Conrad et al., 2017; Kikulwe, Fischer, & Qaim, 2014; Bandiera & Rasul, 2006).

4.3.2 Data exploration and cleaning

As a whole, the dataset consists of 1,216 alters nested within 208 egos. Out of these 208 egos, 174 use mobile money and have at least one social contact. Generally, egos stopped in junior high school or junior secondary school, which is 11 years of schooling. The average score in the sample level is 11.9 years out of the highest possible 15 years structured in the Ugandan education system. Ego's possess medium mobile phone skills with a mean score of 5.8 out of the possible 9 points. (1-3 score would be low skills, 4-6 medium skills and, 7-9 high skills). The ratio of females to males in the sample is 55% to 45%. Ego networks have an average of six (6) alters. Typically, four (4) alters in ego's network use mobile money. The mean mobile money skill of alters in ego's network is a score of 1.73 with skills ranging from 1(not so good) to 3 (very good). Similarly, ego networks are relatively dense (0.73/1) and have ties that are relatively strong (2.6/3).

The data used in the present study consists of characteristics of ego and characteristics of ego's social network, and we want to focus on the cases in which social learning can, in principle, occur. Hence, egos without alters are not included for further analysis. In our

data, there are five (5) participants (out of 208 observations) without a social network. All five participants also reported that they do not use mobile money.

Within the remaining dataset, some egos do not learn from alters in any way. These occurrences, however, are not very common but are critical nonetheless. Given our interest in individuals who learn from their social network, having a large number of individuals who do not learn at all would render the study irrelevant. In principle, we can discern two types of "nonlearners." The first group is those who exclusively use proxy methods to operate mobile money. We captured proxy use in our data. We find only three (3) cases in our residual pool of data. These individuals have the mobile money application on their mobile phones but have no clue what to do with it and hand over the phone to someone else to execute transactions on their behalf.

The second group is made up of egos that solely have alters who do not use mobile money within their network, or have a network composed of alters that ego does not know whether they use mobile money, or a network comprising exclusively of the above two types of alters. In either of these cases, the assumption is that no learning takes place because alter has no mobile money skill from which ego could benefit. In the remaining data pool, six (6) egos fit this category and are not considered for further analysis. Of the six egos above, one does not use mobile money and reports a network composed of two alters, both of whom do not use mobile money while the other five egos use mobile money.

Furthermore, we assume that learning can only take place in a dyad if both ego and alter use mobile money. Our data contains 27 participants who do not use mobile money at all and hence cannot have learned mobile money skills from social contacts. The dataset that we use for further analysis contains 167 participants (egos) with 752 alter connections, where all 167 are mobile money users.

4.3.3 Descriptive statistics

Table 4.1 shows the descriptive statistics of variables from the sample available for analysis. On average, alters are reasonably skilled (1.98/3) and quite close to egos (2.48/3). 44% of alters are female (gender of alter hereafter). The sample of egos has more females (gender of ego hereafter) with a 52% observation. Generally speaking, egos have medium mobile phone skills (6.22/12), quite dense networks (0.72/1), and a relatively large number of years of schooling (12.4/15). Ego has an average of 6 alters within his/her network. Ego networks have mean mobile money skill of 1.68/3.

Table 4.1. Mean, standard deviations and correlations of study variables (N=752 alters and 167 egos).

	Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
Alter Level												
1	Learning	1.75	1.27	1.000								
2	Mobile money skills	1.98	1.03	0.400**	1.000							
3	Strength of a tie	2.48	0.65	0.178**	0.237**	1.000						
4	Gender of alter (female=1)	0.44	0.49	0.024	0.005	0.072*	1.000					
Ego Level												
1	Mobile phone skills	6.22	1.87	1.000								
2	Density	0.72	0.27	-0.082	1.000							
3	Education in years	12.4	3.15	0.371**	-0.136	1.000						
4	Mean SOT of ego network	2.43	0.41	-0.041	.354**	0.012	1.000					
5	Mean skill of ego network	1.68	0.71	0.057	0.205*	0.015	0.146	1.000				
6	Mean gender of ego network	0.45	0.26	-0.137	0.089	-0.046	0.141	-0.040	1.000			
7	Network size	6.05	2.11	0.147	-0.163*	0.192*	-0.006	-0.255**	0.007	1.000		
8	Age	36.85	12.4	-0.370**	0.063	0.079	0.133	0.145	-0.022	0.013	1.000	
9	Income	30.5	36.8	0.109	0.109	0.276**	0.023	0.066	-0.133	0.070	**0.026	1.000
10	Gender of ego (female=1)	0.53	0.5	-0.243*	0.173*	-0.135	0.082	0.026	0.459**	-0.146	-0.018	-0.263**

*$\rho < 0.05$; **$\rho<0.001$

Table Notes: 1. Alter level and ego level correlations are presented separately.
2. Alter variables number of observations is 752 **(rows 1-4)** while ego level number of observations **(rows 1-10)** is 167
3. Income is in euros with an exchange rate of 1 euro = 4,500 Ugandan Shillings.
4. SOT – Strength of a tie.

4.3.4 Analysis

The sample contains 752 relationships nested within 167 ego respondents. Since our dataset has a hierarchical structure with alters nested within egos, we used a random intercept multilevel model for analyzing the data (Hox, 2010).

4.3.4.1 Null Model

We started with a null model that included the intercept as the only predictor. The interclass correlation (ICC) is 0.22, which shows that about one-fifth of the variation in learning, can be attributed to characteristics of ego. This value shows that observations cannot be assumed to be statistically independent, so our data indeed requires multilevel modeling (Kahn, 2011).

4.3.4.2 Testing study hypotheses

We disentangled the effects within ego and the effects across egos. In order to do this, we used group mean centering on calculating the mean score of alter level constructs (added these to ego level variables) namely, mean strength of a tie of ego network, mean alter skill of ego network, and the deviation of the mean score within ego variables (maintained these at alter level). This is the standard recommendation that results in unconflated multilevel variances (Paccagnella, 2006; Zhang, Zyphur, & Preacher, 2009).

To test hypotheses 1 through 6, three models were used (see Table 4.1). Model 1 shows the main effects, whereas model 2 includes several covariates, and model 3 includes tests for interaction effects. We consider model 2 as it has the best model fit with a -2log likelihood ratio test statistic of $X^2(14) = 26.25$, $\rho = 0.000$.

Hypothesis 1 proposed that egos with higher mobile phone skills will more likely learn from alter. The data does not support this hypothesis ($\beta=0.04$, $z=0.40$, $\rho > 0.05$). Likewise, hypothesis 2 that postulated better education levels of ego positively influence learning from alter found no support. However, contrary to the direction of the effect proposed, we find that the higher the education level of ego, the less likely ego is to learn from alter and this finding is significant ($\beta=-0.07$, $z=-3.28$, $\rho < 0.01$). Regarding hypotheses three on the prediction of learning of ego using mobile money skills of alter, we do find significant support. The higher the mobile money skills of alter, the more likely that ego will learn ($\beta=0.45$, $z=9.88$, $\rho < 0.001$). For hypothesis 4 on the effect of the strength of a tie, the data shows no support ($\beta=0.10$, $z= (1.39)$, $\rho > 0.05$). Furthermore, model 2 suggests no evidence for support of hypothesis 5, which predicted learning to be more likely to occur in denser ego networks.

In Model 3, we note that the proposition in hypothesis 6 that the strength of a tie will moderate the effect of skills of alter on learning finds no support in the data. When testing this effect, the strength of a tie and alter skill are considered at both alter level (within alters) and ego level (across egos). At both levels, the moderation effect is non-significant respectively ($\beta=-0.14$, $z=-0.68$, $\rho > 0.05$ and $\beta=-0.40$, $z=-0.67$, $\rho > 0.05$). Besides, we tested

for whether learning of different ego gender varies depending on the gender of alter. We find that this not that case. The between variance effects that were re-introduced into the model (as ego level predictors) include, mean mobile money skill of alters and the mean strength between ties at ego level. We find that ego's learning is positively influenced by average mobile money skills in ego's network (β=0.54, z=5.29, $\rho < 0.001$). In contrast, we find no support that ego will be influenced by the average strength of ties within their network.

Additionally, we observe in model 2 an effect of network size of ego on learning how to use mobile money. This is a significant predictor at $\beta = 0.10$, $z = 3.82$, $\rho < 0.001$. Likewise, the decrease of the interclass correlation across the different models (0.22 to 0.15) denotes that the portion of the between effects or the portion of the variability due to ego predictors left to be explained by the model reduces as more explanatory variables are introduced in the models.

Table 4.2. Multilevel models predicting learning in a dyad (Urban area).

Level and Variable	**Null model**	**Model 1** ***Theoretical variables***	**Model 2** ***Including control variables***	**Model 3** ***Interactions***
	(Step 1)	**(Step 2)**	**(Step 3)**	**(Step 4)**
Alter Level				
Mobile money Alter skills (MMS)		0.43 (9.66)***	0.45 (9.88)***	0.45 (9.83)***
Strength of a tie (SOT)		0.10 (1.39)	0.10 (1.39)	0.10 (1.36)
Ego Level				
Mobile phone skills		0.06 (0.76)	0.04 (0.40)	0.03 (0.34)
Density		0.16 (0.69)	0.28 (1.26)	0.28 (1.27)
Education in years		-0.04 (-2.13)*	-0.07 (-3.28)**	-0.07 (-3.32)**
Mean SOT of ego network		0.19 (1.29)	0.12 (0.85)	0.35 (0.97)
Mean skill of ego network		0.52 (5.97)***	0.54 (5.29)***	0.87 (1.75)
Control variables (*alter level*)				
Kin (family relation)			0.13 (1.36)	0.13 (1.32)
Gender of alter (female=1)			0.02 (0.28)	
Control variables (*ego level*)				
Age			-0.0002 (-0.06)	-0.0004 (-0.08)
Income			0.11 (1.93)	-0.10 (1.85)
Gender of ego (female=1)			-0.03 (-0.28)	
Network size			0.10 (3.82)***	0.11 (3.84)***
% of adopters in ego network			0.26 (0.82)	0.28 (0.86)

Interactions Gender ego#gender alter				
Male-ego#male-alter				-0.01 (-0.12)
Male-ego#female-alter				-0.06 (-0.43)
Female-ego#female-alter				-0.03 (-0.21)
MMS (alter)#SOT				0.02 (0.32)
Mean MMS#Mean SOT				-0.14 (-0.68)
Intercept	1.72(27.15)***	0.66 (1.49)	0.15 (0.31)	-0.40 (0.67)
Variance components				
Within (L1) Variance	1.26	1.07	1.07	1.07
Between (L2) Variance	0.35	0.25	0.19	0.19
Additional information				
*2log likelihood/Deviance	64.41	46.22	26.25	29.25
ICC	0.22	0.19	0.15	0.15
Df	1	7	14	18
N	752	752	752	752

*p < .05; **p < .01; ***p < .001
Note: Number of egos = 167.

4.3.5 Discussion

Study 1 aimed at investigating which constructs explain the learning of mobile money within a dyad in an urban context. The results can also be categorized into two types of hypotheses. One category relating to attributes of the individual affecting learning such as mobile phone skills and education while the other type comprises characteristics of the ego network or network effects, for instance, alter skills, the strength of a tie, mean skill of alter, mean strength of a tie and density. On the whole, we found that the data supports more, the characteristics of ego network, whereas the individual attributes do not hold as predicted. We predicted that more educated and higher mobile phone skilled individuals would be advantaged to learn from alters. We find the contrary, particularly, that more educated persons are less dependent on the social ties in learning. A possible explanation for this finding is that persons in this category have the ability to self – teach mobile money technology.

The results of study 1 suggest that network effects are critical in explaining the acquisition of skills to use mobile money technology. Principally, the mobile money skills of alters, along with the average skills of ego network, are important predictors of learning. Consequently, as far as learning in urban areas is concerned, one's network will be valuable to the extent that it is endowed with mobile money skills. We additionally tested (results not tabulated) and found no support for network effects moderating the influence of education levels on learning. Thus prudently, more educated egos do not depend on their network to learn how to use mobile money. Further, the findings provide

evidence that the size of the effects of network characteristics are stronger relative to ego characteristics. This impression underscores the importance of social networks in learning how to use mobile money.

4.4 Study 2: the rural sample

In the second study, we selected a sample of inhabitants of a rural location in Uganda. Compared to the urban location, education levels are rather low in rural locations in developing countries (Martin & Abott, 2011). We, therefore, expect to find stronger social network effects on the learning of egos in rural areas, as individuals can rely less on their skills. Furthermore, the sample size was increased to improve the power of our statistical tests. Alongside this, the resolution of the alter mobile money skills measurement was enhanced from a one-item measure to a three-item construct that captures diverse skills of alter, namely: knowledge depth of alter; uniqueness of skill to alter; and alter's ability to transfer skills to ego.

4.4.1 Method

Face to face interviews were conducted during September of 2017 in Uganda in the rural district of Nakaseke in Central Uganda. Similar to study 1, we employed multistage sampling. Rural districts are divided into counties, sub-counties, parishes, and villages. A village is the smallest unit of a district. The villages that were selected include Bugala, Kalagala, Kamusayi, Kanyale, Kibale, Kikwata, Kivule, Kyambogo, Kyamutakasa, Kykuumango, Lukabala, Mulungi'omi, Nakasseta, and Ssanze. The response rate was 97%. A total of 526 participants were interviewed during the field study. Of the above participants, 478 respondents had at least one social contact. In each village that was visited, interviewers approached people to ask for voluntary participation in the study. We tested for interviewer effects and found no differences. The questionnaire was translated into the local language (Luganda) by a professional translator. We used research assistants to conduct face to face interviews. They were trained by the researchers before data collection for four days to create a uniform understanding of research constructs, standardize the questions, and familiarize them with the data collection software. In order to make village inhabitants more comfortable participating in the study, a counselor of Nakaseke district accompanied the data collectors to support the study. When possible, the counselor requested villagers to gather at a general place to accelerate the interviewing procedure. On average, an interview took 20 minutes. We targeted 50 interviews per village, and in villages that had less than 50 households, all households were considered for an interview. We tested for interviewer effects and found no significant differences.

4.4.1.1 Measures

Except for mobile money skills of alter, all measures are the same as in study 1. Parallel to study 1; we relied on the respondents to evaluate the skills of their ties, consistent with

earlier research (Borgatti & Cross, 2003; Reagans & McEvily, 2003; Sosa, 2011). Respondents were asked three questions in this regard. "*Would you agree that it is easy for [alter name] to explain to you issues of mobile money?*" "*Would you agree that [alter name] is knowledgeable about the mobile money subject?*" "*In your opinion, would you agree that [alter name] can execute most of the mobile money services without assistance or support?*" These items were ranked on a scale ranging from strongly disagree to agree strongly.

4.4.2 Data exploration and cleaning

The original sample consists of 3,257 alters nested within 478 egos. Of the 478 egos, 339 use mobile money. Egos have medium mobile phone skills with a score of 4.9. The data shows that many egos stopped at the primary level of education, with an average of 8 years of schooling. Egos report an average of 7 alters in their networks (ranging from 1-10). The sample has a lower percentage of females with a percentage of 0.43. Egos have relatively dense networks (0.88/1), with alters possessing notable mobile money skill levels (3.9/5).

Not all cases are suitable to be used in hypothesis testing. First, there are egos who do report to have no social connections (48). Then, there are egos who do not use mobile money (139). Further, the data contains egos who solely use mobile money by proxy (1). Finally, there are also alters who do not use mobile money (929) and, therefore, may be assumed to have no mobile money skills. We removed all of those cases from the dataset, since learning in a dyadic relationship will be, in principle, inexistent. Consequently, further analysis was done on 1,390 alters nested within 338 egos.

Table 4.3 provides the characteristics of the rural sample. 38% of the rural sample consists of women. We note that there are fewer females in the rural sample, and one reason could be that whereas in the urban area, women were usually found in the households, in the rural area, both genders were encountered at home. In cases where both were found culturally, the head of the household, who is typically male, is interviewed.

When comparing the descriptive statistics between the rural and urban samples, we find a few differences. In general, rural inhabitants have lower mobile phone skills (5.23 versus 6.22) and lower levels of education (8.04 versus 12.4 or primary level compared to upper secondary level). While the size of their networks is more or less similar (6.86 versus 6.05), networks in rural areas are denser (0.88 versus 0.72).

4.4.3 Descriptive statistics

Table 4.3. Mean, standard deviations and correlations (N = 1,390 alters and 338 egos).

	Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
Alter Level												
1	Learning	2.63	1.47	1.000								
2	Mobile money skills	3.92	1.17	0.628**	1.000							
3	Strength of a tie	0.7	0.45	0.079*	0.050	1.000						
4	Gender of alter (female=1)	0.36	0.48	-0.032	-0.126**	0.152**	1.000					
Ego Level												
1	Mobile phone skills	5.23	2.17	1.000								
2	Density	0.88	0.2	-0.112*	1.000							
3	Education in years	8.04	3.71	0.442**	-0.048	1.000						
4	Mean SOT of ego network	0.62	0.31	0.002	0.078	0.004	1.000					
5	Mean skill of ego network	3.86	0.73	0.122*	0.035	0.106	0.149*	1.000				
6	Mean gender of ego network	0.37	0.24	0.078	0.097	-0.037	0.228**	-0.071	1.000			
7	Network size	6.86	1.61	0.186**	-0.027	0.111*	-0.060	0.099	-0.091	1.000		
8	Age	36.73	12.5	-0.523**	0.111*	-0.280**	-0.016	0.040	0.018	0.035	1.000	
9	Income	54	23	0.206**	-0.061	-0.061	-0.226**	0.107*	-0.204**	0.230**	0.081	1.000
10	Gender of ego (female=1)	0.38	0.48	-0.123*	-0.018	-0.018	0.056	-0.010	0.425**	-0.084	0.030	-0.145*

*$p < 0.05$; **$p<0.001$

Table Notes: 1. Alter level and ego level correlations are presented separately.
2. Alter variables number of observations is 1390 **(rows 1-4)**, while ego level number of observations **(rows 1-10)** is 338.
3. Income is given in euros with an exchange rate of 1 euro = 4,500 Uganda shillings.
4. SOT – Strength of a tie.

4.4.4 Analysis

Again, we tested our hypotheses using a multilevel random intercept model of a sample of 1,390 alters nested within 338 egos. The unit of analysis is a dyad (alter-ego relationship) and, variables at alter level and ego level are group mean-centered and non-centered, respectively. As in study 1, the effect within egos across ties and an effect across egos are divided for the strength of a tie and mobile money skills at alter level.

Table 4.4. Multilevel models predicting learning in a dyad (*Rural area*).

Level and Variable	**Null model**	**Model 1** ***Theoretical variables***	**Model 2** ***Including control variables***	**Model 3** ***Interactions***
	(Step 1)	**(Step 2)**	**(Step 3)**	**(Step 4)**
Alter Level				
Mobile money Alter skills (MMS)		0.80 (29.97)***	0.80 (29.94)***	0.80 (29.13)***
Strength of a tie (SOT)		0.28 (3.70)***	0.25 (3.26)**	0.26 (3.28)**
Ego Level				
Mobile phone skills		-0.92 (3.61)***	-1.20 (-4.00)***	-1.20 (-4.04)***
Density		0.19 (0.92)	0.20 (0.98)	-1.62 (-1.55)
Education in years		-0.02 (-1.00)	-0.02 (-1.13)	-0.02 (-1.11)
Mean SOT of ego network		-0.03 (-0.20)	-0.09 (-0.63)	2.09 (2.61)**
Mean skill of ego network		0.85 (13.76)***	0.88 (14.28)***	1.27 (8.41)***
Control variables (*alter level*)				
Kin (family relation)			0.02 (0.26)	0.01 (0.09)
Gender of alter (female=1)			0.11 (1.76)	
Control variables (*ego level*)				
Age			-0.01 (-1.78)	-0.01 (-1.71)
Income			0.06 (-1.48)	-0.06 (-1.47)
Gender of ego (female=1)			-0.17 (-1.99)	
Network size			0.01 (0.58)	0.01 (0.48)
% of adopters in ego network			0.05 (0.28)	0.09 (0.55)
Interactions Gender ego#gender alter				
Male-ego#male-alter				0.06 (0.60)
Male-ego#female-alter				0.18 (1.64)
Female-ego#female-alter				-0.09 (-1.00)
MMS (alter)#SOT				0.79 (1.01)
Mean MMS#Mean SOT				-0.57 (-2.76)**
Variance components				
Within (L1) Variance	1.78	0.94	0.95	0.95
Between (L2) Variance	0.40	0.31	0.28	0.27
Intercept	2.63 (51.26)***	-0.15 (-0.40)	0.07 (0.16)	0.10 (0.10)

Additional information				
*2log likelihood/Deviance	66.31	113.57	96.30	89.35
ICC	0.18	0.25	0.23	0.22
Df	1	7	14	18
N	1390	1388	1388	1388

*ρ < .05; **ρ < .01; ***ρ < .001

Note: 1. *The drop of two observations in model I is because of 1 ego mobile money user who uses mobile money by proxy only is eliminated.*
2. *Number of egos = 338*

Table 4.4 shows findings for the learning of mobile money skills by egos in the rural area. Step 1 shows the null model. In step 2, we included the main predictors to test the main effects. In step 3, we introduced the control variables at both levels. Step 4 tests for interaction effects. We test the improvement of each model over the previous one by computing the differences of the respective log-likelihood statistic -2*log and submitting this difference to an X^2 test. Additionally, we observed the change in the interclass correlation (ICC) to monitor changes of within and between effects.

4.4.4.1 Null Model

We find an interclass correlation (ICC) of 0.18. This means that differences across ego's account for 18% of the variability in learning. Hence the data has a nested structure, and multilevel modeling should be used (Khan, 2011).

4.4.4.2 Testing study hypotheses

To test hypotheses 1 through 6, three models are run. To discuss the results, we consider model 3, which has the lowest deviance. Hypothesis 1 that proposes higher mobile phone skills of ego will positively influence learning from alter, finds no support. Divergent to our prediction, we find that ego with higher mobile phone skills is less likely to learn from alter, and this finding is strongly significant (β=-1.20, z=-4.04, $\rho < 0.001$). Therefore, mobile phone skills in rural areas more or less take the place of education in the urban location. Hypothesis 2, which states that better-educated egos will learn easily from alter, finds no support from the data, shown by the non-significant effect. This effect is negative, as well.

Looking at hypothesis 3, we predicted that mobile money skills of alter would positively influence learning by ego, and we find strong support for this hypothesis (β=0.80, z=29.13, $\rho < 0.001$). Hypothesis 4 regarding the effect of strength of a tie on learning, finds support in the data. We find that closer ties between alter and ego do explain the learning of ego (β=0.26, z=3.28, $\rho < 0.01$). On the proposition that learning is more likely to take place in denser networks given under hypothesis 5, we find no support given a non-significant effect. Since the strength of a tie is an alter level variable, it was split into two interactions — one for between effects and the other for within effects. The within

effects interaction finds no support in the data. Regarding the between effects prediction, we find that though the mean strength of a tie does moderate the relationship between mean mobile money skill and learning significantly, this estimate is negative (β=-0.57, z=-2.76, ρ < 0.01). Therefore, where skills of alters influence learning, the presence of stronger ties within this dynamic reduces learning.

The between variance effects of mean mobile money skill of alter, that was re-introduced into the model as an ego level construct, significantly predicts learning of egos (β=1.27, z=8.41, ρ < 0.001). Therefore, ego's learning is positively influenced by average mobile money skills in ego's network, a finding parallel to study 1. Also, the average trust that ego has in the network as a whole, shown by the mean strength of a tie does influence ego learning. This finding is significant (β=2.09, z=-2.61, ρ < 0.01). The increase in the interclass correlation from the null model to model 1 (0.18 – 0.25) suggests that the portion of the variability in learning due to within effects are stronger than between effects. Therefore, in model 1, by adding main predictors, the alteri or dyadic variables explain more learning variation than the portion explained by ego characteristics. In effect, this reduces the portion left to be explained by alter level variables.

4.4.5 Discussion

The aim of study 2 was to investigate whether network characteristics and ego attributes explain learning within a rural area in Uganda. The findings show that there will be more learning when egos are endowed with networks that have skilled alters, both at a dyadic level and network level. Learning takes place at a higher rate within strong ties compared to weaker ties. Hence it appears that trust is an essential element in knowledge transfer in rural areas. Our results suggest that social groups and existing grassroots organizations in rural areas can be used as a means to promote learning, and subsequently increase adoption and usage of mobile money. However, being bound by trust ensures effectiveness in the transfer.

Furthermore, results suggest that education does not play any role in rural areas in explaining who will learn from a dyad. This could be attributed to lower variation and low levels of education in the rural area. Most of the sample in the rural area has eight (8) years of schooling, which translates to completion of the primary or elementary level of education. Thus, as suggested by the data, the dependency on social networks to support learning is vital in areas with low education levels.

On the surface, our results show that higher mobile phone skills of egos do not support learning within a dyad. This suggests that prior experience with using a mobile phone will most likely enable individuals in this category to self-teach the mobile money system. However, it is essential to know the extent to which skilled individuals are independent of their social network in learning how to use mobile. To do this, we tested for the moderating effect of mobile phone skills on the relationship within network effects and learning and found no significant effects (not tabulated here). This suggests

that egos with mobile phone skills do not depend on the network to learn how to use mobile money. Identifying individuals in rural areas with higher mobile phone skills, and empowering them to train others within a social setting, could be another pragmatic intervention to upskill others and increase usage.

4.5 Comparison of Urban and Rural results

The two data sets are very similar, and hence allow us to compare learning in social networks between an urban and rural region. Findings from studies 1 and 2 seem to concur on network characteristics being more critical in learning how to use mobile money. Alter skills, and a skilled ego network are essential in study 1, while in addition to the above two, the strength of a tie between alter and ego and the network as a whole have a positive effect on learning in study 2.

To test whether there are differences in the effect sizes of network characteristics between rural and urban areas, we calculate the predictive margins. Effect sizes will show the magnitude or strength of the individual constructs in explaining learning (Durlak, 2009). The margin statistics are based on estimates of the main effects model 1. For each construct in the model, all other predictor variables are held at their mean value. The effect size margins comparison will give an indication of the extent to which the effects differ between rural and urban areas. Notably, we are interested in how large the margins are. The results will be suggestive of which locality, relative to the other, is more influenced by network characteristics.

Table 4.5. Predictive margins of network characteristics of rural and urban effects.

	Effect size Margins	
Network characteristics	**Rural**	**Urban**
Mobile money skill of alter	-0.08-5.00 = +4.92	0.44-2.73 = +2.29
Strength of a t	2.39-2.90 = +0.51	1.54-1.87 = +0.33
Mean MMS of ego network	0.05-3.63 = +3.58	0.81-2.36 = +1.55
Mean SOT of ego network	2.75-2.61 = - 0.14	1.46-1.82 = +0.36
Density	4.06-2.46 = - 1.60	1.60-1.75 = +0.15

Contrasting the effect sizes margins between network and ego characteristics, we can distinctly see that social networks play a larger role in learning than ego attributes in study 2. For instance, a change of mobile money skills of alter in the rural area from the minimum score to the maximum score will lead to a prediction increase for learning varying from -0.08 to 5.00, showing a large margin of +4.92. This difference reflects a strong effect size. Though this same margin is large in the urban area, it is still lower than the rural area value at +2.29. Other results in Table 4.5 show that the effects of the strength of a tie, and mean skill of ego network in the rural area, have larger margins in comparison to urban areas.

This shows that network characteristics are more influential in rural areas, relative to urban areas in ego learning of mobile money.

Aside from the size of the network characteristics, we do find more varied network effects in study 2 compared to study 1. Apart from competent alters and a skilled network, the strength of a tie in a dyad contributes to learning. Further investigation of ego characteristics reveals that the interaction effect of mobile phones skills and network characteristics (not shown in main analysis) suggests that egos who have higher mobile phone skills do not depend on the network to use mobile money. The latter effect is the same for education levels in study 1. Therefore, more educated people in urban areas seem not to learn through social contacts, and more skilled individuals depict the same trend in rural areas.

4.6 General Discussion

This research set out to investigate how people acquire mobile money skills through social networks in rural and urban areas in Uganda. In particular, we investigated the determinants of learning how to use mobile money within a dyadic relationship. We hypothesized that alters with better mobile money skills, and alters with strong ties to ego will contribute more to learning than alters with lesser skills and weaker ties. Additionally, we expected that egos with advanced mobile phone skills, higher education levels, and denser networks would be more advantaged to learn from alters. Similarly, we hypothesized that egos are more likely to learn from skilled alters with whom they have stronger ties. Comparing the two data sets, we hypothesized that network effects would be stronger in rural areas. We found broad support for our hypothesis. We find a pattern showing network characteristics as the major determinants for the acquisition of mobile money skills.

4.6.1 Theoretical implications

We find that learning mobile money skills in Uganda is driven by three main factors: having alters, having an average skilled network of relationships, and having strong ties with alters. This suggests that it is not enough to have alters in a network that have adopted mobile money. The type of alter is more central to learning. Individuals benefit more from experienced (skilled) adopters of technology. Likewise, the presence of stronger ties that promote trust between individuals is essential. We note that independently, strong relationships might not lead to learning. However, they are a prerequisite that creates favorable conditions that support learning. Therefore, the resources in the network in the form of skills are more critical. This finding is in line with other studies into technology adoption and learning in social environments (Beaman, BenYishay, Magruder, & Mobarak, 2018; Bursztyn, Ederer, Ferman, & Yuchtman, 2014; Conley & Udry, 2010; Foster & Rosenzweig, 1995). For instance, Beaman et al., (2018), while investigating the adoption

of a planting technology in Malawi, found that farmers will acquire knowledge when they have sufficiently many knowledgeable social contacts. Our results have implications for theories about learning in social networks (Borgatti & Cross, 2003; Cross et al., 2001; Reagans & Mcevily, 2003). The present study adds insights to this literature since it is the first to study learning in networks within a developing country context. Moreover, the results show that in rural settings in developing countries, the network effects could be very important. In contrast, in other urban settings, network effects will not be as vital to the learning process. Though the study does not delve into the plausible causes for these differences, we can prudently conclude that context matters in social network learning. Contextual issues, for instance, culture, norms, and resources within environments that propel or hamper learning within social settings, need to be considered.

Additionally, our findings have broader implications for theories about learning in social networks since it considers the skills already acquired by ego as an explanation of learning. Ego skills (education and mobile phone skills) will provide an edge for learning mobile money within networks. This idea is closely related to theories about "absorptive capacity," which argues that prior related knowledge (absorptive capacities) confers an ability to recognize the value of external new information, assimilate it, and apply it to commercial or innovative ends (Cohen & Levinthal, 1990). The present study findings show that this idea can be incorporated into theories about learning in social networks.

Mobile money technology is in itself a social application, in that it is interactive in nature, and facilitates the transfer of monies between individuals. Therefore, studying the diffusion of this application in a social setting is appropriate. Social network structure has been used to explain which potential adopters of innovation find out information about these innovations, which can cause them to make decisions to adopt using the innovations for diffusion theory (Abrahamson & Rosenkopf, 1997). Nevertheless, how social learning beyond social influence can lead to diffusion is still vague. Our findings can enrich the diffusion of innovation theory (Rogers, 2003) and social learning theory (Bandura & Walters, 1977) by shading light on more intricate details of how diffusion through social learning can take place.

4.6.2 Practical implications

In the interest of effective interventions for the diffusion of mobile technology innovative solutions in developing countries, our findings suggest that social contacts are valuable in contexts where education levels and mobile phone skills are rather low for learning purposes. These demographic attributes are more distinct in rural locations in developing countries, where a mobile phone is still a recent technology (Martin & Abott, 2011; Muto & Yamano, 2009), and literacy levels are still remarkably low (Gillwald, Milek, & Stork, 2010). Furthermore, the collective nature of rural communities in Uganda (Rooks, Klyver, & Sserwanga, 2016; Rooks, Sserwanga, & Frese, 2016), coupled with mobile phones considered as social gadgets, renders social contacts a critical player in the diffusion of

mobile-related technologies. This suggests that context (culture, norms, and resources) matters, and influences what happens in social networks for adoption, learning, and diffusion.

For optimal policymaking to boost skills through social networks, the government can leverage already existing organized groups within rural areas by using them as avenues for training and coaching members. One operative technique is the identification of core members within these groups (Valente, 2012) who are trusted by members to act as champions spearheading the skills training campaign. By targeting central persons in a network, and educating them, the intervention will be more effective since effects will be "multiplied." The enhanced skills will be transferred to their network.

4.7 Research limitations and future research

The study focuses on two contexts, rural and urban communities. Our findings suggest that context influences what happens in social networks. Context matters not only for the technology in question but also for the network effects. However, though the study context is embedded within a developing country, it is difficult to generalize the findings of the present research as the study lacks information on what factors, in particular, within each context that foster or hamper learning. A more systematic review of the context focusing on issues such as culture that could explain the network effects observed is required to generalize the above research to similar cultural contexts.

Though the research makes use of extensive survey data, it is not in a position to explain the longitudinal aspects of learning as a process within a dyad. Future qualitative case studies are needed to understand the intricacies of the process of learning. Additionally, future research is needed to understand the interaction of trust and competence in learning through social networks. Our findings suggest that the decision on whom to approach is a weigh in on the strength of a tie in rural areas. Indeed, stronger ties are more accessible and more comfortable to approach for assistance. The question of whom one selects for help in learning is still underdeveloped in the present research and requires more exploration.

4.8 General conclusion

Mobile money technology is projected to close the financial inclusion gap, especially in developing countries. Therefore, research that can shed light on how to close this gap is critical. Previous research has pointed out a prerequisite of skills for using mobile money, which happens to be a glaring challenge, even more so among the uneducated. This article highlights social networks as one of the conduits through which mobile money skills acquisition takes place and one that can counteract the low education levels.

Furthermore, the present study highlights the attributes and their interplay within these networks that ensure the effective transfer of mobile money skills. In particular, the present research provides five key insights. First, social networks are essential in the acquisition of skills to operate mobile money. However, network features are stronger than individual attributes in explaining learning. Furthermore, social networks effects are stronger for learning in rural areas. Finally, the educated are less dependent on social networks for learning in urban areas, whereas those with mobile phone skills are less dependent on social ties in rural areas. Given the findings, we can conclude that the resourcefulness of social networks is vital in learning how to use mobile money technology. We view this research as one of the initial steps in deriving practical interventions that address context-specific barriers and challenges to mobile money use.

References

1. In social network theory; a dyad is a social relationship that ego (an individual) maintains with alter (his/her social contact or peer)

Chapter 5

General Conclusion

General Conclusion

This thesis sought more in-depth insight into the adoption and use of mobile financial services using a skills perspective in a developing country. I argued that our understanding of the actual use of mobile financial services could be improved by including skills to operate mobile phones and its applications in theoretical models. To research the role of skills I raised three main questions in the thesis: (1) what role do skills play in the adoption and use of mobile money; (2) which factors determine who is more likely to have mobile money skills; and (3) can skill learning take place through social ties and networks and if so, what attributes influence skills transfer?

5.1 Why are skills essential?

The findings reported in this thesis suggest that adoption of mobile-related solutions in developing country contexts is more about 'what I can do, or I can operate' (skills) and less about 'what I would like to do or what I think I can do' (motivation and perceptions). This thesis does not discount the contribution of perception-based models in evolving the understanding of technology adoption and use. However, beyond that, a new paradigm that merits consideration when studying the use of mobile-based technologies in developing countries is fronted in this body of work. The new paradigm fronts the shift from perception-intention based studies to actual adoption and the need to identify gaps that prevent actualization or materialization of intentions to be investigated further.

Extant literature on adoption takes a perception-based approach which provides valuable insights on drivers of acceptance of mobile money technology (Ali & Dhaha, 2014; Lubua & Semlambo, 2017; Mahfuz & Saha, 2015; Mugambe, 2017; Narteh et al., 2017; Nkwede & Agha, 2017; Sayid et al., 2012; Tobbin, 2009), but then again, this perspective yields diminutive understanding of barriers to using mobile money and how to tackle these hitches. Perceptionbased models have been for investigating adoption at a general level, as opposed to the contexts of actual real-world payment scenarios (Dahlberg et al., 2015). Moreover, most perceptionoriented studies measure 'intent to adopt' as a proxy for adoption, further providing a partial interpretation of 'actual use or adoption.'

The thesis further draws attention to the need for caution when importing commonly used western models to developing countries disregarding context applicability. The use of perception-intention based models, for instance, ignores constraints to use that stretch beyond intentions. Perceptions and motivation taken in isolation are not enough to translate into actual use. The movement from intuition (I think I will be able to do this) to action (use) might be marred with barriers (skill deficiencies) to overcome first (Gollwitzer & Brandstätter, 1997). Indeed, positive intention with barriers to action or goal attainment might not materialize (Gollwitzer & Brandstätter, 1997). Chapter 1 suggests that the gap between intentions and behavior, action, or goal attainment can be explained by skills in

the mobile money context. Although this was not within the scope of this thesis, further research could be undertaken in this respect. Caution should be taken in this endeavor as a weak relationship between perception and actuals behavior has previously been emphasized in different studies as a drawback (Straub, Limayem, & Karahanna-Evaristo, 1995; Szajna, 1996). The approach in the thesis sheds light on how to move away from perceptions and further how to investigate technology use with contextual barriers in mind.

Beyond theory, skills as a requisite to use mobile money technology are listed among the top three critical factors influencing the growth of mobile money use in developing countries (IFC, 2011). Extant studies are limited in explaining the role skill play in the use of mobilerelated technologies in developing country contexts (Alampay, 2009; Kabbiri, Dora, Kumar, Elepu, & Gellynck, 2018; Senou, Ouattara, & Acclassato Houensou, 2019; Wyche & Steinfield, 2016). The majority of these studies provide anecdotal evidence that suggests that skills could be of interest in explaining mobile app technology adoption. In Uganda, for example, the financial inclusion insights report 2017[(1)] indicates that the lack of skills might be of interest in explaining the stalling mobile money adoption progress in some areas. Chapter 2 provided substantial empirical evidence that skills are a critical component in the trek to understanding mobile money adoption and use. In line with Dennehy & Sammon, (2015), Dahlberg, Guo, & Ondrus, (2015) and Pal, De, Herath, & Rao, (2019) reviews, skills which is a context-specific barrier[(2)], should be considered an essential element while investigating use of technology, especially in developing countries.

For the most part, mobile technologies are ubiquitous, even in the remotest parts within emerging economies; however, one must bear in mind that this technology is still a recent phenomenon in most of these communities (Aker & Mbiti, 2010). This, in itself, renders skills to use the relatively new technology a vital consideration in adoption. Additionally, these communities are generally characterized by low literacy levels, which further cripples' usage of technology (Medhi, Ratan, et al., 2009). In reference, mobile money, in particular, is a financial technology that is biased towards including the poorest of the poor (who usually form the larger populace in rural areas) in the financial circle (Aker & Mbiti, 2010; Donovan, 2012; Peruta, 2018). This segment of the population in developing countries is primarily characterized by high levels of illiteracy (Donovan, 2012). A combination of new technology introduction and high illiteracy makes a sound case for consideration of skills in such contexts.

Chapter 2 findings indicate that education and literacy, in general, do not predict mobile money use. Perhaps this can be explained by the high correlation between skills and education, as both constructs were modeled as predictors of use. The non-significant effect of education in the presence of skills could be explained by findings in chapters 4 and 3. In chapter 4, we find that more educated individuals are less dependent on others for learning how to use mobile money. In contrast, chapter 3 findings show that inequalities in skills access are biased towards more educated individuals. The above

results suggest that education does play a role in mobile money use, especially in low resourced communities (i.e., high illiteracy levels). In contexts where literacy levels are low, the uptake of technology will be slow, characterized by inefficiencies in use. Furthermore, in instances where the use of the technology is a means to an end, for example, when mobile money is used to execute a financial transaction, the propensity to error will be high. This further lends support for the development of a new paradigm (skills perspective) to investigating technology use in low literate environments.

A skills perspective on mobile money use is much more relevant today, where access to mobile money is not the problem. Salazar, (2018) suggests that it not access to relevant infrastructure that poses a hindrance to use but usability. Indeed, the usability of the technology merits our attention, and therefore, a skills perspective contributes to a pragmatic paradigm to understanding mobile financial technology in developing country contexts. In line with this, enhancement of skills provides a short- and medium-term practical intervention that can have a positive impact through training and harnessing social network avenues, as suggested in Chapter 4. Devising means to make this effective is a possibility for future research. In the long-term, policy-makers should consider widening access to education as an educated populace is more likely to have skills. The materialization of this recommendation is one within reach of governments. To echo Donovan, (2012), basic and quantitative literacy are necessary to realize the benefits of mobile money fully.

5.2 From intentions to actual use

Gollwitzer & Brandstätter, (1997) argue that intentions may not materialize into action, more so when the movement from intentions to goal achievement is marred with obstacles. This brings into question whether intentions (commonly used as indicators of adoption) are sufficient enough to indicate or measure adoption. Unlike the norm of measuring intentions in technology acceptance models, actual use (direct use) is investigated in this thesis. Given the preceding paragraphs that discuss the challenges in developing countries, for instance, low literacy, deviating from the norm (intentions), and focusing on actual use gives a more realistic picture of adoption.

Further still, through this operationalization (actual use), identification of irregular usage of mobile money is possible, for instance, proxy use (one uses mobile money on behalf of another person), which is then accounted for appropriately in methodology. By application, we find that many studies measure adoption statistics using subscriber numbers (Donovan, 2012; Hughes & Lonie, 2007). Given the identification of 'indirect use or proxy use' in this thesis and dormant accounts in other studies (Intermedia, 2016), we can prudently assume that the adoption numbers could be far less than normally reported. This suggestion, therefore, challenges the methodologies applied to categorize

use versus non-use of technology in general and highlights the inequities and biases measuring intentions as a proxy for adoption can create.

5.3 A new approach to skills measurement

In line with highlighting the contribution of skills to the technology use debate, the thesis develops a new approach to measuring skills in mobile money technology use. Skills as a construct is frequently measured in technology and digital use studies. Scholars have widely used self-assessments in the measurement of skills (Hargittai & Hinnant, 2008; Matzat & Sadowski, 2012; Zhong, 2011). Self-assessment is a reflective process in which an individual evaluates one's abilities, competencies, or quality of output. These assessments are then considered as representing an individual's actual skills or abilities. Self-assessments of constructs, much like skills, can produce misleading data since many a time, respondents experience the social desirability pull that leads to overestimates. For instance, using items similar to "I think I am clever or smart" to measure intelligence. Not many people would respond by placing themselves on the low end of the continuum. Interestingly, the reverse is not improbable. Studies in some cultures, for instance, in the Philippines, show that prudence can lead to underestimating one's abilities (Alampay & Bala, 2010a). In order to minimize the above biases, this thesis has operationalized skills in rather an unconventional manner.

This thesis takes an adapted approach from Deursen & Dijk, (2009) that measured actual digital skills through the use of laboratory set assignments. Respondents were tested on their abilities to use a mobile phone through a mobile phone skills test. The test uses item response logic to test real abilities; therefore, the results are a closer indication of reality than the typical self-assessments frequently used. The skills scale can be replicated in different studies, as seen in chapters 2 through 4. Additionally, the measurement criterion can also be applied in training or skills enhancement interventions, a baseline for skills level measurement.

5.4 Context matters in understanding adoption

This thesis highlights context as an essential part of not only designing technology but also in studying the use of technology and tackling inequality in skills access. In chapter 4, findings indicate that the effects of social networks on learning skills differ in urban and rural in Uganda. However, we are not sure why this is the case, or what the underlying drivers of these differences are within the scope of this thesis. Perhaps network effects differ because of disparities between collective (rural) and individualistic (urban) societies (Rooks, Klyver, et al., 2016; Xiao, Z. & Tsui, 2007). In Uganda, rural communities tend to be collectivistic, while urban communities are largely individualistic (Rooks, Sserwanga, & Frese, 2016). Feasibly too, in low resourced communities (high illiteracy, for instance,

in rural Uganda), that are also collective in nature, there will be a tendency to share skills. Collectivism has a direct effect on attitudes towards sharing knowledge in societies where people have a sense of identity (Hwang & Kim, 2007). The dependency on social ties for acquiring resources or skills is then assumed to be larger in communities where access is more straightforward, i.e., in collective societies. In contrast, in individualistic communities (that is more often an urban context in a developing country), people tend to seek information and knowledge on their own (Lee, Trimi, & Kim, 2013). All the above speculations point to new questions and the necessity for empirical work to understand the link between society settings to skills access in social networks.

Still, on context, the thesis highlights the significant inequalities that exist in rural areas within developing countries in terms of skills access. Inequalities in access and use of technology, especially mobile phones in developing countries is not new (Blumenstock & Eagle, 2010; Burrell & Oreglia, 2015; Chabossou et al., 2009; Penard et al., 2012). However, the new landscape promoting usage instead of access places skills inequality in mobile technology usage as a unique and vital divide to be investigated. Findings in this thesis suggest that the effects of access to mobile technology run similar to the impact of skills access with one unique key contrast. Whereas older people are likely to access technology, they are less likely to have the skills to use it, which in turn brings new challenges. One can argue that older people can use technology by proxy or through others. However, to what extent is this sustainable, and how can one reduce the risks associated with proxy use, for example, fraud?

The advance of digital services in different sectors of the economy in developing countries situates this research in a crucial time. More than ever, there is a need for users of various applications to either possess or acquire knowledge and skills to exploit and benefit from digitization fully. In certain circumstances (low resourced environments), limited options are available; for instance, in the financial realm, the mobile money application is the safest money transfer option available for certain societies that have limited access to formal financial institutions. In other words, mobile money is the only opportunity to go cashless in many remote locations. Nonetheless, in other environments, several vital mobile applications are quickly mushrooming that require adoption decision making after weighing costs and benefits. Transport sector applications, for instance, 'Taxify' or 'Safeboda' (Uganda); agricultural applications namely, 'MFarm' (Kenya) and 'Jaguza' livestock App (Uganda); services retail 'Jumia' App (Nigerian founded though, spreading across Africa), require some form of skill to use. The optimization of these digital interventions in the economy is hinged on the extent to which the users can operate the system. It is also worth mentioning that some of these applications are very much alike, for example, 'SafeBoda' and 'uberBoda' offer the same service. Therefore, one has to make a choice which one to use. However, as much as there are options, the usage of either one is more or less certain, and therefore, skills become part and parcel of usage.

5.5 Skill enhancement programs are key

In the most immediate relevant sector – finance, findings from this thesis suggest that to improve financial inclusion, the focus must be placed on mobile phone skills because that, in turn, improves mobile money skills. In chapter 2, the importance of mobile phone skills is clearly highlighted. Not only is the effect of mobile phone skills on adoption significant, but it is also the strongest. Later in chapter 4, we find that persons limited in skills seek the assistance of others to execute transactions. In the information-seeking process, learning can take place (Borgatti & Cross, 2003; Reagans & McEvily, 2003). The generic use of a mobile phone might seem obvious to many, but in the context of developing countries, this is less obvious and can become overlooked easily. The necessity for generic training on how to use mobile phones is emphasized through findings in this thesis.

5.6 Rethinking design of technology in developing countries

In broad terms, the findings in the thesis highlight a mismatch between user skills and technology, which, in turn, reflects a design gap. This prompts suspicion that comprehensive usability analyses of many 'necessary' (where users have less or no options) mobile technologies are not performed, arising out of a need to 'hit the market' as soon as possible for profit maximization by developers in developing countries. In the process, both parties lose (the developers on usage numbers translating to sales, and for the user, it creates complications and associated risk).

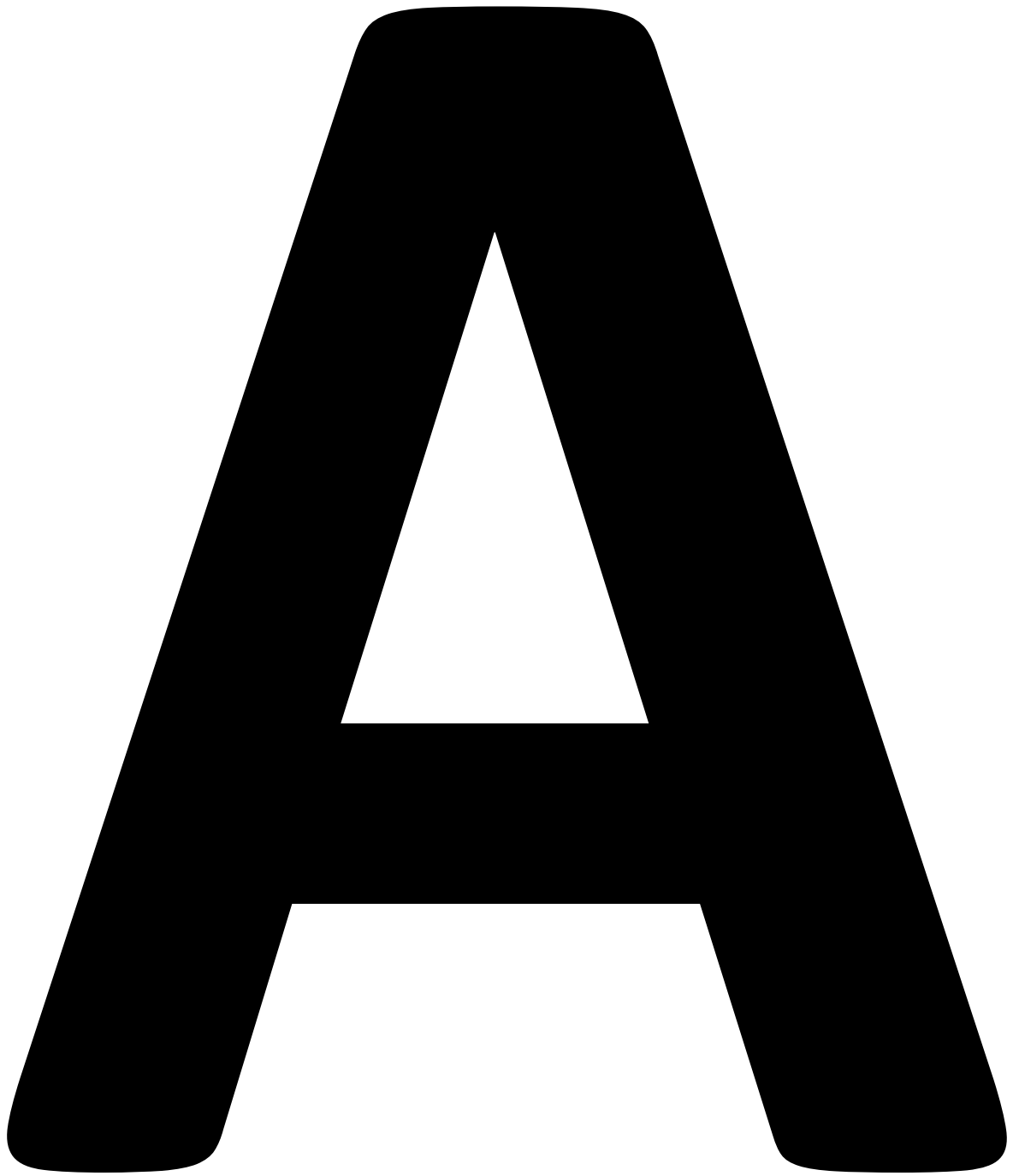
Moving forward, mobile interfaces can be modified to promote the inclusiveness of a wide range of users (literate and illiterate) in the medium-term. Additionally, companies should be encouraged to design technologies matching the skill level of the intended users in the longterm. This will ensure not only adoption but also the sustainability of mobile-based solutions. A study intended to test mobile interfaces for novice and low-literacy users was done in Kenya, India, The Philippines, and South Africa (Medhi, Gautama, et al., 2009). Medhi, Gautama, et al., (2009) concluded that instead of the typical text-based menus currently used, non-text designs are strongly preferred. Such studies need to be integrated into the design of essential applications that have the potential to be far-reaching, for instance, mobile money at the service providers' level. To echo Dahlberg et al., (2015), customers or end-users need to be involved in the development of mobile applications or services.

5.7 Conclusion

The body of work in this thesis contributes a skill perceptive - a new paradigm to investigating mobile money usage and adoption in developing countries. We do find: [1] skills are essential in adoption and use; [2] large inequalities exist in skills access, biased

towards an individual's cognitive effort, younger people, higher incomes, educated persons, access to a supportive network and the male gender; and [3] skills transfer learning does occur in social networks, largely hinged upon skilled ties. Additionally, it was interesting to find that skills transfer through social ties is stronger in rural areas as opposed to urban areas. The rationale for this disparity remains work for future research. 82

The skill perspective provides answers to gaps not only found in commonly used perception-based models; for instance, why do intentions sometimes not materialize into action. Indeed, barriers, for instance, a lack of skills, do exist that can hinder the actualization of an intent (use of mobile money). In line with this, a context-specific barrier (skills) is explored in this thesis. Furthermore, the thesis shows that taking a skills stance delivers a practical approach to sustainably solving low adoption rates, proxy use, and inefficient use of mobile money and other mobile-related technologies. By and large, skills are trainable, and skills enhancement should provide a short-term solution for communities and individuals with skill inefficiencies to use mobile applications. In the long-term, a user-centric approach to developing new technologies can assist bridge the skills-usage gap in developing countries similar to Uganda. Going forward, research should take into consideration a specific context's readiness to adopt technologies, and this approach will ensure that the pertinent barriers within which these innovations are placed are not ignored.



Appendices

Bibliography
Summary
Appendix I
Acknowledgments
Curriculum Vitae

Bibliography

Abhipsa, P., Rahul, D., Tejaswini, H., & Raghav, R. (2019). A review of the contextual factors affecting mobile payment adoption and use. *Journal of Banking and Financial Technology*, *3*(1), 43–57. https://doi.org/10.1007/s42786-018-00005-3

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211.

Ajzen, I., & Fishbein, M. (1977). Attitude-Behavior Relations : A Theoretical Analysis and Review of Empirical Research. *Psychological Bulletin*, *84*(5), 888–918.

Aker, J. C., & Mbiti, I. M. (2010). Mobile Phones and Economic Development in Africa. *Journal of Economic Perspectives*, *24*(3), 207–232.

Alampay, E. a. (2009). Mobile 2.0: m-money for the BOP in the Philippines. In *International Conference on Mobile Communication and Social Policy. Rutgers University, New Brunswick*. New Jersey, USA. Retrieved from http://ssrn.com/abstract=1618185

Alampay, E., & Bala, G. (2010a). Mobile 2.0: m-money for the unbanked. *Information Technologies & International Development*, *46*(6), 77–92.

Alampay, E., & Bala, G. (2010b). Notes from the Field. Mobile 2 .0: M-money for the BoP in the Philippines. *Information Technologies and International Development*, *6*(4), 77–92.

Albuquerque, J. P. de, Diniz, E. H., & Cernev, A. K. (2016). Mobile payments : a scoping study of the literature and issues for future research. *Information Development*, *32*(3), 527–553. https://doi.org/10.1177/0266666914557338

Ali, A. Y. S., & Dhaha, I. S. Y. (2014). Factors influencing mobile money transfer adoption among Somali. *International Journal of Business, Economics, and Law*, *4*(1), 180–188. Alleman, J., & Rappoport, P. (2010). Mobile Money: Implications for Emerging Markets. *Communications & Strategies*, *1*(79), 15–28.

Allen, T. D., & Eby, L. T. (2003). Relationship Effectiveness for Mentors: Factors Associated with Learning and Quality. *Journal of Management*, *29*(4), 469–486. https://doi.org/10.1016/S0149-2063(03)00021-7

Anderson, M. H. (2008). Social networks and the cognitive motivation to realize network opportunities : a study of managers ' information gathering behaviors. *Journal of Organizational Behavior*, *29*, 51–78. https://doi.org/10.1002/job

Arvila, N., Fischer, A., Keskinen, P., & Nieminen, M. (2018). Mobile Weather Services for Maasai Farmers : Socio-cultural Factors Influencing the Adoption of Technology. *In 2nd African Conference for Human Computer Interaction (AfriCHI '18), December 3–7, 2018, Windhoek, Namibia. ACM, NewYork, NY, USA.* (pp. 34–44). https://doi.org/10.1145/3283458.3283466

Asongu, S. A. (2013). How has Mobile Phone Penetration Stimulated Financial Development in Africa? *Journal of African Business*, *14*(1), 7–18. https://doi.org/10.1080/15228916.2013.765309

Asongu, S. A., Nwachukwu, J. C., & Orim, S. M. I. (2017). Mobile phones, institutional quality and entrepreneurship in Sub-Saharan Africa. *Technological Forecasting and Social Change*, (August), 0–1. https://doi.org/10.1016/j.techfore.2017.08.007

Baganzi, R. (2017). Examining Trust and Risk in Mobile Money Acceptance. *Sustainability*, *9*(2233). https://doi.org/10.3390/su9122233

Bagozzi, R. (2007). The Legacy of the Technology Acceptance Model and a Proposal for a Paradigm Shift. *Journal of the Association for Information Systems*, *8*(4), 244–254. https://doi.org/10.17705/1jais.00122

Bandiera, O., & Rasul, I. (2006). Social Networks and Technology Adoption in Northern Mozambique. *The Economic Journal*, *116*(1957), 869–902.

Baptista, G., & Oliveira, T. (2016). A weight and a meta-analysis on mobile banking acceptance research. *Computers in Human Behavior*, *63*, 480–489. https://doi.org/10.1016/j.chb.2016.05.074

Behrman, J. R., Kohler, H., & Watkins, S. C. (2002). Social Networks and Changes in Contraceptive Use over Time: Evidence from a Longitudinal Study in Rural Kenya. *Demography*, *39*(4), 713–738.

Biljon, J. Van, & Kotzé, P. (2008). Cultural Factors in a Mobile Phone Adoption and Usage Model. *Journal of Universal Computer Science*, *14*(16), 2650–2679.

Billett, S. (2004). *Mimesis: learning through everyday activities and interactions at work*. *Workplace learning in context*. London.

Blumenstock, J., & Eagle, N. (2010). Mobile divides: gender, socioeconomic status, and mobile phone use in Rwanda. *In Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development* (p. 6). ACM. Retrieved from http://dl.acm.org/citation.cfm?id=2369225%5Cnpapers2://publication/uuid/E295F40F- 5A53-4F3A-915C-AA713FB713E6

Borgatti, S. P., & Cross, R. (2003). A Relational View of Information Seeking and Learning in Social Networks. *Management Science*, *49*(4), 432–445.

Bower, G. H., & Hilgard, E. R. (1981). *Theories of learning.* Prentice-Hall.

Burrell, J. (2010). Evaluating shared access: Social equality and the circulation of mobile phones in rural Uganda. *Journal of Computer-Mediated Communication*, *15*(2), 230–250. https://doi.org/10.1111/j.1083-6101.2010.01518.x

Burrell, J., & Oreglia, E. (2015). The myth of market price information: mobile phones and the application of economic knowledge in ICTD. *Economy and Society*, *44*(2), 271–292. https://doi.org/10.1080/03085147.2015.1013742

Burt, R. S. (1984). Network items and the General Social Survey. *Social Networks*, *6*, 293–339. Burt, R. S. (2004). *The Network Structure Of Social Capital*. *Research in Organizational*

Behavior (Vol. 22). Elsevier Masson SAS. https://doi.org/10.1016/s0191-3085(00)22009-1 Cacioppo, J., Petty, R., & Chuan, K. F. (1984). The Efficient Assessment For Need Of

Cognition. *Journal of Personality Assessment*, *48*(3).

Cazan, A.-M., & Indreica, S. E. (2014). Need for Cognition and Approaches to Learning among University Students. *Procedia - Social and Behavioral Sciences*, *127*, 134–138. https://doi.org/10.1016/j.sbspro.2014.03.227

Chabossou, A., Christoph, S., Matthias, S., & Zahonogo, P. (2009). Mobile Telephony Access and Usage in Africa. *In 2009 International Conference on Information and Communication Technologies and Development (ICTD)* (pp. 392–405).

Chauhan, S. (2014). Evaluating Acceptance of Mobile Money by Poor Citizens in India: An Empirical Study Mobile Money.

Cohen, J. (1992). A Power Primer. *Psychological Bulletin*, *112*(1), 155–159. https://doi.org/10.1037/0033-2909.112.1.155

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, *35*(1), 128–152.

Coleman, J. S. (1990). *Foundations of Social Theory*. *Cambridge, MA*. Massachusetts and London: Harvard University Press. https://doi.org/10.2307/2579680

Crabbe, M., Standing, C., Standing, S., & Karjaluoto, H. (2009). An adoption model for mobile banking in Ghana. *International Journal of Mobile Communications*. https://doi.org/10.1504/IJMC.2009.024391

Cross, R., Parker, A., Prusak, L., & Borgatti, S. P. (2001). Knowing What We Know: Supporting Knowledge Creation and Sharing in Social Networks. *Organizational Dynamics*, *30*(2), 100–120.

Dahlberg, T., Guo, J., & Ondrus, J. (2015). A critical review of mobile payment research.

Electronic Commerce Research and Applications, *14*(5), 265–284. https://doi.org/10.1016/j.elerap.2015.07.006

Dahlberg, T., Mallat, N., Ondrus, J., & Zmijewska, A. (2008). Past, present and future of mobile payments research: A literature review. *Electronic Commerce Research and Applications*, *7*(2), 165–181. https://doi.org/10.1016/j.elerap.2007.02.001

Davis, F. D. (1989). Perceived Usefulness , Perceived Ease of Use , and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319–340.

Davis, F. D. ., Bagozzi, R. P. ., & Warshaw, P. R. . (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical ModePublished by : INFORMS Stable URL : https://www.jstor.org/stable/2632151 REFERENCES Linked references are available on JSTOR for this article : You may need to log in to JSTOR to . *Management Science*, *35*(8), 982–1003.

De Boeck, P., & Wilson, M. (2004). Explanatory item response models: a generalized linear and nonlinear approach. *Psychometrika*, *71*(4), 787–787. https://doi.org/10.1007/978-1-4757- 3990-9_2

Demirgüç-Kunt, A., Honohan, P., & Beck, T. (2008). *Finance for all? Policies and Pitfalls in Expanding Access.* World Bank.

Deursen, Alexander van, Helsper, E., & Eynon, R. (2014). *Measuring Digital skills. From Digital Skills to Tangible Outcomes Project Report*. Retrieved from http://www.lse.ac.uk/media-and-communications/assets/documents/research/projects/disto/Measuring-Digital-Skills.pdf

Dijk, J. A. G. M. Van. (2006). Digital divide research, achievements and shortcomings. *Poetics*, *34*, 221–235. https://doi.org/10.1016/j.poetic.2006.05.004

Dodson, L., Sterling, S., & Bennett, J. (2013). Minding the gaps: Cultural, technical and gender-based barriers to mobile use in oral-language Berber communities in Morocco. In *Proceedings of the Sixth International Conference on Information and Communication Technologies and Development* (Vol. 1, pp. 79–88). https://doi.org/10.1145/2516604.2516626

Donner, J. (2009). Blurring Livelihoods and Lives: The Social Uses of Mobile Phones and Socioeconomic Development. *Innovations: Technology, Governance, Globalization*, *4*(1), 91–101. https://doi.org/10.1162/itgg.2009.4.1.91

Donner, J., & Tellez, C. A. (2008). Mobile banking and economic development: linking adoption, impact, and use. *Asian Journal of Communication*, *18*(4), 318–332. https://doi.org/10.1080/01292980802344190

Donovan, K. (2012). Mobile Money for Financial Inclusion. *Information and Communication for Development*, 61–74.

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving Students' Learning With Effective Learning Techniques: Promising Directions From Cognitive and Educational Psychology. *Psychological Science in the Public Interest*, *14*(1), 4–58. https://doi.org/10.1177/1529100612453266

Durlak, J. A. (2009). How to Select, Calculate, and Interpret Effect Sizes. *Journal of Pediatric Psychology*, *34*(9), 917–928. https://doi.org/10.1093/jpepsy/jsp004

Eagle, D. E., & Proeschold-bell, R. J. (2015). Methodological considerations in the use of name generators and interpreters. *Social Networks*, *40*, 75–83. https://doi.org/10.1016/j.socnet.2014.07.005

ECDL. (2009). *Digital Literacy Report*.

Economides, N., & Jeziorski, P. (2017a). Mobile Money in Tanzania. *Marketing Science*, *36*(6), 815–837. https://doi.org/10.2139/ssrn.2539984

Economides, N., & Jeziorski, P. (2017b). Mobile Money in Tanzania. *Marketing Science*, *36*(6), 815–837.

El-Zoghbi, M. (2018). Measuring Women's Financial Inclusion: The 2017 Findex Story. Retrieved from http://www.cgap.org/blog/measuring-womens-financial-inclusion-2017- findex-story

Etim, A. S. (2014). Mobile banking and mobile money adoption for financial inclusion. *Research in Business and Economics Journal*, *9*, 1–13.

Evans, D. S., & Pirchio, A. (2014). An Empirical Examination of Why Mobile Money Schemes Ignite in Some Developing Countries but Flounder in Most. *Review of Network Economics*, *13*(4), 397–451.

Faqih, K. M. S., & Jaradat, M. I. R. M. (2015). Assessing the moderating effect of gender differences and individualism-collectivism at individual-level on the adoption of mobile commerce technology: TAM3 perspective. *Journal of Retailing and Consumer Service*, *22*, 37–52.

Feld, S. L. (1981). The Focused Organization of Social Ties. *American Journal of Sociology*, *86*(5), 1015–1035.

Ferro, E., Helbig, N. C., & Gil-Garcia, J. R. (2011). The role of IT literacy in defining digital divide policy needs. *Government Information Quarterly*, *28*(1), 3–10. https://doi.org/10.1016/j.giq.2010.05.007

Fleischhauer, M., Enge, S., Brocke, B., Ullrich, J., Strobel, A., & Strobel, A. (2010). Same or different? Clarifying the relationship of need for cognition to personality and intelligence. *Personality and Social Psychology Bulletin*, *36*(1), 82–96. https://doi.org/10.1177/0146167209351886

Flores-Roux, E. M., & Mariscal, J. (2010). The Enigma of Mobile Money Systems. *Communications and Strategies*, *1*(79), 41–62.

Frias-Martinez, V., Frias-Martinez, E., & Oliver, N. (2010). A Gender-centric Analysis of Calling Behavior in a Developing Economy. In *AAAI Symposium on Artificial Intelligence and Development*.

Frias-Martinez, V., & Virseda, J. (2012). On the relationship between socio-economic factors and cell phone usage. *In Proceedings of the fifth international conference on information and communication technologies and development* (pp. 76–84). ACM. https://doi.org/10.1145/2160673.2160684

Gebremichael, M. D., & Jackson, J. W. (2006). Bridging the gap in Sub-Saharan Africa : A holistic look at information poverty and the region ' s digital divide. *Government Information Quarterly*, *23*(2), 267–280. https://doi.org/10.1016/j.giq.2006.02.011

Gencer, M. (2011). The Mobile Money Movement Catalyst to Jump-Start Emerging Markets. *Innovations: Technology, Governance, Globolization*, *6*(1), 101–117.

Ghosh, S. (2016). Does mobile telephony spur growth? Evidence from Indian states. *Telecommunications Policy*, *40*(10–11), 1020–1031. https://doi.org/10.1016/j.telpol.2016.05.009

Gichuki, C. N., & Mulu-Mutuku, M. (2018). Determinants of awareness and adoption of mobile money technologies: Evidence from women micro entrepreneurs in Kenya. *Women's Studies International Forum*, *67*, 18–22. https://doi.org/10.1016/j.wsif.2017.11.013

Gillwald, A., Milek, A., & Stork, C. (2010). Towards evidence-based ICT policy and regulation: Gender Assessment of ICT Access and Usage in Africa.

Global System for Mobile Communications. (2016). *The Mobile Economy 2016*. London. Retrieved from https://www.gsma.com/mobileeconomy/archive/GSMA_ME_2016.pdf Gollwitzer, P. M. (1999). Implementation Intentions: Strong Effects of Simple Plans. *American Psychologist*, *54*(7), 493–503.

Gollwitzer, P. M., & Brandstätter, V. (1997). Implementation intentions and goal achievement. *Journal of Personality and Social Psychology*, *73*(1), 186–199. https://doi.org/10.1037/0022-3514.73.1.186

Golub, B., & Sadler, E. (2016). Learning in social networks. In *The Oxford Handbook of the Economics of Networks* (Yann Bramo). Retrieved from https://ssrn.com/abstract=2919146

Gosavi, A. (2015). The Next Frontier of Mobile Money Adoption. *International Trade Journal*, *29*(5), 427–448. https://doi.org/10.1080/08853908.2015.1081113

Gosavi, A. (2018). Can Mobile Money Help Firms Mitigate the Problem of Access to Finance in Eastern sub-Saharan Africa? *Journal of African Business*, *19*(3), 343–360. Retrieved from https://www.tandfonline.com/doi/full/10.1080/15228916.2017.1396791

Gurtner, S., Reinhardt, R., & Soyez, K. (2014). Designing mobile business applications for different age groups. *Technological Forecasting & Social Change*, *88*, 177–188. https://doi.org/10.1016/j.techfore.2014.06.020

Hargittai, E., & Hinnant, A. (2008). Differences in Young Adults ' Use of the Internet.

Communication Research, *35*(5), 602–621. https://doi.org/10.1177/0093650208321782 Haythornthwaite, C., & Laat, M. de. (2010). Social Networks and Learning Networks : Using

social network perspectives to understand social learning. In *Proceedings of the 7th International Conference on Networked Learning 2010.* (pp. 183–190).

Henama, U. S., & Sifolo, P. P. S. (2017). Uber: The South Africa experience. *African Journal of Hospitality, Tourism and Leisure*, *6*(2), 1–10.

Holloway, K., Naizi, Z., & Rouse, R. (2017). *Women's Economic Empowerment Through Financial Inclusion. A Review of Existing Evidence and Remaining Knowledge Gaps*.

Hox, J. J. (2010). *Multilevel Analysis: Techniques and Applications* (Second). New York: Routledge Taylor & Francis Group. Retrieved from https://opeconomica.files.wordpress.com/2012/03/multilevel-analysis.pdf

Hughes, N., & Lonie, S. (2007). M-PESA: Mobile Money for the "Unbanked" Turning Cellphones into 24-Hour Tellers in Kenya. *Innovations: Technology, Governance, Globalization*, *2*(1–2), 63–81. https://doi.org/10.1162/itgg.2007.2.1-2.63

Hwang, Y., & Kim, D. J. (2007). Understanding Affective Commitment , Collectivist Culture , and Social Influence in Relation to Knowledge Sharing in Technology Mediated Learning. *IEEE Transactions on Professional Communication*, *50*(3), 232–248. https://doi.org/10.1109/TPC.2007.902664

IFC. (2011). *Mobile Money Study 2011*. Washington, Dc.

Inkpen, A. C., & Tsang, E. W. K. (2005). Social Capital Networks, and Knowledge Transfer. *The Academy of Management Journal*, *30*(1), 146–165.

Inoue, N. (2019). *Digital economy and development : An empirical study on motorcycle driver jobs in Uganda* (No. No. 753).

Intermedia. (2016). *Wave 3 report FII Tracker Survey February 2016*.

Islam, A., Muzi, S., & Meza, Luis, J. R. (2017). Does mobile money use increase firms' investment ? Evidence from Enterprise Surveys in Kenya , Uganda , and Tanzania. *Small Business Economics*, *51*(3), 687–708.

Ivatury, G., & Pickens, M. (2006). Mobile Phone Banking and Low-Income Customers: Evidence from South Africa. *Consultative Group to Assist the Poor Washington*, 1–14. Retrieved from http://www.cgap.org/gm/document- 1.9.2953/mobilephonebanking.pdf%5Cnhttp://www.cgap.org/sites/default/files/CGAP- Mobile-Phone-Banking-and-Low-Income-Customers-Evidence-from-South-Africa-Jan-2006.pdf

Jack, W., & Suri, T. (2011). *Mobile money: The economics of M-PESA* (No. 16721). *National Bureau of Economic Research*.

Jack, W., & Suri, T. (2014). Risk Sharing and Transactions Costs: Evidence from Kenya's Mobile Money Revolution. *American Economic Review*, *104*(1), 183–223.

Kaaira, L., & Schueth, S. (2018). *Wave 5 Report. Fifth Annual Financial Inclusion Insights Tracker Survey*. Nairobi. Retrieved from http://finclusion.org/uploads/file/uganda-wave-5- report_final.pdf

Kahn, J. H. (2011). Multilevel modeling: Overview and applications to research in counseling psychology. *Journal of Counseling Psychology*, *58*(2), 257–271.

Katengeza, S. P., Okello, J. J., & Jambo, N. (2011). Use of Mobile Phone Technology in Agricultural Marketing. *International Journal of ICT Research and Development in Africa*, *2*(2), 14–25. https://doi.org/10.4018/jictrda.2011070102

Katusiime, J., & Pinkwart, N. (2016). Supporting Maternal Health Education in Developing Countries Using Mobile Phones-Results of a Pilot Study. *In Proceedings of the First African Conference on Human Computer Interaction* (pp. 48–57). ACM. https://doi.org/10.1145/2998581.2998588

Kendall, J., Maurer, B., Machoka, P., & Veniard, C. (2012). An Emerging Platform: From Money Transfer System to Mobile Money Ecosystem. *Innovations*, *6*(4), 49–64.

Kiconco, R., Rooks, G., & Snijders, C. (2020). Learning mobile Money in social networks: comparing a rural and urban region in Uganda. *Computers in Human Behavior*. Retrieved from https://doi.org/10.1016/j.chb.2019.09.005

Kiconco, R., Rooks, G., Solano, G., & Matzat, U. (2018). A skills perspective on the adoption and use of mobile money services in Uganda. *Information Development*, *35*(5), 724–738. https://doi.org/10.1177/0266666918788908

Kikulwe, E. M., Fischer, E., & Qaim, M. (2014). Mobile Money, Smallholder Farmers, and Household Welfare in Kenya. *Plos One*, *9*(10). https://doi.org/10.1371/journal.pone.0109804

Kirui, O. K., Okello, J. J., Nyikal, R. A., & Njiraini, G. W. (2013). Impact of Mobile Phone- Based Money Transfer Services in Agriculture : Evidence from Kenya. *Journal of International Agriculture*, *52*(2), 141–162.

Kohler, H., Behrman, J. R., & Watkins, S. C. (2001). The Density of Social Networks and Fertility Decisions : Evidence from South Nyanza. *Demography*, *38*(1), 43–58.

Kondratek, B. (2016). UIRT: Stata module to fit unidimensional Item Response Theory models. Kreindler, G. E., & Young, H. P. (2014). Rapid innovation diffusion in social networks. In *Proceedings of the National Academy of Sciences of the United States of America* (Vol. 111, pp. 10881–10888). https://doi.org/10.1073/pnas.

Lave, J. and Wenger, E. (1991). Situated Learning: Legitimate Peripheral Participation. *Cambridge University Press, Cambridge,* 33.

Lee, S., Trimi, S., & Kim, C. (2013). The impact of cultural differences on technology adoption. *Journal of World Business*, *48*, 20–29.

Lindstrom, D. P., & Muñoz-franco, E. (2005). Migration and the Diffusion of Modern Contraceptive Knowledge and Use in Rural Guatemala. *Studies in Family Planning*, *36*(4), 277–288.

Luarn, P., & Lin, H.-H. (2005). Toward an understanding of the behavioral intention to use mobile banking. *Computers in Human Behavior*, *21*(6), 873–891. https://doi.org/10.1016/j.chb.2004.03.003

Lubua, E. W., & Semlambo, A. (2017). The influence of the ease of use and perceived usefulness to the adoption of mobile money services in SMEs in Tanzania. *Information Technologist (The)*, *14*(2), 131–141.

Mahfuz, I., & Saha, S. P. (2015). Adoption of Mobile Money Transfer Services in Bangladesh: A Structural Equation Modeling Approach. *Journal of Marketing and Consumer Research*, *15*, 5–16.

Manfreda, K. L., Vehovar, V., & Hlebec, V. (2004). Collecting Ego-centred Network Data via the Web. *Metodološki Zvezki, 1*(2), 295–321.

Marsden, Peter, & Campbell, K. (1984). Measuring Tie Strength. *Social Forces*, *63*(2), 482–501. Marsden, P. V. (1990). Network data and measurement. *Annual Review of Sociology*, *16*, 435–463.

Martin, B. L., & Abott, E. (2011). Mobile Phones and Rural Livelihoods: Diffusion, Uses, and Perceived Impacts Among Farmers in Rural Uganda. *Information Technologies & International Development*, *7*(4), 17–34.

Masuki, K. F. G., Kamugisha, R., Mowo, J. G., Tanui, J., Tukahirwa, J., Mogoi, J., & Adera, E. O. (2010). Role of mobile phones in improving communication and information delivery for agricultural development: Lessons from South Western Uganda. In *ICT and Development - Research Voices from Africa. International Federation for Information Processing (IFIP), Technical Commission 9 – Relationship Between Computers and Society.* (pp. 1–13). Retrieved from http://mak.ac.ug/documents/IFIP/RoleofMobilePhonesAgriculture.pdf

Mathieson, K., Peacock, E., & Chin, W. (2001). Extending the technology acceptance model: The influence of perceived user resources - ProQuest. *The Database for Advances in Information Systems*, *32*(3), 86. Retrieved from http://search.proquest.com.dianus.libr.tue.nl/docview/196631426/fulltextPDF/C19B17D19B574762PQ/1?accountid=27128

Matthew Kam, A. D. M. R. H. T. N. S. (2009). Human-Computer Interaction for Development : The Past, Present, and Future. *Information Technologies & International Development*, *5*(4), 1–18. Retrieved from http://itidjournal.org/itid/article/view/420

Matzat, U., & Sadowski, B. (2012). Does the" Do-It-Yourself Approach" Reduce Digital Inequality? Evidence of Self-Learning of Digital Skills. *The Information Society*, *28*(1), 1– 12. https://doi.org/10.1080/01972243.2011.629023

Mbiti, I., & Weil, D. N. (2016). Mobile Banking: The impact of M-PESA in Kenya. In E. Sebastian, J. Simon, & W. David N. (Eds.), *African Successes, Volume III: Modernization and Development* (pp. 247–293). Chicago: National Bureau of Economic Research.

McKay, C., & Kaffenberger, M. (2013). Rural vs. Urban Mobile Money Use: Insights From Demand-Side Data. Retrieved from http://www.cgap.org/blog/rural-vs-urban-mobile- money-use-insights-demand-side-data

Medhi, I., Gautama, S. N., & Toyama, K. (2009). A comparison of mobile money-transfer UIs for non-literate and semi-literate users. *Proceedings of the 27th International Conference on Human Factors in Computing Systems*, 1741–1750. https://doi.org/10.1145/1518701.1518970

Medhi, I., Patnaik, S., Brunskill, E., Gautama, S. N. N., Thies, W., & Toyama, K. (2011). Designing Mobile Interfaces for Novice and Low-Literacy Users. *ACM Transactions of Computer-Human Interaction*, *18*(1), 1–28. https://doi.org/10.1145/1959022.1959024

Medhi, I., Ratan, A., & Toyama, K. (2009). Mobile-banking adoption and usage by low-literate, low-income users in the developing world. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *5623 LNCS*, 485–494. https://doi.org/10.1007/978-3-642-02767-3_54

Mehrotra, A., Nguyen, A., Blumenstock, J., & Mohan, V. (2012). Differences in Phone Use Between Men and Women: Quantitative Evidence from Rwanda. *In Proceedings of the fifth international conference on information and communication technologies and development* (pp. 297–306). ACM. https://doi.org/10.1145/2160673.2160710

Melhem, S., Morrell, C., & Tandon, N. (2009). *Information and Communication Technologies for Women's Socioeconomic Empowerment*.

Mimbi, L., Bankole, F. O., & Kyobe, M. (2011). Mobile phones and digital divide in East African countries. *In Proceedings of the South African Institute of Computer Scientists and Information Technologists Conference on Knowledge, Innovation and Leadership in a Diverse, Multidisciplinary Environment*. (pp. 318–321). ACM. https://doi.org/10.1145/2072221.2072267

Morawczynski, O. (2011). *Examining the adoption, usage and outcomes of mobile money services: the case of M-PESA in Kenya*. The University of Edinburgh. Retrieved from http://hdl.handle.net/1842/5558

Mothobi, O., & Grzybowski, L. (2017). Infrastructure deficiencies and adoption of mobile money in Sub-Saharan Africa. *Information Economics and Policy*, *40*, 71–79. https://doi.org/10.1016/j.infoecopol.2017.05.003

Mudiri, L. J. (2013). Fraud in Mobile Financial Services. *Rapport Technique, MicroSave*, 30. Mugambe, P. (2017). UTAUT Model in Explaining the Adoption of Mobile Money Usage by

MSMEs' Customers in Uganda. *Advances in Economics and Business*, *5*(3), 129–136. https://doi.org/10.13189/aeb.2017.050302

Munyegera, G. K., & Matsumoto, T. (2016). Mobile Money, Remittances, and Household Welfare: Panel Evidence from Rural Uganda. *World Development*, *79*, 127–137. https://doi.org/10.1016/j.worlddev.2015.11.006

Murendo, C., Wollni, M., de Brauw, A., & Mugabi, N. (2018). Social network effects on mobile money adoption in Uganda. *The Journal of Development Studies*, *54*(2), 327–342.

Nair, K. U., & Ramnarayan, S. (2000). Individual Differences in Need for Cognition and Complex Problem Solving. *Journal of Research in Personality*, *34*(3), 305–328. https://doi.org/10.1006/jrpe.1999.2274

Narteh, B., Mahmoud, M. A., & Amoh, S. (2017). Customer behavioural intentions towards mobile money services adoption in Ghana. *Service Industries Journal*, *37*(7–8), 426–447. https://doi.org/10.1080/02642069.2017.1331435

Nkwede, F. E., & Agha, N. (2017). Mobile Money Adoption in a Fragile Economy: The Case of a Seven Year Failed Experiment in Nigeria. *International Journal of Business and Management Invention*, *6*(4), 78–87.

Okello Candiya Bongomin, G., Ntayi, J. M., Munene, J. C., & Malinga, C. A. (2018). Mobile Money and Financial Inclusion in Sub-Saharan Africa: the Moderating Role of Social Networks. *Journal of African Business*, *19*(3), 361–384. https://doi.org/10.1080/15228916.2017.1416214

Oluwatayo, I. (2013). Banking the unbanked in rural southwest Nigeria: Showcasing mobile phones as mobile banks among farming households. *Journal of Financial Services Marketing*, *18*(1), 65–73. https://doi.org/10.1057/fsm.2013.2

Omol, E., Abeka, S., & Wauyo, F. (2017). Factors Influencing Acceptance of Mobile money Applications in Enterprise Management : A Case Study of Micro and Small Enterprise Owners in Kisumu Central Business District , Kenya. *International Journal of Advanced Research in Computer and Communication Engineering*, *6*(1). https://doi.org/10.17148/IJARCCE.2017.6140

Osabuohien, E. S., & Karakara, A. A. (2018). ICT usage, mobile money and financial access of women in Ghana. *AfricaGrowth Agenda Journal*, *15*(1), 14–18. Retrieved from http://journals.co.za/content/journal/10520/EJC-dc947bee3

Osei-Assibey, E. (2015). What drives behavioral intention of mobile money adoption? The case of ancient susu saving operations in Ghana. *International Journal of Social Economics*, *42*(11), 962–979. https://doi.org/10.1108/IJSE-09-2013-0198

Otieno, O. C., Liyala, S., Odongo, B. C., & Abeka, S. O. (2016). Challenges Facing the Use and Adoption of Mobile Phone Money Services. *World Journal of Computer Application and Technology*, *4*(1), 8–14. https://doi.org/10.13189/wjcat.2016.040102

Paccagnella, O. (2006). Centering or not centering in multilevel models? The role of the group mean and the assessment of group effects. *Evaluation Review*, *30*(1), 66–85. https://doi.org/10.1177/0193841X05275649

Paredes, W. C., & Shing, K. C. K. (2012). Modelling Learning & Performance: A Social Networks Perspective. In *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge. ACM* (pp. 34–42).

Penard, T., Poussing, N., Yebe, G. Z., & ELlla, P. N. (2012). Comparing the Determinants of Internet and Cell Phone Use in Africa: Evidence from Gabon. *Digiworld Economic Journal*, *2*(86), 222–224. Retrieved from https://search.proquest.com/central/docview/1024446615/fulltextPDF/D259F5AA6E184013PQ/1?accountid=36534

Peruta, D. M. (2018). Adoption of mobile money and financial inclusion: a macroeconomic approach through cluster analysis. *Economics of Innovation and New Technology*, *27*(2), 154–173. https://doi.org/10.1080/10438599.2017.1322234

Porter, G. (2012). Mobile Phones, Livelihoods and the Poor in Sub-Saharan Africa: Review and Prospect. *Geography Compass*, *6*(5), 241–259. https://doi.org/10.1111/j.1749- 8198.2012.00484.x

Rashid, A. P. T., & Elder, L. (2009). Mobile Phones and Development: An analysis of IDRC- supported projects. *The Electronic Journal of Information Systems in Developing Countries*, *36*(1), 1–16. https://doi.org/10.1002/j.1681-4835.2009.tb00249.x

Reagans, R., & McEvily, B. (2003). Network Structure and Knowledge Transfer: The Effects of Cohesion and Range. *Administrative Science Quarterly*, *48*(2000), 240–267.

Rogers, E. M. (2003). *Diffusion of innovations.* New York: Free Press.

Rogers, Everett M. (1995). *Diffusion of innovations*. New York: The Free Press. https://doi.org/citeulike-article-id:126680

Rooks, G., Klyver, K., & Sserwanga, A. (2016). The Context of Social Capital: A Comparison of Rural and Urban Entrepreneurs in Uganda. *Entrepreneurship: Theory and Practice*, *40*(1), 111–130. https://doi.org/10.1111/etap.12107

Rooks, G., Sserwanga, A., & Frese, M. (2016). Unpacking the Personal Initiative-Performance Relationship: A Multi-Group Analysis of Innovation by Ugandan Rural and Urban Entrepreneurs. *Applied Psychology*, *65*(1), 99–131. https://doi.org/10.1111/apps.12033

Rooks, G., Szirmai, A., & Sserwanga, A. (2012). Network Structure and Innovative Performance of African Entrepreneurs : *Journal of African Economies*, *0*(0), 1–28. https://doi.org/10.1093/jae/ejs011

Rudolph, J., Greiff, S., Strobel, A., & Preckel, F. (2018). Understanding the link between need for cognition and complex problem solving. *Contemporary Educational Psychology*, *55*(August), 53–62. https://doi.org/10.1016/j.cedpsych.2018.08.001

Salazar, D. (2018). *The Next Frontier in Financial Inclusion : Moving Beyond Access*. Sander, C., Mukwana, P., & Millinga, A. (2001). *PASSING THE BUCK Money Transfer*

Systems : The Practice and Potential for Products in Tanzania and Uganda. Retrieved from http://www.microsave.net/files/pdf/Passing_the_Buck_Money_Transfer_Systems_The_Pra ctice_and_Potential_for_Products_in_Tanzania_and_Uganda.pdf

Sayid, O., Heights, D., & Echchabi, A. (2012). Investigating Mobile Money Acceptance in Somalia : An Empirical Study. *Pakistan Journal of Commerce and Social Sciences*, *6*(2), 269–281.

Scott, N., Mckemyey, K., & Batchelor, S. J. (2004). The Use of Telephones amongst the Poor in Africa : Some Gender Implications. *Gender, Technology and Development*, *8*(2), 185–207. https://doi.org/10.1177/097185240400800202

Shih, C.-F., & Venkatesh, A. (2004). Beyond Adoption: Development and Application of a Use-Diffusion Model. *Journal of Marketing*, *68*(1), 59–72.

Smyth, T., Kumar, S., Medhi, I., & Toyama, K. (2010). Where There's a Will There's a Way: Mobile Media Sharing in Urban India. *In Proceedings of the SIGCHI conference on Human Factors in computing systems* (pp. 753–762). ACM. https://doi.org/10.1145/1753326.1753436

Solano, G., & Rooks, G. (2018). Social capital of entrepreneurs in a developing country : The effect of gender on access to and requests for resources. *Social Networks*, *54*, 279–290. https://doi.org/10.1016/j.socnet.2018.03.003

Sosa, M. E. (2011). Where Do Creative Interactions Come From? The Role of Tie Content and Social Networks. *Organization Science*, *22*(1), 1–21.

Steinfield, C., Wyche, S., Cai, T., & Chiwasa, H. (2015). The mobile divide revisited: mobile phone use by smallholder farmers in Malawi. *In Proceedings of the Seventh International Conference on Information and Communication Technologies and Development* (p. 8). ACM. https://doi.org/10.1145/2737856.2738022

Straub, D., Limayem, M., & Karahanna-Evaristo, E. (1995). Measuring System Usage: Implications for IS Theory Testing. *Management Science*, *41*(8), 1328–1342. https://doi.org/10.1287/mnsc.41.8.1328

Suri, T. (2017). Mobile Money. *Annual Review of Economics*, (9), 497–520.

Szajna, B. (1996). Empirical Evaluation of the Revised Technology Acceptance Model. *Management Science*, *42*(1), 85–92.

Thorndike, E. L. (1898). Animal intelligence: An experimental study of the associative processes in animals. *Psychological Review*, *2*(4), 1–107. https://doi.org/10.1097/00005053- 190001000-00013

Tobbin, P. (2009). Modeling Adoption of Mobile Money Transfer : A Consumer behaviour analysis. In *The 2nd International Conference on Mobile Communication Technology for Development, Kampala, Uganda*. https://doi.org/10.1108/14636691211256313

Tobbin, P. (2012). Towards a model of adoption in mobile banking by the unbanked : a qualitative study. *Info*, *14*(5), 74–88. https://doi.org/10.1108/14636691211256313

Tobbin, P., & Kuwornu, J. K. M. (2011). Adoption of mobile money transfer technology: structural equation modeling approach. *European Journal of Business and Management*, *3*(7), 59–78. Retrieved from http://www.iiste.org/Journals/index.php/EJBM/article/view/593

Tuz, J. F., & May, M. (2015). How hard is it to use mobile money as a rural Bangladeshi woman ? *Appropriate Technology*, *42*(4), 54–56.

United Nations. (2015). *The world's women 2015: Trends and Statistics*. New York. https://doi.org/10.1016/S0022-4359(98)90021-5

United Nations Development Programme. (2008). *Human development indices: A statistical update, 2008-Human Development Index ratings.*

Uzzi, B. (1996). The Sources and Consequences of Embeddedness for the Economic Performance of Organizations : The Network Effect. *American Sociological Association*, *61*(4), 674–698.

Uzzi, B. (1997). Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness. *Administrative Science Quarterly*, *42*(1), 35–67.

Uzzi, B., & Lancaster, R. (2003). Relational Embeddedness and Learning: The Case of Bank Loan Managers and Their Clients. *Management Science*, *49*(4), 383–399. https://doi.org/10.1287/mnsc.49.4.383.14427

van Biljon, J., & Renaud, K. (2016). Validating Mobile Phone Design Guidelines: Focusing on the Elderly in a Developing Country. *In Proceedings of the Annual Conference of the South African Institute of Computer Scientists and Information Technologists* (p. 44). ACM. https://doi.org/10.1145/2987491.2987492

van Deursen, A., & van Dijk, J. A. G. M. (2009). Improving digital skills for the use of online public information and services. *Government Information Quarterly*, *26*(2), 333–340. https://doi.org/10.1016/j.giq.2008.11.002

van Deursen, Alexander, & van Dijk, J. (2010). Internet skills and the digital divide. *New Media and Society*, *13*(6), 893–911. https://doi.org/10.1177/1461444810386774

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, *27*(3), 425–478.

Verplanken, B., Hazenberg, P. T., & Palenéwen, G. R. (1992). Need for cognition and external information search effort. *Journal of Research in Personality*, *26*(2), 128–136. https://doi.org/10.1016/0092-6566(92)90049-A

Vong, J., Jeff, F., & Song, I. (2012). Delivering financial services through mobile phone technology: a pilot study on impact of mobile money service on micro-entrepreneurs in rural Cambodia. *International Journal of Information Systems and Change Management*, *6*(2), 177–186.

Wambalaba, P. F., & Machoka, P. (2012). E-Money for Enhancing MDGs at Bottom of the Pyramid : A Case Study of Mpesa Agents in Kenya. *International Journal of Computing and ICT Research*, *6*(1), 11–23.

Wellman, B., & Wortley, S. (1990). Different Strokes from Different Folks: Community Ties and Social Support. *American Journal of Sociology*, *96*(3), 558–588.

West, E., Barron, D. N., Dowsett, J., & Newton, J. N. (1999). Hierarchies and Cliques in the Social Networks of Health Care Professionals: Implications for the Design of Dissemination Strategies. *Social Science & Medicine*, *48*(5), 633–646. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10080364

Wyche, S., Simiyu, N., & Othieno, M. E. (2016). Mobile Phones as Amplifiers of Social Inequality among Rural Kenyan Women. *ACM Transactions of Computer-Human Interaction*, *23*(3), 1–19.

Wyche, S., & Steinfield, C. (2016). Why Don't Farmers Use Cell Phones to Access Market Prices? Technology Affordances and Barriers to Market Information Services Adoption in Rural Kenya. *Information Technology for Development*, *22*(2), 320–333. https://doi.org/10.1080/02681102.2015.1048184

Xiao, Z. & Tsui, A. S. (2007). When brokers may not work: The cultural contingency of social capital in Chinese high-tech firms. *Administrative Science Quarterly*, *52*, 1–31.

Young, H. P. (2009). Innovation Diffusion in Heterogeneous Populations: Contagion, Social Influence, and Social Learning. *The American Economic Review*, *99*(5), 1899–1924.

Yousafzai, S. Y., Foxall, G. R., & Pallister, J. G. (2010). Explaining Internet Banking Behavior: Theory of Reasoned Action, Theory of Planned Behavior, or Technology Acceptance Model? 1. *Journal of Applied Social Psychology*, *40*(5), 1172–1202. https://doi.org/10.1111/j.1559-1816.2010.00615.x

Zhang, Z., Zyphur, M. J., & Preacher, K. J. (2009). Testing Multilevel Mediation Using Hierarchical Linear Models. *Organizational Research Methods*, *12*(4), 695–719. https://doi.org/10.1177/1094428108327450

Zhong, Z. J. (2011). From access to usage: The divide of self-reported digital skills among adolescents. *Computers and Education*, *56*(3), 736–746. https://doi.org/10.1016/j.compedu.2010.10.016

Appendix I

Mobile phone skills assessment scale

A scale developed based in ECDL (2009). Correct answers are marked with a red checkmark. Questions that were included in the final questionnaire are marked as excluded. These few questions are like a small "test" to see how well you know your mobile phone. Some of these questions are very easy, and others are very difficult, even for us. Don't worry too much; just do your best effort in answering them.

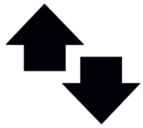
1. Which of the following could be a SIM PIN code? *

1234ab	1234 √	ab1234	abcd	I don't know

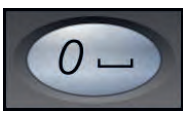
2. Which of the following definitions explains better what a PUK code is? *

Same as a PIN code	The code you use before the PIN code	The code you use if a PIN code fails √	The code used to get money from the bank	I don't know

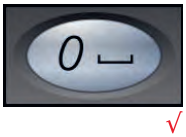
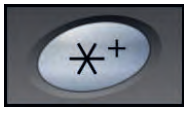
3. Which of the following icons is the one used to represent "Bluetooth"? *

			 √	I don't know

4. Which of these buttons has the "hash" symbol? *

		 √		I don't know

5. Which of these buttons would you press to make a space while texting? *

 √				I don't know

6. The following symbol appears on your phone: 

What does it mean, and what action would you take?

It means I received a new SMS. I check my SMS inbox.	It means I received a new voicemail. I call my voicemail box. √	It means I have a missed call. I'll check the recent calls log.	It means the signal is lost. I wait for it to return or look for a place with the stronger network.	I don't know

7. Which of these is most likely failing if your phone loses power quickly? *

		 √		I don't know

8. Which of the following images shows a SIM card? *

	 √			I don't know

9. What are the iTunes Store and Google Play? *

Physical places to buy new mobile phones.	Virtual marketplace for mobile phone applications √	Websites where you can find the latest news about mobile phones	Search engines for browsing the web	I don't know

10. What are the iTunes Store and Google Play? *

Bluetooth	Wi-Fi	USB	Ethernet √	I don't know

11. Which of these technologies is not a 3G technology? *

EDGE	CDMA2000	GSM √	HSPA+	I don't know

12. You want to send a picture from your phone to a friend, which of these systems does not allow you to do that? *

MMS	Facebook Messenger	WhatsApp	SMS √	I don't know

A

Acknowledgments

The six-year plus PhD journey I have traveled brought many contacts my way that I will be eternally grateful for. That is not to say that the old ties did not matter, quite the contrary.

To my brilliant supervisors, thank you, thank you, and thank you. I owe it all to you. I can only imagine the frustration along the turns when progress was extremely slow. Forgive the tardiness. Many thanks for instilling in me the openness to unlearn, learn, and continually relearn. On every occasion, I received not only creative ideas and support but encouragement as well, which was very much needed and deeply appreciated. I remain indebted.

Special mention to the Ph.D. fraternity at HTI. For the warm welcome at each of my visits, coffee breaks, cookie Wednesdays, lunches, dinners, assistance with setting up all the technology I was not familiar with. I lacked for nothing. My ever-changing office-mates, Giacomo, Alejandro, Sima, Anne, Hanne, Laura, thank you for the distracting conversations and inspiration. I do not take for granted the technical assistance with the printer and yes – the coffee machine! It teased me more often than not.

Special gratitude to my parents, Mr. and Mrs. Bitarabeho. I can't recall an event three years into the Ph.D. that my father did not ask about the completion of the Ph.D. For providing a fertile foundation to seeking more and more knowledge, cheerleading me along the way, exercising patience over the Ph.D. that seemed to never come to fruition, thank you. To my brothers and sisters, Dickson, Brooks, Brenda, and Joanah, and by extension Anne, Betty and Roland, thank you. For the unconditional love and for taking care of my family while I was away. I did not worry, for you filled my shoes exceptionally well. Special mention to my Father in law - Mr. Stephen M. Katabula, and Mothers in law, thank you for the extraordinary care. You are a special kind of people whom I hold dear.

I am grateful to the entire management team of Makerere University Business School, particularly, The Principal - Prof. Waswa Balunywa, for investing in the advancement of my academic career.

To the MSc students – Pedro Poblete Lasserre and Bas Elders who were instrumental in data collection, software orientation, and research assistance, I am appreciative.

In special mention, Arthur and our children (Junior, Edwina, Edwin and Elisha): You were deprived of my attention for many months at a time without complaint (Okay…Elisha grumbled a bit ha!). Thank you for the patience extended towards my Ph.D. journey, and I will forever owe you a debt of deep gratitude.

Curriculum Vitae

Rebecca Isabella Kiconco was born on 05 January 1984 in the town of Kabale, in Southwestern Uganda. After finishing a Bachelor's in Business Administration (Accounting) degree in 2006 at Makerere University Business School (MUBS) in Uganda, she studied an MSc in International Business and Management specializing in International Financial Management, and an MSc in Economics and Business (double degree program) at the University of Groningen in The Netherlands and Uppsala University in Sweden, respectively. In 2010 she graduated, and her Master's research centered on understanding the behavioral aspects affecting Ugandan small and medium enterprise owners in tax compliance. From September 2013, she started a Ph.D. project at Eindhoven University of Technology (TUe) at the Human- Technology Interaction (HTI) group, of which the results are presented in this dissertation. Her doctoral work focuses on the role cognitive resources play in mobile financial services use. NWO-WOTRO partly funded this work in The Netherlands, Makerere University Business School, and the HTI group at TU. Since November 2006, Rebecca is employed at Makerere University Business School in Uganda.

Publications

Peer-reviewed papers

Kiconco, R. I., Rooks, G., and Snijders, C. (2019). 'Learning mobile money in social networks: comparing a rural and urban region in Uganda.' Computers in Human Behavior, 103, 214-225. DOI: 10.1016/j.chb.2019.09.005

Kiconco, R. I., Rooks, G., Solano, G., and Matzat, U. (2019). 'A skills perspective on the adoption and use of mobile money services in Uganda.' Information Development, 35(5), 724-738. DOI: 10.1177/0266666918788908

Papers submitted for publication

Kiconco, R. I., Rooks, G., and Snijders, C. 'Skills to use mobile money within rural communities in developing countries: who has them?'