Beyond Access: Broadening technological and financial inclusion

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Abstract

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The *Theory of Access* urges us to redefine access beyond ownership as "*the ability to derive benefits from things*". Once a user has technology access, many factors enable or limit the user in understanding how to use technology, engage with it to achieve their tasks, and utilize the benefits of technology. *'Meaningful use of ICTs'* is defined as a stage of the digital divide when the user exercises a degree of control and choice over the technology and its content and the resulting use is useful, fruitful, significant, and has relevance to the individual. In this thesis, I look at the impact of social access and cognitive access in enabling or limiting low-income populations' ability to access and understand the possibilities of technological systems and users' ability to learn and fully engage with technological services.

I share six research projects that show the impact of gender, family, socioeconomics, socio-cultural norms, and religion impact the *social access* and supportive actors and user training build user's *cognitive access*. Most models of digital inclusion assume physical access as a prerequisite to social access in the form of sociocultural support and cognitive access in terms of users' understanding. My work shows how users overcome physical access and cognitive access limitations using their social circle.

In social access, I describe how social structures and social factors like gender, religion, socioeconomic status, sociocultural setup, and the implementation of social values by families form the social access for low-income users, especially women. I first introduce the

'Theory of Readiness' which shows how social readiness, technological readiness, and financial readiness combine to form the basis for users' access and use of digital financial services. Using this theory, I highlight the cultural and social values associated with gender and its impact on women's technological and financial inclusion. I tease apart gender issues from economic issues, by showing social access and gender's impact across socioeconomic classes. I then present the *Technology Engagement Framework* to explain the spectrum of access and describe the various actors, their motivations, and roles in a user's technology engagement journey. My work is the first to draw focus on the impact of religion on technology use. Using the *'Technology Engagement Framework'*, I explain how religious and cultural values are implemented by the family members and impact the form and extent of users' ability to utilize digital services. This work started an important conversation about the religious and cultural values and their impact on Human-Computer Interaction - both on the users and researchers.

While social access and its contributing actors are an integral part of users' understanding and use of technologies, the affordances within technological systems and the guidance of users and user training are equally crucial for meaningful use. I share the cognitive access that is enabled or limited by users' social circles and how technologists and trainers try to bridge this cognitive access gap by training as family members at home or as formal trainers at work. Learning from human-mediated training forms a strong foundation for users to derive benefits in the presence and absence of human trainers.

The presented works collectively explain the factors impacting the access, understanding, and use of technological and financial services by users in low-resource settings. I argue that future works to design with and design for marginalized communities need to look beyond the classification of haves and have-nots. These nuanced factors will enable conscious reporting of digital divides and our successes in bridging them. When reporting population percentages with access to technology, the theory of readiness, or technology engagement framework can be used to understand what this access looks like and what are the barriers still hindering these users from meaningfully using or engaging with these technologies.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY*

* This list is sorted alphabetically.

DFS: Digital Financial Services

GSMA: Global System for Mobile Communications

HOH: Head of Household

ICT: Information and Communication Technology

ICTD: Information and Communication Technologies for Development

IVR: Interactive Voice Response

M4D: Mobile for Development

ODK: Open Data Kit

USSD: Unstructured Supplementary Service Data

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DEDICATION

To my late parents - to Ammi (mom) and Abbu (dad).
For their unconditional love and support, for their endless patience and kindness, and for their sacrifices till the end of their lives. May you rest in peace (Ameen)

Chapter 1

INTRODUCTION

"Digital divide" refers to the societal gap between those who have access to digital services and those who do not [54]. Historically, *digital divide* has been associated with the physical access to technological infrastructure and technology [183, 87]. Most of the studies and investments to bridge this divide have focused on the availability of physical infrastructure, reducing the cost of devices or connectivity, the demographic characteristics of users like age, income, and education, and their effect on infrastructure access. Therefore, with the steady increase in digital services, affordable devices, internet, and airtime packages, more users are online than ever before.

Smartphone penetration around the world has steadily increased, reaching 44.9% of the total global population in 2020 as compared to 33.5% in 2016 [253]. The GSMA predicts that by the year 2025, the world's mobile service subscribers will increase from 5.2 billion noted by the end of the year 2019 (accounting for 67% of the global population) to 5.8 billion (70% of the world's population) [95]. This increase in the availability of devices and connectivity has led to an increase in the design and deployment of services geared toward various populations. With the growing popularity and reduced costs of mobile phones the ICTD field has also shifted focus from PCs, PDAs, and telecenters to the potential of mobile phones, giving rise to the field of *Mobile for Development (M4D)* [67]. With the higher computational power, multiple sensors, and colorful displays of smartphones, the potential for a wide variety of interventions is now possible on smaller devices.

I argue that even with the pervasive access to mobile and computing devices, and the development or deployment of services, users from low-resource settings cannot fully utilize these devices and services. Ribot and Peluso [211] in *Theory of Access* urge us to redefine access beyond ownership, and redefine access as *"the ability to derive benefits from things*". Inspired by this idea, the goal of my research is **to understand and chronicle**

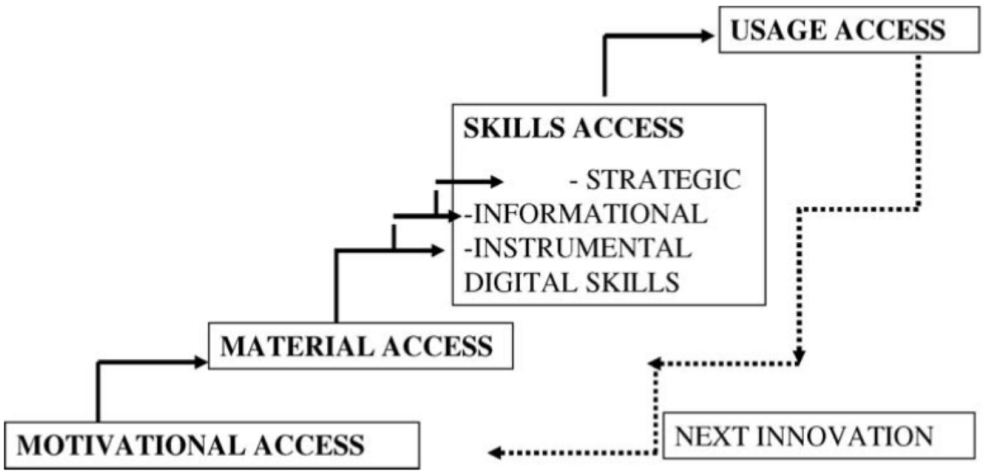

Figure 1.1: Jan Van Dijk's four stage dynamic model of technology access. It shows that even after the interest of users (motivational access) and connectivity (material access), users still need to have digital, informational, strategic skills (skills access) to be able to use technology.

the factors impacting low-income users' ability to access, understand, and use technological and financial systems. As ICTD researchers, we cannot solely focus on innovating and creating new applications and systems, without concerning ourselves with the understanding, adoption, and uptake of these services.

Where technology availability and access are important to bridge the digital divide and bring more people to use technological devices, equally important are the socio-cultural and cognitive factors that enable users to fully engage with and use these technologies. The problem with the technological infrastructure approach is that it limits the problem to the devices and connectivity and then the expectation is that once the availability is made possible, the usage and social support will follow automatically. However, we repeatedly see that the mere presence or availability of technology does not equate to its use, especially not equal use or one that derives the maximum benefits of these technologies. My research highlights, *how users' gender, religion, socioeconomic segment, family, or their surrounding*

sociocultural norms play a role in what technological and financial services users can and cannot access, understand, and use.

1.0.1 From Physical Access to Meaningful Use

Most policymakers and implementers focus on physical access to technology and technology infrastructures. However, there is a distinction between technology access and being able to access the content that resides on it [183]. Many projects in ICTD are also focused on providing or subsidizing digital devices or services for the users in the Global South. However, the provision of devices without users possessing requisite skills, cognitive ability, or social motivation can act as a mere token gesture [44]. ICTD as a field has focused on the physical and system access for its users. However, *even with the increasing demand for smartphones, we need to improve users' ability to understand, adopt, consume content, and maximize their benefits from these devices.* Because even though mobile phones and smartphones are increasing, end-users capabilities and use are still varied.

Selwyn [231] while defining the stages of the digital divide described that *'Meaningful use of ICTs'* happens when the user exercises a degree of control and choice over the technology and content and the resulting use could be considered as useful, fruitful, significant and has relevance to the individual. Bucy and Newhagen [183] argue that physical access to devices or the internet is not sufficient alone unless the users of these machines possess the requisite skills, cognitive ability, and social motivation needed to fully access and engage with the content of this technology. The authors further debate that when defining access, it means more than just the physical presence of information technology. In the increasing interactive audiovisual content available on the new mediums, users are faced with challenges in making sense of a complex stream of information. The navigational components and the simultaneous interaction of text and images all need understanding. And after initial exposure, individual differences in knowledge or literacy determined by education or sophistication come into play [87]. They equate giving someone a device without meaningful use like access to a book without the ability to read.

Jan Van Dijk in [255] presented a dynamic model of new media access with four successive

kinds of access that can create or present information inequality among users (Figure 1.1). The first stage is that of *mental access* and represents the barrier be it due to anxiety about technology or due to users' lack of interest and attractiveness to new technology. The second stage is that of *material access* which is the physical access to technology infrastructure e.g., a computer and a network connection. The third stage, which is relevant to my work, is that of *skill access* which refers to the digital, informational, and strategic skills that come from education, user-friendliness of tools, or social support needed to use technology. Skill access enables the user to reach the fourth stage of *usage access* which refers to the lack of applications and usage opportunities for the user.

Bucy and Newhagen describe technological access and content access as two dimensions of access (Figure 1.2) where technological access consists of physical access (e.g., access to the computer) and system access (e.g., access to the internet). They urge that once technological access is covered, we need to focus on content access to enable users to derive meaning and consume the content [183].

They also caution that content access does not only concern the motivation of a user to use information technology but also the ability of a user to process the meaning once they are connected [183]. Social access and cognitive access are defined as:

- **Social Access:** Some social or demographic groups are systematically excluded due to system-efficacy or self-efficacy or other social factors.

- **Cognitive Access:** is different from the HCI and usability studies. It not only deals with the efficient interface design and successful navigation in hypermedia environments but also includes the users' reception of meaning from the content.

In my work, I look at the Social and Cognitive access of mobile technology for low-income users. I explore how once these users have access, what can enable and increase the meaningful consumption of this content for low-income and low-literate users. Selwyn [231] questioned the difference and relationship between access and use of ICT. Jonathan Donner, continuing Swelyn's question, in his book *After Access* [68] argued for the focus on the gradation of mobile and internet access rather than the binary descriptions of haves

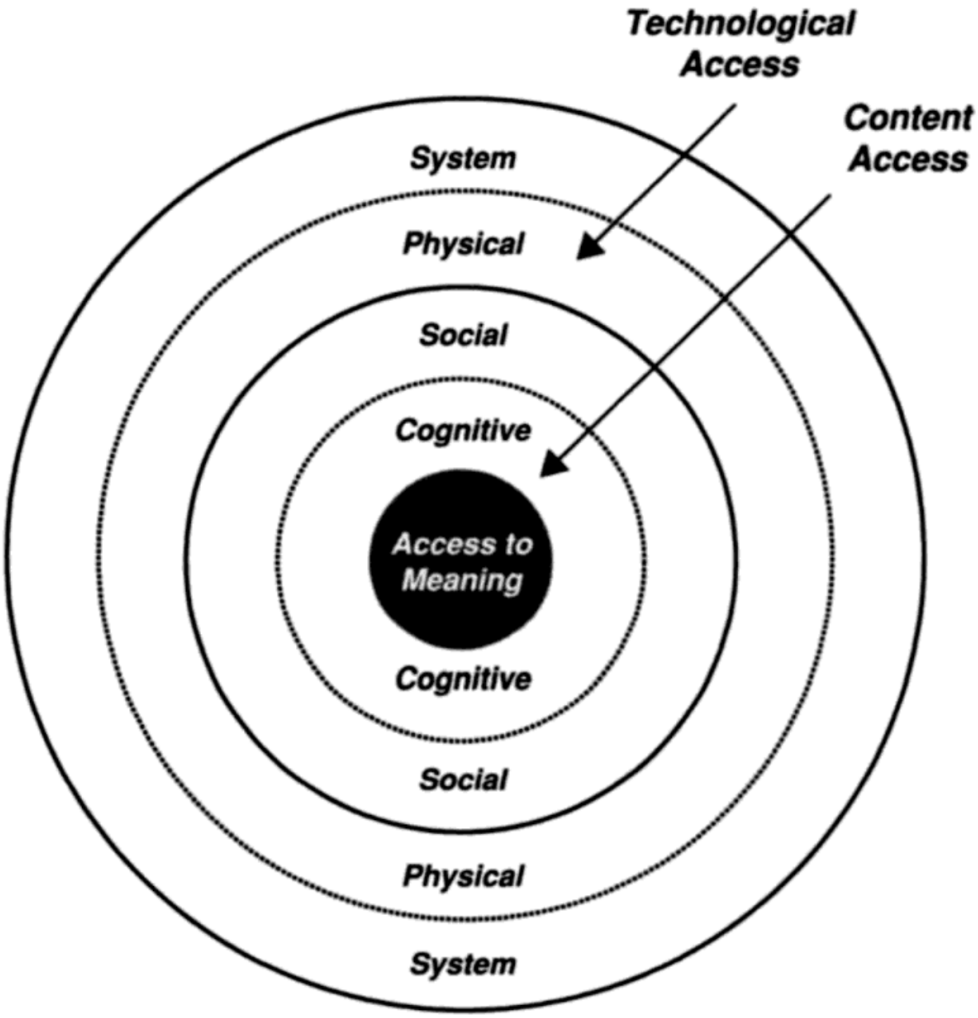

Figure 1.2: Bucy and Newhagen's explanation of the non-linear model of technology access. This model assumes the need for physical access to devices and systems to be in place before social access in the form of sociocultural support and cognitive access in terms of users' understanding can take place. My thesis focuses on the *social access* and impact of religion, socio-cultural norms, and religion on *social and cognitive access* and the impact of supportive actors and training on building this *cognitive access*. My work also shows how access is non-linear and users might engage with or learn about technology using their *social access*.

and have-nots. He argued that as technology ownership changes and technology reaches all across the globe, we need to understand the resulting heterogeneous experiences to better design for them. Various researchers [123, 68, 202] have discussed that there is a spectrum of digital services and their ownership, access, and use, and not just a single model. In my research, I have tried **to explore the technological continuum through an exploration of the rich, multifaceted experiences of users. My research focus is on understanding the various factors affecting users' access and effective use of technological services after access is available to them in one form or another.** In working towards this goal, I have explored how learnability[1], gender, religion, sociocultural, and household settings can impact users' technological and financial inclusion.

Beyond Intermediated Use:

Kemp and Jenson [53], in their CHI 2019 work, extended the theory of access [211] to show that users' ability to realize the benefits of any given service or access is based upon their ability to build an effective access network, to leverage the power necessary for successful access. Thus, one of my goals is also **to identify the networks of low-income users that can be leveraged to improve users' technology knowledge and understanding.**

ICTD as a field needs to shift from being reactive to proactive and work to increase users' engagement with the growing shift to smartphones. Theory of Access [211] also argues that the ability to access is a form of power, and together with all cultural, material, political, and economic aspects that enable or limit a user's access form a web of power. This ability needs to be studied to understand a user's ability to benefit from these technologies.

Sambasivan et al. [225] have explored the role of intermediated use in helping users from low-resource settings use technology. My work can be thought of as *Infrastructure Inversion* bringing whatever is happening the backstage of technology work and practice to the foreground [42] as mentioned by Star and Bowker.

In the identification of these infrastructure and sociocultural factors, the aim is the identification of long-term systems where an intervention would be most useful. I am using an adoption-centered design where the focus is on how we can engage with and increase

[1]Ability to pick a system and use it on your own without any external help.

the adoption of these services. Focusing on groups resisting adoption or with an absence of prerequisites for adoption is not useful. Thus, **I explored the users, their support structures, and their needs where adoption, increased engagement, and meaningful consumption is needed and can take place.** Researchers, practitioners, and industry alike have been working on finding ways to increase the number of online users and their use of services. Specifically, in relation to my work, there is a range of research on increasing technological and financial access.

1.0.2 Defining Access and Use beyond Access

While the conversation of the *"Digital divide"* started from haves and have-nots, those who have access to digital services and those who do not [54], with the growing increase in ICTs, the question has now changed to that of equity of access and inequality between those who have access and skills and those who do not. This focus on *digital inequalities* and *information inequalities* have come to the fore in research and policy debate as well.

Researchers have also questioned the meaning of access and if the availability of devices alone is sufficient. Jonathan Donner, in his book *After Access*, [68], outlines how technology ownership and access is a complex spectrum of users, devices, access mediums, and connectivity types and speeds. Selwyn [231] also questioned what is meant by access and the relationship between 'access to ICT' and 'use of ICT' by outlining four conceptual limitations to the conventional dichotomous view of the digital divide based on individual access to ICTs. Pearce and Rice [202] showed that digital inequality exists in access to the Internet, the use of different devices, and the extent of usage and engagement in different internet activities.

As developers and service providers, there is a need to conceptualize access beyond interaction with individual users and to consider it as an interaction with a network of users [53]. In this regard, an important concept is the understanding of infrastructures that form this access. Sambasivan and Smyth [227] debate that while infrastructures are always thought of as tangible artifacts like electric grids and optical fibers etc., a broadened understanding of infrastructure to include the social aspects of shared social practices and the resulting

flow of information and material is important to understand the *human infrastructure*. The sociotechnical model of access needs to acknowledge the varying access capability needs besides digital literacy and access to technology and everyday uncertainties and insecurities concerned with the benefits of a system [53]. Thus, an access analysis should identify the various means, relations, and processes that enable various actors to derive benefit from these resources [211]. As Sambasivan et al. [227] shared that the human infrastructure of technology is used to overcome the constraints in access and use, including financial constraints (high device or content costs), resource constraints (lack of device or power), and other deficiencies like textual and numeric literacies. Thus, the current assumption of the end-user security which is based on the individual user model and assumes individual access to user accounts is challenged by such access through social networks, especially through kin and friendship networks [53].

Satchell et al. [228] argued that HCI has evolved to include more than users and their interactions with the computer as a machine. Rather, there are sociocultural implications and limitations beyond cognitive use. Bannon [31] discussed the need to define users more deeply, where the user is more than a mere actor of technology and is instead a human with motivations and intentions. The sociotechnical model of access needs to acknowledge the varying access capability needs besides digital literacy and access to technology along with everyday uncertainties and insecurities concerned with the benefits of a system [53]. Users are complex beings and applying that same reasoning, Burrell [47] makes a case for studying non-use because it enables us to understand not only the absence of use but the various ways in which non-use is emerging or existent.

HCI4D researchers have explored reasons including lack of education leading to limited digitalization of low-income populations [29], cognitive differences due to low-literacy [161] in addition to difficulty reading [250], differences in language proficiency, unequal internet access [51] as well as income and trade policies by governments [29]. Donner [67] also made the case for a need to focus on the mobile as a complex artifact with variations of policy, pricing, marketing, technical, and aesthetic design decisions that interact with cultural, contextual and social preference, economic constraints and environmental factors. Infrastructure and deployments form an important part of the access and use of resources.

If infrastructures are biased, so are the resulting deployments from these infrastructures [181].

1.1 Overview of Thesis

In this thesis, I present six projects exploring the six factors impacting technological and financial inclusion in the form of user access, understanding, and use for low-income users.

1.1.1 Chapter Format

Each chapter shares one of the six factors including factors like gender, socioeconomic class, religion, and family that impact social access and factors like user learning and user training that impact the cognitive access of the users. The project motivation, related literature review, and findings are shared in each chapter. The methodology section of the first chapter highlights the overall methodology of qualitative interviews: data collection, transcription, coding, and analysis used throughout this thesis. Each chapter contains the detailed methodology and participant details for the corresponding project.

1.1.2 Contributions

In the first few chapters, I showcase the impact of social access on technological and financial inclusion. In **Chapter 2**, I show the implications of gender on the access and use of technological services especially Digital Financial Services. I explore how gender impacts the agency of women in Pakistan when it comes to the social and physical access to the prerequisites for Digital Financial Services. The chapter contributes to my thesis by:

- Introducing the 'Theory of Readiness' which shows the three types of access namely social, technological, and financial access that forms the basis for the access and use of Digital Financial Services.

- Showcasing how gender impacts Pakistani women's readiness to use financial services through a mixed-methods approach. These factors include affordability - their ability to earn or own funds to utilize financial services, authority - their agency to make

transactions using these funds once they acquire or earn them, and access - their ability to gain access to physical or digital mediums, shops, banks, and applications that are the conduits for using these financial services.

- Highlighting how the socio-cultural and religious contexts that support, enhance, or limit women's readiness for and adoption of Digital Finance Services (DFS) impact women's ability to access and utilize the financial services for each of these prerequisite steps.

Chapter 2 shows how gender impacts the technological and financial inclusion of women. However, we also saw that there was a difference in this impact based on the professional status (working vs. non-working) and professional work (women entrepreneurs vs. employed) of these women. One of the results of studying the impacts of gender on technological and financial knowledge and understanding was the observation that women-business owners were the most technologically and financially independent women compared to other interview participants. This was due to their family's acceptance of their mobility and technology ownership due to their professional duties and resulting financial contribution to the family. Thus, I set forth to not only test this understanding but also explore the various technological and financial support that can be provided to these women to improve their understanding, use, and engagement with technology. In **Chapter 3**, I set out to explore the differences or similarities of impacts of gender across socio-economic segments.

- This work shows how gender negatively impacts women across socioeconomic segments and their multi-layered identities. While technology helps circumvent some of these impacts, many of them are transferred or seen when the interpersonal components of the business come up.

- The study showed that women business owners are ahead in technological and financial access and decision making as shown in our last study but also showed that there are differences in the technology knowledge access and use based on the socioeconomic level of women business owners.

- I show how Pakistani women fall at the intersection of two feminist movements - Muslim and South Asian feminists which part themselves from the Western notions of feminism and values of culture and religion are implemented by family.

- Using analysis of 51 qualitative interviews I share stories of Pakistani women's resistance, negotiation, and solidarity as they operate within Islamic values in the society and the family.

- I also share examples of how women support each other within and across socioeconomic segments which can be leveraged to increase the social access to technology for low-income women.

My work from previous chapters shows that religion and sociocultural settings form an important part of the impact on technological and financial inclusion. However, we cannot have financial inclusion without technological inclusion. The question of the lack of use of Digital Financial Services becomes irrelevant when we cannot understand the digital capabilities, understanding, and use of the users. At the same time, technology adoption and uptake is not an individual effort. Based on my existing research, technology understanding, adoption, and use is a complete process with many actors performing various roles at each step of this process. I set out to explore what technological engagement - understanding, access, and use looks like for low-income women. In **Chapter 4**, I explore the impacts of gender on the technological engagement of low-income women. In doing so,

- I present the Technology Engagement Framework which explains the various non-linear steps in the technology engagement of a user from knowing about the existence of technology, to trying, testing, repairing, and use of technology.

- I share the various roles played by their family members, immediate and extended, in deciding to buy technological devices, teaching and using the device, troubleshooting, and repairing devices.

- The work shows how all of these steps are affected by socio-cultural norms, religion, and gender, especially in male-dominated societies of the developing world, most of which have male-centric patterns of technology consumption and knowledge diffusion.

- While the technology engagement cycle has been defined for low-income households in developing countries, I believe that this model of technology introduction, understanding, and use can also be expanded to other markets and users.

- This work does the articulation work [239] that brings forward the hidden tasks, actors, and actions happening behind a user's technology use and adoption and the hidden actors performing these tasks.

Chapter 4 shows the need to consider a user's gender, religion, or cultural heritage because it can impact technological use within a family. Most of the existing research on religion and gender within HCI looks at the relationship between religion and technology but does not discuss the implications of religious beliefs and values on the use and non-use of technology. Thus, in **Chapter 5**, I set out to understand the implications of socio-cultural norms and participants' beliefs on HCI research.

- I list three implications of religious beliefs on HCI research as end-users as well as HCI researchers. These implications impact researchers and participants in the collection and analysis of data, impact us as authors in the understanding and presentation of data, and as HCI reviewers of papers that include the mention of belief systems and their impact on sociocultural norms, values, and use of technologies by the populations.

- I show how HCI needs to look beyond engagement with populations to include the belief systems to understand the interpretations, negotiations, and enactments of these values, their implications on our research, and its results.

- Using personal stories from my work in an Islamic country, I share the various facets in which the socio-cultural and religious norms in such contexts can impact the research assumptions, research processes, and research contributions in HCI.

- I posit that belief systems that incorporate various value systems about interaction with digital systems, interaction with same or other genders, or travel and communication outside the house pose a need for deeper understanding and even reforming our research methods to suit these populations.

While the social access, social networks, and the actors which form that access are an integral part of the users' understanding and use of technologies, two other important parts of the user understanding are 1) the affordances that are present within the technological systems namely the usability and learnability of the applications; and 2) the enabling of the users by the guidance and training that is provided to them. This support, whether provided online or in-person, in the applications or software or outside of them, enable users to be able to learn and onboard the systems as well as overcome any anxiety, barriers, or questions and uncover features all of which might not be possible by the user alone. Especially with users in low-resource settings where both the users as well as their social access and circle have either limited, incomplete, or at times inaccurate information, such training and hand-holding are important to enabling them to maximize their benefits from these systems. Thus in **Chapter 6 and 7**, I explore the components of cognitive access and the role of supportive actors and trainers.

- I explore how these trainers and supporting actors plan on, execute and decide on the training content and training material.

- Using expert interviews with 8 subject matter experts from five continents I share how these trainers conduct training and understand the efficacy of their end-users and repeat, modify or adapt their knowledge sharing based on the field realities and the cognitive access capabilities of their trainees.

- I share the various types of training, the challenges, and opportunities that have emerged due to the transition from in-person to online training, and their understanding of components of training that can be digitized or effectively communicated digitally vs. those that might not be best suited to digital mediums.

Finally, in **Chapter 8**, I conclude by discussing how the presented works collectively contribute to my thesis of understanding the various facets beyond mere physical access to technological infrastructure and technological devices. I share various research projects which look at the impacts of gender, religion, sociocultural setup, and the implementation of its values by families to form the social access for low-income users, especially women. I also share the cognitive access that is enabled or limited by these social actors and how technologists and trainers try to enable users to bridge this cognitive access by enabling training in the form of family members at home as well as formal trainers at work.

My work started an important conversation about the values brought by religion and culture and implemented by families and their impact on Human-Computer Interaction - both from the users' side when it comes to access, understanding, and use of technology but also as researchers who need to understand and empathize with these users as well as design for them. While there are commonalities across digital divides around the globe based on location or income, there are also differences in culture and religion which are unique and need to be accounted for.

I argue that future works that want to look at roles of designing with and for marginalized communities whether it is gender, income, or agency, need to look at these factors beyond the simple explanation of haves and have-nots. These nuanced values also enable us to be conscious in our reporting of digital divides and our successes in bridging them. When we report that a certain percentage of the population has access to technology or does not use a certain technology, we can use the theory of readiness, or technology engagement framework to understand what this access looks like and what are the barriers still hindering these users to use or engage with these technologies.

Chapter 2

GENDER & RELIGION'S IMPACT ON TECHNOLOGICAL & FINANCIAL INCLUSION

In resource-constrained economies, lack of financial participation prohibits women's economic empowerment and opportunities to improve circumstances. With the advent of Digital Financial Services (DFS), a growing emphasis has been placed on the possible positive impact of DFS on lives of individuals. However, for people to understand, adopt, and use DFS, they require certain prerequisites and enablers. In this project, I used a mixed methods approach to analyze the gendered barriers in the readiness for and adoption of DFS as well as the impact of gendered roles in curtailing or enhancing the same. This chapter presents the analysis of 51 semi-structured interviews to evaluate the affordances or, lack thereof, in affordability of funds, authority of transactions, access to technological devices, and agency of social and cultural mobility–all of which are prerequisites to fully utilizing DFS. This chapters' findings presents factors around social readiness, technological readiness, and financial readiness which combine together to form the readiness for a user to use Digital Financial Services. In this chapter, I discuss the sociocultural and religious context in Pakistan that underpins some of these gendered barriers and the perceived views of both men and women.

An earlier version of this chapter was presented at the 1st ACM SIGCAS Conference on Computing and Sustainable Societies (ACM COMPASS 2018)[1] [114]. Following this work, I have also co-led workshops on the topics of *Designing Digital Payments for Next Billion Users* [125] and *Platformisation of Digital Financial Services (DFS): The Journey of DFS in the Global North and Global South* [124].

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2.1 Introduction

Around two billion people worldwide do not have a formal financial account, and more than 50% of the world's poorest households are unbanked, which means that they lack formal financial services like savings, investments, and insurance [249]. This can be the result of insufficient penetration of the banking network or the absence of collateral or proper documentation of users, leaving those users at risk to slip back into poverty with a single financial shock as well as exposing them to exploitative financial mechanisms.

The concept of financial inclusion refers to creating solutions which enable access to financial services for *all* members of a society, particularly those at the bottom of the economic pyramid [249]. DFS aim to address the problem of financial inclusion stemming from insufficient banking infrastructure in emerging economies [23]. They provide mechanisms for accessing savings, spending, and utilization of money digitally [142] through mobile money platforms, retail agents (Over-The-Counter or OTC transactions), and mobile phone-based services.

Resource-constrained economies, like Pakistan, face additional challenges to achieving financial inclusion. Globally, there is a gender gap, however, this gap is amplified in emerging economies where women and children suffer disproportionately. This gap also manifests in lacks of financial capacity, empowerment, and security. In developing economies, 37% of women are banked compared with 45% of men. This gap is further increased for rural women who have a 28% lower chance of owning a bank account than men [144]. Gender is defined as the culturally and socially constructed differences between men and women that vary from place to place and time to time [192]. These differences also include perceptions and self-efficacies about women's capabilities to use technology [257] and their financial decision making [203].

My work draws attention to the impact of gendered roles in Pakistan that support, enhance, or limit the readiness for and adoption of Digital Financial Services (DFS) by Pakistani women. Before talking about the specific context of Pakistan, I situate the topic in the global perspective.

In this chapter, I report a mixed-method study of 50+ semi-structured interviews with

individuals from different geographic and diverse socioeconomic backgrounds in Punjab, Pakistan as well as statistical data from the Financial Inclusion Insights (FII) Survey 2016 for Pakistan. This work provides a nuanced view of the factors that influence whether and how these individuals have the prerequisites to use DFS and the role of gender in access, agency, and mobility for financial transactions. My research confirms, and in some cases, controverts the typically assumed barriers that limits women's understanding and use of DFS.

2.1.1 Motivation

Although Pakistan is considered a DFS ready country [113, 234] with its strong national identification system, steadily increasing smartphone and internet penetration, and branchless banking friendly regulations [30, 240], it has a low financial inclusion rate, which is even lower for women. The lower financial inclusion of women may be the result of Pakistan's gender gap, which, in 2016, the World Bank reported as second to last (144 out of 145 countries) in their Gender Gap report [263].

Given the persistent concerns about gender equity in Pakistan, the path to women's inclusion is afflicted by a host of challenges that persist across all aspects of everyday life [130]. Lack of uptake of financial services can, therefore, be a cumulative result of the gender disparities in the prerequisites to adopt and use these services. These disparities may manifest in the realms of owning and using technology, earning and spending income, understanding and practicing complex financial behaviors, and physical mobility. *The goal of my research is to understand the role of gender and the resulting affordances, barriers, and opportunities it provides especially in financial knowledge, transaction, and decision making of women. The long-term goal is to identify how the needs and gendered dynamics affect financial matters, and where and how digital financial services can (and can not) support the women of Pakistan.*

2.2 Related Work

2.2.1 Technology and Gender

Studies on differences in technology use, knowledge, or access based on gender not only form the basis of this work but are also extended by my work. Blumenstock et al. [38] discussed how phone use and access varies by gender, demonstrating how men and women show different patterns of phone use even when spending the same amount of time on the phone, and [164] outlined gendered patterns of communication over mobile phones, banking, and internet use. Specifically, in the context of Pakistan, Reed et al. [209] investigated gender disparities between men and women through an analysis of cell phone logs. Researchers have made attempts to evaluate the reasons behind use and non-use of mobile phones by women, such as the perceived lack of technical knowledge [259].

Research on mobile access and usage in low and middle-income countries, including Pakistan, indicates the existence of a gender divide [91, 275] According to [96], the gender divide is primarily influenced and framed by socio-economic and political factors, which also include social and cultural barriers to the use of technology. Wyche et al. [267] studied Kenyan women's interactions with mobile devices and argued that HCI and ICTD researchers should focus on designs specific to the everyday needs of women rather than trying to overcome socioeconomic concerns. While technology has been shown to be a source of gender empowerment for women in the case of mobile phone usage [107], other studies have found certain mobile phone functions, such as text messaging, to be limiting for women who do not possess certain skills of literacy and numeracy [65]. Through ethnographic work in Brazil, [181] explored how men and women adopt new technologies and found that gendered spaces are associated with technology adoption. [196] investigated multiple marginalities and their impact on technology accessibility. They proposed that gender is a major factor in how technology is accessed and that women utilize technology to overcome gendered institutional and social barriers. In terms of design interventions, [14] implemented Protibadi, a mobile phone app, as a way for women to have a voice about public harassment.

2.2.2 Digital Financial Services & Financial HCI

While financial services have appeared within ICTD research in the past, the initial studies focused on microfinance [84, 201] and microcredit services [200] on feature phones [160]. Studies have since addressed the various barriers that limit the use of financial services by women [24], including factors like lack of documentation, collateral, and agency to use financial services [143]. Research also shows that the rural and gender gaps in financial inclusion are persistent throughout all developing economies [50].

DFS have been analyzed both from a technical perspective [49, 39] and from a social perspective [212]. Researchers have also explored how technology can support the usage of DFS through designing user interfaces that enable money transfer [158] and improve the learnability of money transfer smartphone applications [113]. [172] made the case for a focus on financial education because, in addition to technology, policy and regulation can affect adoption and use.

The field of financial HCI is nascent as indicated by [135]. This work extends the research in this area as financial HCI looks at both human interactions around money as well as the associated technological artifacts and the impacts of one on the other. Although finance remains a very secretive and private concept [135] there has been research on how people perceive, manage, and utilize money. For example, [258] looked at how low-income people manage money in England and how technology helped or hindered in managing finances. [191] studied loan workflows with both digital and real money and how social meanings, social relations, and socio-technical ecosystems impact the practice of dealing with money. [137] did an ethnographic study of the existing payment and banking practices to identify the applications and services to support the needs of the community.

2.2.3 Gender and Culturally Situated Design

Gender as an analytical category for HCI has appeared in recent literature [32]. Beyond this, many researchers have elected to engage in a feminist HCI framework to guide their research and ultimately to inform how they think about technology design. This framework has focused HCI researchers on the importance of and sensitivity to gender identities [33].

It has also given them an appreciation for the usefulness of value-sensitive design [80]. Furthermore, it has enabled researchers to apply and engage with feminist HCI in areas like public safety [133], computing, and design [10].

Technology adoption and use are more likely to succeed if researchers consider what is meaningful in the daily lives of their target users. In terms of culturally situated design, HCI researchers are beginning to consider how religious institutions influence people's technology use and adoption [**?**]. While religious institutions may offer one avenue for context-specific design, understanding how interpretations of religion affect the daily lives of people, including perceptions of gendered roles, may also lead to fruitful design recommendations.

2.3 Methodology

Before embarking on the field work, I identified the various elements that collectively impact the adoption of DFS. These include 1) affordability, which means that one has funds (from any source) for transactions and 2) authority, which suggests permission and agency to use these funds and / or ownership of the funds necessary to make transactions. Without affordability and authority, individuals cannot make financial transactions. An additional element includes 3) access to sources of DFS transactions including technology to use DFS (phones and SIM for wallets) or access to agent shops (OTC transactions). Without access to or availability of technological devices, as well as the know-how to use them, funds can only be transferred using non-digital means. Thus, the interplay of affordability, authority, and technology access was the primary lens for my inquiry.

Through this lens, I inquired about the understanding and performance of gender roles as well as the socio-cultural and economic conditions that affect affordability, authority, and technology access. I explored the limitations and barriers faced by women due to perceived gender roles, the various sociocultural and gendered reasons for these barriers, the uses and non-uses of financial technologies due to mobility and ownership, and design opportunities that can be utilized to enable DFS usage and adoption among women in Pakistan.

Financial Inclusion Insights

I used a mixed methods approach, drawing from an analysis of both qualitative interviews and an existing quantitative survey, Financial Inclusion Insights (FII) [119]. FII tracker survey is a periodic survey of national scale conducted annually in eight countries to measure financial inclusion status as well as the knowledge and information level of the population [118]. First step included reviewing the publicly available dataset of the third wave of FII for Pakistan, which contained a total of 6000 data points for various metrics. It contained trends for financial inclusion among both genders, which better allowed us to understand the Pakistani context of financial inclusion.

2.3.1 Qualitative Fieldwork

Prior to conducting the fieldwork in the province of Punjab, Pakistan, I had several assumptions about the impact of socioeconomic conditions for women and what these meant in terms of women's empowerment in general and, more specifically, women's financial inclusion. The assumptions that also formed the basis of recruitment criteria are:

A1 - Financial empowerment and financial income are not correlated. I based this assumption on local contextual information and my personal knowledge that indicated that some women, who do not earn, still have access to funds in the forms of finances provided by their families or close relatives. In contrast, other women with income sources have little to no authority to decide how that money is allocated.

A2 - Education is not directly correlated with the financial empowerment of women. Many of the limitations that are based on socioculturally determined gendered roles remain unaltered by the education level of the women or that of their family members.

Considering these assumptions, I interviewed women from *all* varieties of socioeconomic and cultural backgrounds. I did not assume that any particular woman was more financially empowered than another. I also interviewed several men to discuss their perspective on gendered roles and their impact on financial empowerment.

Gender	**Men**	**Women**
Participants	10	41
Age	18 - 25 yrs: 5	18 - 25 yrs: 16
	26 - 45 yrs: 3	26 - 45 yrs: 25
	>46 yrs: 2	>46 yrs: 0
Locality	Urban: 4	Urban: 22
	Peri-Urban: 3	Peri-Urban: 7
	Rural: 3	Rural: 12
Marital-Status	Unmarried: 5	Unmarried: 17
	Married: 5	Married: 24
Education Level	Uneducated: 3	Uneducated: 11
	Up to 8th grade: 3	Up to 8th grade: 5
	Up to 12th grade: 0	Up to 12th grade: 9
	College: 4	College: 16
Profession	Employed: 9	Employed: 26
	HouseHusbands: 0	HouseWives: 6
	Entrepreneur: 1	Entrepreneur: 9

Table 2.1: Participant Demographics for the Gender Study

The Interviews

I conducted the interviews of women being fluent in English, Urdu, and Punjabi. However, to interview some of the male participants, I had to rely on male researchers. Following the culturally and socially accepted gendered norms facilitated a level of comfort amongst participants who then felt at ease to disclose personal information and accounts. All interviews were conducted in the preferred language of the participants, recorded the interviews with participants' consent, and later made transcriptions. The interviews ranged from 45-60 minutes depending on the participants' responses and were conducted in the participants' preferred location (i.e., participants' homes, participants' offices, office buildings, homes where they worked, microfinance offices, and vocational training centers). I transcribed and encoded the interviews to evaluate the common themes as well as additional findings that went beyond or contradicted the barriers described in previous literature.

The semi-structured interviews consisted of two sets of questions. The first set was close-ended questions related to literacy, income level, access to finances, ownership of and access to phones, SIMs, bank accounts, and the household in general. This first set was to gauge if participants were below the basic threshold of affordability (of money) and access (to phones), and, thus, could not benefit from technological interventions at this time. The second set was open-ended qualitative questions that allowed the participants to further detail their experiences.

The Participants

In summer of 2017, I conducted a total of 51 semi-structured interviews of both men and women in and around the cities of Lahore, Multan, and Kasur and their connecting villages. I spoke with 41 women and 10 men, in urban, peri-urban and rural parts of northern Punjab (34 interviews) and southern Punjab (17 interviews). The women (ages 15 and older) varied from non-literate to well-educated (university graduates). Table 1 gives the demographic summary of the participants.

I relied on purposeful sampling using social contacts and also worked with the microfinance organization, Akhuwat, that lends small-scale loans to households and entrepreneurs.

A large number of their borrowers are women, who run beauty parlors, embroidery shops, and other small businesses. When visiting the organization's centers in Kasur (North) and Multan (South) the local organizers introduced me to some of their clients. I recruited participants through word of mouth and relied on Akhuwat to reach participants in areas where I could not openly recruit. None of the participants were given incentives or reimbursed for their participation.

Some of the women worked outside their homes as maids, high-income professionals, office staff, assistants, teachers, beauticians, nurses, software developers, and entrepreneurs. Others were housewives, some of whom had previously worked or ran their own entrepreneurial enterprises from within their homes (i.e., jewelry makers, home-based beauty parlors, and embroiderers). All participants had access to funds either in the form of their salary, income from their businesses, and / or money given to them by their husbands or family members (or they at least knew about the finances being managed by the male members), and, thus, could answer questions about financial decision making.

2.4 Findings

Now I present the findings on women's social, technological, and financial access in Pakistan using the analysis of qualitative interviews and FII data.

2.4.1 SOCIAL ACCESS AND GENDER

The gender gap in Pakistan manifests not only as differences in access to physical assets and material opportunities for men and for women but also as the ability to choose how to manage and benefit from those assets. Offering a mobile phone or a financial services infrastructure alone cannot address the problems of women's financial inclusion without the ability to make decisions and take actions on one's own behalf.

Mobility

Financial services, like frequent trips to a bank to access services, require frequent mobility. However, DFS has the benefit of shifting most interactions to a mobile device with less

frequent need to leave one's home. To open a mobile wallet account or top up one's wallet or cash out, one has to visit an agent shop, which could be a small grocery store in the nearby market. Impediments to mobility because of cultural, religious, or security concerns can, therefore, hamper a woman's ability to access financial services even if those services are digital.

It was observed that women possess various degrees of mobility, which can be categorized as being forbidden to go outside of the home, as permitted to leave with a male relative, or as permitted to travel alone. The women had preferred days or times of travel that were driven by the mobility category to which women belonged. Respondents who had to be accompanied preferred times that were most convenient for their male relatives, which included either after work or weekends. Women who traveled alone preferred to do so early in the day or mid-day when they were free from domestic chores or when it was relatively cooler outside.

Pakistani society endorses gender segregation in both public and private settings. Interactions with unknown men can be both atypical and stressful for women, especially in the case of unsolicited contact. Women informed us that when they traveled alone, they faced problems such as longer waits before finding a ride, men following them to their homes or blocking their way, verbal and physical harassment, and incidents of theft and mugging on public transport. This is true for women in other developing countries as well [14, 133]. Therefore, women traveling alone preferred private transport or rickshaw. Women disliked public transport fearing physical and verbal harassment, traveling with strangers, and longer travel times. For low-income women, the lack of affordability of private transport made physical mobility even more difficult. One woman said that,

> *"I don't prefer Chingchi because anyone can hop on and off, and it gets really uncomfortable if a guy gets on."*,(female, urban). Another woman specified that *"There are many issues that we have to face while going outside the home. People tease girls in public transport and markets but it's better to stay quiet, finish your work, and return home without paying attention to anyone."* (female, urban)

Previous negative experiences of women made them more vigilant and selective about the

places they would visit. Most women shared that they made conscious choices of visiting markets or public places with more people to avoid harassment. Even then, places with mostly male visitors were avoided (e.g., mobile shops for buying airtime or phone repair). Women, who had previously felt comfortable traveling alone, altered their behavior after being faced with incidents of harassment or crime. One woman related the following: *"I was once mugged while walking. So, I don't go around window shopping anymore."*, (female, urban)

Concerns for physical safety are the dominant constraint in women's ability to move freely, and these concerns are exacerbated at night, further driving the necessity for accompaniment by a male relative. None of the participants, irrespective of the permission status for traveling alone, education, or working status, preferred or felt secure going outside after dark on their own. One woman expressed her fears in this way:

> *"There are many issues in going out at night. Sometimes when a kid gets sick and we need to take him to the hospital at night, it becomes very difficult. There is a risk of robbery or mobile or bike snatching while traveling at night."* (female, urban)

Traveling permissions originated from male relatives and were influenced by concerns for women's safety as well as the social perception of the family. From my interviews, it was observed that although traveling permissions changed for some women after marriage this did not hold true for all married women. Participants resoundingly indicated that being accompanied by a male relative made travel safer. For instance, this woman said that

> *"I go with my husband if I need to go out in the evening or at night. It's not safe to go out in the evening and it's also considered bad in our culture [for women to travel alone]."* (female, rural).

Another woman explained that *"No, I never go outside of the house without my husband's permission. And if it's an emergency then I tell him and go with him or if he says go with my son, I go with my son"* (female, rural). Both women and men, when describing their concerns about women traveling alone - be it their sisters, wives or daughters - focused

more on socio-cultural apprehensions rather than on personal preference. Even though interpretations of Islam in South Asia encourage *purdah* (seclusion from unrelated men), participants did not mention this as a reason for the prohibition of movement. For instance, one woman said that

> *"I don't let my daughter go anywhere alone. There are many relatives and neighbors out in the street. They might say that her daughter is roaming around alone. I pick and drop her at the stitching center."*(female, rural)

2.4.2 Religious Interpretations

Religion and Gender. Being an Islamic majority country, the social and cultural norms in Pakistan are influenced heavily by interpretations of Islam. Islamic law indicates functional roles based on gender. Men are responsible for acting as the Head of the Household (HOH), earning income, and providing for the family. This is intended to ensure financial security for women. Women are entitled to support as daughters, wives, mothers, and sisters. Similarly, women hold the right to refuse to perform household chores (e.g., women can ask for money in return for nursing their babies). However, at the same time, men make decisions for the family and may inherit twice as much as women in order to fulfill these financial obligations (Quran 4:11). Thus, participants also derived their understanding and beliefs around gender from the interpretations of Islam that are prevalent today in Pakistan. They discussed how financial decision making, as denoted by Islamic law, assigns men the role of head of the household. One woman related that,

> *"Fathers are the head of households in all of the families. We saw this before our father died. After his death, our mother started making decisions. In all other families, females are asked for suggestions. It's good because men make good decisions and it's their role. It is said that the house where women lead isn't successful."* (female,peri-urban)

Some male participants referenced religion as the source from which they derived ideas about the family, including their responsibility to protect the family from the deterioration

of society. There were women who were completely comfortable with their husbands or fathers running the household with or without their consent or contribution because, as per the participants, the men were performing their duties to the household. One woman's opinion was as follows: *"Men should take the final decision. Because God has made it that way."* (female, urban)

Another declared,

> *"Men of the house are household heads. In our family, in other houses, my uncles (from the maternal and paternal side) make decisions. Islam says that men are accurate and gents know more things."* (female, urban)

Religion and Finance. Islamic legal discourse does not allow or encourage charging interest on loans. Prior to the fieldwork, I hypothesized that participants would state the involvement of interest in all bank dealings as a reason for non-use of formal financial services. However, in my conversations, only a few participants mentioned interest as a concern. It was also noted that concerns about interest rate varied by affluence. Women with alternatives, who could forgo interest-based options by borrowing from family members etc., mentioned that interest-based options were not preferable. However, small-scale female entrepreneurs, who did not have enough resources, relied on interest. One woman's concern with interest-based loans was purely economical. She lamented how she had experienced a business loss because of high-interest rates on microloans. This influenced her decision to later take out an interest-free loan from a microfinance institution.

2.4.3 TECHNOLOGICAL ACCESS

When women have limited mobility, due to seclusion or other issues discussed earlier, mobile-based propositions may provide them with access to previously unavailable information and services. This is especially advantageous in limited banking infrastructure settings. The current DFS paradigm requires phone ownership with a SIM registered in an individual's own name. This forms the basis of the Digital Transaction Account for that particular individual and provides benefits such as the notion of identity as being linked to a verification process or a certain device for executing transactions.

Gender	**Men (10)**	**Women (41)**
Phone Access	Yes: 10	Yes: 35
	No: 0	No: 6
Access Type	Personal: 10	Personal: 31
	Shared: 0	Shared: 4
Phone Type	Feature: 3	Feature: 9
	Smart: 7	Smart: 26
Sim Registration	Self: 10	Self: 22
	Others: 0	Others: 9
Internet Usage	Yes: 8	Yes: 26
	No: 2	No: 15
Internet Access	Wi-Fi (W): 0	Wi-Fi (W): 4
	Cellular (C): 4	Cellular (C): 8
	W & C: 4	W & C: 14

Table 2.2: Table showing the technology access, ownership, and usage of the participants of Gender Study

Phone Access. In Pakistan, mobility constraints for women are accompanied by a significant gender gap in mobile ownership. The FII survey data shows that women's ownership of mobile phones (36.7%) is approximately half that of men (79.4%). Phone ownership is also distinctly lower in rural areas compared to urban areas. Although 35 of 41 women participants had phone access, as mentioned in Table 2, I explored the underlying reasons why women had not own phones both in the past and in the present. Most women considered 'permission' as a limiting factor to ownership or access. The interviews also revealed that phone ownership among unmarried women was considered inappropriate due to concerns about maintaining an image of purity to ensure future marriage prospects [130]. The element of permission, or its lack thereof, is even more influential in single women's phone ownership. One woman explained that,

> *[W]omen are not allowed to use phones in our family. They just do not feel the need when men have them [phones]. I have a phone, but most people know that it is my mother's. My father, however, is less restrictive. My brothers are more restrictive. My brothers say that if they have a mobile phone, I can borrow it from them. I should not have my own mobile.* (female, peri-urban).

The constraints of non-use by unmarried women were based on hearsay of women eloping with men who had contacted them by phone.

The interview responses confirmed that male relatives dictated phone ownership as well as the type of phone (feature phone or smartphone). These constraints depended on the men's technical education and familiarity with technology. While some men prevented the use of phones altogether, others insisted that feature phones could be used but not smartphones, and some restricted functions like social networking applications or uploading of photographs. One participant expressed that, *"I gave my brother money to buy me a smartphone. But he brought me a feature phone, asking, what would I do with a smartphone. (female, urban)"*

Phone Ownership. Only a few women shared that they themselves bought the phones. Usually, phones were purchased by male relatives, with or without consultation regarding women's phone preference. In rural regions of southern Punjab, a few women reported

receiving phones (either a phone or an upgrade to a smartphone) as gifts from their husbands at their wedding. One newlywed recounted that,

> *"[M]y husband gifted me a phone on our wedding. I did not have a phone before this. In our family, unmarried girls are not allowed to have a phone. I, my mother-in-law, my sister-in-law, all of us use this phone. When my husband comes home, my sister-in-law (unmarried) puts down the phone. Otherwise, she plays games on it continuously!"*(female, peri-urban).

Marriage did not ensure phone use for every woman. For example, one woman described her situation as follows:

> *"No it wasn't about permission. I had unmarried girls at home. So my sons did not let me keep a phone. They used to tell me to get them married and then you can have a phone at home. (Why didn't they let you?) No special reason. The environment of the household is not like this. Now they [the daughters] are thankfully married. So I also got it [a phone]. And my sons too!"* (female, rural)

One participant reported that she did not begin using the phone she received from her (female) employer before seeking permission from her husband. In general, the freedom to engage digitally was curbed for several reasons. However, these limitations were not imposed *on* women alone; they were also imposed *by* women. For example, several women participants indicated that they used the internet on their tablets, laptops, or their husbands' phones. Yet, they were careful not to buy internet access for their own phones to prevent their children from using it as illustrated here: *"I use it on my husband's phone if he has the internet package. I use the internet for exploring things for my beauty parlor and stitching. I don't use internet on my phone because I don't want kids to use the internet. If I would have the internet package, kids will start using it because they unlock my phone and keep using it."* (female,peri-urban)

Most male participants believed that there are dangers or disadvantages to women using mobile phones with some citing social or personal preferences. One male participant (peri-urban) confided that his father had recently passed away and that he was now responsible

for taking care of this entire family. He did not permit his younger sister to own a phone, even though his elder sister had owned a phone before marriage when his father was alive. Another participant (urban) said, *"Even on YouTube and other such apps, unsolicited vulgar images or videos appear, which are inappropriate for women to see."* On further inquiry, he indicated that it was okay for men to view these videos, but not women. A few male participants said that they do not try to restrict their female relatives and that they feel reluctant to share their annoyance about women's use of technology as well. These men had wives from a socioeconomic class in which they could not restrict their wives' technology use. However, their opinions aligned with those that favored restrictions. One participant (rural) said that women's ownership of phones only increases their likelihood of talking to male strangers, and, thus, it should not be allowed (starting from a very early age). Another participant (peri-urban) shared that he had allowed his daughter to use a tablet because she was using it in front of him at home, yet he did not agree to buy a SIM for the tablet.

Digital Harassment, Fraud and Theft. Concerns about harassment, which discourage women's mobility in public spaces, are also present in the digital space. When faced with harassment, women relied on the male relatives to address the issue. One participant described over the phone harassment:

> *"I used to get harassment calls. A delivery man got my number and then he would call. I didn't file any complaint but I told it to my husband. He handled it."* (female, urban)

Beyond harassment, men were concerned about women being more susceptible to socially engineered frauds and how phones increased women's chances of falling prey to fraudsters. However, rather than educating or informing women about potential frauds, men suggested banning the use of phones altogether. One man exclaimed that,

> *"I don't want them [women] to talk to anyone who can use them or who can gain money through fraudulent scams, either through having an affair or otherwise. Someone can ask them for help over the phone. Women have not seen the world and they just don't know who to trust."* (male, urban)

The lowest income rural women reiterated what their male elders had emphasized the dangers of phones for women. One woman from a rural area outlined her concerns:

> *"Yes, women can have more issues [than men]. It is easy to snatch a mobile from them. However, if someone places a gun to your head, anyone would give up their mobile. But women have jewelry and other stuff."* (female, rural).

In contrast, the lowest income urban participants thought that phones could be useful for women and were resentful of the lack of access or ownership. Many women also claimed that phones had both pros and cons, yet they believed that the pros outweighed the cons, and, thus, the use of phones should not be banned for women. Some women were aware of how a phone might open up possibilities: *"Mobiles have numbers of so many organizations that you can reach out to, for many issues. Females are strong these days."* (female, peri-urban)

Women from rural communities who worked were not allowed cell-phones. Thus, their business-related calls and orders were received on their husbands' phones. A rural midwife explained that,

> *"For seven months now, I've delivered babies with a lady doctor. The calls for deliveries come through my husband's phone. I am not allowed to own a phone even though I am allowed to go (for deliveries)."* (female, rural)

2.4.4 National ID Cards and SIMs

The government of Pakistan mandates every adult (above 18 years) to have a Computerized National ID Card (CNIC). Pakistan has a strong national identification system (NADRA), with reportedly 90% of its population registered in a central identification system [**?**]. Although 83% of the female respondents owned CNICs, some respondents informed us of reasons why they or the women in their families previously did not have CNICs. The reasons included missing documents required for CNIC (e.g., birth certificates or marriage certificates), long travel distances, long queues, and the inability to pay for the new required SIM-based CNICs.

In Pakistani villages it is common practice to ask a village guard who has basic literacy to record the Date-of-Births (DOBs) of newborns. People refer to this DOB when requesting a CNIC. However, such bookkeeping is prone to errors as the guards often forget or mix-up names and dates, or are relocated. One woman, whose DOB was recorded by a guard, told us that due to imprecise bookkeeping of her DOB and that of her sister, she could never get an ID since the system would not accept DOBs recorded with only three months between the births of the two siblings. She could not exist in the National database, which made it impossible for her to open a bank account and prompted her to use her sister-in-law's name for a SIM as well as other family members' names on other official documents.

Frequent security checks, in the last two decades, require Pakistani citizens to produce their CNIC, which has a direct effect on mobility. This has motivated the acceptance of CNICs among citizens.Women informed us that they had to produce their ID cards in certain residential areas, and because of this, they are necessary. Other reasons for obtaining a CNIC included marriage and the transfer of property. A mother explained her reasons for obtaining CNIC:

> *"I got a CNIC because my son needed me to have one before he could get his. They demand the CNIC of the father and mother for issuing a child's CNIC. My son has to pass through an army check post while going to work and they don't let him pass without a CNIC."* (female, rural)

Obtaining a SIM card in Pakistan requires having a valid CNIC, where one person can have a maximum of five SIMs. In 2016, due to heightened security requirements, the Interior Ministry of Pakistan mandated biometric verification of all SIM cards owners [169, 168]. The FII dataset shows that (97%) of men and (92.2%) of women SIM owners successfully verified their SIMs.

During interviews, women were asked about their SIM ownership and biometric verification. Contrary to the unpopularity of SIM verification in Bangladesh [13], many women stated that after the enactment of the new legislation, male relatives urged the women to transfer SIMs to their national IDs, thus avoiding penalties for having more than five SIMs. According to the FII data, some women have SIMs registered in someone else's name. Hav-

ing such SIMs operational means they have been verified with the name of the household member rather than the woman actually using them. In the interviews, some women had SIMs in the name of their husbands, brothers, mothers, or sisters-in-law. A few participants shared how their family did not think transferring a SIM to their CNIC was necessary. One woman described her situation as follows:

> *"No this SIM is in my mother's name. I don't have a need for my own number. I use my mother's number. My brother doesn't give me permission either. My brother asks, 'why do you need a SIM?' There are so many issues in Pakistan because of ID cards."* (female, urban).

In contrast, all the male participants had SIMs registered in their own name.

FINANCIAL SERVICES AND INCLUSIVITY

2.4.5 Financial Authority and Head of Household

In Pakistan, men are typically considered the heads of households (HOH) and are assumed to be the primary earners. This emphasizes the importance of male offspring and also determines the roles of both men and women in terms of finances and authority. In the interviews, none of the 41 women claimed to be the HOH, as mentioned in Table 3. The HOH was usually the father or another male elder, a husband, or a brother. Whereas, three of the ten male respondents claimed HOH status.

I also saw that the lower the social status and income level of the family, the higher the need for financial participation from women. One woman explained her situation as follows:

> *"My father-in-law is the head of the house. He manages all these things like bringing something from the market like vegetables and other things but sometimes he gives money to me for shopping and asks me to go and bring the required things. My husband and his brothers give their salary to their father. But the amount that we earn from embroidery or beauty parlor work is ours and we don't need to give it to our father-in-law."* (female, peri-urban).

Gender	**Men (10)**	**Women (41)**
Supplementary Financial Source	None: 10	Husband: 16 Parents: 5 None: 20
Household or Personal Spending Source	Job: 5 Business: 4 None: 1	Job: 7 Husband: 16 Job & Husband: 4 Parents: 7 Sister: 1 Male relative: 2 Rent: 1 None: 3
Participant as household head	Yes: 4 No: 6	Yes: 0 No: 41
Other household heads	Parents: 6	Parents: 15 Husband: 14 In-laws: 3 Brother: 1 Mother & Brother: 1 Husband & Self both: 7

Table 2.3: Table showing the Gender study Participant's household and financial setting

Another shared: *"My husband keeps our money with him, in his pocket. It's not safe to keep the money at home as our house is on rent and then I and my husband stay away from the home all day and kids are alone at home."* (female, urban)

Women do not necessarily have control over their earned funds and, in turn, save without the knowledge of their male relatives. Women from both urban and rural locations practiced saving money privately as illustrated here:

> *"I keep some of my savings in a locker at the vocational training institute where I study embroidery. I don't tell my brother about this money. Otherwise, he will ask me to give all of the money to him."* (female, urban)

and here: *"I save money. But one doesn't have to tell men. Today my daughters are young, but tomorrow they will grow up so quickly."* (female, rural)

2.4.6 Making Transactions and Dealing with Money

In the interviews, women were asked about the details of both large and small financial decisions to understand the dynamics of financial decision-making. A correlation was found between gender and decision making based on the amount in question. For example, one woman stated that *"My dad thinks that electronics are big financial decisions, so they (girls) should take advice."* (female, urban).

Since women are not allowed to move freely outside of their homes, they rely on secondary methods of transacting even with the available finances. Low-income women participants were only allowed to go to and from work, but they were required to be accompanied by other women who worked nearby. These women only purchased items that were available on their way to work. Women participants relied on their male relatives and children to buy groceries for them. One such woman outlined this process as follows:

> *"I send my third-oldest child with a daily grocery list. Sometimes we have money and sometimes we don't have money to pay the shopkeeper. So we are on khaata [diary, meaning credit] with the shopkeeper"*, (female, rural)

2.4.7 Bank account ownership

According to FII, 12% of men and 6.4% of women in Pakistan own a bank account. This pattern was also observed in my interviews with 50% of men owning an account compared to 34% of women. The FII also showed higher bank account ownership in urban areas (13.4%) over rural (7.4%), which is expected due to limited banking options in rural areas. Apart from the overall disparity between urban and rural banking penetration, the gender disparity also persisted across this urban-rural divide with 19% of urban men and 8.6% of women owning bank accounts as compared to 9.3% of rural men and 5% of rural women. None of the 12 rural women who were interviewed had bank accounts.

The FII data shows that in Pakistan more men (98%) make transactions themselves than women (77%) and that 23% of women rely on someone to assist them. Most, if not all, interviewed women said that they did not go to banks. Women in urban areas sent their husbands, office boys, or trusted colleagues for bank transactions. In peri-urban and rural settings, women preferred to not have a bank account because there was no need, money, or permission. One woman outlined her experience with banks as follows:

> *"When my husband used to work in Lahore, he used to leave the checkbook with me. Sometimes when someone was coming home, he would give them money; sometimes he would come himself. Sometimes I used to give a check to the kids to go to the bank and cash. I have never been there [to the bank] by myself. Only one time, my son took me to pay the bill, because he said that the queue for women is shorter at banks."* (female, rural)

Another woman said she had frustrations with going out and that it was easier to leave the account in her husband's name. She said that, *"I do not have an account on my name because I don't go out of the home and it's better to save in my husband's account because he can go anytime to deposit or withdraw. If I go I will have to answer many questions from my father-in-law like, 'Where are you going? Why are you going?' (female, peri-urban)"*

Although some participants preferred keeping money at home due to easy access, others kept it in a savings groups or at a bank. Outside of the usual savings in banks, some

participants saved secretly in banks to hide money from family. Men and women would sometimes collaborate to overcome the mandates of the HOH, as in this case:

> *"He [participant's husband] has a bank account. We haven't told anyone at home about this account. My father-in-law asks us to give all of our money to him to manage. But we have kids and we should have our own savings. We keep a balance in the bank account that we get from committee [savings group] but we never tell anyone about this."* (female, peri-urban)

2.4.8 Mobile Money

In the FII data, a total of 9% of respondents used mobile money including both accounts and OTC transactions, with 14% of males and only 4.5% of women using it. The FII survey inquired about mobile money services from respondents without distinguishing the level of knowledge or usage. Thus, I asked participants about mobile money services available in Pakistan (e.g., brand recognition), and their knowledge of mobile money, the source of knowledge, and previous experience. Eight of the ten men had used mobile money accounts at least once, and the majority of women had not used a mobile money account. The FII data shows that men engage in more activities on their mobile money accounts and do so more frequently than women. Many women recognized the EasyPaisa and Jazz Cash brands, the two largest mobile money players in Pakistan, but most participants did not know the details of transaction costs or the whereabouts of nearby shops that provided OTC services. Most of the women said that they knew about these services from their male relatives or had overheard of their existence in conversations.

Women were also asked about the possibility of mobile money shopkeepers (OTC agents) defrauding them. Urban and peri-urban women who had heard of mobile money seemed to trust the OTC agents. One urbanite considered: *"I don't think a shopkeeper can defraud you. It is the responsibility of the shopkeeper [to send money]. He began this service at his shop. If he commits fraud, he will have to close his shop."* (female, urban). However, rural women feared the complexity of the transaction and questioned giving money to a shopkeeper:

> *"I do not trust any of these services. What if we send money to someone but the shopkeeper doesn't make the transaction? Or when we go to the shop and there is someone else there. Who will we contact with a dispute in such a situation...I have heard that shopkeepers abuse and slap women."* (female, rural).

Contrary to this, men from rural areas, described ways to assure a successful transaction: *"To assure (that the money has been transferred) I make a phone call, right there, standing in the shop. It's only human to be skeptical."* (male, rural)

The State Bank of Pakistan recently mandated biometric verification of the recipient of a mobile money transaction before disbursement of funds (previously a secret code was required). In the past, women had sent male relatives to OTC shops to receive money in-person. One female participant knew about this change, explaining that *"[i]n the modern era, we have biometric verification. Instead of sharing a secret code, you only have to place your thumb and they give you money."* (female, rural). This can either increase a woman's mobility or also reduce transactions initiated or sent to a woman's account. However, this will potentially help with avoiding frauds like the one described here: *"Previously shopkeepers used to tell their friends the secret pins and their friends used to receive money. Now there is biometric verification."* (male, rural)

2.4.9 ROSCAs or Savings Groups

Savings Groups or Rotating Savings and Credit Associations (ROSCAs), commonly known as 'committees' in Pakistan, are a social saving activity which is also popular in many other parts of the world [220]. All women participants knew about ROSCAs and had participated at some point in their lives (with the exception of a few high-earning urban women). Most women had grown up hearing about or seeing other people, especially mothers and other female relatives, participate in ROSCAs. One such woman shared that,

> *"I have saved money through committees since I was a teenager. I like saving money through committees. My mother used to manage committees, but that required large amounts of money, so I used to have a share in one committee with three or four other members."*(female, urban)

Men had heard of ROSCAs, but only one of the interviewed men had directly participated and another one participated indirectly via his mother. One interviewee shared that he did not feel comfortable participating in ROSCAs due to a large number of women.

Most women relied on the administrator or the person running the group for assurance and trust. Whereas some women said that they participated in the groups only if they knew everyone, or if the other members were relatives, family friends, or neighbors. Women told us about the existence of daily, weekly, and monthly ROSCAs, ranging from PKR 10 (USD 10 cents) to a few thousand (USD 100-500). One teenage girl had bought her family a used fridge and her brother a used computer by saving in a PKR 10 (10 cents) daily ROSCA.

Most women began participating in larger or more regular ROSCAs after marriage when they realized the need for savings and planning ahead. I observed habitual participation in ROSCAs, goal-oriented saving through ROSCAs, and special occasion ROSCA participation due to an upcoming expense (e.g., weddings). One ROSCA participant explained that,

> *"I used to save money in committees in the past. My husband and I both participated and we each contributed one thousand per month. From the money that we got from the committee, we purchased some land with installment payments. Now the installments are complete."* (female, rural).

Women who currently borrowed with the microfinance loan organization shared that they no longer participate in ROSCAs because they do not have discretionary income to do so.

2.5 Additional Findings and Recommendations

Now, I share some additional findings and recommendations that can influence the direction and design of services for women, in particular, Digital Financial Services (DFS).

Influential women. During the field work, I came across women who had influence over other women as employers, vocational trainers, entrepreneurs, and women with higher levels of education or technology exposure. These women could be recruited as technological and social ambassadors for other women. While many of these women are already consulted passively, and I argue that they could also actively inform other women. The literature mentions that women require trustworthy sources of information as well as frequent

assurance. These women could encourage their employees and relatives to learn about, own, and experiment with technology. Women's comfort with trusted groups for financial saving might also be leveraged to provide additional financial information and advice.

Go where the women are. I observed that although women, both users, and non-users, were aware of the location of the nearest banks, they had hardly noticed the existence of mobile money shops. Bank branches place great stock on visibility compared to a multi-purpose corner shop. I propose increasing the visibility of mobile money shops as a step to enable more participation by both men and women. I also recommend to bring the mobile money services to places which are frequented by women such as beauty salons or neighborhood shops for them to be more accessible for women.

Women entrepreneurs as DFS-ready. Women entrepreneurs who run small businesses (e.g., beauty parlors, embroidery shops, boutiques, and textile and clothing vendors) overcame certain cultural norms regarding mobility and agency. They also enjoyed greater access to and ownership of phones in addition to managing funds. Beyond this, some of the women entrepreneur participants sought out information on the internet on their device or a male relative's device. The women in this group are already well-positioned and often encouraged to seek more financial and technical solutions to improve their work, which indicates that their businesses could align well with future initiatives to design DFS services for women.

Marital status affects access. I observed that social trends regarding the ownership of mobile phones or mobility among women are linked to their marital status and are affected by assumptions regarding the effects of owning mobile phones on marriage prospects for young girls. However, the situation often changed when a woman married, and she was allowed a phone, given an upgraded phone, or permitted to additional mobility.

Women need more financial services. ROSCAs, MFIs, and OTCs have served women's financial needs in various ways from savings to small loans to remittance, however, they have limitations. ROSCAs and OTCs lack records to evaluate individual credit history. With ROSCAs, women expressed concerns that they did not receive any more money in return than they had contributed. Microfinance loan approval takes a long time and often comes with the disadvantage of high-interest rates. OTCs are not the same as mobile

wallets wherein an account is created, and, thus, a record of financial activity. With such a record, credit is more readily assessed, opening up possibilities for new options to save, request loans, and explore other services such as insurance. Financial inclusion of women remains a problem because women may need to be approached differently, but are currently only exposed to the version of products and services designed for the population at large. Service providers consistently fail to see women as a niche market with a unique set of circumstances, behaviors, and requirements.

It is believed that men know better. Men are often perceived to have more capacity to understand issues, and are consulted by women to solve problems (financial, technological, or social). In Pakistan, this problem-solving structure can be attributed to interpretations of Islam that underlie many of the constraints faced by women. In my observation, I did, however, see some variation of the roles of women in their financial decision-making and freedom of movement.

Women can teach future generations. Many of the practices reported by the participants, both financial and otherwise, were learned from their family members, especially mothers. All of the women we interviewed had learned about ROSCAs from their mothers. This suggests that other financial mechanisms or tools, when explained to women by other women, especially mothers, could have a significant impact on their uptake and use.

2.6 Discussion

In this chapter, I shared the various technological, social and financial access of Pakistani women in urban, peri-urban and rural settings. My work indicates that gender plays an important role in deciding financial capability and decision-making, technological access, and physical movement of individuals. This, in turn, affects women's abilities to make decisions and take actions that lead to the adoption and use of DFS.

Affordability, authority, and access are all necessary and a lack or absence of any of these three, causes limitations in the access to, understanding, or use of DFS among women. Some women I spoke to had insufficient funds due to limitations of technology access and/or gendered roles that gave men financial authority in their families. In other instances, the findings demonstrate sociocultural influences that result in women giving up authority, funds

or mobility (access).

The men of the household make decisions about women's physical movement and technology ownership. People consider unmarried women who venture out of their home and use phones as putting their family's reputation at risk due to the fears that they will speak with unrelated men. Male relatives monitor women closely and are widely viewed as a source of authority.

These findings illustrate the many intricate personal, social, and cultural reasons that underlie the gender-based restrictions and limitations for women in Pakistan. I try to understand the affordances and limitations, self-imposed or otherwise, and in doing so, explore the implications of gender on financial authority, transactions, and decision making. The findings paint a nuanced picture of women's demographics, education, social standing, professional level, earnings, and marital status as well as the men in their lives (from fathers, brothers, uncles, husbands to even sons) playing a role in the technological, social, and financial flexibility available to women. In addressing problems faced by women, it is not only important to understand and address concerns of women, but also to take into consideration the concerns of those who make decisions for the women, including men [140]. Most importantly, women cannot be clustered as 50% of the population and rather are diverse individuals with varying socio-cultural and economic setups. These diverse conditions cannot be simplified in one solution and need to be studied individually.

Mobility poses a key impediment to women's access to services, including financial services like frequent visits to banks or OTC shops. Women reported that they had to seek accompaniment by men of the household to visit shops or banks and that the women who traveled alone often faced harassment and were constrained by the scheduling of domestic duties.

In revisiting the two assumptions about women's financial income and education that I had put forward in the methodology, based on my fieldwork, I argue that both of these assumptions hold. Many socio-cultural and gendered barriers exist that transcend income level, social class, and education level of women. I categorize the constraints mentioned by the participants as short-term and long-term barriers, where short-term barriers include technological solutions (e.g., support in the privacy of transactions from the men in their

lives and women-specific value propositions). Some of the constraints mentioned by women are ingrained in sociocultural and religious interpretations. I do not propose to question or change these, but point out that some of the factors limiting women's participation in financial services and adoption of DFS are long-term barriers that cannot be solved by technology alone. These gendered barriers pose open questions for future directions of research in DFS and for ICTD in general.

2.7 Conclusion

We conducted this study using a combination of gender-segregated quantitative analysis of the Financial Inclusion Insights (FII) Wave 3 dataset on Pakistan and 51 qualitative interviews of 10 men and 41 women to assess the constraints in women's adoption of DFS and affordances to create such access. This work outlines the various sociocultural, religious, and gendered dynamics that influence Pakistani women's abilities to access technology as well as to afford and authorize financial transactions. I identify the many nuances of the numerous constraints that impact women and how certain women may be more readily receptive or able to adopt context-specific DFS design for women.

Chapter 3

SOCIOECONOMIC STATUS AND GENDER'S IMPACT ON TECHNOLOGICAL & FINANCIAL INCLUSION

3.1 Summary

Challenges toward women's entrepreneurship are global but exacerbate within culturally conservative and patriarchal contexts. To understand the impact of such challenges, in this chapter, I explore the implications of the interplay of gender and socioeconomic status for women business owners in Pakistan. Using an in-depth qualitative inquiry with 46 women business owners from different socioeconomic backgrounds, I reveal these women's business types and the articulation work that encompasses their businesses, in addition to how these women's multilayered identities differentiate their challenges and opportunities. I highlight the differences in access, use, and understanding of technology across socioeconomic segments. I demonstrate how women across all socioeconomic statuses face gender discrimination in one form or another and how women navigate these patriarchal structures by frequently sharing information with family members, avoiding interactions with unrelated men, opening businesses from their houses, being selective in recruiting male employees. This work contributes to HCI by demonstrating the similarities and differences among women entrepreneurs within and across socioeconomic segments in patriarchal societies and their use of social connections, technological, and financial services. This work validates the results from last chapter that women entrepreneur in Pakistan are indeed technology ready than their counterparts.

3.2 Introduction

Worldwide, more than 250 million women own businesses [76]. Gender discrimination faced by women who own businesses occurs around the globe [28, 251]; and manifests in the form of challenges from lack of capital, differences in funding, etc. However, this discrimination

can be exacerbated for women living in conservative patriarchal societies when it permeates through socio-cultural values. Conservative patriarchal societies are characterized by the gendered division of labor where women are responsible for the household and men fulfill the role of primary breadwinners [219]. Thus, in such contexts, women business owners stand out due to the lack of women in businesses in existing gendered spaces such as markets and other physical and digital social spaces. As a result of this, they face higher discrimination.

Existing literature in HCI and related fields has tried to understand the impacts of gender for women business owners in conservative [218, 219, 19] and patriarchal [16, 19, 252] cultures; the literature is lacking on the impacts across socioeconomic segments for women in patriarchal and conservative societies. An extensive review of HCI literature reveals that the research focus has either been on business owners in low-income settings [74, 73] including business owners in the Global South [226] and the Global North [60, 27] and women entrepreneurs [247, 85, 75]. However, the HCI literature lacks enough research on the impacts of conservative and patriarchal norms on women business owners, especially the implications across socioeconomic segments. To address this gap, there is a need to explore and explain the presence and implications of oppression based on gender or class before we can successfully design for women business owners. Research to explore the interplay of gender, class, and other factors is important to understand the success, failure, challenges, and prospects of such activities [22].

In Pakistan, women business owners face misogyny due to various religious and cultural norms [246] and the interconnection of gender with other forms of exclusion in Pakistani society [218]. In work described in Chapter 2, I interviewed 41 women in Pakistan, finding that among all interviewed, women business owners had the highest mobility and agency, and that these women business owners overcame other barriers associated with the socio-cultural norms. Mustafa et al. [179] built on my work and interviewed 20 low-income women business owners finding that low-income micro-entrepreneurs have very little autonomy in their personal and professional lives. Both works urge to design while considering the limitations faced by these women. This chapter extends and expands this line of work to understand the implications of patriarchy and gender on women business owners from diverse socioeconomic segments and ask the following research questions in the backdrop of

patriarchal social structures:

1. How does gender impact women business owners in their professional lives?

2. How does gender affect women business owners' personal factors like readiness, knowledge, and use of technology and financial services?

3. What differences in challenges and opportunities occur across different socio-economic segments for women-business owners in a conservative society like Pakistan?

This work presents the first in-depth analysis of the lives of women business owners in Pakistan across socioeconomic segments by conducting qualitative semi-structured interviews with 46 women business owners from various socioeconomic backgrounds. The findings show that irrespective of women's socioeconomic and business settings, all women faced gendered barriers in their personal and professional lives. I highlight women's negative interactions with men as service providers and services seekers, the discrimination faced by women as funding seekers, and employers leading women to be selective in their interactions and recruitment. This work also emphasizes the tension between women's business endeavors and the gendered norms within the household and society. It showcases how women across socioeconomic segments enact agency even within the constraints of a conservative patriarchal society sometimes through engaging the assistance of relatives, especially husbands of low-income women and fathers of unmarried middle-income women. The findings also show the various strategies employed by women business owners to support other women within and across socioeconomic segments.

This work makes the following contributions to HCI:

- Provides the first cross-segment analysis of women business owners in Pakistan.

- Describes how these women's multilayered identities differentiate their education, business selection, challenges, and opportunities.

- Presents the strategies employed at individual and collective levels, various supportive actors, and impacts of gender at the personal and professional levels in a patriarchal context.

3.3 Background

Pakistan is a unique backdrop for this research. Pakistani women - 48% of its 202 million population [193] - regularly face obstacles in their lives due to culturally conservative patriarchal social, religious and cultural norms [246], in addition to lack of mobility and economic opportunity [218]. Pakistan ranks third-to-last (151st) on the 2020 Global Gender Gap Index, having closed only 56% of the gender gap [266], and ranks 150th in Economic Opportunity for women with only one-quarter of women as labour force participants (i.e., working or looking to work) compared with 85% of men [266].

Gender segregation and purdah, derived from Islamic values, are still practiced in Pakistan, especially in its rural and conservative regions. Islam does not limit women's earning opportunities as Khadija, the first wife of the Prophet, was a successful and renowned business woman [5]. However, Pakistan inherited its customs from multiple co-existing religious and cultural customs that existed before independence in 1947. Some of these customs contradict Islamic teachings and lead to inequalities in the form of rejection of women's rights given by Islam. Moreover, Pakistan's women's movements, which are primarily feminist messages promoted by upper and middle-class women, are associated with Western ideas [233]. Thus, like many Muslim countries where norms have departed from Islamic values [103], honor killing of women by their male relatives, legal and social discrimination for women, and the association of a family's honor with women's behavior, exist in Pakistan [127].

Pakistan's socio-cultural landscape is patriarchal in nature with women facing marginalization at all stages of their lives. This discrimination starts before birth with a preference for a male-child, sex-selective abortions, and prayers for expectant mothers to 'have a boy' [276]. Sons continue to live with their parents, and boys are seen as investments for old age, whereas when daughters marry, join their husband's family. Thus, investment in women's education is replaced by preparation for dowry and most Pakistani businesses are are handed

down from fathers to sons.

Pakistan has faced many crises ranging from natural disasters to security operations within its borders leading to the uprooting of international organizations and industries. Job losses by men and necessity have compelled women to take on supportive roles where they can earn [136]. However, within Pakistan conservative patriarchal society, inadequate recognition, lack of mobility, ignorance of opportunity, and the societal perception of women as having a lower status [77, 219] prohibit women business owners from reaching their full potential. Pakistan's Female Labor Force Participation Rate (LFPR) has decreased from 22% reported in 2014-15 to 20% in 2017-18 [190] in both informal and formal sectors.

Punjab, the most populous province of Pakistan, is the site of our research. The 2017-18 Punjab Commission on the Status of Women reported that only 3.7% of the literate women were employed as opposed to 20.9% of the literate men [204]. With regard to vocational training, in 2016-17, 64.6% of males and 35.4% of female trainees were enrolled in technical and vocational training [204]. This type of training is an important stepping stone for one's own business.

3.4 Related Work

South Asia has always seen considerable gender gaps in the labor force participation as women are primarily acting as caretakers and homemakers [244, 219]. In Pakistan, less than half of women are literate and only 18% of labor income goes to women [266].

3.4.1 Entrepreneurship and Gender

Entrepreneurship has been a focus of academic research in economics and business studies with a primary focus on entrepreneurial qualities and behaviors like risk-taking. Researchers have categorized business owners based on their reasons for starting businesses with the most prominent in HCI4D being need-driven entrepreneurs and opportunity-driven entrepreneurs - used to denote the involvement of personal choice vs. need in starting a business [111, 74]. Similarly, women business owners have received categorization based on their attachment to entrepreneurial ventures as well as conventional female roles [86] and women's aspirations about personal and business life [57]. Women in developing countries can also engage

in businesses due to the pursuit of challenge, creativity, and financial independence; or can be driven away from employment into entrepreneurial ventures due to labor market discrimination, frustration with gender pay discrepancies or glass ceiling barriers [128].

Women entrepreneurship is a well-researched area in domestic Pakistani literature. Shabbir et al. interviewed 33 participants of an Entrepreneurship Development Program, out of which only 16 started businesses, and categorized women as *Freedom seekers* - who went into businesses to have the freedom to choose their work, hours, environment; *Security seekers* - who wanted to maintain or improve their family's social and economic status; and *Satisfaction seekers* - women with little or no formal work experience who wanted to prove to themselves and others as productive members of the society. I draw on these works to explore differences in types of businesses and reasons for establishing those businesses across socioeconomic segments in Pakistan.

In conservative and patriarchal societies, women business owners face increased challenges due to socio-cultural norms including being discriminated against in the name of religion and culture [218, 219, 19] and restricting women's role to domestic chores [19, 16, 219]. Social support from family can be beneficial to women business owners in patriarchal societies [19] as the family can act as role models and supporters in familial duties. This limitation of women's socialization also impacts their resources and social capital, and, thus, their business success [218]. Women business owners lack networking opportunities and networks of businesswomen [19]. This is compounded by a lack of social support, positive opinions about women's business capabilities, a lack of interactions with other businesswomen, and a lack of independent mobility and permissions to meet with men [218], impacting women's success [206]. While most women in Pakistan have limited homogeneous social networks, women with business management backgrounds who engage in networking are found to identify business opportunities quickly and effectively [6]. I build on this prior research by including the interplay of gender with socioeconomic class in a patriarchal and culturally conservative context.

3.4.2 Challenges for Women Business Owners

Gender discrimination faced by women impacts the success of women as entrepreneurs. Research has shown that women business owners are most affected by the struggle with work-life balance, societal attitudes, and access to capital [128]. Roomi et al. interviewed 256 Pakistani women entrepreneurs and noted challenges such as lack of access to capital, land, business premises, information technology, training, and agency assistance [219]. A decade later, research by Khan et al. showed persistence of those challenges including a gender gap in education, women's limited access to finances, lack of skills and training, time poverty, lower salaries, and violence against women [136]. Women in developing and patriarchal cultures also face mobility issues due to socio-cultural norms. Women either require travel permission or male chaperones to travel [114] and carry the onus of protecting the family's "honor" when conducting their business dealings [254]. Women's mobility is also constrained by concerns for physical safety and harassment [248, 14] and impacts women from all socioeconomic segments [133]. This can impact women business owners who have to accompany male family members to market to buy inventory leading to limited or absent information about vendors. This is further exacerbated in rural areas where there is a lack of transport, physical infrastructures such as electricity, footpaths, etc. [254] in comparison to high-income women with private transport and less mobility restriction [218]. Sexual harassment, especially in public places [133], is another serious concern for women entrepreneurs who might need to interact in or visit public spaces. In Pakistan, women report being frequently harassed on public transport [238, 114].

Another implication of patriarchy can be the difference in access or ownership of funds. In developing countries women business owners face discrimination and shortages of funds [176], lack of awareness about funding opportunities [126], and lack of financial literacy [104]. In Pakistan, women business owners also face a lack of funds due to being undervalued as economic participants, viewed as unable to handle anything other than a small loan, the persistence of discriminatory property and land laws which reduce collateral options [186, 219].

Besides lacking in funds and mobility, women are also impacted by their gender [65] and

socioeconomic class [38] when it comes to technology ownership and use [164], which impacts women business owners. Gendered cultural norms in patriarchal contexts can restrict women's access to or engagement with technology, disrupt women's sense of privacy online [132, 223], allow for relatives to monitor their online activities [222, 115], and ensure that the labor of house chores keeps women occupied most of the day [138, 267]. Pakistan has a wide gender gap in phone ownership with 78% of men and 36% women owning phone [117]. Once online, Pakistani women have a higher chance of harassment [100, 101, 222]. According to GSMA's research in South Asia, women are considered to be vulnerable to corruption through the use of technology as unknown men might contact them, which can, in turn, affect a family's reputation in such a society [94]. In Pakistan, women are 37% less likely than men to own a mobile phone largely due to family disapproval [94].

These differences in mobility and technology ownership also limit women's ability to socialize and network outside their immediate circles. HCI4D research has showcased the benefits of technology especially mobile phones to low-income entrepreneurs in maintaining and increasing their social (personal and business) connections [66, 69], which helps women entrepreneurs identify opportunities [78]. Technology ownership by women entrepreneurs increases their self confidence and efficiency, and enables them to access services [175]. In today's digital world, entrepreneurs face additional challenges like the need to learn new skills and constantly up-grade to keep up with newer technologies [27]. In developing economies like Pakistan with a lack of infrastructure and support from the authorities, a disparity of income and education, including quality of education, combined with the patriarchal setting imposes varying expectations on women. In this study, I explore such expectations on women business owners and differences in their challenges and opportunities due to their gender and socioeconomic class. A goal of this research is to underscore and expand on the implications of gender for women business owners in Pakistan across economic segments. I do this by comparing the experiences of women across segments and demonstrating the gender discrimination and culture common to these women as well as the uniqueness of their resistance, privileges, and negotiations.

3.4.3 Feminist HCI, and Feminism in Pakistan

Feminist HCI is an important theoretical lens through which to understand and expand the field and its designs to be more gender inclusive [32]. However, there is limited research in Islamic and culturally conservative contexts that explores and addresses gendered social values deriving from religion. The anthropologist Saba Mahmood [154] depicts women's agency and empowerment within Islamic societies by using examples of women in Egypt who set out to create social change through and within a system based on Islamic values. Pakistani women fall at the intersection of two major feminist movements - Muslim and South Asian, both of which part themselves from Western notions of feminism in significant ways to uphold the importance of their identity, culture, and demands for justice. I build on these two rich bodies of work within feminism to inform my analysis on the analysis. Besides the patriarchal norms in Islam, Pakistani women are exposed to South Asian patriarchal culture that silences women and further reduces their agency. The postcolonial and literary theorist, Gayatri Spivak, in her seminal work, "Can the subaltern speak?" [173] explains how women in the Indian subcontinent cannot often speak - instead they live under two opposing risks: patriarchal oppression and losing cultural attachment. Similarly, Pakistani women, suffer from the suppression of their voices which can limit the avenues to empowerment, especially through entrepreneurship. Hanna Papanek, an anthropologist whose research focuses on Pakistan, conjectured that while purdah was associated with limiting women's earning opportunities [199] and their social interactions [198], that gender segregation in the form of purdah has also been shown to be a representation of class, a status of luxury, and, at times, a representation of women's unfamiliarity with their environment [199] where women from villages only wear a burqa when visiting unfamiliar cities, thus using it as a *portable seclusion*. Lila Abu-Lughod, using Hanna's and her own stories from Afghanistan, calls to form a deeper understanding of the lived experiences of Muslim women and their situations [149]. This work extends this line of work by sharing the resistance, negotiation, and solidarity of Pakistani Muslim women while they operate within the Islamic values as shared within society and the family.

3.5 Methodology

3.5.1 Research Team

Before I describe the methodology of the qualitative work, I share the details about the research team. I, the lead author identify as woman and was born and raised in Pakistan and am fluent in multiple languages including Urdu, Punjabi, and English - which were the primary languages used by the participants. I have conducted more than ten years of HCI research while living in Pakistan. All interviews were conducted and analyzed by me, at times accompanied by research assistants (women), in the languages of preference of the respondents.

Self-Disclosure

I would like to share here that while my knowledge and familiarity with the Pakistani socio-cultural landscape, languages and previous experience was helpful to me in our research, it might have also introduced biases and assumptions. I ask that this chapter and thesis be read as such. I am aware of and sensitive about the educational and income differences between me and the participants. I connected on the commonalities as Pakistani women, sitting on their floors talking about their lives. I also acknowledge the *emotional labor* that went into conducting (listening, recording) and analyzing the stories of these women. While my personal life might be different from these women's, the research process was emotionally and mentally laborious and I want to acknowledge this labor for ourselves and share this self awareness of our labor with our readers.

3.5.2 Research Setting and Participants

This IRB approved research work was done in the cities of Lahore, Sheikhupura, Multan, Faisalabad and Gujranwala and surrounding suburban areas. These are among the most populous cities in Punjab and all receive migrants from surrounding rural areas due to industry and employment opportunities. The cities that I visited included both developed

areas [1] with paved roads and under-developed areas, at times, accompanied by open drainage and pedestrian-only streets. The suburban areas included industrial and low-income areas pushed to the city outskirts due to urbanization, cost of living, and pollution concerns.

I conducted a total of 46 semi-structured interviews. Since the goal of our recruitment was to reach out to women business owners from different socioeconomic classes and businesses, I requested introductions from organizations which could connect me with women business owners - microfinance organizations which provided loans to women-businesses, start up incubators, and through word-of-mouth where individuals recommended businesses they had interacted with (ordered from, worked or shared co-working space with, or consulted for). Thus, all participants were two or more degrees apart from the research team irrespective of their socioeconomic status. I obtained informed consent from the participants about participation and audio recording of the conversations.

All 46 participants were women business owners. For a woman to be considered for the study, the potential participant had to be the one who started (as founder/co-founder) a business and be involved with the financial and operational aspects of the business. I divided the participants into four socioeconomic segments (high-income, upper-middle income, lower-middle income, and lower-income) based on their income, assets (household and business) including savings, active ROSCAs or committee participation[2], and household expenses like private or public schooling of children, and business details (costing, revenue). I found that recruiting women business owners from higher income segments (upper-middle and high-income) was harder. However, once I conducted the interviews I observed a concentration of findings early on due to similarities.

3.5.3 Interviews

All interviews were conducted based on the comfort and availability of the participants. The interviews of upper-middle and high-income women were conducted at startup incubators,

[1] These are marked as urban-developed, under developed, and suburban to distinguish that are useful to reader than assigned participant IDs.

[2] ROSCAs are group based saving methods where multiple men or women pool money together and on each cycle one person gets to receive the pool amount. They are called *committees* in Pakistan [162]

co-working spaces, or business-spaces (offices, cafes). The lower middle and lower-income women were interviewed at the Micro-Finance Institution (MFI) branches (separate rooms for privacy), homes or shops of the women-business owners. For instance, some low-income women who met me at the microfinance organization offices requested that the researchers accompany them to their homes or shops.

Only one participant refused audio recording. Upper-middle and high-income women felt comfortable sharing stories of gender discrimination, harassment or personal situations on record. However, lower-income women either requested to pause the audio recordings or at times shared these instances in casual chit-chat, after the interview. These stories included (negative) instances of harassment from in-laws or others questioning their character or choice of profession, harassment by family members or in public dealings, or (positive) stories about their husband's support that might not be seen in a positive light by society. The reason for privately sharing husbands' support stories was that husbands who supported their wives were deemed as inferior men and uxorious by their families and the society, which gives another lens into this patriarchal society. For all interviews I took extensive field notes. I also transcribed the particular interview without audio on my way back from the interview while the information was recent.

The semi-structured questions were formed from the list of interview topics (see Appendix A) and all of these topics were covered with all participants, based on applicability to the participants. All participants were asked at the opening of the interview, as well as at the start of the financial topics (See Appendix) to refrain from sharing any private or financial details that were considered private or business secrets[3].

3.5.4 Data Analysis

I coded the transcribed interviews by reading through using the inductive coding with the help of NVivo software. In the first round all interviews were coded. I read the transcripts

[3]An example of this is before the questions about banks, I would explicitly ask participants, "Please do not share any bank names, amounts or details" and include it in the question as *Do you use any banking service, yes or no, without the name?* when the topic of banking services would be initiated.

and made codes which were a combination of in-vivo [4] and constructed codes. In the next pass, the codes were pruned, regrouped and renamed to make a comprehensive list of codes. After another round of codes, I reviewed all codes to form super-codes. Since the interviews contained predefined topics (See Appendix A) the initial concepts and themes were identified [88]. I was continuously in contact and frequently discussed the analysis and themes with my collaborators as they emerged.

3.6 Entrepreneurship Types

Before explaining the findings I want to share about who these women business owners are, their education, technology understanding and use as seen in common across income segments.

3.6.1 High-Income Women Entrepreneur

Most of the high-income women were engaged in some form of technology-based business (Technology-based business: 4, High-end dress designer : 1) with involvement from family members in one form or another. The participants were between the ages of 25 and 45 (26-35: 3; 36-45: 2) and diverse marital status (Single:1, Married:3, Divorced:1). Most of these women (4/5) worked in multinational or top-tier organizations before founding their businesses, and their own organizations mostly consist of a team with specific departments and roles for founders(s) and team-members. These women are highly educated (Undergraduate: 2, Graduate: 2, PhD: 1), often in countries other than Pakistan. Technological exposure from those countries gave them advanced knowledge of technological possibilities and needs. They belong to high-income families with resources like drivers or workers recruited by their parents. and also have access to mentors, consultants, and VCs as a part of their social circle. Thus, their technology-based businesses are a modern equivalent to well-established family businesses.

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[4] All in-vivo codes are mentioned in italics or *"italics"* throughout the chapter.

3.6.2 Middle-Income Women Entrepreneur

The businesses ran by middle-income women were small and medium-sized businesses which had small teams (e.g., cleaners, helpers, or a few teachers).

Upper-middle income participants (n=6) were all single women between the ages of 26 to 35 with a minimum of 18 years of education (Undergraduate: 2, Graduate: 4). All middle-income women were either first or second-generation graduates. [5] Since their middle-income families were unable to financially support their businesses, many of them reported earning and saving through jobs before starting their venture (Service-based business: 3, Baking-related: 2, Technology-based: 1). Jobs provided with "enough savings," "confidence" and time between education and their execution of the entrepreneurial idea. When employed, these women supported the household either by contributing funds or financing expenses. They travel abroad, perform financial tasks (banking) and at times manual labor (paint, cleaning, lifting) for their businesses.

I observed only a handful of middle-income women business owners. I posit that middle-income women choose stable, white-collar, professions, which is possible because of their education, over a risk-taking activity such as running their own business. These women engage with businesses through familial financial help, especially the social and financial support of fathers. However, the risks are always higher because of a comparatively lower economic cushion. While the upper-middle-income women were educated and living in urban settings, most of them had parents from rural backgrounds. None of them had business-women or at times employed women in their family, thus making them the first generation of women to work or pursue a business.

Upper-middle income women show the highest change as a result of the utilization of technology to create businesses from scratch by accessing customers through online platforms, often social media. They start small from home and grow into full-scale businesses with physical locations and teams. They increase their income and freedom from previously being employed to now running their own enterprises. They often try out accounting and project management software as well as hiring portals but find these insufficient or ineffec-

[5] Those who are the first to enroll in and complete a graduate degree.

tive for their needs. They also rely on their social network to seek and increase information, but these social networks also keep expanding as a result of technology. They show ambition to grow these enterprises and constantly seek ways, including through technology, to improve their businesses.

The lower-middle-income women (n=5) were between the ages of 26 and 55 (26-35: 3, 36-45: 1, 46-55: 1). They were engaged in businesses due to socioeconomic conditions and were much closer to the lower-income women in terms of similarity of cultural norms, personal and professional processes, and situations. Four of them were married and one participant was single. They had diverse educational backgrounds (Not educated: 2, Primary: 1, Undergraduate: 2). Like upper-middle-income women, lower-middle-income women also supported their families and converted existing skills into business opportunities (Salon owner: 2, Seamstress: 2, School Owner: 1).

3.6.3 Low-Income Women Entrepreneur

Low-income women (n=30) were less educated (Not educated: 10, Between Grade 0 to 5: 6; Grade 6 to 8: 7; Up to Grade 10: 2; Grade 12: 5) due to financial reasons or family expectations. Most of them were married at an early age (Married: 27, Divorced: 1, Separated: 1, Widow: 1) and had children. The participants were between the ages of 18 and 55 (18-25: 4, 26-35: 12, 36-45: 11, 46-55: 3). Low-income women often start their enterprises after marriage and hence their decisions are heavily influenced by family needs and consent of husbands including the need to work from home. All low-income women ran businesses from within or around their houses and covered their head (including those not from Islamic faith)[6] and avoided interactions with men due to the conservative socio-cultural norms in Pakistan.

Due to lack of education and skills, low-income women resort to known skills to start a business. Another reason cited for choosing particular businesses was ease of working within the boundary of their homes along with chores and childcare (No children: 1; 1-

[6]No religious or political information was inquired from the participants. Participants sometimes mentioned information (e.g., donating to their church or permission to travel to their church), which is taken as indicators of other religions.

child: 2; 2-children: 4; 3-children: 6; 4-children: 6; 5-children: 4; 6-children: 3; 7-children: 3; 8-children: 1). At times when one business (Embroidery: 3; Shop: 2; Buying and selling clothes: 1; Garments Business: 4, Chain manufacturing 1; Quilt Maker: 1; Midwife clinic: 1; Salon Owner: 3; School owner: 2; Seamstress: 4; Stitching & embroidery: 2; Handloom/Powerloom business: 1) was insufficient for household expenses due to seasonality of business or insufficient income, these women relied on multiple income-generating businesses (Shop + Seamstress: 2; Tuition center + stitching: 1; Seamstress + Parlor: 1; Salon + Cooked Meal: 1) as seen in many low-income contexts.

Their use of technology also derives from the socio-cultural context around them resulting in late exposure (mostly after marriage) and low technology knowledge and use. The aspirations of low-income women do not include technology because of a lack of knowledge about the potential of technology for improving their businesses. The social circle and often their customer base is determined by physical access (driven by mobility) and relies on existing contacts rather than making new ones through technological platforms. Therefore, their sources of information are limited to social networks within the same socioeconomic class.

3.6.4 Starting a Business

Women's reasons for starting businesses vary across income segments. Low-income women reported starting businesses due to financial needs which included *"husband's health issue"*, increase in the number of children and family expenses, or relocation from joint to a nuclear family system with increased reliance on personal finances due to the absence of shared resources. One woman shared that,

> *"So then my husband went through a surgery his hernia was burst and after the operation, he sat at home... so then I started doing the labor and hard work. I started selling cloth while staying at home. [I: You were not doing anything before this?] P: Yes, I was not doing anything previously and only started my work after he got sick."* (low-income, suburban underdeveloped)[7]

[7]Our additions or interview questions are presented in square brackets.

Similarly, women were forced to earn due to the absence of earning source following a divorce or the demise or incarceration of husbands. Since most of the low-income women lacked the education to engage in the formal job market, they relied on their existing skills learnt when unmarried as *feminine* skills deemed beneficial for married women like the stitching of clothes, embroidery, or a parlor course. Similarly, lower-middle-income educated women tapped into their educated background to teach tuition or start a school for the neighborhood.

Women seamstresses shared that they relied on neighborhood clients or being asked by *"people from factories"* nearby to complete a job (for instance adding laces or hemming of ready-made garments). In some cases, someone from their social circle currently or previously engaged in this business advised them to start a particular business. Some low-income women were inspired by *"seeing other successful businesses"*. This replication of businesses was common, which resulted in a concentration of service-providers in one place which not only reduced the market share but also missed the opportunity to tap into other unmet needs. This was especially problematic for some salon owners as the income level of the surrounding low-income users did not allow for frequent salon visits or facial services.

Besides running multiple businesses simultaneously (explained in Section 5.3) as also seen in [27], low-income women reported changing businesses based on personal or health issues, or relocation which impacted supply and demand. One low-income woman reported that, *"Yes, I became nearsighted, I had to wear glasses, and the power was increased to a power of 2. That is why I left that work. This clothes [selling] business is straightforward."* (low-income, urban)

Another woman explained this lack of demand. *" I couldn't have received many orders in the area that I live in [name ommitted] though I stitch my clothes and this area also has many tailors. [I: And the area you were living in previously there were no tailors there?] P: That was a poor locality and all women would stitch their clothes."* (lower-middle, urban)

Upper-middle income women defined their business selection as something *that they were passionate about* or good at. While the high-income women chose businesses or ideas where they considered a possibility for innovation, "social good", *"a gap in the market"*, or profitability margins. *"It was just like I want to do this, and this is the right time to*

do it. I am not married, I don't have any responsibility right now. I can do this." (urban, high-income)

Women in all segments, especially those in higher segments who left better-paying jobs, reported initial apprehension and resistance by their relatives. This included in-laws and extended family for the lower-income women and parents, especially fathers, from middle and higher-income families showing concern for their children. One participant shared her father's apprehension, *"You have such a good job, they have given you a car. Even in our office, no one gets this much salary. You cant get this salary for the next 5 years, and what you are about to start, you cannot make this much. So it is stupid."* (urban, upper-middle-income)

Business Training

When asked about receiving specific or generic training for their business, women from all segments, except a few lower income salon owners, reported lacking any professional training for their businesses[8]. A few upper-middle and high-income women reported obtaining a business degree as some form of training about business aspects like *"financial planning"*. However, due to lack of time they could not perform these calculations.

3.6.5 Funding

Funding is required during initial setup and the expansion of conventional and technology businesses. Similar to global VCs [81] most of the funders are men in Pakistan, in the business world as well as in family lives. Thus, women relied on men for funding. Middle-income women, especially upper-middle-income outside the microfinance brackets, could not be supported by the salaried budgets of middle-income parents. Women either saved up themselves through jobs or parents helped them (with retirement funds or savings). However, expansion and sustainability required additional funding. Women reported multi-

[8]The training for beauty parlors and salons included hair cutting, makeup types (bridal, party, etc.), and facials. All the participants engaged in beauty businesses reported receiving some form of training either through a formal Vocational Training Institute (VTI) for free, from a family member at a discounted rate or another parlor for a fee.

ple gendered requirements which made them refuse or reconsider funding sources including offers for women to give up ownership and be an employee.

"There was a [profession omitted]. He wanted me to .. sell my company to him and start working there as an employee, in my own company. .. he was offering me a share of 20% and he will be keeping the 80% so I was like what is this? (laughs) .. some other people also tried extending similar offers to me because they knew that I'm passionate about what I'm doing and I will keep doing it. So just to make money out of that they would say that okay let's invest in this as well ... but at the end when you don't have any ownership of anything then it's of no use." (upper-middle-income, urban)

One woman reported a difference in funders' reactions to the same numbers reported by different genders.

"Having him was beneficial when we would meet investors. It sounds really sexist, I know. But they would not listen to us when we would be talking about finance. Like when we would say a number, they would kind of gaslight us, being like are you sure? are you sure you are gonna make that much revenue? and we would be yeah we are sure. But like one meeting we would go, like us females, and second meeting we would take him and we would say the same number and they would be like yeah yeah makes sense, excellent, great and we would be like ... what is this?" (urban, high-income)

When the women considered the funding stipulations to be fair, they agreed to them. *"He [the investor] made sure that I invest in it. He said that there is a certain percentage that you [have to] invest, I wouldn't be able to, you know, trust my money with you, if you are not investing anything. If you have no stakes in it. He made me invest. I was like I am ok with it. I don't mind investing like this. So then, there was a percentage that I had to invest."* (upper-middle-income, urban)

It is also worth mentioning here that securing a bank loan is not easy for women in Pakistan in terms of assurance to the bank. To provide assurance, women need a male to vouch on her behalf because female assurance counts as half a male assurance in Pakistan. This comes from the Islamic teachings and Quranic verse that suggests using one man or two woman - where one woman reminds the other - in the case of financial dealings. While many scholars have contested the understanding and applicability of this rule [15, 129], in

Pakistan anything that requires one witness - either one man or two women can provide assurance, where preference is given to men claiming ease in documentation and follow-ups, thus making it impossible for women to seek loans alone or without the support of a man. A few low-income and lower-middle-income women rejected Micro-Finance Institutions (MFIs) with interest-based loans as Islam rejects interest-based transactions. Low-income and lower-middle-income women had clarity in loan options and MFIs, through their peers and neighbors. Most of these were group loans where women partnered with other business women to take the loan. Upper-middle-income women were a) unaware of funding sources that finance starting businesses other than banks, b) unwilling to engage in interest-based loans, payments on credits, or c) *"spending beyond their means"*. Thus, they took loans from family or friends *"that can be managed"*.

Discrimination in Business Processes

MFIs screen loan applicants to determine risk. Most loans are given to women with stable circumstances. Some organizations also give family loans - provided after agreement of the family (the man and the woman). While the family loan was created to protect women from unknown burdens, in cases the husband takes the loan and disappears or uses it for drugs, etc. However, such loan structures impact women secretly seeking to fund themselves and their families. Similarly, women in abusive relationships or with drug-abusing husbands, are considered high risk. Women who are already in difficult financial situations continue to be marginalized. Whereas, it makes financial sense, it is unequally discriminatory and disproportionately affects women.

Upper-middle income women reported discrimination as service seekers and faced rude interactions with men in public offices, landlords, property dealers, and cross-border transactions like importers and customs. Participants then dealt with this by including or substituting male relatives in the conversations. When funding was associated with gender discriminatory restrictions, upper-middle-income women reported either refusing funding or ignoring the comments without pursuing further to maintain the goodwill. One participant shared that,

> *"I was rejected ... because of, oh, you are a single founder and female as well, not because of anything else, ... I was also getting an investment from ... [names a job title, he] said that I have to sign the paper that if I don't get married for x years, then I will invest in it. [I: (interrupts) why didn't you?] P: (interrupts) why I did not? (laughs) I was going to sign the paper because I was not looking forward to getting married, so like I told you my father is the final decision maker, so when I come home and I said that [her startup] is not making exceptional money but I have this opportunity for getting money, (laughs) and my father looked at me like are you stupid? It does not work like this, you won't sign it.... but now when I look at it, my father was right. This clause is not given to men, investors don't even ask guys like when are they going to get married and what are their plans for marriage and after marriage, so why should I be asked such questions. So that was a good decision that I took." (upper-middle, urban)*

3.6.6 Gendered Interactions

Business Processes

Irrespective of the income segments, participants reported facing gender harassment in business dealings or business-related public places (like banks, etc). Men from lower-income segments were even discriminatory and dismissive of women supervisors. Participants believed that this was due to a possible lack of experience with women supervisors, stronger patriarchal values in lower-income segments, and differences in women's outlook and conduct across classes. High-income men were not free from discrimination. However, they avoided outright discrimination and were subtle in gendered comments due to the social pressure of acting professional, human resource guidelines, or public dismissal of gender discrimination by educated women. One woman shared,

> *"There was an incubation center in Pakistan they were giving investment and [identifiable information of center omitted]. I thought that I should apply there and ... get incubated and work ... on my idea and I had some ideas as well. ... So when I applied there, the judges believed that 'Umm, you are a girl and .. a*

> *fresh graduate, you don't have enough experience and since you are in Pakistan so you may get married very soon and you won't be able to focus on that', so (laughs) there is no chance for you."* (upper-middle, urban developed)

Besides funders, women service providers reported facing difficulties with men clients as well.

> *"See, most of my clients are foreign clients, They haven't seen me, they don't care how I look ... as long as the work is being done. Here people don't take you seriously like that... I don't take up local work unless they are 100 percent advance payment, then I will take them up otherwise I will not. [I: So what happens? When they don't take you seriously?] P: Firstly, they don't take you seriously like this, that meetings happen and they wouldn't hire me... they think that .. I am just someone, saying this. I think that is a lot of wasted time on my part, and effort also, because I go and do all this long effort and then say goodbye. Here clients drag you so much for money, oh my god, they humiliate you, I feel like I owe THEM money. And that's your due that they should give you on time."* (urban, upper-middle-income)

Upper-middle-income participants believed that the clients' behaviors - skipped payments, delayed payment, need for payment negotiations and reminders, and requests for installments and discounts - were because of their gender. *"There is this one client,... he pays well, ..but he annoys so much before paying.... After that, I stopped taking work from him because I was like he is too annoying. Then I stopped taking his calls, he showed up at the office one day. 'You are not listening to me' [mimicks male voice]. He tried to convince me. 'No No, you would do this!'. I was like ok, what can you do? I was like he has come to the office. And then again, the same humiliation [for payments]." (upper-middle, urban)*

Considerations in Recruitment

Lower and lower-middle-income women never considered men as helpers or apprentices/trainees. When it came to hiring other women, they feared differences in behaviors, motivations, and

work practices and preferred working alone. While most low-income women provided stitching or salon training to young women from the neighborhood, they remained concerned about the safety and honor of the girls and their businesses. This included ensuring that these young women would not engage in interaction with unknown men - a frowned upon action in the society, as well as preventing any actions that might damage their or business's reputation. *"I'm at a new place where I work and it's very hard to find a trustworthy guy. And the girls these days, it's not safe to keep them with you so we don't. They bring mobile phones with them and you never know they make a move and I get to face all the blame that their madam helped them run away with someone. So this is why I only keep those girls whom I know and have worked with them before or else I never keep anyone with me."* (upper-middle, urban)

One participant was inquired if her apprentice is running the shop during the interview. She replied *"No, I locked it up and came here. Because the parlor is also my home, so this is why. Some guests could come over so in that case, it doesn't look nice to have girls there alone." (low-income, urban)*

Upper-middle-income and high-income women considered hiring men helpers but hesitated due to the apprehension about the negative impacts of male presence in the workplace especially those who can be detrimental to their created work environment. which was designed to be women-centric and women-friendly. *"As a boss, we don't even hire such people, from whom we get a slightly uncomfortable feeling. That is why I am taking so much burden. Because if a wrong guy gets here, I won't be able to handle it. It would get uncomfortable and I would have to fire them." (urban, upper-middle)*

Preparation for Business

Women are socialized differently since childhood and reported feeling unprepared to take financial or risky actions. Pakistani culture dictates that women get married and move from their father's houses to husband's and are the husband's responsibility. Thus, women lack skill-level, confidence, or public interactions experience that might be beneficial as an entrepreneur. None of the participants had inherited a family business nor had planned to

be an entrepreneur and reported starting afresh and *learning on the go.*

One woman shared her views on the reasons for this disparity in women's readiness. *"Women are raised differently... I never realized that I will have to fend for myself. I have realized it very late .. around 27 or 28. Before that, I was doing it out of interest, that I am getting pocket money ... like that. It was at 26 or 27 that I realized that no, what if I am all alone? You know. Around that time .., when you are not married by that time, you realize that what if you never get married, and your parents don't always live with you. Brother stays with you for a while, when a brother gets married, he sees his priorities... That is when I realized where am I, what am I doing. And think, that a boy who is 16 years old, he knows exactly what he wants to do, he starts so early on it, and in the years when you learn very quickly and when you do things very quickly, - you know there is a lot of difference. I think I am at a disadvantage like that." (upper-middle, urban)*

Lack of Peers and Role Models

Middle-income women reported a likely preference for a woman co-founder or support team as opposed to men. This can be due to the comfort level of the women business owners and the fear of *male ego to always be right.* However, participants reported that most women in their social circles either had different life paths due to cultural expectations or women lacked the financial or family support required to start and run a business. *"I have had a lot of friends who would have wanted to do this with me. But because they were girls and their life path was going to be different. And I didn't think that parents would be like 'yes come on and we would give you money'. This is what happened to me too. Like I wanted to do business since I was 19. It took me, now I am 35. I took this step when I was 34. Now, he trusts me enough and I got the money from him and did all this. Now he is like ok. But before this, he was not at all confident in me. It could also be the fact that he was a salaried guy and he didn't want to take the risk. But ... It was difficult, because those of my friends who were willing to do business with me, could not, because they didn't get permission from the house maybe because they got married or they didn't get money from parents, cash in hand, that 'go and do your thing'. There were times when I would always complain that*

'man, I wish I had some guy friends'."(upper middle, urban developed) Another reported *"I dont think women have access to that kind of money. Even if they do, its not their own money. And if it is their own money, they are verrrry careful about it. Men are more, men are risk-takers, women are not when it comes to investing."(upper-middle, urban developed)*

All educated upper-middle and high-income women, knowing about the study purpose sought assurance about the accuracy and efficiency of their processes and similarity to other women business owners. They also inquired if we have met similar women - in terms of discrimination faced, processes adopted, or strategies implemented and also inquired *"if there are better ways to do"* these tasks. Some women supplemented these queries with information about being the first woman startup in an incubator or working space, or never meeting or knowing another woman in their business. This repeated inquiry from the upper-income women showed a lack of role-models for women to follow and a lack of assurance for women-business owners lacking the formal or informal apprenticeship model like lower-income women.

Role of Gender in Family Life

Lower-income women reported "earning trust" and "being tested" to run their businesses. These instances also showed the constant tension that men, alongside women, especially in the roles of husbands face as they also negotiate between the society, their family's wishes, their income needs, or their wives' wishes. One woman when asked about how her husband responds to the negative comments of her in-laws that parlor is not a respectable profession and you should not let your wife run this, she said *"My husband knows that too. He has never tested me? Like at times he comes to the parlor without calling me. Like he calls me saying that be ready I'm coming to pick you up but at times he comes without calling me too and knocks at the door and I'm right there. Sometimes it happens that he drops me off at the parlor and after half an hour or so I may go outside to go to the restroom only to see him sitting in the mobile shop right on the opposite side of the road (across the parlor). [I: Because of trust?] P: No, he trusts me a lot - he has never said or done anything. But maybe he just tests me to see where my wife is going where she is not going. But I'm so*

thankful to God that he never found anything to date. So I also say to him sometimes that 'see how your family keeps saying that I go to the salon and all', but he says but I know how you are and if I'm allowing you to go then others should not have a problem with that. This is because he has tested me and he has trust in me."(lower-middle, urban-developed)

In Islamic law of inheritance [70], after a parent's demise parents inheritance is distributed 2:1 where 2 portions are given to the male child and one is given to the female child. This played both ways - while most middle-income fathers believed in *"distributing among their girls in their lives"* and helped the women; at other times, where fathers supported women, I heard a few instances of brothers being resentful of investing in women's education or enterprises. As one woman explained *"the more they spend on me, the less there is for him to get"*. In one strongly patriarchal upper-middle-income household, the father did not pay for the private university education of the participant upon the brother's advice. On the other hand for high-income women, brothers were much more supportive. This could be because as reported by the participants, either the brothers were fully self-sufficient or the high income of the family ensured surplus assets for everyone, or the more liberal environment of the family which did not discriminate based on gender.

All women business-owners irrespective of socioeconomic segments considered their fathers (if unmarried) or husbands (married participants) as the head of the household. One upper-middle-income participant shared about the financial decision making in her house *"My brother and my father. Like they don't listen to me. No matter how logical my argument is, .. my father will not listen to me. He will listen to my brother, even when he says it night when it's daytime. I am not kidding. This is not the frustration that I am venting. but that's true." (Upper-middle-income, Urban)*

Familial Responsibilities

All women reported a shortage of time due to their business activities. Middle-income women lacked specialized staff and performed diverse tasks leaving no time for self-care, record keeping, or business management. Lower-middle and lower-income women reported managing personal and professional lives together. *"I sew dresses and when I start wash-*

ing clothes by hand it will take all day. In the machine, I just had to put clothes in and ask my daughter to take them out for drying. This will save time. " (low-income, Urban-underdeveloped) Another woman reported *"When I come back home at 9 pm, I bring vegetables with me at 9 and then whatever I have to cook I make it and then we have our dinner, we usually have our dinner by 10-10.30 pm." (lower-middle-income, suburban)*

3.6.7 Use of Technology

Technology ownership and use by participants was representative of their socioeconomic status. Most low-income women did not own phones or shared devices with family as also observed by [242, 115, 222] A few lower and lower-middle-income women used smartphone-based applications like Whatsapp for communication purposes only. Some lower-income women maintained two phones - one for business or one for home purposes - to avoid misconceptions of talking to men on personal phones. Besides, public opinion of the communication with men, participants also feared harassment if the numbers are shared outside of familiar circles. One participant described how her number was leaked.

"*For instance I am sitting in someone's home and some guy sees me. He would get my number by offering some sweets or would say something like 'I have to get clothes for my sister can you give me her number?'. Then they [men] call you and say 'You are so nice, this and that'. "* (Low-income, suburban)

Middle-income and higher-income women's technology ownership and knowledge increased with economic class. Among all the participants, the middle-income women were the most frequent social media users for their businesses (Facebook and Instagram for publicity and promotions and Whatsapp for communication).

Gender and Technology

Technology is promoted as an equalizer that can increase the reach and efficacy of personal and entrepreneurial activities. Numerous organizations are working towards reducing the digital divide and increase the uptake by women. However, the conversations showed that even with technology access and use, gender discrimination and power structures prevail.

The most prominent gendered dimension of authority and control existed in professional social networks. Most of these groups were run by men including male administrators of all women groups being suppliers and vendors, and participants reported power dynamics and even reluctant in adding women to such information groups. One woman travel-agent explained how she had been excluded from a professional all-male group: *"Even the existing tour operators had a WhatsApp group where they would coordinate about the best routes, which place has the best hotels, and a lot of other information that you could get through that group. And I asked them to add me to that group. So for a very long time they didn't add me in that group at all saying that since they don't have another female in that group so they can't add me just because of this reason. Then I got after them and kept pursuing saying that what sort of logic is this and what sort of professionals are you operating on this logic. They would say no we have our male-specific jokes and all and we can't add girls in this group. Eventually, I don't know what happened but they added me, either out of pity maybe or I don't know what. But everyone kept fighting and arguing, asking me to 'get a male representative who would talk to us in this group on my behalf', saying because you are a girl and you can't do this."* (upper-middle, urban)

Some lower-income women also reported using YouTube or the internet to search for items related to their businesses like *henna designs, dress ideas, makeup videos* as seen in [179]. However, while YouTube acted as a positive medium enabling low and lower-middle-income women to increase learning and improve their service offerings, this device use was mediated by, shared with, or restricted by family members, as reported by other researchers [225, 11, 115].

3.6.8 Failure as a Data Point

Normalization of failure, *Build early, fail often*, and consideration of failed businesses as data points is a recent phenomenon [120, 52]. I asked the participants about failures - their worries, and their contingency plans. To understand failure's impact on women's lives, it is pertinent to revisit reasons for why these businesses exist. High-income women converted their passions into businesses. *"And then if it doesn't work, what the worst that can happen?*

It will fail, I will get another job. " (high-income, urban developed). Whereas other income segments, especially low-income women, relied on business income to run the household.

For the low-income women, a failed business is not a data point but a skipped schools' fee, *"a skipped meal"* or many meals. While middle-income women lived with families and had accommodation and meals, the low-income women were married and relying on their finances, at times without the benefit of a husband's earnings. To explain this, one woman shared the hardships she had faced after her husband's deteriorating health that had led her to this business:

> *"The day my son was born, we had nothing to eat at home. We would cut an onion into slices and sprinkle it with salt and pepper and eat it and would never let anyone in our surroundings know and we never asked anyone for help. I never even told anyone in my parents' home that we don't have anything. It was God who just made us go through that time. And then my son was young and was feeding on milk and there would be no milk at home and the home next to us had cattle and goats with them. I'm just telling you the circumstances that there were times when we would just give away 4-5 kilos of milk to friends and then there were those times when nobody asked us. But then we had to ask them if they could give us milk for our kid although I didn't feel like asking for it. I asked them how much would they charge for it but they said to me that I can just take it like that. Then I would bring that [milk] and add water to it and give it to my son. I have also gone through those times and I thank God that He gave us the strength to go through those times. We could have never thought that we would be able to go through those hard times."* (low-income, suburban)

3.7 Findings: Design within the Margins

3.7.1 Negotiating Existence within Patriarchy

Limiting or avoiding gendered interactions

In order to maintain image of piety and avoid societal retaliation, women avoided interaction with unknown men or were selective in their interactions and hiring. Thus, lower-income

women relied on the male relatives to perform all tasks *"outside the house"*, whereas upper-middle women substituted with family members as needed.

> *"Like the owner of this place, whenever we have to talk to him or something, there are times when I want [co-founder's father] to make the call. When it's like a more difficult conversation where I think they take me lightly, which they do. So then I have asked uncle a couple of times to call. If uncle is not available, I do think who to ask, or to ask my dad."* (Upper-middle, Urban developed)

Low-income women shop owners minimized their interactions with unknown men by being selective in the products they sold and their hours of operation as well as by asking their sons to watch the shop in the evening. One woman reported being specific about never keeping cigarettes at her shop to avoid men visiting her shop and random men visiting or standing at her shop. Another woman said,

" So, I don't keep stuff like pumps or seats [of bikes]. Just stuff for children so that kids come to my shop only or mothers and sisters like me. And I close in the evening when men have to come back from work." (Low-income, Urban developed)

Informing about actions

Another strategy used by low-income women was regular information sharing with their family about their daily interactions. They reported that working outside is already controversial in many ways. They always keep their husbands or family informed, so that in case of a problem, blame or misrepresentation about them, the family already knows everything. As one participant explained,

"I never do anything without my husband. Whatever task it is, I always let him know. Whatever I do outside even if I have a fight with someone outside or I receive an extra amount of Rs.10, I tell him everything when I get back so that he knows it too so that in case if something happens in the future where I get in trouble so he doesn't blame me for going outside to work. If a problem occurs in future he would say to me that you didn't tell me earlier or that he had no knowledge of the matter of what I do outside. So to avoid this

I tell him everything I do or happens outside like I did this, this call came in or if somebody bullied me or whatever happens I tell him immediately." (lower-middle, urban developed)

3.7.2 Business within the Margins

All low-income women worked from within their homes either due to "lack of permission" from husband or family or due to familial responsibilities, including childcare, meal preparation, and house keeping. By working from homes and engaging in businesses like stitching, running small shops or selling clothes from homes, women could perform familial and business responsibilities simultaneously.

The most fascinating examples of this constant negotiation between personal and professional tasks was seen in the cases of women who were running their shops from within their homes. These women utilized one of the rooms of their homes that faced the street and either made a window or a door in that room that acted as a way to interface with customers. While the women stayed in that room with their supplies, thus staying within their homes, the customers interacted through the window or door. These women would open their shop, take breaks to go to the back of the house to prepare meals, and alternate between child care, household chores and shop duties.

One such shop owner (pseudonym: Noor) while being interviewed was interrupted by her daughter who inquired about what to prepare for lunch. Noor responded with some vegetable and the daughter then came in and asked the mother if this is what she meant. Noor and her daughter went to the house. The shop owner came back and told me that 'she (her daughter) will be trained soon and will be able to cook complete meals'. The customers who came to the shop while Noor was away, just stood there waiting in the shop indicating that this was typical. When she appeared from the back of her house, the customers proceeded to request their items.

These shops, besides being a sources of independence for the women-business owners were also a source of independence for the women in the neighborhood. For instance, in Noor's and many other women-owned shops I saw feminine products like women's sanitary napkins or razors. These items are usually not part of the merchandise found at corner

shops. These feminine products could often be found for sale at women-owned lace and button (sewing notions) shops. Upon inquiry I learned that these women-specific products were added to the shop inventory at the request of local women who shopped there and had asked these owners to keep such items.Women feel uncomfortable requesting such items from male-shopkeepers or asking male relatives to buy for them. Most women in Pakistan do feel uncomfortable discussing such issues with men including with family members. In one instance I saw a woman slide a PKR 10.00 note (bill) to the shop-owner, raise a product to show it to the shop-owner and walk away. This entire non-verbal communication was quick and did not appear to be unfamiliar.

3.7.3 Solidarity

Irrespective of their income segments, women sought and provided support to other women. Women in the lower and lower-middle income segments trained young girls in skills like make-up, stitching, and embroidery for free.

"No, we do not take any fee from them. We were trained for free so we are training them for free." (urban, lower-middle income).

During an interview with a shop owner, another woman holding a baby came over from across the street and asked if the interviewee could watch her baby while she worked. The baby readily sat in her lap as if a familiar face. The shop owner shared that the baby's mother prepares meals and leaves her children with her while she cooks. This form of solidarity for women watching out for and supporting other women was frequently seen throughout this work.

While many women reported lack of women business owners as friends or role-models, they relied on other women for gendered advice. As one participant reported, *"She said I know just the guy for you. She is also single and she knows the type of guy who would be comfortable working with single ladies like us."* (upper-middle, urban developed).

Similarly, higher-income women tried to create women-friendly atmospheres and work environment. They proactively recruited individuals who would be suitable to a *female friendly* environment. Two high-income women reported seeking services from other women-

owned business to show solidarity.

Upper-middle and higher-income women reported a difference in performance across genders as owing to limitations posed by patriarchal social structures such as expectations to perform familial roles, permissions and conditions associated with work schedules, travel and interactions (especially with other men). They found it difficult to solely rely on women employees despite their best efforts. One woman believed that this is due to society's expectation from men to be primary breadwinners with no such expectation of women.

Giving back

One common theme across interviews was of giving back to the society. Upper-income women wanted to create an environment and services to give back, whereas, low and lower-middle income women believed that they should provide for others as God is providing for them from the unknown and helped them through difficult times.

> *"No customer rates. I just charge them looking at the customers. Like at times some ladies come to me who have a lot of constraints and not many resources. Although everyone has a thing for beauty, every person has a heart whether poor or rich or whoever. So they just come and say this is the amount we will pay for the facial so then I say fine. Then some other kind of ladies come over who at times say such stuff that makes my heart feel so bad that I decide on not to charge anything ... Although at times my husband says you are doing so much free work. But I say that God grants me from somewhere I don't even know of."* (lower-middle income, urban developed)

Participants reported giving charity to religious institutions like mosques, churches and the MFIs so they could give loans to others. She said,

> *"I did not want to tell you but let me tell you now, because my installments have not ended yet. I am Christian and I have a money box at home. When I started my parlor work and I did eyebrows of someone for PKR.50 (30 cents), I used to keep 10 rupee in money box to save that. And give for church. Suppose I do facial*

> *of PKR 1000 (USD 7), I keep 10 percent of it in money box. [I: Do you do this from start?] Yes, I keep for church first that is why business prospers. Everyone has different nature, I dont know what others do. I first take out for church then I spend for children to buy something for them."* (low-income, suburban)

3.7.4 Navigating Gender and Class Boundaries

Due to Pakistani socio-cultural norms, women from all segments prefer homes for service provision as well as while seeking services. An informal economy exists of beauty services being provided from homes. Once a woman beautician seeks training, she can either create her own salon, purchase accessories, and seek customers or work in someone's salon, which may be at a distance, with no pay for being an apprentice and a meager pay for full-time work.

One high-income woman supported women across segments in training, connecting them with clients, and helping them to navigate the patriarchal social structures. She founded a technology platform to connect low-income women with upper-income women who sought at-home beauty services. With *clients near their houses* the low-income women could provide their services at the client's homes. Once recruited, women were trained in a limited number of skills, soft-skills - valued by upper segment clients, and technology skills - to use the platform and other related technologies in return for a micro-finance loan that low-income women both take and return themselves. After they completed their training, these women serve clients and receive income.

Once deployed, the platform designers had to accommodate the fear of the trainees' husbands about their wives' independence and ability to earn outside the house.

> *"Like they [husbands] were thinking that they [wives] will get too independent - they are signing contracts with the company, the company is just dealing with them, we have no say in this. So we kind of like have to do [act] of like we call the husbands in and we say what is your opinion, you should always tell us. But actually the contract is still with just the woman, but kind of massaging their injured masculinity."* (urban, high-income)

Thus the company rebranded women's engagement as a family business including the husband,which was already happening through the service.

> *"Just because we now position [platform name] not as like a female making money but a micro-enterprise for the family because a lot of their husbands have quit their jobs and they take their wives from appointment to appointment and the wife gives them ... like take this 20,000 for being my driver."* (urban, high-income)

Higher income women showed solidarity across socioeconomic segments, by training, connecting and supporting women to reach a new market whose needs and existence might be unknown to low-income women.

3.7.5 Supporting Actors

Family members

Women's businesses are made possible due to the financial and social support from their families, irrespective of their socioeconomic class. While this support varied from professional tasks (e.g., market visits for supplies or delivery), technical, and financial assistance, the most prominent was social support. For all women with the exception of some high-income women, male relatives acted as allies within the patriarchal society.

Married women were mostly supported by their husbands, sometimes despite in-laws' opposition. Some low-income women relied on paternal/maternal uncles, brothers, and nephews in the absence or inability of the husband (due to separation, divorce or husband's health). Unmarried (upper/lower) middle-income women were supported by their family led by their fathers - who looked out for and frequently inquired about the business and if *"it was going well"*. This support was not only in the form of financial loans or advice for the business, investment, technological and social connections but also in the form of permission or social support when it came to acceptance within the society.

> "*A lot of my confidence in this society is due to my father. Even if he is not with me, I know that if I play that card and it works. Sometimes, lately, because*

> *I guess they are getting older, these are natural thoughts that occur to you. I feel many times, I feel very very, I feel almost helpless, like what would I do without him?*" (Upper-middle, Urban-developed)

Men in the society

Upper middle-income women reported reaching out to other middle-income business owners, mostly men, who were *"relatable"* or were *"following the same business models"*. Participants mentioned maintaining a distance, *staying professional* during these interactions. Two participants reported *personal comments* or dismissive comments like *how would you do that as a girl* when they became friendlier.

Children

Low-income women try to educate their children in the hopes for a better life. The children, in turn, help their mothers in maintaining business records (writing of transactions), learning to use the phones, etc. As one woman shared *"I ask my girls at the back of the house. They write it [items sold and price] on a piece of paper and give it [the hand written receipt] to me to give to the customers." (low-income, suburban).*

3.8 Discussion

This work is the first cross segment analysis of women business owners in a patriarchal society. I aim to understand the interplay between gender, class and patriarchal socio-cultural norms. Using qualitative interviews of 46 Pakistani women business owners from diverse socio-economic segments, it provides insights into the dynamic relationship between the patriarchal socio-cultural norms, individual and family needs, and the challenges and opportunities in their personal and professional lives.

3.8.1 Patriarchy across segments

This work reveals that gender relationships in a patriarchal context impact women across income segments. Differences in education and income levels affect the type of businesses

that women choose to open. For women business owners, within personal and professional interactions, patriarchal cultural norms are at play whether it includes talking to landlords, engaging with financial institutions as service seekers, interacting with clients, funders as service providers or with unknown men for support and advice.

These women employ various strategies to navigate these norms and continue their businesses. Low-income women, who are from relatively more conservative households and, at times, who engage in businesses against in-laws' or society's recommendations, rely on frequently informing their allies - usually husbands - about their interactions with the outside world. This frequent information sharing is an insurance against future allegations, miscommunications or confusions about women's interaction in the public spaces. Here, another important point is that the conservative in-laws can include women (like mother-in-law, sisters-in-law, etc.) who are born and raised in conservative cultures and have internalized the socio-cultural norms. Worried parents of middle-income and high-income families also frequently inquire from women about their businesses.

All women business owners realize and utilize their relative empowered status to support other women. Low-income women training other women and young girls in skills like stitching, beauty courses, etc., buying and selling feminine products for the ease of other women in the community, informing other women about loans and businesses to pursue were all examples of this solidarity and support without regard for competition. Middle and high-income women, who were also employers, supported other women by creating women-friendly work environments, seeking services from women-led businesses, and creating services to connect low-income women with earning opportunities. However, patriarchal social structures that limit women employees' mobility, interaction, and work hours, hinder their support and business productivity. Based on women's solidarity within and across socioeconomic classes and support for other women in their neighborhoods and society, I propose considering the women business owners of a community and upper-income women business owners as potential leverage points and possible supporting structures for designs by the HCI community, in addition to the popular consideration for inclusion of women's families, [115], male relatives, and mother-in-laws [242] in patriarchal contexts.

Women at all levels continued to be apprehensive about their interactions with men.

To negotiate their concerns, low-income women completely circumvent these interactions by avoiding selling products associated with men like cigarettes and relying on the male relatives to do *the outside chores*. Higher-income women try to maintain their confidence and autonomy but are forced to substitute for male relatives or employees when a serious conversation is required. Works on design in patriarchal societies have urged to focus on local values rather than adopting Western perspectives [242, 132, 274]. In alignment with these works, this work presents the socio-cultural norms and familial and personal values held by women business owners in Pakistan. As HCI researchers, our design and deployment of technologies and solution for these contexts will have to work within these women's constraints.

3.8.2 Hierarchy of power and prestige

In her book "Chasing Innovation" [120], Lily Irani discussed 'the conditions of recognition and reward for innovations are powerfully constrained by histories of colonialism, contemporary capitalism and other forms of social hierarchy, exploitation, and oppression.' I saw that these value judgments drive women, especially low-income women, to rely on ideas and ventures deemed lucrative by a different class; e.g., parlor services, or bridal make-up courses while still surrounded by low-income customers (neighbors, family, and friends) whose affordability and needs do not necessarily match these services. Another way one sees a continuation of the existing hierarchy of power and prestige is in the value associated with the outputs. Women from diverse socioeconomic segments produced stitched and embroidered clothes, yet products sold from home raised meager profits while the same product sold in a boutique earned considerable profit margins. While low-income women try to innovate by learning through courses and YouTube videos, their businesses are not as lucrative and valued as those of high-income women. Similarly, one sees women from diverse incomes engaging in cooking - where food is sold in a neighborhood public school canteen for children from the neighborhood; another is sold online and in-person with effective branding and packaging and, in turn, viewed as an innovative startup.

3.8.3 Empowerment within Margins

Women's empowerment can be measured using personal (power from within, power to), relational (power with, power over) and environmental empowerment [151]. Women in higher-income segments (high-income and upper-middle-income) are able to expand their personal empowerment (self-confidence, knowledge, autonomy) with education, income, and financial independence even before they start businesses, in comparison to lower-income women. However, when it comes to relation power (household decision making, participation in public events and markets) or environmental power (ability to break stereotypes and influence at political level), these same women lack this empowerment due to the strong patriarchal socio-cultural values around them.

While low-income and lower-middle-income women lack financial support, education, and professional exposure to successfully engage in businesses, they compensate by negotiating within the barriers and displaying solidarity. However, for middle and high-income women such social cohesion is lacking and also sparse. Thus, we need to expand the lens to marginalization by gender, isolation due to lack of peers, guidance, and role models.

Middle-income women were the most uniquely positioned among all income segments. They are educated and independent to run their businesses, have technology ownership and understanding, and are keen on the utilization of technology or tools that could support them. However, they are surrounded by a patriarchal society where men, besides their immediate family members, continue to be uncomfortable by their presence in the public spaces as well as hesitant in supporting them financially or socially. Low-income women who were born and raised in conservative or restrictive environments had specific processes to rely on the men and their families or had negotiated their lives to stay within the boundaries of the homes. Similarly, high-income women could utilize their income and social contacts per their socioeconomic status to engage within society. However, middle-income women, unlike low-income women, did not face strong restrictions, lack of education, independence, or agency, nor did they have the resources or social supports of high-income women to enable them to bypass these processes and interactions with men. Thus, these women have to interact within public spaces, which means with men. They either relied on their

immediate family members especially male relatives to support them and in cases where the family members refused, were absent, unavailable or unwilling, these women had to rely on themselves and interact within the restrictions of a patriarchal society.

3.8.4 Designing for the Margins

Technology platforms help technology literate women to bypass interactions with men by using digital tools (e.g., online bill payment or online ordering). However, technology alone, especially in a patriarchal society with limited digital services, cannot fully support women business owners irrespective of their socioeconomic status. For the middle and high-income women, while technology reduces the friction and communication hurdles for women, there are still in-person aspects of businesses - like construction and maintenance work, purchase of supplies and reaching the customers, financial activities requiring travel to banks or corner shops (for over the counter transactions) - that require women to engage with society in public spaces.

Women who are online, on social media still face gendered dynamics and power structures which impact or limit their participation. In a society where women are frequently harassed on social networks [101, 224] and fear shame or retaliation about sharing harassment incidents online [274], dynamics of power in digital mediums requires deeper inspection. As more work is done to reduce the digital gender divide [266] researchers should also explore the effects of patriarchal societies on women in male-dominated digital spaces and male-moderated media.

In recent times, there have seen ICT workshops (like how to create Facebook pages) or business workshops (accounting and marketing) for women business owners. This is in alignment with the stereotypical ideas and expectations of skills associated with entrepreneurship. However, the low-income women from this study would be better supported by tools that enhance their existing situations. Here I point out a few possibilities as seen from my work:

The first possibility is resolving low-income women's lack of visibility on supply-demand and competitive landscape. Low-income women's current model of business selection is based on information received from their husbands, other male relatives, or through obser-

vation of women in their social or geographical circles pursuing business with familiar skill. The result is twofold: a lack of diversity in supply and cannibalization of revenues. Thus multiple businesses with the same services lead to reduced business profitability due to high competition while at the same time missing out on other opportunities. Future HCI efforts could seek to connect these women to other avenues; for example, listing low-income women as skill-trainers, listing additional skills they have but lack equipment for, and connecting women with other opportunities to utilize their skills from home. I saw in my work that factories nearby utilized these women's services to complete their jobs like completing garments and wrapping candies in packets. Similarly, existing upper-income businesses could support seasonal demand (like wedding make-up salons requiring extra help, factories with additional jobs for women to complete from home) at a larger scale.

Another possibility is creating information sources about supply or demand. Existing services like training bureaus and microfinance organizations already have clear visibility about women's businesses due to their loan portfolios. Presenting such information might inform low-income women who would otherwise invest their loan money to start *"the sixth parlor in the same street"* and this could also increase loan returns and reduce default rates of these microfinance organizations.

A third possibility is diversification. Low-income women business owners are bound by a revenue ceiling for two reasons: existing customers only utilize a subset of offered services due to limited buying power and women's preference to establish a home-based business—balancing child-care and domestic chores with income generation—limits the ability of these women-owned enterprises to grow. Their time remains divided between family and business, and their clientele is limited to those within their vicinity, where the competition may already be high. This creates a need for information about horizontal diversification options (e.g., a beauty salon could start providing haircuts for children).

3.8.5 Labor of Women Business Owners in Patriarchal Settings

The findings show that Pakistani socio-cultural norms consider *"outside the house"* as an unusual place for women to be. Women reported that most of the technical, financial, and

business institutions in Pakistan are formed and run by men as well as continue to serve men better when compared with women. I observed women sharing about their *bifurcated consciousness* as women from all socio-economic segments still push against and navigate the patriarchal structures of the *outside world* even when they act independently in their businesses with the support of their immediate families, including husbands, brothers and fathers supporting their endeavors.

Previous works have discussed the various types of labor that entrepreneurs do in resource-constrained environments [27]. This chapter adds to this line of work by explaining the additional labor for women-business owners due to their gender. 1) Women across income segments were vigilant of their interactions. During recruitment, middle and high-income women are concerned about hiring the *wrong person* that can impact the women-safe environment created for themselves and their female employees. Similarly, lower-income women are also vigilant to recruit young girls and show concern for their reputation and their apprentices' reputations and safety based on gender. This constant concern forces women to take much of the workload upon themselves. 2) Low-income women business owners constantly go through the labor of seeking permission from their family, regularly updating their husbands or family members about their interactions and transactions to avoid any future allegations, confusion, or miscommunications making this additional labor both emotional and physical. 3) Besides these, women also overcome all the negative comments about them and their chosen professions. These gendered interactions put unconventional and additional demands on women business owners in comparison to men business owners.

3.9 Conclusion

I share an in-depth qualitative investigation involving semi-structured interviews with 46 Pakistani women business owners from diverse socioeconomic backgrounds. I found that personal reasons for starting businesses and types of discrimination faced in personal and professional life varied based on a woman's socioeconomic status. This work highlights the strategies used by these women to resist and navigate in a conservative patriarchal society and contributes as the first cross-segment analysis of women business owners in Pakistan.

It shows how women were supported by their families, especially fathers and husbands, who provide the pivotal social and financial support for these businesses in a patriarchal context. Besides resistance in their own lives, these women act as supporters for other women in their neighborhoods, communities, and across socioeconomic segments. Future works in HCI4D can extend the lens beyond low-income women and can also design with upper-income women in conservative patriarchal contexts.

Chapter 4

ROLE OF FAMILY AND RELIGION'S IMPACT ON TECHNOLOGICAL INCLUSION: TECHNOLOGY ENGAGEMENT PERSPECTIVE

The intersection of Islam and gender affect technological and social interactions for Muslim women in significant ways and remains an understudied domain for HCI and related fields. Building on 73 qualitative interviews with low-income women in Punjab, Pakistan, this chapter analyzes the complexity of family relationships and the subsequent dynamics of authority around technology uptake and usage by women within non-Western contexts, and specifically, within the Islamic world. I argue that a Pakistani woman's experience with technology depends on many factors, including gendered roles, generational differences in a family, and wider socio-cultural and religious influences against the backdrop of a culturally conservative and patriarchal society. This chapter highlights the rich family dynamics, including key life events, that transform the roles of both Muslim women and their relatives. This work is intended to inform scholars, practitioners within development agencies and industry, and other individuals studying technology and development about household dynamics that influence Muslim women's use of technology, to encourage them to consider these dynamics during design and implementation processes for technological inclusion.

Technology adoption and uptake is not an individual effort. Based on my research, technology understanding, adoption, and use is a process with many actors performing various roles at each step. This understanding was formed after analysis and review of my research about technology use in low-literate households.

This work can be viewed as the articulation work [239] that bring forwards the hidden tasks, actors and actions happening behind a user's technology use and adoption and the hidden actors performing these tasks. This chapter is adapted from an earlier work presented at the 22nd ACM Conference On Computer-Supported Cooperative Work And

Social Computing [115] [1].

4.1 Introduction

CSCW scholarship has focused on families through the lenses of collaboration, learning, and ethics. Often, the definition of the family refers to the basic unit of human society. I discussed with the participants a range of technologies, from digital devices to everyday appliances to sewing machines. In this chapter, the word *technology* includes basic phones and smartphones, the internet, computing devices, daily household devices, and the features of such devices. Technical and social roles pertaining to these devices (mentioned in this chapter) apply universally, whereas acts such as monitoring and restricting use apply primarily to mobile devices. Technologies play an important role in family relationships.

Research in CSCW and related fields has shown how the use of technologies can extend or enhance relationships between family members and has indicated how to include families in the design process [122]. For example, after reviewing 84 papers from CHI and IDC, Isola et al. noted that HCI researchers have viewed families as users, informants, testers, and design partners, reminiscent of Druin's designing for children taxonomy [72]. However, beyond this taxonomy, families can play secondary roles. One important impact of families is their effect on the use of technologies by an individual. The socio-cultural foundation of the family affects what one owns to what one creates, consumes, or shares online, and, thus, warrants further study. This is especially important when considering a user's gender, religion, or cultural heritage, which can impact technological use within a family. In such cases, the family also plays a role in suggesting, regulating, or limiting how and what technology is available and how it is used.

ICTD research has illuminated the affect of family dynamics in discussions of technology engagement in non-Western contexts. For instance, [139] illustrated how, in rural India, women exhibit agency and successfully access support networks despite strict social conventions and patriarchal values that inform interactions between men and women. While highlighting the challenges faced by women in conservative and patriarchal contexts within

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South Asia and elsewhere, the literature on family and technology is less developed with regard to the analysis of religious norms, especially those prominent throughout the Islamic world, and their impact on technology engagement. Several scholars explore the intersection of religion and technology but not directly in relation to the family. For instance, Genevieve Bell urged the exploration of ICTs for spiritual practices, which she called "techno-spiritual re-purposing" [34]. In response to Bell's paper and her keynote at CHI 2010 [83], Buie and Blythe [45] explored the gaps in techno-spiritual research in the HCI literature. They discussed additional techno-spiritual themes for HCI researchers, including the adoption and adaption of new technologies, enabling spiritual practices, and spiritual experience. Wyche et al. recommend the use of religion and faith as a lens through which to view these practices [272] and explored these techno-spiritual practices for everyday life [269], including use by American Christians in homes [272], use by American ministers in their religious work [273], and use of prayer time application by US Muslims [270, 271]. Researchers have examined the role of technology in the family in the contexts of the Middle East and North Africa, but they do not directly discuss the impact of religion. Norah Abokhodair's research on social media in the Gulf states and her call for culturally inclusive research and design highlighted women's use of technology within a distinctly patriarchal society [3]. Dodson et al. [65] drew attention to gender gaps when considering technology use by Berber-Muslim women in Morocco and how these gaps are fueled by gender-specific cultural norms that limit women's ability to seek assistance and overcome barriers to mobile phone use. While Dodson et al. sought to extend their claims to other indigenous communities within North Africa, this work argues that the nuances of family dynamics and the challenges for Muslim women to engage with technology also have far-reaching implications across geographical regions. In this chapter, I describe such a context observed in low-income Pakistani households, where technological use was gendered and family-guided decision making played a key role in how and why women did and did not use technology.

This study accounts for the family dynamics that dominate technology access against the backdrop of a culturally conservative and patriarchal Islamic society. I present the complexity of family dynamics around technological inclusion. Further, I articulate the different stages of technology access, knowledge, and use by women, as well as how these stages are

influenced by family members.[2] Many social actors beyond a woman's household can influence a woman's engagement with technology. Some prominent actors in the data include mobile shopkeepers, women employers, and technologically savvy neighborhood women. All these actors supported women's technological interaction. However, this work focuses on family members and their impact on women's technology use and inclusion.

Pakistan offers a unique setting for this research since it holds the next-to-last place in the world for magnitude of gender gap [264]. Pakistani women face issues that arise from gendered norms interconnected with religious and cultural practices [246] [218].

In this study, I analyzed 73 qualitative, semi-structured interviews with women from various low-income communities across and around six major cities in Pakistan to answer the following:

- Who among a woman's family members dictates, mediates, supports, or limits her technology access, use, and understanding?

- What are the various relationships between women and their family members, and how do these relationships define the roles of each family member?

- How do key life events transform and evolve the roles of women and their family members with regard to technology engagement and technological inclusion?

To answer these questions, I identified the various actors, from direct enablers to limiters, as well as secondary roles that collectively inform the usage of, access to, knowledge of, and interaction with technology for Pakistani women. These actors influence the way women engage with technologies in addition to the type, quality, and frequency of interactions that are possible for these women. This work demonstrates the richness of interactions of these women with technology. Their stories form the basis for my analysis of how socio-cultural, technical, and personal motivators enable and limit women's ownership, access, and use of technology. I argue that the family unit and family considerations are the strongest motivators for low-income women's decisions about technology.

[2]Both immediate and extended family members (nuclear and joint) are referred to as 'family'.

In the remainder of this chapter, I first outline the context, background, and related research for this work. I next describe the methodology and present two representative cases studies intended to show the complexity of familial relationships. Then, I share the findings, which address the stages of technology engagement and technological inclusion, the actors in women's engagement with technology, and the drivers of authority. Ultimately, the discussion reinforces the claim to take family dynamics into account when assessing technology engagement and technological inclusion of women in contexts that emphasize religious and cultural norms. These norms affect gendered roles within families, the gendering of public and private spaces, and notions of authority that are linked to age, gender, and status within the family.

4.2 Background

Studies have investigated technology design for collective use within the family. However, the impact of family dynamics on the use of technology designed for individuals requires attention, especially since it directly affects technological interventions designed for improving aspects of women's lives. "Designing for Families", a special interest group at CHI 2009, highlighted the fact that a family can extend beyond biological relations and committed relationships to include cohabiting familial boundaries (e.g., roommates) [182]. The word *family* used in this chapter is defined as both individuals related to one another and individuals living together as a household.

In Pakistan, as in other parts of the Islamic world, family structures are driven by bonds of biological relations and created through marriage. Sons and daughters tend to live with their parents until they are married. After marriage, the patriarchal structure demands that daughters leave their paternal homes to live with their husband's family, while sons remain with parents and take responsibility for them, their wife, and children as the primary earner. In a joint household, the kitchen and courtyard are spaces shared among parents and the families of their sons. As family size increases, a couple might decide to move to an independent home. Islam grants a woman the right to demand a space for herself that is separate from her husband's parents. The duty-bound son must consider his wife's requests but balance them with the needs of his aging parents, who may require additional care-giving

from the younger generation. Because of this, multi-generational families are commonplace in Pakistan and other parts of the Islamic world. In light of these living arrangements, in addition to the prescriptive practices to respect and provide care for elders, the opinions and decisions of the eldest family members (regardless of gender) carry great weight. This stems from the teaching of being answerable (to Allah) for the people for whom you are responsible. This responsibility is explained in the following hadith:

> *Take care! Each of you is a shepherd and each of you shall be asked concerning his flock; a leader is a shepherd of his people, and he shall be asked concerning his flock; and a man is a shepherd of the people of his house, and he shall be asked concerning his flock; and a woman is a shepherd of the house of her husband and over their children, and she shall be asked concerning them.* [Sahih Al-Bukhari, Al-Adab Al-Mufrad and Sahih Muslim 1829]

Furthermore, the Qur'an emphasizes the role of men as the protectors and maintainers of women, as described in Sura an-Nisa' (The Woman):

> *Men are the protectors and maintainers of women, because Allah has given the one more (strength) than the other, and because they support them from their means. Therefore, the righteous women are devoutly obedient, and guard in the (the husband's) absence what Allah would have them guard.* Q4:34

These passages and other excerpts from Islam's sacred texts demonstrate a particular way of defining the roles of men and women in the family and the household. The shepherd has responsibility for others, but this does not imply absolute control. My observations in Pakistan showed that immediate families (i.e., nuclear families) lived in separate households, demarcated areas of a collective home, or in proximity to other related nuclear families that belonged to siblings, cousins, etc. This type of shared living arrangement supported the lending and sharing of household goods, supplies, and services, such as childcare.

Beyond these prescribed roles for men and women, Islam provides agency to women in choosing their spouse, refusing to stay with their spouse, and annulling a marriage [131, 8]. Furthermore, scholars have called for understanding the primary texts of Islam in the time

and place in which they first appeared when considering their implications within modern contexts [98]. Some then apply these verses to convey a message of respect, honor, and women's rights that speak to the core agendas of many contemporary feminist movements [221].

Religious beliefs and practices influence gender relations and the resulting socio-cultural and technological interactions. However, this influence remains an under-explored area of research in CSCW, HCI, ICTD, and related fields. Part of the hesitation to engage in this type of analytic framework is discussed in Section 3.3.

4.2.1 Women, Digitization, and Contemporary Pakistan

I conducted this research in Pakistan, a Muslim majority country, founded in South Asia in the mid-20th century. Although its name, the Islamic Republic of Pakistan, suggests an underlying religious orientation, Pakistan's secular legal system does not implement regulations for women, such as covering one's head in public spaces or enforcing that a male relative must accompany a woman outside the home.

However, Islamic beliefs and practices persist through social norms that maintain gender segregation in places such as mosques, marketplaces predominately populated by male vendors, events such as weddings, and educational institutions, from primary school through university. For example, one university imposed fines on female students who wore jeans or who did not wear a dupatta[3] [245]. Another university fined women for breaking the rule that *male and female students should maintain a distance of at least six inches while sitting or standing together* [194]. These stories illustrate how educational institutions enforce gender segregation based on conservative values that form the basis of society. This gender segregation has created wider gender gaps in areas of education, health, political participation, and employment [246]. Besides this, Pakistan has gender-segregation in the form of women police and security personnel specifically for interaction with women as well as gender-specific times for the use of gyms and swimming pools, all which reinforce the notion of gender segregation.

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[3]A scarf worn around the neck or over the head by women in South Asia.

With a population of 101 million women in a country of 207 million people, Pakistan is the world's fifth most populous country. However, it is second to last in the gender gap per the World Economic Forum's annual Gender Gap report [265]. South Asia has the largest gender gap, 26%, with respect to mobile phone ownership [93]. According to GSMA's Gender Gap Report, 44% of Pakistani women have a mobile phone compared to 80% of Pakistani men [percentage of the total adult population]; only 10% of Pakistani women use mobile internet compared to 26% of men. In urban settings, this gender gap in mobile phone ownership and internet use is 40% but increases to 49% in rural settings [93]. Pakistan has 35 million Facebook users, with 77% male and 23% female profiles [92.06% of its online population] and the sixth-highest worldwide male ratio on Facebook [260].

GSMA research identified Pakistan as the most conservative society in South Asia in terms of social norms regarding women's mobile internet adoption, followed by Bangladesh, India, and Sri-Lanka. This research outlines the enormous pressures women face to follow social norms and protect their families' reputations [92]. Significantly, it reinforces how conservative social norms, as informed by religious and cultural practices, are deeply embedded in family dynamics and the way people make decisions about technology.

4.3 Related Work

This work intersects with and builds on several bodies of scholarship within CSCW, ICTD, and HCI, including those that analyze gendered engagement and consumption of ICTs, technology uptake and use within families, and feminist HCI.[4] While the understanding of gendered norms and relationships across genders and ages are critical to these areas of research, this work extends these areas in crucial ways, primarily by considering non-Western and Islamic contexts.

[4]Here, too, one might consider the rich literature within the field of digital anthropology, which examines the ways people adopt and adapt new technologies within a broader social and cultural context. Through extensive ethnographic research, these works explore how new digital communities are formed, the impact of digital technologies on people, and the uses and consequences of digital technologies. See [109, 56, 55, 167]

4.3.1 Gendered Engagement and Consumption of ICTs

A rich body of work in HCI and ICTD literature explores women's interactions with computing technologies. A full description of the work done at the intersection of gender and computing lies beyond the scope of this work. However, a few key areas of this research are particularly relevant to this work, including gendered access and use of technology, women-focused technology design, and women's empowerment through technology. Some of this literature focuses on sexual harassment through various communication platforms and design implications for different experiences around it [61, 62, 36], including cyberstalking, impersonation, and personal content leakages in South Asia [222], and the role of technology in financial life cycles of women in Pakistan with respect to finances for circumnavigating patriarchal society [179]. A parallel body of work in HCI and related fields emphasizes the systematic (and often invisible) marginalization of women in various computing-related fields [197, 71, 43, 48]. Besides computing, [25] describes the marginalization of women through their absence from digital photographs. Most strikingly, gender affects a person's access to and knowledge of technology [114] and also influences how technology is consumed [275].

Depending on a given context, men and women are socialized to make gendered associations with technology. [207] discussed how Qatari women use creative approaches to interact online while adhering to social norms. [113] observed that women have different technological challenges than men in terms of understanding and adopting technological and financial services in Pakistan. This can include a fear of technology, which is more pronounced for women than men. For example, Sultana et al. demonstrated how rural Bangladeshi women face barriers to technology access, especially the fear of using mobile phones; they also describe how mobile interfaces in the West do not address the values and needs of these women [243]. Nova et al. advanced this discussion by showing how women in Bangladesh are often harassed over anonymous social media by friends and relatives who hide their identities [189]. Hassan and Unwin [100] described the fear of harassment and bullying faced by Pakistani women and how it affected the construction of online identities by Pakistani youth. Hassan et al. advanced this argument, showing why many Bangladeshi

women did not participate in the online #MeToo movement [102]. Another study argued that even though men can be the subjects of sexual harassment on Pakistani digital media, women experience sexual harassment far more frequently, which the authors attribute to the patriarchal and Islamic character of Pakistan's society [101]. These fears can be mitigated through a technology consumption framework that allows others, mostly men, to intermediate the engagement and consumption of technology [114]. My work contributes to this line of research by illustrating the technological status of women in Pakistan, especially within families where certain members act as technological intermediaries [225]. I present nuanced stories to extend the conversation of intermediaries beyond input and output.

Some works focus on women as end-users of technological projects, while others discuss existing adoption practices and how they shape women's use of technology. These include projects targeted at women's increased consumption of knowledge through health videos [140] and improved device literacy for mobile phones [268] to tackle gender injustice and enhance critical agency [216]. Other research outlines the differences in technological engagement between men and women using call logs. While men more actively use phones in the morning, women used the phone more at night [164]. In both Rwanda [38] and Pakistan [209], researchers observe consistent gender disparities in mobile phone use. Gender differences also exist in terms of women's learning of technologies [210] and adoption of technology [181].

Previous research explored the use of technology for women's empowerment and enactment of agency [107, 171] and for overcoming social barriers [196]. [138] investigates men's perceptions about the use and non-use of technology by women, and how notions of non-use and digital illiteracy are imprecise in the case of women in rural India. In other contexts, such as low-income settings in Bangladesh, [10] found that one's gender impacts and limits one's technology use, and that gender inequality with respect to technology requires a three-pronged approach that addresses design, policy, and theory.

4.3.2 Technology and Families

Beyond the gendered dimension of technology engagement and consumption, a body of research on technology and families exists [105, 79, 229, 106]. Most of this scholarship focuses on Western contexts where, for example, researchers discuss parents' restrictions concerning their children's technology use (e.g., at the dinner table) [105]. This extends to parents seeking direct oversight of their children's technological devices and apps, even when they may struggle to understand unfamiliar technologies [37]. For low-income families, regardless of the context, parents may have significantly less education and technology exposure than their children. Technology can bring families closer together and act as a source of entertainment. For example, [116] illustrates how families in France, Sweden and the U.S. utilize technology to coordinate within and across families as well as maintain playfulness and have fun, even at a distance. Relevant to my work is that of [17], which found that matchmaking technologies in Saudi Arabia lacked the necessary features to include the roles of family members, who would typically participate in such a process.

Several studies show that decision making in families affects technology use, especially user privacy, in shared phone settings. Within patriarchal societies, social and gendered norms for use and non-use of mobile phones exist [138, 242], and, in turn, these norms shape how married women, in particular, use mobile phones [177]. [12] observed the gender dynamics that impact women's privacy in the instance of shared phone usage as well as practices for protecting data. This work closely relates to my work in that it reveals the sharing of devices between family members. [46] illustrates how husbands exclude women from phone use, letting them talk on the phone but not dial it. They also found that women receive phones as gifts but were denied permission to decide how to use them. Other studies have shown that dependency – in the form of usage, access, or sharing models – can limit women. Relying on others because of their lack of functional literacy and numeracy, phone sharing, and gendered cultural norms can lead women to cede personal privacy [65, 11, 174].

4.3.3 A Feminist HCI for the Islamic World

Viewing HCI research through a feminist lens is emerging as an important theoretical approach within the HCI field [217]. Pioneering this approach is Shaowen Bardzell, who proposed six agendas to make computing more gender-inclusive [32]. Feminist approaches are now well-accepted in HCI as research methods [33]. While such a turn is thought-provoking, most initial work in this area focuses on the Western world, omitting experiences of women in developing countries.

This is slowly changing due to the work of a group of ICTD researchers, who began to focus on this issue.[5] A growing body of research situated in developing contexts has begun to call attention to women. For example, [14] argues that in Bangladesh, the failure of a mobile application that combats sexual harassment is a result of post-colonial conditions for women. In related work, [10] highlights how women's access to computing is limited by social and cultural politics. [138] demonstrates how women in rural India manage to use mobile phones despite the barriers imposed upon them by others and argues that Western feminist frameworks often cannot address the problems in India. Other scholars stress the need to consider inclusiveness and the intersections of identity [261] or propose the use of a feminist lens to understand care [134]. [12, 13] furthers this discussion by finding tensions around women's privacy and ownership of mobile phones in Bangladesh. [224] reports how women in South Asia perceive, manage, and control their privacy differently on shared phones. This and related ICTD work that addresses gender and digital technologies have begun to reveal salient features of the challenges faced by women in different non-Western contexts. It has led to a call for context-specific design that considers women's experiences, needs, and desires.

While feminist HCI in non-Western contexts has illuminated various hidden challenges for women, scant work has focused on women living in predominantly Islamic societies. A few studies have shown women's struggle to access technologies due to misogynistic social

[5]The feminist lens allows researchers to understand the effects of gender on technology design, consumption, and use as well as the intersection of other markers of identity (e.g., race and ethnicity). Generally, the work on non-Western contexts focuses on understanding the lived experiences, needs, and desires of women.

values. For instance, Abokhodair surveyed social media and gendered relationships in Arab contexts, specifically in the Gulf states [3]. These studies positioned women as marginalized and have not framed the problem in a wider socio-religious context to understand women's capabilities within it. Doing so requires a thorough examination of Islamic family values and cultural practices as well as an understanding of the complexity of women's lives.

Part of the intellectual contribution of this work is based on long-standing scholarship about women's empowerment within Islam and the interpretations of Islamic values in the modern period.[6] In many forms, popular beliefs and scholarly arguments have criticized Islam as a mechanism for disempowering women [99]. Scholars of Islam have debated these points, with some emphasizing certain passages within the vast textual tradition to point to a more egalitarian view of men and women; others caution that Islam's textual tradition is, by its very nature, patriarchal [9].

Departing from this theoretical discourse, I turn to anthropologist Saba Mahmood's work to develop a deeper understanding of how women can be empowered within an Islamic society [154]. Mahmood conducted ethnographic work in Cairo, Egypt, and studied a local mosque movement that, as she argues, was primarily driven by Muslim women who enacted change in society through their Islamic values and practices. Mahmood demonstrates how, within an Islamic value system, 'shyness' and 'civility' can be a source of strength rather than a weakness [155]. Her work builds on that of Talal Asad, who illustrates how Muslim values have often been interpreted as negative and disempowering within secular neoliberal political contexts, and how women's disempowerment is caused by those broader socio-economic conditions and not by Islamic values [153, 26]. Asad, Mahmood and other scholars, such as the anthropologist Lila Abu-Lughod, have called for an understanding of the condition of Muslim women through an ethnographic lens that recognizes those women's lived experiences and voices, rather than through an external gaze [170, 148, 149].[7]

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[6] In various forms of intersectional feminist scholarship, especially in post-colonial literature, imposed standards and values have often been seen as a mechanism for silencing (and disempowering) women. For example, Gayatri Spivak's magnum opus *"Can the subaltern speak?"* [173] and bell hook's celebrated book, *"Aint I a girl?"* [108] denounced colonization and racism as the overarching drives (along with misogyny) for silencing women.

[7] Abu-Lughod pushes us further to consider similarities rather than differences when we seek to understand Muslim women. She points to the work of the historian Asfaneh Najmabadi, who cautions us not to view

Age		Marital Status		Education	
Range	**Total**	**Category**	**Total**	**Bracket**	**Total**
				Non-literate	26
15 - 25	19	Single	14	Up to 5th grade	8
26 - 35	32	Married	54	Up to 8th Grade	11
36- 45	17	Separated	2	Up to 10th Grade	10
46 - 55	4	Divorced	1	Higher Secondary	7
>55	1	Widowed	2	Undergraduate	6
				Graduate	5

Table 4.1: Technology Engagement Framework: Participant Demographics (Total: 73)

This growing literature around Islam and feminism opens a novel avenue for CSCW and HCI research to conceptualize Muslim feminist interactions with technologies. This is the context for this study. I demonstrate how family dynamics, as influenced by Islamic values and local cultural practices, shape Pakistani women's use of technologies. Moreover, this work further advances the agenda of addressing feminism through a *'feminist'* lens, i.e., one that considers the historical, social, and political context through a series of social practices, including decision making, maintaining relationships, and understanding authority.

4.4 Methodology

These findings are from a two-year study (2017 and 2018) that included in-depth, semi-structured interviews and participant observations. For the study, I initiated direct conversations with 73 women participants in Punjab, Pakistan. I conducted interviews in various cities: Lahore, Multan, Sheikupura, Gujranwala, Kasur, and Faisalabad and the surrounding suburban areas (both developed and underdeveloped).

The participants, recruited in three phases, ranged between the ages of 17 to 56 (see Table 1). I recruited them through social contacts, word of mouth, vocational training institutions, and local microfinance institutions (MFIs). Of these women, 54 were married, 14 were

the West and Islam too simplistically or in direct opposition to one another.

single, one was divorced, one was separated, and two were widowed. The participants were housewives as well as women who worked outside their homes as maids, office staff, teachers, seamstresses, clothing retailers, and proprietors of tuck shops (grocers), beauty parlors, midwifery clinics, schools, shops, and cafes. Some housewives had previously worked or currently ran their enterprises from within their homes (i.e., jewelry makers, home-based beauty parlors, and embroiderers).

Being a Pakistani woman fluent in Punjabi, Urdu, and English, conducted the interviews I led all the interviews and was at times accompanied by another woman research assistant who took handwritten notes. The decision to have same-gender researchers was based on previous literature about impacts of gender [147] especially when communicating with Muslim female participants [180]. To ensure privacy and remove potential bias due to the presence of others (e.g., family members, employees, etc.), interviews were conducted individually for each participant. Nonetheless, participants' children, other family members, or customers occasionally interrupted the interviews. Interviews lasted between 30 minutes and an hour based on details shared by the participants and their degree of technological engagement.

Depending on the participant's preference, the interviewer asked questions in Urdu or Punjabi, and, because the discussion focused on technology, borrowed English words came up regularly. Again, depending on the participant's preference and comfort-level, conversations took place in homes, shops, offices, and branch offices of MFIs that provide micro-loans. None of the participants received compensation. During the interviews, women told us about their lives (e.g., family, education, employment), family dynamics (i.e., relationships with parents, siblings, husband, and in-laws), and their and their family member's engagement with technology. While participants described the various ways they use these technologies for diverse purposes, I focus only on the role of the family in technology engagement.

With the participants' consent, I audio-recorded the interviews and paused the recordings upon a participant's request. Usually when women requested that I stop recording, they shared sensitive information about their personal lives and instances where their husbands or other male relatives behaved badly or imposed restrictions.

4.4.1 Reflexivity

The three women researchers, I and the two research assistants who accompanied me, were born, raised, and educated in Pakistan and completed university degrees in STEM fields. Together, we had 20+ years of conducting field-work in the areas of gender, health, financial technologies, and technology use.

Participants welcomed me and the research assistant by escorting them to special guest areas or by offering chairs instead of allowing them to sit on the floor. At times, the participants offered beverages such as soft drinks even when they did not themselves partake. These actions emphasized the socio-economic and educational divide between the interviewers and participants.

After transcribing the audio recordings, the authors coded and clustered all instances of technology interaction. The authors analyzed and presented the themes with careful consideration of the participants' descriptions of events, reactions, and reasoning, being mindful that they may view these differently based on their personal experience. Participants shared other stories about technology, but my work focuses on conversations and themes related to a family's impact on participants' technology engagement and technological inclusion.

4.4.2 Interview Observations

These observations about the social settings of the interview locations provide a lens into the gendered nature of both public and private spaces.

Physical Spaces

In urban and peri-urban settings, the doors of both homes and places of business (often part of participants' home) remained open; a cloth curtain partially obscured the doorways, leaving uncovered the lower portion where one could see the floor. I observed that men and women from the street would stand outside the house and speak loudly to seek permission to enter or to make inquiries. While women could enter the home, men would have entire conversations from the exterior side of the curtains. These curtains offered a form of privacy yet allowed interactions between women of the home and unrelated men from outside.

Urban low-income areas had some roads with vehicular traffic. Women would occasionally walk with us to their shops or to other women's shops that were nearby. In peri-urban settings, the houses were in neighborhoods with narrow streets that had no outlet and were away from the markets. Women would walk down the streets with us to introduce us to their neighbors. They approached the door of a neighbor's home, knocked, and asked the children about their mother's whereabouts. In rural areas, I met with women in one- or two-room centers of MFIs. Institution employees would ride their bikes to women's houses, often far from the centers, to invite them to the centers for interviews. Women would then walk to the center for the interview.

All women participants covered their heads, irrespective of their religious affiliations. All but two of the MFI offices had women employees, and participants referred to MFI employees as "brother" or "sister" during the conversations. Some of the officers went with us to visit participants at their homes, while others inquired about women's families or their children's health.

Gender Dynamics

During some of the interviews, male relatives of the female participants would interact with them or with us, which gave us a view into the gender dynamics within families. The presence of male relatives occasionally generated challenging situations for both cohorts. For example, in one interview a woman's husband joined us in the room of the house where she was being interviewed. He continuously interrupted, stating that, *"She doesn't know" or "She doesn't need it [technology or financial services]"*. At other times, he commandeered the conversation altogether. This particular interview was later discarded from the initial analysis since the wife's answers were likely influenced by the husband's presence. The fact that the husband chose to answer for her may suggest that he thought he was better able to answer questions about technology or that she did not have the authority to make decisions regarding technology and finances.

During another interview with a woman who ran her shop from home, a man entered the shop and greeted her toward the end of my interview. He paused for a while, observed

us, and then asked me and the accompanying research assistant, who we were and who had sent us. Nearly all of the remaining questions were interrupted by him with a joke or a rhetorical remark. The female participant explained that this man was her nephew and her husband's business partner and that we should ignore him. This proved difficult because he stared at the female interviewers and other women customers in this all-woman shop. The research associate taking notes mentioned being 'uncomfortable as he constantly stared at the interviewer and research associate'. This observation is important both in terms of gender and generational dynamics for two reasons. First, the nephew feels that he should answer on behalf of his aunt or possibly protect her from disclosing any personal information. Second, because it reveals the challenges of conducting research by women in a socially conservative and patriarchal society.

We observed that women had concerns about the public portrayal of their family members, especially their husbands. While they readily shared difficult circumstances or negative incidents that took place in their families, some participants would quickly change their stance if their response involved their husband. In all these instances, no male relatives were present. This suggests that women wanted to maintain respect for their husbands and their perceived responsibility to uphold and protect their husbands' image and honor.

4.5 Case Studies

Here, two case studies are presented to demonstrate the technology engagement of low-income women in Pakistan through their interactions with family members.

4.5.1 Case Study 1: "Our brother does not trust us, and our parents prefer his decision."

Amna and Sara are teenaged sisters, both single and living with their parents, two brothers, and the wife and child of the elder brother in a rented house in an underdeveloped urban area.[8] They came from a large family of ten siblings, all of whom were married except Sara, Amna, and their younger brother. Amna, Sara, and their mother worked to support the household. The eldest brother would contribute occasionally when he could find work.

[8] All names have been changed for anonymity.

The sisters consider their mother to be the head of the household because their father is ill, which makes it impossible for him to take responsibility for decision-making.

Amna, the elder of the two sisters, was 17 years old when I met her in the summer of 2017 at a vocational training center. Due to financial issues, she did not attend school but instead received tutoring to prepare for her tenth grade exams. She studied in the late evenings because she worked at the vocational training center in the morning and held a job at a beauty salon in the afternoon.

That same summer, the second sister, Sara, was 15 years old and in the eighth grade. Household chores, such as buying groceries and vegetables from a market (two hours by foot from home) and cooking meals for the family, were her responsibility. In addition, she was learning to sew at the same center as her sister, and she made clothes to contribute to household funds.

With the father being ill, the mother made all family decisions. The sisters mentioned that the family put the needs of the sons above those of the daughters. The resulting dynamics of authority within the family gave the eldest brother the role of gatekeeper regarding technology use by Amna, Sara, and the younger brother. Although the sisters contributed to the household funds, doing so did not improve their ability to access, select, or use technology.

> *"(Why does your brother make restrictions?) I do not know. Maybe he has some trust issues. He does not believe us and even our parents take his point of view. (If you get a job, would you be allowed to use a phone?) Maybe, but it depends on my brother. (Are your cousins or other female relatives allowed to use phones?) Yes, all of my cousins have phones and there are no restrictions on women's phone usage among our relatives. Only our family restricts women's phone usage."*

The sisters depended on their brother to purchase technology. Amna had a feature phone that she used to stay in touch with family members while she was out of the home for work. She gave her brother money and asked him to buy her a smartphone. When he returned from the market, he handed her a feature phone, saying that she did not need

a smartphone. Amna wanted a smartphone so she could access the internet, which her friends had explained was a great tool for learning. The brother thus acted as gatekeeper, restricting internet use for the house. Amna used her feature phone for SMS and calling, and she asked her friends at the vocational center for technical support regarding phone use. Even with a feature phone, Amna's brother monitored her phone usage by checking her call and message logs when she returned home each night.

Although Sara could afford a phone, she did not have one because her brother forbade it. Sara often saved money from sewing clothes to buy things for her younger brother. Once, the younger brother even asked for a computer. His mother refused because she could not afford it. Like Amna, Sara saved money and gave it to her older brother, asking him to buy a computer for the younger brother. This time, the elder brother did not have an issue with the younger brother using a computer and brought one home with the money Sara had given him. Sara had also saved money through a savings' group to buy a refrigerator for storing her father's medication and travels to the market alone in the evening to buy groceries when the prices are lower, which shows her responsibility and dedication to family. Yet, her brother refuses to let her have a phone. In this situation, an unmarried woman is considered to be more at risk if permitted to have a phone than to walk alone to a market at night.

Both sisters agreed that their brother was skeptical of girls using phones because he believed they would contact boys and find boyfriends. Sara shared that,

> *"Yes, I have asked him twice [for a phone], but he replied, 'Why do you need the phone? There is no need to use the phone'. The problem is that he does not trust us. One reason for this is that my elder sisters, who are married, had phones before they got married but used them for purposes that questioned their trustworthiness, and, consequently, we have to face restrictions. My father once agreed and told my brother to get me a phone, but he refused. (What are the reasons that your brother does not allow you to use a phone?) Girls use phones for getting in touch with boys and making friends. My elder sisters did this, and that is why my brother does not believe us."*

Amna and Sara believe that girls should not talk to boys when given access to phones. They say that such precedence creates problems in getting access to phones for girls like them because it generates unfounded suspicions from their family.

4.5.2 Case Study 2: "I was not using it (the smartphone) as per their wishes, so my mother broke it out of anger."

Sana is a 21-year-old single woman living with her parents and brothers in an urban locality. A member of her extended family, her paternal uncle, introduced technology by gifting a phone to the family. Women in Sana's family never considered or initiated phone purchases, and the two phones she has interacted with were gifts from relatives. When asked if she had ever bought a phone or visited a mobile shop, she replied, *"No, my family does not allow [me] mobile phones, so I never thought about buying it for myself."* When I met her, she had been using her smartphone, which she referred to as *her* first smartphone, for six months. Before this, she shared her mother's smartphone [gifted from an uncle to the whole family]. Sana's excessive use of the phone made her mother furious. Her mother subsequently threw the phone and broke it. *"My chachu [father's brother] gave it [the smartphone] to my mother as a gift for everyone for the first time. I was using it a lot, so my mother broke it out of anger. I was not using it as per her wishes (i.e., in moderation). I had it in my hand all the time. (What do you use your mobile phone for now?) I text and use it to make calls. I do not use it a lot now. I have no internet package. "* Apart from that, only her father had a mobile phone. When asked whom the phone belonged to, she kept switching between the narrative of *"her phone"* and *"her mother's phone,"* but mostly used by her.

> *"(Does your mother have a mobile?) Well this mobile belongs to mom and we all use it, although it is mostly with me. (Do other women in the house have permission to use a mobile phone?) Yes, although my little sister does not have a mobile and does not use it. (Why?) She is little so she is advised to focus on her studies. She also does not have a need to use it. She only uses it for pictures sometimes."*

Sana's father is the head of the household. He provides for the family and makes decisions

about expensive purchases, such as a new refrigerator. Sana's mother takes the roles of advisor and supporter of the head of household's decisions. She also persuades her husband to make purchases.

> *"(So who handles the financial decisions or is the head of household in your family?) My father. (Not your mother?) No, mostly my father, but mother contributes by making suggestions as well. If we want something we ask our mother, and she helps us out with our father. Also, we bought a refrigerator this Eid (Muslim holiday). We wanted to get a refrigerator so we talked to Mom, and she convinced Abbu. (But there is a need to convince him?) Yes, there is."*

When asked who would buy a phone if Sana needed one, she replied that it would be her father. This illustrates how the dynamics of authority for this family lead back to the working father, who controls finances and purchase decisions. According to Sana, her father was less restrictive than her brothers. Her brothers did not let her have her own phone; instead, they asked her to share theirs. But with her father's support, she can now own and use a phone. *"At first my brothers did not like that I had a phone. Now they see that my father is at work, so they allow me to keep a phone."* She acknowledged that her family does not consider it appropriate for girls to have phones, and that, even in the case of her own phone, she tells people it belongs to her mother.

Extended family members influenced access to technology, but they also disapproved of technology for women.

> *"(Who else restricts you from mobile usage in your family?) Some relatives, some uncles, not all of them. We have such a trend with our relatives."*

Sana learned to use the phone through experimentation and by directly observing her cousins use it.

> *"(Who helped you in learning the mobile for the first time?) I got some help from cousins but mostly learned myself. My cousin – she is married, so she used a mobile. I got help from her in WhatsApp. We do not use internet that much. I did learn YouTube."*

Next I present the various roles that family members play in women's technology engagement as understood from my conversations with low-income women. I then illustrate the effects of family dynamics and decision-making on women's technology engagement.

4.6 The Stages of Technology Engagement

Technology engagement involves more than active use. It is influenced by deeply intertwined social and religious norms. The participants shared the roles of their family members in deciding to buy technological devices, visiting shops to make purchases, learning how to use a device, using the device, and troubleshooting and repairing devices. These insights form the basis for this chapter. Each instance of technology engagement may require different types of intermediaries, skill sets, and/or other support structure. Likewise, each stage of technology engagement is affected by gendered divisions of space (both public and private), time constraints, and perceived duties as influenced by a system of Islamic values.

Family dynamics and decisions made by relatives on behalf of women were the primary components of how the participants engaged with technology. All of the participants relied on their families or considered their families' needs when making decisions about technology. Many technological advisors to these women were neither highly literate nor expert in technology. Instead, they were individuals who could visit a shop on the woman's behalf or had minimal device exposure. Thus, one could conjecture that those in the women's family and social networks may have had limited and, at times, imprecise knowledge.

We now identify the various stages of technology engagement, each of which is gendered and not necessarily linear. Pakistan is a male-dominated society with androcentric patterns of technology consumption and knowledge diffusion.

- The **introduction of any new technology** is an important first stage, especially for the women who were interviewed. For these women, their male relatives most commonly introduced them to new technologies. This pattern of introduction defines both the permissions around and perceptions of technology use as well as the types of technology available to women.

- The second stage is the **purchase of technology**, which typically occurs in technol-

ogy markets and shops populated by male vendors and customers. If a woman cannot visit these places, she must rely on a male relative to select and procure the technology on her behalf.

- The third stage of technology engagement is **learning to use basic or advanced features of a technology** (e.g., phone, television, etc.). To learn how a certain technology works, women explore by themselves or must be taught by someone.

- The fourth stage is **access to supporting services** (e.g., airtime top-up, repair, installing or upgrading content) that are required once a woman has access to a technology.

- In addition to these four stages, family also played a role in **monitoring or restriction of technology use**.

The segregation of men and women in physical spaces creates a gendered *diffusion* of technology. Diffusion is a social process, and the diffusion of technologies in Pakistan is dominant in spaces that are outside of women's homes and social spheres. Segregation of physical spaces stems from the Islamic concepts that restrict the mixing of unrelated men and women. Thus, Pakistani women's discomfort in interactions with unrelated men limits their information sources to relatives or women in their social spheres and is the basis for their reliance on male family members for procurement, engagement, repair, and maintenance of technological devices.

4.7 Actors in Technology Engagement

To understand Pakistani women's technology engagement, one must consider the various actors involved in each of the stages described above.[9] These actors, their knowledge, and their relationship with women dictate the engagement and limitations faced by women.

[9]Beyond this point, the word *technology engagement* is used to mean any or all of these levels of technological interactions.

None of these actors works independently from a complex system of interconnected relationships, negotiations, and power dynamics, all of which determine the ways in which a given technology is accessed, consumed, repaired, etc.

4.7.1 Technology Introducers

Technology introducers inform a woman about new technologies that they might have observed, heard about in the market, used, or brought home. Typically, male relatives introduce women to new technologies, but occasionally women who previously learned about a new technology through their own network will fulfill this role.

Informed about the Existence of a Technology

To uphold piety, unmarried women from low-income communities in Pakistan are not allowed to have phones [114]. Many married participants' husbands informed them about a new technology or new features of a technology. We observed this pattern. One participant explained how she does not have a smartphone, but that her husband shows her videos and searches the internet on her behalf.

> *"Yes, that I keep watching. There are hairstyles, etc., that come up or some henna colors and designs, etc. He [the husband] looks them up for me and then I keep watching them [laughs] .. He also shows them to me sometimes when, while browsing the internet, these things pop up in front of him so he says to me to check out these new designs." (P41_2018)*

Used in the Presence of Women

Some women reported learning about a new technology, application, or use by observing a family member. One participant recounted her experience with email:

> *"My employer [a woman] taught me how to make an email. I observed my brother using email as well but did not tell him much about my email account. I made it [the account] first, and, just very briefly, informed him that I have an [email] account." (P4_2017)*

Got Them to Use It (Trial)

Some women who were not active smartphone users reported that their family members, especially husbands, gave them their devices. This was not only for a particular occasion (like watching a video or making a video call over the device), but, at times, to make participants comfortable with devices and seek their feedback on potential ownership of such a device. One participant rejected smartphone ownership after trying her husband's phone because of a lack of knowledge and the possibility of her children sharing the phone.

> *"No, I don't know how to use it that much. If I knew how to use all of the features, I would have bought one of my own. He did give me his mobile once or twice for me to use, but I don't know how to use it. And also I have a son and kids who use it, and then they learn bad things, so that isn't right." (P38_2018)*

4.7.2 Technology Sharers

As noted in previous ICTD literature [12], I observed various actors who shared technology with low-income women in different ways. It is important to comprehend these sharing dynamics to understand the flexibility of time, access, and services available to women.

Equal Sharing

This type of sharing was seen when a device at the home is used by all family members. Women from this category also reported the phone as their own. Upon deeper questioning, I formed a more nuanced understanding of the dynamics of phone sharing. As one woman from Kasur said:

> *"Yes, I have (a phone). It is a feature phone. (Does every family member have their own personal phone?) No, only one phone is used by all family members. He (my husband) has a phone, but most of the time he leaves it at home. If we need to contact him, we used to contact him on his boss's phone. My brother-in-law has a separate phone, but his wife doesn't. In our family, girls are not allowed to have their own mobile."* (P14_2017)

Later in the interview, the same participant mentioned that she does not mind if someone else uses the phone since *"it is a family phone."* Smartphones, be it a participant's or their family member's (mostly husbands), were the most shared devices. These phones would be used like a family computer: children would play games, women would watch videos or talk to family using WhatsApp, husbands would engage in social media, and the family would take photos. Most smartphone ownership and use by women focused on communication and entertainment.

Borrowed Use

This type of use occurs when the device or technology is owned by one person, and another person borrows and uses it only for a finite time. For example, a husband returns home and gives his phone to his wife for a particular purpose, or a mother gives the phone to her children to play games. Here, one important distinction is the subcategory of ***limited borrowed use***, where women were allowed to do only a specific activity on the phone. For example, a husband would call his wife's mother and give the phone to his wife, or a husband would allow the viewing only of YouTube videos, or a mother would let children play only one particular game. One participant explained how she used her nephew's phone even though her brother also had a smartphone.

> *"If we have to do this [look at designs or something embroidery-related on the internet], our nephew has a phone we take from him. We never take from our brother. (Why?) His work is like this that he can't leave his phone at home. The nephew can leave the phone at home. (And nephew?) He can. He is 18 years old. (He has a smartphone?) Yes, it is a smartphone. (And you use his phone?) Yes, for the internet or for designing, we use that." (P40_2017)*

A few participants asked family members (brothers and married sisters) who had computers to let their children use them. Two women had computers for their children's school assignments, one purchased by a brother and the other with an accompanying nephew *"who knows about computers."*

4.7.3 Technology Selectors and Buyers

An important step that defines these women's engagement and experience with technology is its selection and acquisition. There were two major types of technology purchase in low-income families: (1) where women buy the technologies themselves, and (2) where a family member purchases the technology. Selection and buying dynamics impact the devices that women eventually receive.

Women as Buyers

For a woman to buy a technological device, the ability to go to mobile shops took precedence over required technical knowledge. The transaction depended on a woman's confidence and her ease of traveling to and conversing in these shops. Many women informed us that they feel comfortable traveling to various shops, but, due to a large presence of men inside and outside technology shops, they do not feel comfortable entering and sometimes accompany other individuals.

> *"We bought (this phone) ourselves. Just like we go to buy things for our work, we (me and my sister) went to buy clothes for embroidery. We went to the market and bought this [phone] as well. We asked our dad. We told him that we need a phone for our work, and he said ok you can buy it." (P40_2017)*

However, women who worked or engaged in daily activities that required conversing with men were comfortable in these situations. One woman shared how she procured everything herself:

> *"Even then (when her husband was in the city), I used to go myself. When I have made my parlor, then it means that you have to work like a guy. This* chaddar *(head cover) is what we are wearing, else all our work is like men." (P8_2018)*

Some women were accompanied by the men in their family, for safety, travel purposes, or technological input. One woman, who went to buy her phone with her brother from a

shop in the city, shared how she bought the phone of her choice even though her brother did not agree.

> *"My brother said that this is a very cheap phone of 12-1300, and it won't work well; but I said no it will work because I only had to use it for my work. So then I used that one for 5-6 years. And then after that, my kids spilled water on it, and I sold it for 700." (P9_2018)*

Family Members as Buyers for Women

Family members frequently include a male relative who can go to the market and buy the devices for the women. Buying on behalf of women can take several forms.

Buyer-Recommended Purchase occurs when women explain their needs and budget to an informed buyer, e.g., "I use it only for calls" or "I like the one with a radio", and buyers bring the latest or best available option as per their understanding. As one participant shared, *"My cousin went to buy the phone for me. I don't go to mobile shops. (Why?) I don't know much about mobile phones. If I have any problem, I ask my cousin to go and fix for me." (P49_2017)*

User-Recommended Purchase (Transactional Purchase) happens when the person going to the market and buying phones for women is informed by end-users (women) about requirements for the type of phone (feature, basic, or smart) and quality (expensive, low-quality or China) required. The buyer then purchases the phone according to the woman's specifications.

Choosing a Phone is when women have the agency to pick from and react to different phone types, even though they do not go to the shop themselves. These transactions were usually made possible by men in the family, who either worked themselves or knew someone who worked at the mobile shops, or when there was enough trust with the shopkeepers to borrow phones for decision-making. Since most of these purchases include used or second-hand phones, it is easier to have them returned, which might be difficult for new or boxed phones. Women chose from a selection of mobile phones. Participants also reported return-

ing the purchased phone when they disliked a particular buyer-recommended purchase, or they asked to exchange it for another phone type.

Many women relied on their children as liaisons to technological markets and shops. One woman, sharing a story about her son's role in choice and selection of phones, mentioned, *"No, I still don't know which one I want. I know this much, that the son got the other touch one, and I returned it. I said, son, I don't know how to use it, then what is the use of getting it? He then changed it for this [button] phone, but my grandson broke it. Then he got me this one."* (P39_2017)

Another shared that, *"The phone that I have, my son-in-law (who is also my brother's son) bought for me, and the previous was bought by her brother. They care for me a lot, and people praise how my brothers and their sons care for me, even though my parents are dead. I tell them which phone to buy and give them money, but they go and buy for me. They come and show me the bought phone if I approve of it. Before I had any phone, I used to request whoever had a phone in the street at their homes to help me call. Before this, I used to live in Noshera thus did not need a phone." (P4_2018)*

4.7.4 Family as Technology Providers

Yet another distinction of the role of family was seen in terms of devices made available to women. Besides devices purchased using any of the preceding dynamics, women were also given phones by their family members. The two most commonly seen themes follow.

Hand-Me-Downs from Immediate Family Members

In many of the contexts where husbands or relatives with a higher income upgrade to a newer technology, they also give their old phones, TVs, or fridges to their family members. This occurs mostly within an immediate family or at the household level.

Devices Gifted by Family Members

Where hand-me-down devices were mostly exchanged within the same household, sometimes devices were gifted to women, both by immediate and extended families, including uncles

and in-laws. One women reported that

> *"I got this phone within two years of moving here (to the city). My brother came to my house and gave me this phone. He said that you don't have a phone, and you cannot buy, and you don't ask (for it). Just take this phone and use it. I never paid for it." (P4_2018)*

In this instance, the women previously lived in a close-knit community and reported not needing a phone. She also related how she would visit someone or use someone else's phone to make infrequent contacts. However, once she moved to the city, she did not have a phone, nor did she ask anyone. But her brother gifted one to her.

Many unmarried women are not allowed to use mobile phones in Pakistan [114, 236]. Thus, once women marry, communication with their husbands and parents introduces the need for a phone. When asked about their first phone, most women, especially from conservative households, reported that they were given/gifted mobile phones by their husbands on or after their wedding. These gifts were given without any requests from the women.

Devices Requested from Financially Able Family Members and Friends

Sometimes, women asked family and friends to give them devices when they had the means, either by selling them used devices or by buying them new, affordable ones. One woman reported that she requested that her sister, who married into a well-off family and had a supportive husband, procure her a device. The sister asked her husband for an old television and got it for the participant. *"I asked her (my sister) a long time ago for a television. I said to her that I go to the neighbors to watch television, so she said when I have money, I will buy you a television."* (P18_2018)

Technology as Part of a Dowry

The custom of dowry is prevalent in many parts of the world, especially in South Asia. Islam has no teachings regarding dowries because it grants women inheritance rights. Thus, Islam does not permit women to be owned or traded. Yet, dowries are still prevalent in many

households in Pakistan. Some participants reported the provision of everyday technological devices, such as televisions, refrigerators, or washing machines, as part of their dowry, while others reported taking small loans to pay for their daughters' dowries.

4.7.5 Technology Advisors

Due to limited technological knowledge, the lack of technology-competent peers, and the existence of gendered technology spaces, women relied on male relatives for technology advice and women thought men had "more exposure" or "knowledge about these things". Advisors are the technology experts or individuals with more technological exposure than the women themselves. These mostly consist of men in the family who have been to the electronics markets or technology markets or have friends there and thus have knowledge of available offerings and their differences. Note that not all information provided by these advisors was accurate, complete or adequate, but women still relied on it in the absence of alternative sources.

4.7.6 Technology Tutors

Many women reported learning or using technology with the help of their children or brothers. Learning tasks was need-based, where women actively asked for a certain feature or help (e.g., calling their husbands). One woman shared that her children told her how to use the internet. She said, *"My children taught me how to use it. They have downloaded 'IMO', and I know how to use it."* (P35_2018). The accuracy of their knowledge depended on their children's skills.

When women learned from their children, we then asked how their children learned about technology. One participant revealed that her children learned by watching people on the street. Her children knew how to use airtime packages and the internet. She shared, *"No, those people who are sitting outside on benches and stalls [in the streets and markets]. So they [children] keep watching them how they use [phone]. Then I learned it from them [my children]."* (P42_2017)

4.7.7 Technology Maintainers

After selecting and buying devices, actively maintaining them requires many types of support (e.g., financial support for repairs or technological support for upgrades and troubleshooting). In addition, we saw that women need social support when family members would make a case for their ownership and access.

Technological Support

Technology maintenance requires accessing information, troubleshooting, installing updates, and performing repairs. In many developing countries, mobile users can buy airtime, *known as topping up airtime,* in corner shops either by making a specific payment or through scratch cards (with numbers that must be entered into the mobile phone). Due to financial considerations, women preferred topping up airtime at shops because it allowed them to purchase with lower denominations than the pre-paid card amount of PKR 100 (0.81 USD) or more. Regardless, women relied on men to top-up for them or buy scratch cards because sharing phone numbers in public top-up shops could lead to harassment either from men in the shop or someone obtaining their phone number. GSMA reports that retailers in Pakistan sometimes actively discourage women from buying data or topping up in shops due to men in shops [92], and the shops are male-dominated sites where women felt uncomfortable [114].

> *"My husband does that. You know why? Because these people later start making wrong calls to you. When they see that a girl has come to them to get her balance loaded, then they later start making calls on those same numbers. So if my husband goes that way, they know that it's a gent's number and not a ladies number. So this is why my husband goes for it every time." (P6_2018)*

Some participants' children assisted the women so they could more easily use their phones. One woman shared how her son set up speed dial for her to call them, though she still has to ask them to search for other people's numbers. *"I have this [phone] since last five to six years. But it is that my children have done this (while pointing to the screen) 1,2,3,4,5,6; they set this up, then I can call them using this [referring to speed dial]. And*

when my elder son or my third son calls, I can yes the call [receive the call]. And if I have to search for anyone else's number, I ask my children to take the number out. It is working like this, thanks to God." (P28_2018)

Brothers as Technological Support emerged as one of the most important, multi-faceted actors in the technology engagement of women. When unmarried, women's technology use was restricted by their brothers. But once married, the same brothers emerged as strong supporters of their sisters. Many married participants reported that they rely on their brothers to learn how to use new technology, for support in the selection or purchase of new technology and for advice or action on matters of troubleshooting and repair.

> *"So because I'm at home so I have to do all the chores. My brother bought it for me. [When asked about previous phones and learning to use them.] This is my first phone. I learned it from my brother. He knows how to operate it. If it ever stops working or an issue occurs, I take it to my brother." (P20_2018)*

Social Support

Like technological support plays a role in every step of technology usage, social support also plays a role, from acquisition of technology to its long-term, continuous use. These supporters can be immediate or extended family. One participant explained that since her brother does not approve of her phone use, she had two supporters who enabled her access to a smartphone, namely, her mother and her male cousin. She used to share a phone with her mother; once her mother's feature phone broke, she convinced her mother that they should buy a smartphone. When her brother disagreed, her mother intervened and *"handled him".* The male cousin then helped them buy the smartphone.

4.7.8 Technology Disapprovers

Besides active restrictions, we also noticed active and passive disapproval of technology from both the household and the community. Disapprovers included men and women who do not actively restrict any use of technology but build a negative image of technology access or use by quoting instances, hearsay, or commenting on the downsides of women's technology

access and use. It also included social disapproval or suggested alterations in behavior as a consequence of technology use by women.

We refer to these actors as *'disapprovers'* rather than limiters because they do not directly limit use. Rather, they cast the issue in a negative light, e.g., sisters-in-law suggesting women with phones are not good, or sons saying sisters are not married so mothers cannot have a phone, or brothers saying girls should not be allowed to use phones.

4.7.9 Technology Gatekeepers

We observed men acting as gate-keepers to women's use of technology. This behavior is driven both by a need to protect women in the family and to ensure conformance to the religious and social norms of not mixing with the opposite gender or having inappropriate contact as a consequence (a perspective developed primarily from hearsay).

Restricted Use

Women who were allowed to use technology also had to face many conditions to its use, a very important factor when considering women's uptake or usage. These conditions included: 1) being allowed to use a feature phone, but not a smartphone, 2) being allowed to use a smartphone but not to own one, 3) being allowed to have smartphones but not allowed to use social media (or the internet), 4) not being allowed to have a device of their own but allowed to share one with the family, and 5) not being allowed to interact with any device.

One unmarried participant shared that she had a Facebook account that her brother had helped her create. Her brother later asked her to delete it, and she had to ask her employer to help her make a new one. This is the same brother who helped this participant buy a phone a few years earlier. His change of heart could possibly be the result of his social interactions or hearsay specifically related to Facebook because he still allowed her to use Whatsapp and upload photographs. Given that the participant did not know about technology, phone selection, or account creation, it is also possible that the privacy settings of her Facebook posts could have led to some event, hearsay, or conversation that prompted

her brother's request to delete the account. The participant later mentioned that

> *"Yes, he [my brother] ended my Facebook account. Actually told me to end it, so I had to. Then I asked madam here [at the parlor she works] to help me make an account. Brother does not have an issue with WhatsApp usage or other things. I can even upload pictures on WhatsApp."* (P4_2017)

Monitored Use

Monitored use occurs when men, especially husbands and brothers, allow women to use devices but then observe or review the women's activities on those devices. This includes male relatives allowing women to use technology but only in their presence; checking the women's devices later for logs, messages, and interactions; or sharing a personal device with the woman but only to use a certain feature. Sometimes the monitoring is verbal, where men inquire about a call's recipient, the sender of a message, or content on the phone. In the first case study (Section 5.1), the elder sister Amna shared that when she goes home from work, her brother goes through her feature phone and all its contents (messages, call logs) daily.

Prohibited Use

Prohibited use occurs when family actors limit a woman's use or interaction with technology altogether. This can be due to existing family and socio-cultural situations or changes in opinions or decisions makers. The prohibition of mobile phone use by low-income unmarried women was mostly based on stories or hearsay about women getting in contact with estranged men, developing romantic entanglements, and even eloping with these men.

> *"No, I never got the phone. We don't have the permission. Girls do not have the permission to keep the phone. Only males can keep the phone. (Why?) I don't know the reason. (Did something happen for the family members to believe this ?) Yes, they observed some females using phone for some wrong purpose, and they restricted the use of other females afterwards. Prior to that, girls were*

allowed to use mobile phones. (How do you call someone?) I use my brother's phone. He is living very close to our house." (P33_2017)

4.8 Dynamics of Authority

In this section, I discuss the various drivers through which family members draw power to make and enforce decisions within a family. These dynamics decide who is able to make a decision about a family members' or a woman's technology access, how these decisions are communicated and enforced, and what familial situations and life events can change who the decisions makers are. It is important to note that these structures are not rigid; they are constantly in transition, and there are particular points when they are more visible than others.

Rank in the Family.

Rank can include both the position (eldest sibling, youngest, only child) as well as the rank among all household members (like presence of grandparents, presence of multiple families' children). Rank is important as elder brothers can decide what technology women could or could not use.

Income Source

Since technology access, consumption and retention (repair or upgrade) require financial investment, the economic status of the family member plays an important role in decision making. Many times, ill health or the death of a father force an elder brother or daughter to step up and support the family financially if the mother is unable to earn, is uneducated or is deceased. Even for a family where parents were alive, but brothers were providing financial support to the family, decisions about technology access were agreed upon. Though true for men, women's earning status did not necessarily affect technological autonomy; due to stereotypes associated with the technological engagement of women, some working women refrained from or limited their technological engagement.

Marital Status

Marital status deeply affected the decision making of women irrespective of their age. Women were expected to run the household, especially the kitchen, once they were married. At the same time, they were allowed technological engagement if their husbands permitted it. Many times, husbands had to negotiate this issue with the rest of the family.

A participant said this about not being allowed to have a phone when her brother's wife had one

> *"It totally depends upon permission. A female can use a phone if her husband has allowed her to use the phone. My brother gave permission to his wife to use the phone, but we have no permission. Also his wife doesn't work anywhere and stays at home."* (P33_2017)

It is interesting to note that a change in a son's marital status also increased the mother's authority due to the addition of a daughter-in-law. Where mothers-in-law could not dictate their own technological engagement, they could vote on the engagement of younger women in the house.

Change in marital status also included being divorced or separated. In these conditions, women had to rely on their own income sources and earning capabilities, with limited to no support from their immediate families. Many women reported reducing or limiting their mobile usage or interaction after being divorced, widowed, or separated to avoid rumors of immortality or affairs. Many women also reported feeling more vulnerable to theft or harassment in such situations.

> *"No, I had never used [phone] since start. In my in-laws, I was not allowed to use phone. My husband did not like that I should have a phone or that I go outside all dressed up. Thus, I started living like their ways. Then, my parents got me phone. My brother bought my first phone for me. He bought it as my birthday gift that this is simple one, keep it with yourself. (Was it after your separation or when you were living with your in-laws?). It was after my separation my brother bought it for me. Even now, when I go out with phone in*

my hand, I fear that what if someone snatches it from me? I am not divorced; that is why." (P36_2018)

Health Status

Many women were forced to earn their own money after their husband's health deteriorated or their income levels fluctuated due to health conditions. This changed the dynamics of income in the household. It also changed the decision making abilities and restrictions at times.

"My mother-in-law is the head of the household. Father-in-law is is mentally weak, so my mother-in-law use to take decisions." (p15_2017)

Albeit a small percentage of the interviewed sample, women with vision problems, migraines, trauma, injuries, or stress all reported limiting their use of technology (on prescription or through their own will). One woman reported that she relies on her children to dial numbers for her due to her poor vision. The interviewer recommended using speed-dial for her needs. She did not know, and believed that her sons also did not know, of this feature since the feeling of dependence is mutual. She memorized the concept and promised to ask them later.

Joint vs. Nuclear Families

Household members (joint vs. nuclear) and household dynamics (authority based on age) played a role in deciding women's technological engagement. *Joint families* are households with two or more generations living together. The presence of more than one family, including grandparents at times, resulted in greater restrictions to enable uniformity and perceived conformance to traditions, culture, and values. Technology advisors, sharers, and tutors were available in such situations, but such households also had an increased potential for disapprovers or monitors from the extended family. An individual's rank can include both the position (eldest sibling, youngest, only child) as well as the rank among all household members (grandparents, presence of multiple families' children). Rank is important as

elders, especially fathers, uncles, or brothers, can decide what technology women could or could not use.

Unforeseen or Life-Changing Events

Many times, ill health or death of a father force an elder brother or daughter to step up and financially support the family if the mother is unable to earn, is uneducated or is deceased. Similarly, the death of a husband also forces women to start earning, learning to use technology, and engage in uses that are previously unknown to them. However, many widows intentionally stayed away from technology since its use is associated with lack of moral character, and women fear societal retaliation and questioning about their character. Women whose husbands were in jail feared being harassed, annoyed or teased by people if they used phones.

4.9 Children's Impact on low-income mother's technological use

For low-income women, children are a core interface and component of their interaction with technology. This can be both in the form of needs of technology emerging because of the children, intermediation or use of technology for parents by the children as well as learning, procurement, and troubleshooting by children. Here children means young children, unless mentioned.

4.9.1 CHILDREN AS ENABLERS

Children As Market Liaison

Many women relied on their children as liaison for their technology needs and the technological markets and shops. This played a role in the selection and procurement of technologies like phones and SIMs etc. These children were also seen as the continuous engagement source for purchase of additional transactions like purchasing airtime, repair of technologies or exchange etc. One woman while sharing about her son's role in choice and selection of phones mentioned *"No, I still don't know which one I want. I know this much, that the son got the other touch one, and I returned it. I said son, I don't know how to use it, then what*

is the use of getting it. He then changed it for this [button] phone but my grandson broke it. Then he got me this one."

Women also relied on children for the purchase of or repair of devices, because they were either not allowed to go outside the house alone due to sociocultural reasons or because they considered these shops male-centric. One woman shared, *"The phones that I have, my son-in-law (who is also my brother's son) bought for me and the previous was bought by her brother. They care for me a lot and people praise how my brothers and their sons care for me, even though my parents are dead. I tell them which phone to buy and give them mone1y, but they go and buy for me. They come and show me the bought phone if I approve of it. Before I had any phone, I used to request whoever had a phone in the street at their homes to help me call. Before this I used to live in Noshera thus did not need a phone." (P4_2018)*

Children providing Technological Support

For some participants, their children arranged usage so that they could have uninterrupted access to technology. One woman shared how her sons have set up speed dial for her to call them, though she still has to ask them to search for other's numbers. *"I have this [phone] since last 5 to 6 years. But it is, that my children have done this (while pointing to the screen) 1,2,3,4,5,6 they set this up, then I can call them using this [referring to speed dial]. And when my elder son or my third son calls, I can yes the call [receive the call]. And if I have to search for anyone else's number, I ask my children to take the number out. It is working like this, thanks to God."*

Children transferring their learning

Many women reported learning from or engaging with technology with the help of their children. The learning of the task was need-based where women actively asked for a certain feature or help like calling their husbands. One woman shared that her children told her how to use the internet. She said *"My children taught me how to use it. They have downloaded 'IMO' and I know how to use it"* (P35_2018). The learning was also based on the skills of

the children.

When women participants reported learning to use technology from their children, they were also asked about children's learning of technology. One participant learned to use the phone from her children, where her children learned it by watching people on the street. Her children knew how to use airtime packages and internet as well. She shared that, *"No, those people who are sitting outside on benches and stalls, so they [children] keep watching them how they use [phone]. Then I learned it from them [my children]."*

Children As Reasons for Buying Technology

Children have also emerged as a reason why these women were buying technology such as a television. It was primarily to restrict children from standing in the streets (and watching screens at shops) or visiting other people's houses to watch television. The motivation for buying televisions is mostly, if not always prompted by children's behaviors. Women reported that they disliked their children going to other people's home or standing in the street to watch TV, thus they went ahead and bought it for their house. One woman shared, *"I did not like that my children use to go to neighbors for watching television. So we decided to buy a television"* (P22_2018) and another shared *"they would go to other people's house and would stand there."* Televisions were typically the first technological device that many interacted with at the household level, followed by washing machines and refrigerators. It is mostly the women who make the decision to buy the television, although they might rely on someone else's support for the execution of the purchase.

Initially, the children watched it but the engagement then expanded to other family members, including the women themselves. *"Mostly my girls used to do it, so after watching them I started switching it as well."* (P3_2018). Some women engaged with it for specific information. *"I just listen to the recitation in the morning, read Qur'an and offer prayer and if any Naat or any Islamic Speech is broadcasting I do watch that, and ask my children to show me speeches on TV and nothing more"* (P39_2018).

4.9.2 Children As Limitations

We observed that women's family at one place acted as the motivators or enablers for them to own or access technology, many a time women reported not using smartphones or shifting from smartphones to feature phones because of their children.

Children as Reasons for Refraining from Technology

Women informed refraining from technology either because they either could not afford it, or they did not consider it good for their children. One woman who had a computer at her privately run school refused to bring the computer home. She said, *"They are children; they will just play games on it. So, I find not good for them"* (P22_2018). Participants also mentioned children as reasons for not owning smartphones. One shared, *"He (her husband) does say so [to buy a smartphone] but my kids are young and they don't let my phone be. Once they come back home, they play games etc or other times they watch cartoons on it."* (P41_2018)

It is considered inappropriate for unmarried women in rural and peri-urban socio-cultures to own a phone [114]. Thus, the presence of unmarried daughters at home also acted as a limiter. One woman reported, *"No it wasn't about permission. I had unmarried girls at home. So my sons did not let me keep a phone. They used to tell me to get them married and then you can have a phone at home. (Why didn't they let you?) No special reason. The environment of the household is not like this. Now they [the daughters] are thankfully married. So I also got it [a phone]. And my sons too!"*

Children As Reasons for Abandoning Technology

Besides never using any technology, some women participants reported stopped usage of a technology due to their children. One participant who was previously a smartphone owner reported selling her phone out of anger. She said, *"It's just that I don't feel the need for it, my kids won't get off of it as they kept playing games on it so then I sold it out of anger"*(P9_2018). Women also informed that their children were misusing the technology and thus women did not want their children to engage with usage anymore. Misuse included

wasting more time on excessive engaging in social media or playing games. One woman who ran a school did not agree on bringing any school computer home. She said, *"I can't. They are children; they will just play games on it. So, I find it not good for them."*(P22_2018)

Downgrading: Children Damaging Technological Devices

Women reported downgrading to cheaper or older technology and sometimes giving up technology altogether because of children's abuse or damage to technological devices, mostly phones. A few women reported never owning or non-use after initial smartphone use because of the cost of repair to smartphones.

> *"No so at times when you are not near them and away, so the kids get hold of them [phones] and throw them. The youngest daughter that I have also has broken down two phones [laughs] while playing. And now this one right now she threw it down and it's back got damaged and then threw it down again and it's screen got cracked."* (P16_2018)

When I inquired from the participants as to why they do not use screen locks or app locks for children, many responded that children are ahead of them in unlocking.

> *"No I used to have one [smartphone] but because the kids don't let it be so this is why I now keep this one [feature phone]. These days the kids are so clever that we change it's password every other day but the kids unlock it every time."* (P41_2018)

Another shared that, *"They are kids and they also learn how to open the lock [laughs]. So they look at it once or twice and then they learn how to unlock it so that's why."* (P38_2018)

While some women requested their family members to get the phone fixed, many gave up on smartphones and reverted back to feature phones. P4 described that one smartphone was thrown by her children and damaged, one fell in the water, one in tea, and she also bought a touch screen phone which had screen damage because it was dropped. Someone took 1000 rupee and said he would repair it but again the screen did not work. Thus, she

switched back to a button phone. These situations often put women back in a shared phone usage situation, with or without intermediation.

Relying on Children to Run the Technology

Women participants also reported relying on their children, especially educated, to run technology on their behalf as 'technology surrogates'. This intermediated use by the children not only created a sense of dependence but also created an incomplete learning by the women. Dependence on children's support to use technology sometimes overcame social norms. Women who are unmarried are usually not allowed to use phones in peri-urban and rural areas of Pakistan [114]. However, due to the dependence and reliance on children, women had to expose their unmarried daughters to technology and rely on them for use.

4.9.3 Technology Engagement through Cousins

Cousins have emerged as a strong secondary support system in case brothers in the immediate family are unable or unwilling to support women in technological engagement. In this case, cousins include mostly sons, and sometimes daughters, of paternal and maternal aunts and uncles. The nature of support extended by male and female cousins varied.

Some participants also rely on cousins to bypass or overcome restrictions placed by their brothers. Male cousins were relied on mostly to accomplish buying and maintaining technology when brothers would disapprove and therefore not help in buying or when women did not have brothers. One participant relied on a male cousin to help purchase mobile phones for her, and another male cousin used to send a balance to her if she needed it because she did not have any brother of her own. In the findings above, we see mother and daughter taking help from a male cousin to buy a phone for the daughter when her brother did not approve of her having a phone.

Female cousins who did not face similar restrictions as participants were seen acting as technology tutors and technology supporters. In Case Study 2, we saw Sana learning to use YouTube by observing her female cousin, and the same cousin tutoring Sana on how to use WhatsApp because she was married and had fewer restrictions.

4.9.4 Use of Technology to Disempower

Technology access and ownership are equated with empowerment and agency. However, some participants shared stories where technologies were being used to monitor their communication or whereabouts. One participant told us how her husband gave her a phone for her to seek his permission before leaving the house.

> *"No, he bought one [phone] on his own and gave it to me saying that you can use this to talk to your father and you can also talk to me, or, if you need to go somewhere, you can inform me on the phone that you are going. So it's that he doesn't let me go anywhere, even with my mother, without asking him. He says that unless I give you permission to go somewhere, you cannot go anywhere at all."* (P16_2018)

She later told us that he is a laborer and mostly away from the home for work. If she does not receive a response from him, then she will not leave the house. Once he told her to call her father's number (her father works at the same job site) if a call to him did not go through.

4.10 Discussion

In this chapter, I highlight the direct and indirect roles played by family members in women's technology access in Pakistan, a predominantly Muslim country. The analysis shows that some family members make decisions for women, and others enable or limit access. The roles of family members – including young and adult children, brothers, husbands, cousins, and parents – evolve and form complex dynamics around women's technology engagement and inclusion.

4.10.1 Protectors and Maintainers

The findings around family, especially men's roles in the different stages of technology engagement, emphasize how religious norms can impact interactions between men and women, and, therefore, these norms must be considered when trying to understand technology engagement and technological inclusion.

In Pakistan and elsewhere in the Islamic world, men are socialized through culture and religion to behave as protectors of women, and women participate in this socialization in how they raise their children. These practices are not experienced as 'paternalistic' by the research participants. Instead, it suggests a holistic practice of protecting women's rights and rightful choices when necessary. While enacting their role as protector, men were supporters, buyers (to protect women from public interactions and vulnerability), enablers (as providers or funders), limiters, monitors, and prohibitors (to prevent personal or social damage) of technology engagements. Although some women assumed these roles, men's decisions typically took precedence and were considered more pervasive. In literature on the family in Western contexts, women, and most definitely older women, do not defer to family members (especially those who did not live with them and were not paying for the technology) about decisions regarding technology purchases or use. In Pakistan, women's choices concerning technology are tied to the decisions and influences of their relatives. While some might view this as disempowering to Pakistani women, men are duty-bound to serve women through rightful practices. By acknowledging this different approach to decision making based on Islamic values, new avenues for technological inclusion become available.

4.10.2 When Designing for Women, Design for the Family

The findings show that while the stages of technology engagement for men are based on their personal decisions and preferences, women's technology engagement depends on collective decisions and preferences within the family and wider social network. Women consider their families' opinions and needs, which can enable or limit their technology engagement. The socio-cultural and religious underpinnings of how men and women interact within families are crucial for understanding technology decisions. To include women technologically in the context of Pakistan and elsewhere in the Islamic world, the role of different family members must be considered. This argument necessarily extends the work on intermediated technology use (to enter input, to decipher output, and to engage on a users' behalf) [225] in that it carefully describes the different stages of technology engagement and the complex

dynamics between family members at each stage.

To successfully design technology for Pakistani men and women might require different processes if the goal is to work within the cultural and religious framework. To design for Pakistani women, I propose consideration of "design for the family". By ignoring the role of the family, technology will result in "unintended consequences" [82] for women and their relatives. In low-income households where a device will likely be shared, women, as wives and mothers, consider the impact on the family.

Women situate or limit themselves for the family, and they strategize and bypass restrictions via other family members (e.g., cousins). These supportive actors, like mothers, must also be considered when designing for women's technological inclusion. Similarly, designers can pay attention to these nuanced interactions and add more granularity to their interventions (e.g., women with supporters vs. women who endure monitored use) rather than blanket figures (n% smartphone women users).

Low-literacy can cause fear of, intimidation by, or skepticism of technology [241, 157]. It can be correlated with lower cognitive skills required to learn technology [159] and become a limiting factor in the exposure to and experience with technological devices [157]. However, the interviews showed that children of parents who had low-literacy did not face such challenges. Most of the children were better educated than their parents, had more technological exposure, and possessed a willingness to experiment with technology compared to their family members. These children, who spend most of their time with their mothers, can be a source of knowledge for their mothers and guides for women more generally. They have the potential of being change agents, teachers, and influencers. Low-income parents actively rely on them and are proud of their technological skills [195].

4.10.3 The Interplay between Authority and Knowledge

The roles of various family members and the dynamics of authority that govern these roles provide a lens into the tensions created by technology. While interpretations of Islam form the basis for much of this gender-based and age-based dynamics of authority, this foundation was, at times, questioned and contradicted when there was a need for knowledge about technology.

Contradictions may occur in instances where technology or its presence affects cultural norms and upsets how and what knowledge is maintained and shared. Technology can also influence access to different types of knowledge that may be contrary or supplementary to the knowledge held by the older generation. Thus, the younger generation influences the knowledge of what technology does and how people might use it (including benefits, abuses, and misconceptions). This transforms authority structures around knowledge and can result in a transfer of authority to the younger generation, especially if its members are considered technology experts. This shift in the dynamics of authority and knowledge caused by technology is at the center of understanding how family influences technology engagement.

Another point to note in the context of Pakistan is that information sources – the technology experts, news broadcasters, and local storytellers – are all men. This may magnify the stories of women's misuse of technology that can tarnish a family's reputation. Technology has been characterized as an enabler of good, which can lead to women's empowerment and enactment of agency [107, 171], and as a tool for overcoming social barriers [196]. However, the analysis demonstrates that technology can lead to greater regimenting, monitoring, and controlling of women. Designers and those who implement new technologies must understand the tensions between the positive and negative effects that result from a design and deployment of technology.

4.10.4 Voice, Freedom, and Religion

Beyond the immediate tensions discussed thus far, this chapter addresses some of the core concerns of CSCW and HCI research communities around equity and ethics. Modern computing technology is largely based on an assumption of an individualistic society with values rooted in neoliberalism, consumerism, and capitalism, and the model of 'personal computing' reflects these values. Under this value system, 'community' is grown artificially by connecting individuals in a digital space with optimism of 'unity' and 'growth'. Starting from Nokia's slogan, *"Connecting people"* [166] to Zuckerberg and Bono's speech, *"To unite the earth, connect it"* [41], we see a pattern of isolating a person from their organic social

context and imposing an artificial community on them through digital means. This pattern of design and use of technologies may conflict with local or family value systems that have a distinct understanding of identities, relationships, and accountability. The contradictions that can arise between these value systems give rise to a debate centered on liberty and asks whether communal values allow freedom for individuals.[10]

Through my work, I advance this discussion and argue that Islamic values, as observed in my study, do not necessarily limit women in accessing technologies unless they meet with misogyny, which Islam does not support. These findings parallel those of Saba Mahmood's ethnographic work in Egypt, where Mahmood illustrates how women's empowerment happens from within a culture guided by Islamic norms[155]. In doing this work and listening to the voices of women who told us about their lived experiences with technology use and non-use, I set out to establish a precedent for others to look first at what women want and need before assuming that a new technology or a technology touted as offering freedom in any form is released as the new champion of women's empowerment.[11] With this in mind for the women interviewed, considerations of family and Islamic norms as explained by these women are critical to understanding the complexity of decisions where technology use and non-use are concerned. Instead of considering a woman as an individual isolated from her social network and family, I join Mahmood in considering a Pakistani woman as a member of Pakistani culture who is guided by Islamic values. I envision that positive changes for Muslim women of Pakistan can occur by bringing positive changes in the social functioning that is also supported by Islamic values. This argument prohibits positioning feminism orthogonal to Islam and calls for understanding feminism within Islamic values that are shared by millions of women across the globe.

In doing that, this chapter builds on the work of the political philosopher Isaiah Berlin, who distinguished between 'positive' and 'negative' liberties and showed how an individual-level, accountability-free liberty can actually result in diminishing the essence of freedom:

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[10]This is sometimes (perhaps problematically) viewed as a confrontation between opposing value systems observed through the lens of post-colonial computing, as the West meets the global South [121].

[11]Here, this work is influenced by the work of Lila Abu-Lughod, who offers a balanced perspective on how to approach understanding Muslim women's rights and freedom [149]

it may be guided by ignorance, instant reflex, psychological influence, and narrowly selfish behaviors [35]. On the other hand, 'positive' liberty refers to a collective effort of empowerment of each member of the community so that the community can achieve the goals appreciated through commonly held values. This line of argument is aligned with scholarly work in the social sciences influenced by Marxism, postcolonialism, and South Asian feminism. This body of scholarly work sees human liberty in the freedom from the limitation imposed by various historical and social injustices through collective movement. I argue that for Muslim women, technologies should be deeply engaged with their social context and religious values to help them achieve their goals [242].

4.11 Conclusion

Through interviews with 73 low-income Pakistani women about their technology knowledge, access, ownership, use, and non-use, I show how their family was the source of their motivations, and family members enabled or limited women's use of technology. I demonstrate how different family members in an Islamic society held roles as those who introduce, teach, maintain, and buy technologies in addition to restricting, monitoring, and disapproving of technology use. This work is significant because it offers a lens into how to assess technology engagement and technological inclusion of women in non-Western and Islamic contexts.

This work was done in collaboration with support from Information Technology University's administration in supporting 2017 visits in Lahore and Kasur; Ibtasam Sharif, Saba Tariq, Bilal Bhaddar, Aqsa Hassan and Hassan Khawaja for facilitating our last two-year's visits and stay in South Punjab.

Chapter 5

IMPACT OF RELIGION ON TECHNOLOGY ADOPTION AND USE

There is not an absence of HCI research concerning religion and spirituality. However, most of this research is focused on the understanding and building of use cases supporting religious practices rather than the underlying everyday religious implications. The HCI community believes in understanding socio-cultural norms and designing for users' values - both of which can stem from users' belief systems. This chapter is a reflection of my research work and the implications of religion seen throughout the data collection, analysis, presentation, and reviewing of this work. Using stories from my research work in an Islamic context, I make a case for how religion can impact HCI research. In particular, I discuss a) the implications of socio-cultural norms and participants' beliefs (e.g., hijab or 'veil') on HCI research in these settings; b) how religion forms users' individual and collective values and socio-cultural norms that impact users' understanding, use, or perception of technologies; and c) how our presumptions about a belief system or our value tensions can impact reporting and viewing of such findings. Thus, HCI needs to look beyond engagement with populations to include the belief systems to understand the interpretations, negotiations, and enactments of these values, their implications on our research, and their results.

An earlier version of this chapter was published in the Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems as *For God's sake! Considering Religious Beliefs in HCI Research : A Case of Islamic HCI*[1] [112]. I have also co-led a workshop on the topic of *IslamicHCI: Designing with and within Muslim Populations* [178].

5.1 Introduction

Islam is the second-most practiced religion in the world after Christianity [146]. Islam has gotten increased visibility and attention in the past two decades. However, much of this

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attention has been negative [205, 237, 150]. While this has created a lot of assumptions about the belief system, I argue that there is an opportunity in HCI research for conversations between and among diverse belief systems and how they impact technology consumption and our research.

Followers of Islam are called Muslims. Islam, like most religions, represents a set of values that impact the lifestyle, norms, and practices of its followers. These norms not only impact those who follow this belief system but also impact those who live or conduct research in Muslim majority countries. Efforts like ArabHCI [20] in CHI 2017 and *Islamic HCI* workshop in CHI 2020 [178] have tried to *"bring together CHI researchers and practitioners who engage in studies and interventions within Muslim majority communities around the world"*. These workshops aimed to discuss and understand the Muslim identity, its cultural diversity, and the unique constraints, and limitations of Muslim communities. In this work, I take these conversations forward by giving detailed examples from my work within an Islamic context to showcase the various ways in which individual and collective values impact our users, their interactions, our research, and its reporting.

HCI researchers follow a rigorous process to identify and understand their target population before designing for them and make efforts to understand any underlying implications of our technologies or impliactions of existing values on use of our systems. However, the implications due to religion have been typically/traditionally overlooked. While there is HCI research concerning religion and spirituality, most of this research is focused on the use cases supporting religious practices rather than the underlying everyday religious implications on the access or use of technologies.

In this chapter, using personal stories from my work in an Islamic country, I share the various facets in which the socio-cultural and religious norms in such contexts can impact the research assumptions, research processes, and research contributions for the field of HCI in general. I make a case for understanding and including religious beliefs in HCI research and share details of my experience as a practicing Muslima (female Muslim) working with Muslim populations. I share a) how fieldwork can be impacted in Muslim majority countries by socio-cultural norms e.g., due to gender segregation and hijab; b) how users' understanding, consumption, and perception of technology are influenced by

their belief systems; and finally, c) how reporting and reviewing of HCI work is impacted by our values and value tensions. While I share this narrative about my personal experiences, some of these implications might also be true for other populations or religions. Before each of these stories, I also try to provide a brief description of some Islamic concepts that are used in these stories.

5.2 Background

Before going into the details of these stories, I share some details about myself in the form of a biography as well as the context for my research experience which forms the basis of this narrative. These details will help understand the socio-cultural and religious backdrop that is needed to understand this chapter.

5.2.1 Biography

If you are reading this thesis, you know that at the time of this research and this reflection chapter, I was a graduate student in a Computer Science Ph.D. program in the US. I was born and raised in a conservative, educated, and religious household which meant that while religion was frequently mentioned, taught, or referred to, everyone did their own reading, formed their own understanding, and practiced based on their own preference. Many sociocultural norms practiced around me, in personal, academic, and professional life, were from religious values such as the obedience of elders, and segregation of genders at public and private events including at educational institutions and government services.

I received all of my education and work experience from Pakistan which is an Islamic country and is considered culturally conservative. This education also included completing the recitation of the Quran at the personal level and being taught Urdu translations of the Arabic Quranic verses at the school level. This, along with educational programs on television and written articles which talked about and at times debated Islamic jurisprudence, differences in practices between sects like Sunni and Shiites, and reading of books like Hadith [sayings of the Prophet (SAW)] form my limited knowledge about the religion, Islam.

Along with this, I also had the opportunity to visit many other countries with a Muslim majority and minority populations. This also enabled me to see the diversity of interpretation and implementation of Islamic values such as the mandatory covering of the head or required accompanying of male chaperons for travel, etc., - concepts that are not mandatory in Pakistan and not practiced in urban Pakistan. This broadened my perspective on the diversity of interpretations and practices across different Muslim populations around the globe. While I considered and still consider myself a practicing Muslimah (female Muslim) because I practice five prayers (mandatory on every practicing Muslim each day) or fasting for Ramadan[2], I am considered unrecognizable as a Muslima due to the absence of head-scarf. Growing up I could see that this segregation of genders not only created a difference in information received by men and women, but also created a difference in resulting opportunities. One such particular instance that I remember is from a gathering where no woman in the women's section talked about or worked in Computer Science jobs. Whereas, all men who were engaged in Computer Sciences were audible conversing in another room where no woman ventured. Such segregation creates dependence and sometimes scatters information.

I will also share that, like all cultures, with the propagation of media and change in practices around the world including the Middle East, many of the socio-cultural values and norms are changing. While I share these stories from my perspective, I in no way claim to cover all perspectives, interpretations, and experiences of the Muslim world.

5.2.2 My Research

The research work described in this chapter is a reflection on my work from Pakistan. Pakistan, officially named as *Islamic Republic of Pakistan* is one of the two countries formed in the world on the basis of religion, where Muslims of the sub-continent wanted to form a separate homeland. This concept, famously known as the *Two Nation Theory* [230] implied that there are many differences in religious customs, and traditions between Hindus and

[2]Ramadan, a month of Islamic calendar is considered as one of the holiest months in Islam. During this month, Muslims observe fast where they do not eat or drink anything including drinking water from the pre-dawn meal before the fast also called the suhur, to the meal at sunset that breaks the fast called the iftar

Muslims, and they cannot have a common nationality. Thus, religious values and beliefs form a strong part of its socio-cultural and political identity. Pakistan is a Muslim majority country with many of its political, legal, and social systems drawing from and based on Islamic values and principles.

Pakistan, which was once a part of the sub-continent ruled by the British saw a lot more integration of values from both colonial and multi-ethnic populations in the sub-continent including Hindus, Sikhs, and other minorities. Thus, traveling to other Muslim majority countries especially Saudi Arabia made me realize the difference in implications e.g., most, if not all of the Muslim world could speak and understand Arabic. While Muslims in Pakistan are trained to read and understand the Quran, Arabic speaking and writing skills are not common.

5.2.3 HCI research

I would like to start by mentioning that there is not an absence of HCI research concerning religion and spirituality. However, most of this research is focused on the understanding and building of use cases supporting religious practices rather than the underlying everyday religious implications.

HCI researchers have called attention to the lack of presence of literature on the adaptation and adoption of technology for spiritual practices and in spiritual environments which have been termed as *techno-spiritualism* [83, 45, 40]. The challenges resulting in a lack of research by the HCI community included lack of funding, potential sensitivity associated with the topic, perceptions of lack of scientific rigor, and risks associated with such research [45]. Since then we have seen research on understanding the techno-spiritual practices in everyday life [269], at American Christian homes [272], by American ministers [273], use of home automation by American Orthodox Jewish families [262], American Muslims [270, 271] and integration of technology with existing religious institutions by Muslims [212].

However, beyond the religious practices and research around the use of technology for religious practices, I hope to draw attention to the implications of religious beliefs and values on HCI research and its users. I also hope to draw attention to the need for exploration of

the impacts of religious practices, beliefs, and values on the usage of technologies and how such values might enable or limit various uses and use-cases. A consideration of the beliefs and religious values will help understand, design, and evaluate such methodologies, works, and their implications more accurately.

5.3 Religion, Values, and HCI

The first story that I share here is that of religion's effect on the beliefs, societal, and household norms and their resulting impact on the use of technological tools.

Financial well-being and reliable access to financial services have been associated with narrowing income equality, overcoming poverty, and enabling growth [59]. With the steady increase in internet availability and smartphone use, reaching 45% of the total global population in 2020 as compared to 33.5% in 2016 [253], efforts to promote Digital Financial Services (DFS) for poverty alleviation and financial inclusion efforts have also increased. DFS means financial services delivered through digital channels and include internet banking, mobile wallets, and Over-The-Counter (OTC) transactions. Pakistan is one of the DFS-ready countries - countries with the required infrastructure for DFS e.g., 3G/4G infrastructure, formalized government-issued IDs, mobile money friendly policies, etc. However, the DFS use and adoption in Pakistan remain low.

I started my research on Digital Financial Services (DFS) to explore the lack of use of financial services including DFS in Pakistan. I started with an exploration of the use of existing smartphone-based mobile wallet services in Pakistan. The research was focused on the ability of users to learn to use existing mobile wallet services offered in Pakistan [113] (Chapter 6). During the fieldwork and qualitative interviews with men and women in Pakistan, there were gender differences in not only in the use and comprehension of financial services but also in terms of reactions to mobile wallets.

These differences were not only limited to the usage and ease of use but also included differences in participants' listing of potential uses and privacy concerns. Men appreciated the ease of use and were very easily able to map the steps in the mobile wallet applications and their various use cases to the processes that they had seen while transacting in a corner mobile agent shop where a shopkeeper (also known as mobile money agent) sends or receives

money using the network of mobile operators. In the absence of mobile wallets, men would go to mobile agent shops around the corner and hand over their identification documents or information to send or receive money. With these wallets, the men noticed that the process would be easier, and save them time and effort.

However, when I inquired from women about the same transactions, women shared that they normally waited for their male family members to return from work or outside and then accompany them (observation 1). These women believed that mobile wallets would enable them to transact from the comfort of their homes. Similarly, women wanted secrecy and privacy in their transactions. They appreciated that with the help of mobile wallets, they would be able to transact from home, or even while sitting among family members without others realizing that they are transacting (observation 2). These observations made me think that gender has a role to play in financial understanding and use and I wanted to explore this further.

5.3.1 Religion, Finances, and Gender

When I explored further, I found out that men and women looked at and engaged with finances and financial transactions differently. And at times, to my surprise, women (both married and unmarried) who even earned and had financial independence gave up their earned money to the men in the family. This led me to start another study to understand the dynamics around the three important components that needed to be in place before a financial transaction could be made (described in Chapter 2). These included a) Affordability - the finances required to make a transaction; b) Authority - the agency and authority to spend or receive money to make a transaction; and c) Access - which meant access to a physical bank or corner shop or a digital device like a mobile phone to make the transaction. All of these combined would enable anyone to be able to make financial transactions.

In the qualitative interviews with Pakistani men and women, I learned that both genders looked at financial transactions differently and there were established gender norms throughout the society which permeated through generations. The amount of the transaction decided the gender of the person who dealt with it. When it came to bigger financial

transactions e.g., buying property, cars, and electronics, men were considered as the decision-makers. However, when it came to smaller financial decisions which included day-to-day grocery and childcare, women would make these transactions.

When I explored further, I found out that it is because men are considered the Head of the Household. Women and men believed that this is how religion defined it and God has made it to be that men are supposed to be the breadwinners and the managers of the house. These values were derived from socio-cultural and religious norms. Women considered men as the ones responsible for finances and decisions related to money. Some women even went to the extent of sharing their belief that if women led the financial decisions or the decisions of the household, and its financial transactions, the household would never achieve prosperity as they are not supposed to do so.

A deeper exploration revealed that this is derived from the Islamic principle of *Nafaqah* which denotes the financial support that a husband must provide for his wife. This includes both provision during the marriage and for a time after the divorce which obligates the husband to pay for his wife's housing, food, and clothing in the course of their marriage. Thus, men should provide and make decisions and women willingly wanted them to lead the financial decision-making and transactions to keep up with these values and resulting norms practiced by the elders.

If I had not gone into this phased approach and made efforts to understand women's perceptions about financial transactions and the underlying values that drive these perceptions, I would have also continued to explore the usability of the financial applications as reasons for this lack of use.

5.3.2 Islam and Rights

Islam is at times associated with patriarchal values especially when it comes to women's rights and representation in religious leadership roles e.g., women are excluded from leading or speaking at religious gatherings, religious prayers where women are supposed to pray behind men, etc.[2]. However, Muslim women also have many rights e.g., married women can seek separate residence for themselves and their children, and men are supposed to

provide for them. Muslim women can also ask for payment for breastfeeding their babies or can seek others to feed their babies for payment as mentioned in the Quran chapter Surah At-Talaaq which translated to 'The Divorce'.

> *Lodge them [in a section] of where you dwell out of your means and do not harm them in order to oppress them. And if they should be pregnant, then spend on them until they give birth. And if they breastfeed for you, then give them their payment and confer among yourselves in an acceptable way; but if you are in discord, then there may breastfeed for the father another woman.* Q65:6

The reason for listing these rights is not to provide any clarification but to review the existence of rights. When I saw a clear gender discrepancy in the understanding and use of Digital Financial Services, my immediate questions and assumptions were about women's rights. Because like many HCI researchers when I made observation 1 (about women not making bigger financial transactions) and women giving up their financial earnings to men, my first assumption was also about the oppression and patriarchy that might have forced them to act in this way.

However, in my research with low-income women, many women appreciated the fact that they did not have to leave the house to deal with transactions. These could be either due to negative factors outside the house or due to the burden of existng chores within the home. Many women told me that they do not go out of their houses to go to the banks and the mobile money shops to transact because of the fears of harassment in the public including on public transport. Women shared that besides the acts of harassment, they feared negative interactions like theft and mugging. Lastly, women were also fearful of society's negative reactions to their being outside without a male chaperon, and the looks and stares they might receive. Some women even reported being scared of shopkeepers' ill conduct with women. Among these were women who shared that they were happy that the men are dealing with the finances. And since they already have a lot of house chores including childcare, they appreciate men taking some of the tasks from them and that they do not have to worry about going outside and making the financial dealings and do not have to deal with the men in the society.

5.4 Religion and Conducting Research: Islam and Hijab

In Islamic countries, the concept of hijab or *the veil*, known as Pardah in South Asia, takes many meanings and each of these meanings is based on the perceptions, interpretations, and norms of the region [235]. The word *Pardah* is a Persian word that means curtains. This word has been used to understand the physical curtain used to separate men's and women's gatherings as well as the fabric that is worn to achieve modesty. The hijab or covering by women is done in many forms – from the complete coverage where eyes are visible, to the headscarves which cover the head and hair, it is also used as a *chaddar* or one big cloth to cover the head and body.

Hijab is not only the name of the fabric which is referred to as *Khimar* that is worn to cover (seen in the first verse listed below), but it means modesty (seen in the second verse). For example, in the Quran, we see both of these teachings.

> *O Prophet! Enjoin your wives, your daughters, and the wives of true believers that they should cast their outer garments over their persons (when abroad): That is most convenient, that they may be distinguished and not be harassed.* Q33:59

> *And say to the believing women that they should lower their gaze and guard their private parts; that they should not display their beauty and ornaments except what (must ordinarily) appear thereof; that they should draw their khimār over their breasts and not display their beauty except to their husband, their fathers, their husband's fathers, their sons, their husbands' sons, their brothers or their brothers' sons, or their sister's sons, or their women, or the slaves whom their right hands possess, or male servants free of physical needs, or small children who have no sense of the shame of sex; and that they should not strike their feet in order to draw attention to their hidden ornaments.* Q24:31

However, beyond the physical covering through the fabric, is the more important concept of modesty and segregation of genders. The latter concept was observed in my research

findings multiple times. Women believed that by going outside this concept of segregation and pardah ends. Similarly, going outside and talking to men was also seen in the same light.

Islam also includes a concept of *mehram* which means those who are related to you and cannot be married to because of a close blood relationship and from whom purdah or concealment of the body with hijab is not obligatory as mentioned in the Quranic verse above. The reason is that women are not supposed to engage in unwanted interactions and communication with men who are not related to them. A woman communicating with a shopkeeper is not unwanted interaction but men and women engaging in random communication can be deemed as unwanted. All familial relationships mentioned in the second Quranic verse come under the concept of *mehram*. This segregation of genders creates gendered norms where interaction between men and women is not as common and impacts the physical and digital lives of these men and women. In the sections below I share how these values and norms impact research.

5.4.1 Hijab and Fieldwork

These gendered constructs are not limited to the participants or the populations that we work with, but it also impacts us as researchers.

Participants and Hijab

When I went to conduct fieldwork, especially for the Digital Financial Services (DFS), I used the support of existing Microfinance organizations providing loans to low-income households or Non-Government Organizations (NGOs) working towards supporting the lower-income strata. However, when the male members of the MFIs or NGOs used to accompany me to the participants' homes, I noticed a hesitation. Women participants had to be very careful and sometimes had to be accompanied by the male members of the family to participate in the study. This meant that women were not only limited by the availability and comfort of their male chaperons, they were also conscious and at times uncomfortable about being open and detailed in their responses due to the presence of males, who were related or not.

Figure 5.1: Two photographs of interviews with participants. (Left) Participant and interviewer with covered heads with headscarf; (Right) Participant has covered head while the interviewer has uncovered head with the headscarf fallen on her neck during the conversation

Thus, after a few of these instances, I requested the partner organization members to allow me to conduct one-to-one interviews.

Researcher and Hijab

However, in order to support the participants, it meant that I had to be alone in their selected venues or houses or MFI offices, etc. But due to the socio-cultural norms, I could not travel to these places, especially in a rural setting alone. The safety and security concerns as a woman and the sociocultural norms of women never traveling alone both suggested otherwise. Thus, I would then take the male supporters with me who would then wait outside the interviewing venue for me to talk to the women participants. Or at times male researchers would go and interview the men in the family thus the women could be interviewed by me.

Another dimension of my gender as a woman and researcher showed up when I recruited men for interviews. I started my interviews with the assumption that gender biases would not exist because I am introduced by the MFI as *"someone visiting from the city and conducting interviews"* and my profile would be taken as another door-to-door survey collector or similar entities. However, again the pervasive norms became visible when the men were

dismissive of my questions and my interviewing of women for the research and made inquiries about my work. One even scoffed if I was any kind of social worker from some NGO trying to get women some rights when I inquired if there were any gendered dimensions in the financial decision-making.

In all these instances I would ensure to cover my head because all women covered their heads and the uncovering of the head was disrespectful to the culture. Due to the lack of practice in covering my head regularly or due to the types of fabric, sometimes the head covering fabric would slip off my head. At one time, I observed a woman participant looking at my head as I looked up from my notes. This also pointed me to the possible distraction and abnormality of the uncovered head and thus I continued to ensure the headcover is in place.

A few of these points about gendered interactions as a researcher have also been hinted at in my other works [114, 115] (described in Chapter 4). However, my reason for sharing these details is to draw attention to the implications of religious and cultural values on the research methods and the differences and uniqueness that can be introduced in these methods.

5.5 Religion and Reporting Research: Islam and Muslims

5.5.1 Challenge of Reporting:

HCI community focuses on the nuances of research questions and research populations instead of converging on a single user type, user group, or definition of a group. It is imperative that we consider and report the various types of Muslims, the different types of people in each Islamic country, their unique cultures, their lifestyles, in our design for them and do not reduce any population to one box.

Some of the nuances mentioned in this chapter until now might have already pointed out the various differences in interpretations and practices of Muslims around the world. However, when I report many of these findings, I at times receive feedback that I should refer to papers on the Middle East, etc. I argue that the uniqueness and brilliance of the field of HCI is in discussing and embracing identities and user needs. And thus need

a realization that interpretations or practices of Muslims in Pakistan are not completely equal to those of Muslims in Bangladesh, Iran, Afghanistan, or the Middle East. And the same considerations apply to Muslim women as well. As I shared earlier, the laws and practices vary greatly around the globe for all Muslim women to be identified as the same. Thus, while Muslims are unique from other populations in the underlying beliefs and belief systems, there are various interpretations and implementations of those beliefs around the world and we should try to understand and tease apart those differences as well.

A reviewer once inquired in one of our works about the difference between the terms *Islamic* and *Muslim* and suggested that we alternate the use of Islam with Muslims. Islam is the name of the religion and those who practice it are called Muslims. The Islamic values are derived from the Qur'an and the life of the Prophet (SAW). While Muslims around the world might have various interpretations and implementations, replacing Islamic teachings by using a concept like Muslim teachings is unheard of. This also brings up the importance of local and subject expert researchers who can comment on the underlying value systems to review such works.

5.5.2 Muslim populations and Challenge of Reviewing

Another challenge faced as an HCI researcher in discussing these populations and the impacts of religion in their daily lives was in presenting those findings to the broader HCI community. I share a few of them below.

- In my works where I presented these socio-cultural values and how they impacted financial decision-making, HCI researchers wanted me to add technical design recommendations to my work. How can we make more women use these financial services? A bigger question I struggled with was, why should I try to design to make these women want to give up on those values?

- At one instance where I had shared how Muslim women were comfortable with men leading the transactions both for religious reasons as well as to avoid *"yet another chore"*, a reviewer claimed that this was reinforcing the patriarchal values. Similarly,

> in another instance, I had recommended that rather than designing to bring these women outside of their comfort zones, into the mobile money markets where other unrelated men exist, we can design solutions that provide services to women in places where women are the most comfortable. This was called by a reviewer as an idea reinforcing segregation.

However, in sharing these experiences my view is that these values are deep-rooted and have a functional meaning in the lives of these individuals. While many of us do not agree or relate to the values or experiences of these women, we cannot design technical tools and challenge existing values and social setups because of our disagreements, as also hinted by recent works focusing on *design within limitations and contexts* [242].

5.5.3 Challenge of Defending:

The third challenge, which is an important one for us as researchers from the Global North, which should be kept in focus and one that differentiates Muslim populations is the recent and at times negative focus on Islamic cultures and values [205, 237]. As a Muslim researcher who is from and works with Muslim populations, I have observed hesitation among participants when sharing details about their religious beliefs or practices or how it impacts their daily life. This hesitation was at times accompanied by the need to clarify themselves. While it is my opinion that this constant clarification is due to the associated negative images associated with Sharia (code of life that all Muslims should adhere to) [1, 205] and Islam in the media, I form this opinion based on the similarity of all these clarifications where participants would clarify to sound more neutral or liberal.

As an HCI researcher, I have also felt the need to be more descriptive in my work as I continue to clarify and answer questions about the faith and its principles. The feedback that equated Pakistan with Islam in the Middle East or Bangladesh or comments about reinforcing oppressive values made me question every time that do I want to conform and have a CHI paper or should I explain what I see? Thus, as HCI researchers we need to acknowledge and understand how the pervasive global perspectives impact reporting of and reporting by the participants who are unclear or at times fearful about the reactions to their

belief system or practices.

5.6 Discussion

This chapter presents three implications of religious beliefs on HCI research - both on end-users as well as HCI researchers. These implications impact researchers and participants in the collection and analysis of data and impact us as authors in the understanding and presentation of data and as HCI reviewers of papers that include the mention of belief systems and their impact on sociocultural norms, values, and use of technologies by the populations. Other researchers have already called to focus on research and design beyond the popular narratives e.g., Jewish HCI [97] and Arab HCI [20] etc.

HCI is related to research about humans and all our studies and research methods such as usability, testing, interviews, and observations are dependent on human interaction. However, belief systems that incorporate various value systems about interaction with digital systems, interaction with the same or other genders, or travel and communication outside the house require deeper understanding and even might require reforming our research methods to suit these populations. These values and what is permissible or not can play an important role in what kind and quality of interactions can and cannot happen between the researchers and the participants as well as between the participants and the technologies. These norms can alter our research methods and how they can be applied. Thus, such implications as the presence and absence of mehram or related men as well as same or opposite gender and its likely impact on the participants' response are all things we need to consider as HCI researchers.

Value Sensitive Design recommends that technologies are not value-neutral and there are values associated with individuals, as well as groups (collective values) and technologies [82]. And we should explore these further to understand and design for them. I give details of my work to showcase how these values are impacting Muslim users in their processes and decisions towards technology understanding and use, and how these values can also have an impact on the research process.

Presentation and reviewing of papers are an important part of HCI research. However, if we continue to establish what is unique or novel and what is similar, based on

our understanding, we might be eliminating a research conversation altogether. Reviewer commentary or feedback that questions findings or perceptions that a recommendation is reinforcing patriarchal or segregation can only make populations and its researchers feel inadequately equipped in sharing their stories or push them to further defend their stance.

5.7 Conclusion and Other Works

Using stories from HCI research in an Islamic country with Muslim and non-Muslim populations, I share the various assumptions, challenges, and opportunities for research with these populations. I use these stories to showcase how Islamic principles and beliefs form a strong part of the value systems and lifestyles of Muslims in these countries and as HCI researchers we do not work beyond simply engaging with such populations. We need to take a step deeper to understand the underlying values that form these socio-cultural norms.

Following this conversation about religion and its implication on users, many works have looked at the intersection of religion and HCI. Digital expression of religion and religious values were explored by analysis of tweets with Quranic verses [4] where tweets were being considered to perform religious practices, such as reciting Quran, supplication (dua), and ceaseless charity. Other works inlcude the exploration of religious sermons videos [214] as faith based media enabling collaboration and creativity. The Islamic preaching videos were also looked as a source for setting the discourses relating to morality, ethics, and norms [213]. Rifat et al. [215] looked at the idea of persuation represented in the Islamic values and their vision of sustainable living. Al-Dawood et al. [18] discussed how parents in Saudi Arabia look at the utilization of technology by young adults to find potential spouses online in a non-Western context.

Chapter 6

LEARNABILITY'S IMPACT ON TECHNOLOGICAL AND FINANCIAL INCLUSION

In the last few chapters, we looked at the social factors such as gender, family, religion, socioeconomics, and their impact on users' access, use, and understanding of technological and financial services. In this and the next chapter, I look at how learnability and user training play a role in building user understanding and enabling access and use of technological services.

Learnability, the ability of a user to pick up a system and start using it on their own, is important for users' initial interaction with a system. If this initial learnability is difficult for users, they would go back to easier and familiar interactions which will be non-digital in our case. In this chapter, I explain the various components of knowledge or user learning that enable a user to interact with technological systems.

Formal or informal training plays an important role in the understanding, use, and adoption of technology and digital systems in professional and personal contexts. In the previous chapters, I explain the social access and social actors both in the form of immediate family members helping users as well in the form of women entrepreneurs helping other women to understand or use technology. Thus, the role of supporting actors and the guidance and training they provide is crucial to successful engagement with technological systems. In the next chapter (Chapter 7), I look at the role of user training in forming users' learning and use.

When an advanced user interacts with a new system or a novice user interacts with a system, various types of knowledge and learning come together to enable users to achieve their tasks. In this chapter, I investigate the different types of learning that enable users to interact with a digital system to understand how we can better support user learning. Based on multiple user studies, I show that various information components come together

to enable a user to use a digital system. These include a) device-level learning, b) domain-level learning, and c) application-level learning. Within application-level learning, I describe how concept-level and implementation-level knowledge are learned using domain knowledge. This typology will facilitate future works around users' engagement with digital systems. I will utilize this typology to incorporate specialization training and support for new and existing users in mobile-based systems.

A part of this chapter is inspired by my original work *An Exploration of Smartphone-Based Mobile Money Applications in Pakistan* published in the ninth International Conference on Information and Communication Technologies and Development (ICTD 2017)[1] [113].

6.1 Introduction

The Human-Computer Interaction field has continuously worked on improving the interaction and experience of users with devices and new technologies. These improvements have led to a variety of works on providing ease of use, evaluating usability and its sub-components like learnability, flexibility, and effectiveness [232], incorporating affordances and signifiers [188] into the designs, and leveraging participatory design where the end-users are included in the design and building of systems. Once the systems are built, user interaction is continuously measured, understood, and improved using user manuals, customer support, online forums, and data collected from the technologies themselves. However, the success of all these components depends upon the understanding of the users' information needs about how to interact with these systems, how users utilize this information to engage with systems, and what improves their experience and learning. In this work, I explore what are the underlying learning and knowledge that goes into a user's use and understanding of a digital system.

We, as HCI researchers, cannot solely focus on innovating and creating new applications and systems, without concerning ourselves with the understanding, adoption, and uptake of these services. The focus of most of the current ICTD projects is on the development,

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deployment, or understanding of the socio-cultural barriers and opportunities of end-users. Works within user interaction are focused on the user interfaces (UI), and the limited use due to intimidation, reading difficulty [250], language issues [51] and literacy issues [161] etc., and thus lack focus on the User Experience. Researchers caution that content access does not only concern the motivation of a user to use information technology but also the ability of a user to process the meaning once they are connected [183]. Jonathan Donner in his book *After Access* [68] argued that as the technology ownership changes and technology reaches far and wide communities, we need to understand the resulting heterogeneous experiences to better design for them. Various researchers [123, 68, 202] have discussed that there is a spectrum of digital services and their ownership, access, and use and not a single model.

I add to this line of work and argue that in order to enable users to fully engage with and utilize these benefits we need to understand the various types of users and their interactions with these systems. In my work, I explored how users with diverse technology ownership, understanding, and experience interact with digital devices. Based on the user studies conducted over the years, and my understanding of the various types of knowledge required and used by these users to successfully engage with the systems, I share in this work the various type of user learning that come together to enable a *meaningful use of ICTs* in particular smartphone-based applications namely device-level, domain-level, and application-level learning.

In the rest of the chapter, I first explain the methodology of data collection that formed the basis of this theoretical contribution. I then share the typology with examples and sub-types. I also discuss its implications and recommendations for use and conclude with my plans for future work.

6.2 Related Work

After initial access, the ability to understand and learn applications plays an important role in the adoption and continued use of digital applications as well as in enabling customers to fully utilize the numerous services within these digital applications. There are two types of learnability: initial and extended. Initial learnability is defined as the user's ability to understand how to use a service or system right away. The other, extended learning, refers

to longer-term learning of a service or system over time [90].

Usability and Learnability

Usability is defined as the extent to which a product can be used by its users to attain specified goals with effectiveness, efficiency, and satisfaction in a specified context of use [187].

Learnability is considered an important component of usability. However, there is no uniform definition of learnability in the HCI literature [90]. For example, in some studies learnability is defined as the ease with which a user can learn and start using a system [185] [90] whereas, Vatrapu et al. [256] refers to learnability as the evaluation of a particular system in terms of the learning process of the users of that system. Dix et al. [64] define learnability in terms of the ease of a system for users to accomplish basic tasks when using the system for the first time.

Although there is debate over the boundaries between learnability and usability, learnability is often considered as an attribute of usability [141]. Nielson [184] referred to learnability as a fundamental attribute of usability because the first experience that users might have with a product is that of learning to use it. In our work, we define learnability as the ease with which users can learn to use the system, without requiring any external guidance or support, and achieve the task they wish to perform.

Learnability is foundational to sustained use because users who are unable to learn how to use an application within the first few minutes will switch to another application [90]. With this assumption, we argue that difficulties in a mobile money application's learnability may result in the user defaulting to existing modes of payment or cash payments because of their ease of use or familiarity.

Interface design plays an important role in the overall learnability of a system. Difficulties in interacting with the interface, at any point, can decrease overall learnability. Leung et al. [145] studied the learnability of mobile applications for older adults and suggested three approaches for improving device learnability: improve graphical icons, create multi-layered interfaces, and augment the mobile interface.

Many have researched speech, audio, video, and graphical guidance for low-literate users in smartphone interfaces as well. Video Kheti [58] recommended using both audio and graphical interfaces. However, they also found that multi-modal interfaces do not help low-literate users overcome issues related to lack of education. Graphical symbols and photos are excellent for output and convey large amounts of non-linguistic information. However, they introduce the risk of ambiguity and confusion regarding the meaning of images.

Mendoza et al. [165], in addition to discussing user frustrations and user error categories, argued that the causes of novice users' frustrations represent "barriers to entry" rather than fundamental problems with application usability.

6.3 Methodology

Over the years, my research work has involved the design, development, and deployment of mobile-based applications in emerging markets. These include applications used by health workers for record-keeping and information dissemination, by field workers for data collection, and by government employees and non-government volunteers to perform their duties. Most of this research not only required elicitation of user requirements by using user interviews, shadowing of users, and process documentation but also required user training as well as seeking user feedback in the form of usability tests and think-aloud activities.

As I conducted these studies, I have observed that there are various distinct yet interconnected informational needs and knowledge which come together to enable users to better understand and interact with these digital systems. The initial findings shared in this work are my analysis of these user studies that were designed to explore the understanding and usage of mobile applications. In particular, the most recent project was the usability evaluation of mobile wallets and I will use some examples from that project to explain the types of learning.

The interviews with the participants about their understanding of the paper-based systems, mobile-based applications replacing these systems, task-based usability activities within these mobile applications, and user feedback after these sessions about the constraints that limited their ability to perform these activities formed my understanding of the underlying factors at play in users' engagement and use of technology. These learning

are shared in the chapter below.

The participants in these research projects included both low-income men and women with literacy varying from 10th grade to non-literate users. Consent was obtained before all user research and all participation was voluntary. While my typology and understanding of the various types of knowledge used by users to interact with a system are formed from these participants, I believe that my analysis applies to other types of users and their device and application engagement as well.

6.4 Types of Learning

Over the last five years, I have conducted user research which included user observations, user interviews, and task-based activities where users were required to perform a task on a mobile application and respond to surveys before and after these activities. I observed that users referred to and utilized various types of existing knowledge to effectively and efficiently use these mobile applications. This knowledge can be depicted as various non-linear levels of learning that need to be achieved to fully understand and engage with a system as explained in this section. In order to interact with a system, users' understanding at these multiple levels enables them to interact with and use an application on a device.

From my work, I have seen that broadly three levels of learning came together to enable users to use these systems. Table 1 provides the names and a summary of these levels.

6.4.1 DEVICE LEVEL LEARNING

The first knowledge that is used by users to enable interaction with a device is device-level learning. Device-level learning refers to knowledge about the device. This means that the users know and understand how to engage with devices, which were smartphones in my case.

Device-level learning is further divided into two types of learning a) Hardware-level and b) OS-level which are described below.

Device-level	**Domain- Level**	**Application Level**
Hardware-level: Configuration (sensor placement, buttons to increase volume etc) **OS-level:** Interactions and actions	This is the real-world knowledge and includes how a process is done, or names of artifacts etc.	**Concept-level** The mapping of real-world actions to tasks **Implementation-level** The various steps and screens that come together to complete a task.

Table 6.1: Three main types of User Learning 1) Device-level, 2) Domain-level and 3) Application-level learning listed with examples

Hardware-level

Hardware-level knowledge can be thought of as an understanding of the hardware configuration of the device. This can include knowledge such as how different phone types have placement of various buttons or sensors at various locations on the device e.g., some smartphones have fingerprint readers at the front of the phone while some other smartphones have fingerprint readers at the back of the device. This type of information enables users to perform actions that require manipulation of hardware e.g., increasing volume or locking a phone requires familiarity with its buttons and their placement.

Operating System-level

The operating system level of learning refers to the software implementation and the operating system within the mobile devices. A very simple example that can cause users to be confused was where some smartphones have vertical scrolling to see more applications and some other phones have horizontal scrolling and swiping to see the list of applications. Knowledge of the operating system implementation enables users to navigate through the application as well as map interactions across applications. Such frustrations could result in comments from users like *"I have a smartphone too, but it does not do it like this."*

The device-level and operating system-level learning come together to enable device-level knowledge for a user to easily and efficiently interact with the device and perform any operation on it. For example, taking a screenshot on a mobile device requires both hardware-level information about buttons and their placements and the operating system-level knowledge of how a particular OS implemented the screenshot.

Since my studies were based on smartphone-based applications, users who had not used or owned smartphones, explained that they were unfamiliar with the use of smartphones and either refused participation or faced issues with performing or completing tasks. Device-level learning happens when users can engage with devices and they can perform actions and activities on that device. These activities can be as simple as scrolling and searching [7].

6.4.2 DOMAIN-LEVEL LEARNING

I identified that there are aspects of learning about a product that is beyond the device or the application which I call domain-level learning. Even if users have device-level information, they also require domain-level information to engage with systems. Domain-level knowledge, as the name suggests, is the users' awareness and understanding of the domain related to a particular application. All digital applications, irrespective of their use are connected to the physical world. Most of the processes implemented by them such as banking applications, agricultural applications to even dating applications, games, etc., were all concepts already present before the digital world. Thus, users need to gain some knowledge of the domain to understand and interact with these digital systems.

Many digital applications alter their implementation of these domain principles. This is covered in application-level learning. However, a basic understanding of the domain is pertinent to engaging with these systems.

One example of domain-level knowledge from a study about the use of mobile wallets could be about how to send money to someone using a mobile wallet and what types of information and documents are required to send money. This would then translate to the knowledge of the requirement of your phone number, the recipient's phone number,

authorization of the transaction, and possibly a secret code for the recipient to authenticate themselves.

From the same study, I learned that the users needed to understand the concepts of the financial domain like PIN and the difference between PIN (which is for users to authenticate themselves) vs. Secret Code (which is to be sent to the recipient of the amount sent, to authenticate themselves while receiving money). Such domain and context-specific knowledge are also essential in a user's successful utilization of a service.

6.4.3 APPLICATION-LEVEL LEARNING

When users have an understanding of their devices as well as knowledge about the domain, each application is still another implementation of the same domain idea. Thus, application-level learning is where users needed to know how to use a particular application and explore and use its various features. Application-level learning also requires users to translate their existing knowledge (domain-level knowledge) combined with device-level learning to a new context.

One example of confusion due to application-level learning, seen in my work, was due to the implementation of keyboards. While most mobile applications use the native keyboard, some applications also designed or implemented their own keyboard which can cause the users to learn how to interact with them. Figure 6.1 shows on the left one such application using a keyboard recommended by a design toolkit was implemented by an application and on the right is the Android keyboard that the users were familiar with and used to. Thus even with the device-level information, a newer implementation confused the users due to differences in placement of backspace and space etc.

Application-level learning can be further divided into concept-level and implementation-level learning. It can be noted here that application-level learning is a combination of screen-level learning and implementation-level learning.

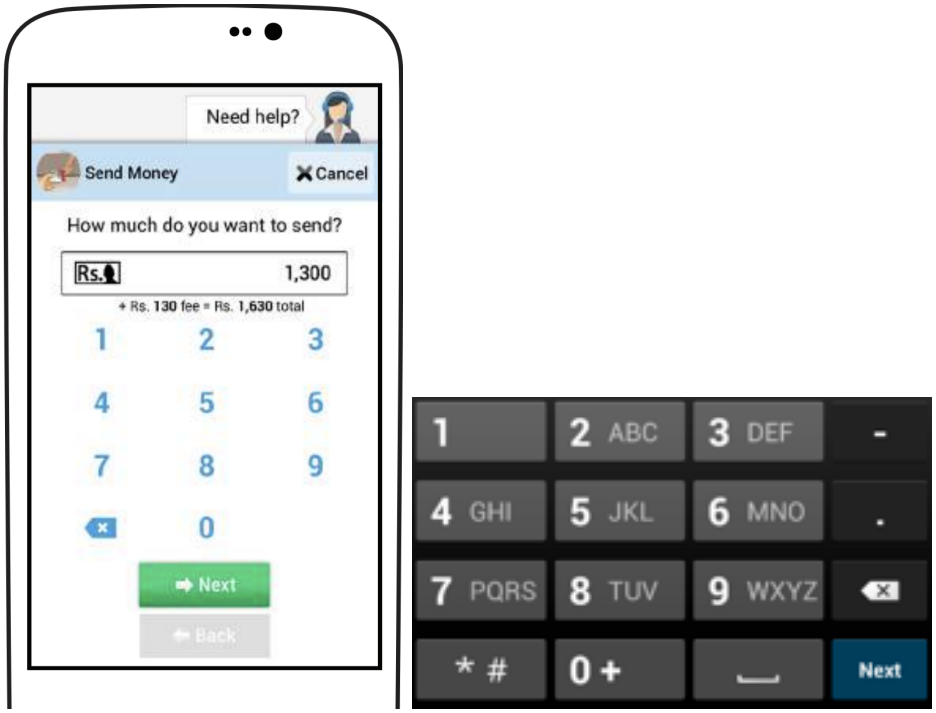

Figure 6.1: [Left] Application specific implementation of the keyboard. Application design based on user interface design toolkit recommended by industry [21, 89], [Right] Android keyboard from https://developer.android.com/ [110]

Concept-level:

Whenever a real-world action is mapped into an application to form a concept or task in a mobile application, the users need to understand this mapping and the association between them. Users look at the various tasks that they can identify within a certain application and try to map it to their previous knowledge about that concept from real or previous digital interactions. This can also be called task-level learning where users knew how to perform a particular task or activity on the application.

For example, a concept or task can be an activity like how to send money. There are various steps of sending money like deciding who to send to, deciding the amount, deciding how you want to pay that amount etc. These steps are also present in the real-world where a shopkeeper might ask you to give the phone number of the recipient or if you want to pay by

cash or card. Mapping this in-person interaction to the digital applications and its sequence is important to build concept level or task level learning. Users who do not have previous experience sending money using physical mediums or users with different experience of sending money in person might find it hard to map to the concept level learning as they cannot map it to their existing knowledge or expectations.

Implementation-level:

Implementation-level learning refers to the understanding of how the various steps and screens come together to complete a task or a concept.

Implementation-level learning enables users to identify the various steps implemented through various screens or forms in mobile applications. At each screen, users want to identify what actions can be performed at a particular screen (for instance this screen asks me to enter a phone number when compared to a screen known as the home page).

For example, a very particular query during my studies prompting implementation-level learning was when users knew the device and the domain, as well as the concept (task) but on a particular step they inquired *"Where do I enter the information the audio is asking me?"*

If a user is stuck at particular implementation-level learning (for instance a screen or sub-task), even if the users have the device-level and domain-level learning, the entire task or concept can become difficult to complete. For example, if a user is unable to enter input or understand any input instructions, or bypass input validation, all other knowledge cannot help users in completing this step. Similarly, if there are various ways to save an information either on the phone, or the memory card, or on the cloud. These implementation level details or sequence of screens can disorient the users on how and why they come together to complete the given concept or task.

For example, there are various ways to input information e.g., by typing, by speech input, by scanning a QR codes etc. Thus users who see various ways to achieve a particular task need to understand how the implementation of that task varies and impacts their mapping of what appears to be a simple physical concept of sending money.

6.5 Discussion

The findings show that various types of user knowledge and learning come together to enable users to engage with applications, specifically mobile applications. This knowledge can not only enable users to engage with the applications, and interact with them but also enable them to best utilize the benefits of such systems.

The work presented here reports from user studies about mobile applications with participants with lower technical and formal literacy. However, after my analysis, I believe that this typology is also applicable to other population groups as well as other application types such as desktop or web applications. Desktop and web applications also require the knowledge of the device, operating system, domain, etc., as different operating systems can also lead to different practices among users [63]. Similarly, user learning is not only at play in mobile-based applications but can be extended to the use of services on the internet as digital inequality exists in access to the Internet, the use of different devices, and the extent of usage and engagement in different internet activities as well [202].

The results from my work reveal that users use their knowledge of the devices (smartphones, laptops) to form future interactions and understanding of what to expect. User interaction elements as simple as the hamburger menus denoted the users about what it represented and what could be achieved from it.

"Digital divide" refers to the gap in society between those who have access to digital services and those who do not [54]. However, with the growing increase in ICTs, the question has now changed to that of equity of access and inequality between those who have access and skills and those who do not. Researchers have also questioned the meaning of access and if the availability of devices alone is sufficient. Since technology ownership and access is a complex spectrum of users, devices, access mediums, and connectivity types and speeds [68], it is time to explore the limitations to the conventional dichotomous view of the digital divide based on individual access to ICTs as pointed out by [231]. This work adds to this line of work to showcase how the users need to learn about the hardware and software of devices, real-world domains, and how application developers implement those domain-specific details and concepts in order to fully utilize a system.

6.5.1 Recommendations for Industry

- **In-Person Training** I believe that this typology can be utilized by industry especially organizations and individuals such as trainers who provide training, to understand the various levels of learning and understanding that their new users or existing users interacting with a new system need to achieve to fully interact with their systems. This understanding can be used to build training agendas and ensure a standard baseline for everyone familiar with different applications or devices and operating systems etc.

- **In-application User Help** Future user help and training solutions can look at these components of learning and incorporate this knowledge into the types of support and training that are provided to its users.

- **Support beyond the application** Industry developers of the applications can incorporate scaffolding to train and provide support for elements outside of their applications e.g., device-level help would be guiding users about the hardware or the OS that enables a certain action. By adding support for the users who are unaware of the device or operating system-level details, these applications can guide the users on how to engage with their applications and perform these tasks without relying on previous learning of the device or the systems. While this might require an understanding of variants of devices and operating systems as well as the provision of support to different types of users, this will also enable a large number of users including novice users to learn and explore beyond a few basic initial features.

- **Device-specific Enterprise applications** Specifically in the case of enterprise applications in the industry that are specifically designed for particular devices, embedding such device-level and operating system-level understanding and training for the users can enable users new to those systems as well as new to those devices to easily use such applications.

6.6 Conclusion

These results form the first step in understanding how users engage with technology and the various form of learning that goes to enable a user to fully engage with and utilize a mobile-based application. More research focused on understanding how we can add more support for users in mobile applications for each of these levels will enable us to better support users in learning and using mobile applications. Provision and testing of user training will also enable us to test this typology and underlying assumptions about the types of knowledge at play. An investigation of the various ways in which such learning can be improved for lower-literacy and technology advanced populations will enable us to see different types of these learning and knowledge are at play for various types of users (novice, intermediate, advanced, etc.).

6.6.1 Limitations

The typology shared in this work is based on an analysis of the user studies and user feedback. However, this typology has not yet been tested on any user training or user interaction and is not evaluated to be applicable to all types of mobile applications. The device-level knowledge is only applicable to novice users who might be new to the functionality or usage of a device. However, for more advanced users, trainers and designers can assume the presence of a certain level of device-level learning for the users.

Chapter 7

TECHNOLOGICAL INCLUSION THROUGH SUPPORTING ACTORS AND USER TRAINING

Formal or informal training plays an important role in the understanding, use, and adoption of technology and digital systems in professional and personal contexts. In the previous chapters, I explain the social access and social actors both in the form of immediate family members helping users as well in the form of women entrepreneurs helping other women to understand or use technology. Thus, the role of supporting actors and the guidance and training they provide is crucial to successful engagement with technological systems.

Beyond personal use, most of the technological tools developed and deployed across the world, including HCI4D development projects, rely on human intermediaries to train the end-users, be it field workers or end customers. In this chapter, I explore how these trainers and supporting actors plan on, execute and decide on the training content and training material. Using expert interviews with 8 subject matter experts from five continents I share how these trainers conducted training and understand the efficacies of their end users and repeat, modify or adapt their knowledge sharing based on the field realities and the cognitive access capabilities of their trainees.

7.1 Introduction

Learning any new information or task is a big undertaking. This undertaking, supplemented by a lack of previous knowledge, pressure about its implications for one's work duties, and the lack of financial, social, and technological support to engage with technology makes this learning even harder. Most of the technology deployments around the world still rely on some form of training. Training has been an important part of technology dissemination and adoption.

In the field of ICTD, many governmental, and non-governmental organizations with the support of technologists have developed and deployed technological solutions around the

globe. Most of these efforts, especially those around the digitization of existing systems and data collection efforts to support communication, rehabilitation, or solution deployment, require some form of user training. ICTD deployments have always contained a component of in-person training. Previous research in the field of ICTD has explored the role of *human infrastructure* [227] in enabling users to understand and use new technologies.

With the start of the Covid pandemic around the globe at the start of 2020, a lot of in-person training was put to a halt. Later the community shifted to online training where participants could join using online video conferencing tools and the trainer could join them online. User training or employee training is a core component of businesses and industries, especially in the US. The Training Industry annual report, which mentions the yearly investment and changes in the training market, reported that over the last three years, the investment by large US companies in staff training has increased from 42.2 annual training hours in 2017 to 102.6 training hours per employee in 2020 [152].

However, there is no formalized understanding of the trainers and trainees in the low-resourced settings of ICTD where the deployment of technological services serves a diverse set of services for a diverse set of populations. In this research study, we ask the following questions. First, we try to understand what are the different types of end-user training. Second, we try to understand how the trainers in the ICTD context design, plan, and execute their training in the presence of a diverse population with varied technological ownership and technological understanding, and previous use. Lastly, what are the challenges and opportunities that have emerged due to the transition from in-person to online training thus trying to know the components of training that can be digitized or effectively communicated digitally vs. those that might not be best suited to digital mediums?

To address our research questions, we conducted qualitative interviews with 8 training experts who have conducted more than 230+ training around the globe. These experts have conducted training for private, corporate, not-for-profit, and government organizations as engineers, academics, project managers, and administrators. Using this study I showcase the various forms of training activities done within the ICTD field and the planning, development of content, delivery, and execution work that goes into it. I also discuss the implications of socio-cultural norms of the places of training, the implications of gender,

impacts of languages, locals, and peer-based learning in these training.

7.1.1 Motivation

My completed research shows that in the current scenarios in the developing world, users rely on other individuals (like friends, family, children), etc., to understand and use technology [115]. My research has also shown that the understanding or knowledge of an end-user is limited by the knowledge and understanding of their technological support trainer. Since, most of the participants are low-income and low-literate and seek help from their social network, which mostly belongs to the same socioeconomic segment and lacks any formal knowledge or detailed understanding, the learning of users is limited by the knowledge of their network. Similarly, in many of my interviews, I have seen that the knowledge of social contacts is also inaccurate or incomplete [115]. Thus, I hope to understand how formal training in a professional setting is different from those of ad-hoc technology trainers at home. What methods and mediums do these formal technology supporters and trainers employ when also educating and training within a limited time?

As explained earlier, participants interacted with various actors in order to engage with technological devices like smartphones. However, while they share the various benefits of tutors, sharers, and maintainers, participants also reported a feeling of lost agency due to the lack of knowledge about their phones like locks and settings. Thus, this research study will also try to understand how the technical training in formal settings bridges the digital divide by providing technology education to the low-resourced groups.

7.1.2 Background

Before explaining about the methodology, I would explain the context and setting of these trainings. Most technological deployment projects, in industry or academia, done in collaboration with the government, private organizations, or technology for social good pilots require some form of formal training to be conducted. These training a) introduce the new technological application, tools or dashboards to the trainees; b) are also a place for distribution of hardware or devices e.g., smartphones, laptops, or tablets required to use

these applications, especially if it is a newly started application or project; c) leap frog the learning process and try to bring all the participants to a uniform status of technology understanding and use.

These training are usually provided by a trainer who is either a local or an international trainer and the trainees might be volunteers recruited for a particular project or employees of the collaborating organizations (mostly last mile fieldworkers). The trainer and trainees might either be trained in a central location or might travel across towns and countries to join at one place. The training are either funded by a company's growth plan, or are included in each new project request. Sometimes these are stand alone trainings requested due to the specialization or services provided by the training organizations. The final goals of all trainings are to a) ensure a standard of learning at the end of the training; b) make the local organizations and field workers self-reliant and independent.

In the sections ahead, I explain how trainers understand the goals of these trainings, understand and map the qualifications and existing knowledge of the trainees, and try to change the training content, plans, and methods based on the trainee's profile.

7.2 Methodology

7.2.1 Participants

The participants were all training experts who had experience in training for digital applications including mobile-based applications and web or desktop applications. For the purpose of this research, we primarily focused on mobile-based applications. However, the participants did lean on their learnings from other mediums to share examples. Most of the participants also had experience in the design, development, and deployment of these applications which made them better suited to explain the workings and edge use-cases of the applications to the end-users.

We talked to a total of eight training experts from five continents. These participants belonged to academic research labs (2), startups (3), and humanitarian organizations/NGOs (3). These participants have combined conducted a total of more than 230+ training across the globe including in countries (listed in alphabetical order) Argentina, Australia, Bolivia,

Brazil, Canada, Chile, Colombia, Ecuador, El Salvador, India, South Africa, Panama, Fiji, Vanuatu, Kiribati, Peru, Guyana, Trinidad Tobago, and Uruguay. and Indonesia, Mexico, Sri Lanka, Vietnam, and United States in various languages and cultures.

7.2.2 Recruitment

We reached out to individuals and organizations working towards the development and development of smartphone-based applications. These included academic research labs, startups, nonprofits like global humanitarian organizations, and Non-Governmental Organizations (NGOs). We shared our consent form, research summary, and talking points with them. The participants who agreed to participate were then sent a Qualtrics survey to gather some preliminary information about the participants.

The survey collected information about their previous experience as a trainer including the types, number, and length of training that they have been a part of, their role in such training, and the medium (online, in-person, or hybrid) and demographics information including their job title, job descriptions and its relation to training. This information was collected to a) have an understanding of the experience of our participants; b) be able to focus the actual conversation on qualitative data about training rather than quantitative metrics.

7.2.3 Interviews

Given the Covid protocols, all interviews of participants including those from the US were conducted online using the university's Zoom. The interviews were conducted in English and conducted over one or more Zoom calls based on the availability and comfort of the participants. The interviews ranged from a minimum of one hour to a maximum of two hours of conversation with most of the interviews averaging 90 minutes. We had more than 13 hours (790 minutes) of recorded conversations with the eight participants. Three participants also request to pause the recordings when they shared details about their organization-specific training plans, content, or training material.

The participants were asked about various aspects of training including: Training plan-

ning (deciding objectives, guidelines, activities, sequences) Training execution (timings, in-person vs. digital experiences) Training evaluation (participants' understanding, content repetition, etc.) Training ideas or categories and differences (first time training, refresher training, training the trainers, etc.).

7.2.4 Data Analysis

The interviews were automatically transcribed by Zoom and then reviewed and corrected by the author by listening to each interview audio. Two interviews where the participants frequently code-switched (between Hindi/Urdu and English) during their conversation were fully translated into English to be analyzed. The interviews were first divided into the various components of the training questions, mentioned above e.g., planning, execution, or evaluation of training, etc. The content was then divided.

Findings

In the next few sections, I summarize the findings from the thematic analysis of the interviews with our training experts, also referred to as trainers or participants in the findings listed below.

7.3 The Training Context:

Before I describe the process of training activities and other findings related to training, I will first list the various types of training and describe the differences between each. I will use the word "experts" and "expert trainers" or "trainers" to refer to the participants of this study and to differentiate them from the "participants of the training" also referred to as trainees in this paper.

7.3.1 Types of Training:

Trainers categorized the training into different types based on distinctions in training goals, training time, and participants of the training.

Categorization based on Trainees:

The expert trainers categorized the training based on who took part as trainees for the respective training in the following broad three categories. Even if the expert trainers had not been directly involved with all forms of these training, they were aware of the categories of training being conducted in the field. There are three forms of training depending on the type of trainees and training goals. One trainer summarized this categorization and its decision as the following:

> *"There's two ways this can be done. One is we can just train all the users ourselves when we are in the country. Or another way we can do is, to try to train the supervisors in each country. So for example, the field coordinator, the person who coordinates all the fieldworkers going out... try to teach them how the application works and then have them train their staff. This is the angle we tend to use because there's no better way to demonstrate one's knowledge than to teach someone else how to use it. So it depends on the situation, like how much time we're able to spend there."*

- *Training of Trainers (ToTs):* also known as Tee-O-Tees, these training are geared towards training the trainers, also described as *master trainers*, or *super trainers*. These master or super trainers then go into the field and train the end-users. This form of training model is also discussed in the conversation as a *"Cascade model of training"* where the organizations train the trainers and the trainers train the fieldworkers – who might either perform the duties themselves or might train other end-users or project beneficiaries.

- *Master trainers training field workers:* In this form of training, the expert trainers observed the master trainers they have trained in leading training activities and provided any support or feedback to them. This not only gives the master trainer confidence to lead sessions but also allows expert trainers to spot any deficiencies and support them.

> *"In this training I have trained the trainer and they have in turn 10 trained [job title anonymized]. We only had two weeks and we were there as support trainers. And when they are going to train people, then, are they doing right or wrong. So we used to provide the on-field support also."*

- *Direct training or Training with End-Users or Beneficiaries:* In this type of training, the trainers directly end up training the end-users or field workers or the community. This is done to demonstration how the community training is done. One trainer shared,

> *"Sometimes we do the direct training, also for them [the potential trainers] to observe and see how we are training, so that they do [can] the training"*

While many projects and programs offered the flexibility to select these training, and the reasoning for each, institutions like funders and governments impacted how and which types of training were done. As one trainer mentioned that while they always intend to train the trainers, governments can insist on doing things differently.

> *"Our model of training is a cascade mode of training, but you know, working with the government doesn't always work as you want to work. You have to work with the government what they want. [We tell them] we are very few people, we will train your trainers, and they will go and train other cadres in turn. But we do the master trainers training also (laughs) and we also go to the field and train the beneficiaries like [job role anonymized]. Because they will say 'Can you please come and see if we are doing right or wrong'. So for three or four batches we go and support them."*

Categorization based on Time of Training:

Trainers clearly distinguished between the training that is offered for the first time vs. those that were offered as a part of on-going efforts. These were defined as:

- *Initial training:* Also referred to by the trainers as *"first timer training"*, these training are conducted when a new tool or application is introduced. These training usually are accompanied or initiated by the distribution of devices (e.g., phones or tablets), login credentials to the end-users, some introduction or explanation of the programs etc.

- *Refresher training:* As the name suggests, these trainings are conducted with an existing group or about an already deployed technology or application. Refresher trainings are conducted either because the time duration lapsed from the last training (e.g., refresher to be given every year) or new version or feature are introduced (e.g., an update has been pushed or any new features or functionality has been added). They can also be demand-based where the user behavior or performance has degraded such that it is deemed that the users need to be trained again. As one trainer said when inquired about how did they consider that there is a need for refresher training.

  > *"We started having massive amount of errors. Massive amount of errors. So, those errors were coming for things for which we had already done the training for them."*

  Another important reason mentioned for the need for refresher training is the increased burden and workload for field workers with digital initiatives. The trainers mentioned that all of the initiatives end up creating additional workload for the last mile workers and since they have multiple initiatives, they might forget all the different new concepts introduced to them and thus need a refresher training.

Categorization based on Content of Training:

Some trainers also distinguished among training based on the knowledge being transmitted in the training.

- *Knowledge based training:* These activities were based on the dissemination and learning of knowledge, concepts or ideas around a topic e.g., immunization or health screening etc. This not only influenced the content covered during the training, but also the

format and instruments used. For example participants frequently mentioned conducting pre-activity and post-activity evaluations in knowledge based training since the goal is to increase the knowledge and the evaluation measures the change or increase in the knowledge after the training.

- *Skill based training:* was defined as one where a skill is being imparted to the end-users e.g., how to operate an application, or how to collect data, conduct interviews, or perform a field activity e.g., measure something or collect some samples etc. Most of the skill based training were first time training. A clear distinction made by trainers for the skill-based training was a) the training contained a demonstration; b) the training encouraged or included a field study or field activity component where the learned skill could be put to use in a real or hypothetical field scenario. For example one trainer shared the skill based activity part of skill training as:

> *"At the time of on site training .. after training, the afternoons are normally designated to actually implement what they have learned. So we actually go out with them in a particular target house or wherever they have to [perform their work, anonymized]. They set that [anonymized]. They use their field application. So during training, we do a mock entry with them, just to let them know this is the mock entry, this is how you make an entry and everything. And in the afternoons, they actually go and actually [work on the app, anonymized] on an actual location using the field app because verbally no matter how much training you do....if they don't implement it, sooner they are going to forget it, for sure."*

7.3.2 Training Mediums:

Before the Covid pandemic, most of the trainings were conducted in-person in mostly a *"class room type fashion"*. However, with the onset of Covid, due to problems relating to travel restrictions, covid protocols, and the infeasibility of bringing many individuals to one location, the mediums have changed to online and hybrid. Here we provide a summary of

each of the three training mediums:

- **In-person Training:** In the in-person training the trainers (our participants) and the trainees were present in the same venue or space to engage in training. These formats of training were more prevalent in pre-Covid times and are still being utilized in low-resource last mile training where the digital tools or connectivity available to trainees might not be sufficient to engage in online training, which is explained next. These activities were mostly held in organizations' central locations like offices, meeting rooms, government's meeting halls, and booked hotels. At times the participants were from the same district or city and could have traveled for the training and then returned to their homes. At other times, they were traveling from out of city or state and thus had to stay in the city throughout the duration of in-person training.

- **Online Training:** This form of training became more popular after the Covid-19 pandemic as associated protocols prevented travel and gathering of groups. In online training, all participants and trainers remained remote and participated through digital mediums available to them such as laptops, desktops, phones and using a video conferencing software. The most prominent software was Zoom followed by Microsoft Teams. The participants were asked to use their camera to mark their attendance and to take any screenshots of the participants for administrative purposes. However, due to the connectivity and internet bandwidth problems in last mile locations, many training were conducted without the requirement of cameras.

- **Hybrid Training:** Hybrid training refers to the training method where some of participants and trainers participate virtually using the remote video conferencing tools while others joined in-person by gathering at the training location. Hybrid mode was used to support the trainers were unable to travel internationally due to travel restrictions and thus unable to reach the training location. Since some participants of these workshops were either government employees or did not own a computer of their own, they were provided with a center to come in and attend training. Even in these training centers, sometimes there are not enough devices for each person and

multiple participants share the same computer to attend the training. The trainer was either made visible on projected screens and the participants could hear them and practice on their devices or the participants could share resources to go online from their localities where multiple trainees shared one computer.

7.3.3 Role of the Funding Agencies or the Work authorizing agencies:

All participants mentioned the role of the organizations that arrange, request, fund or liaise for these trainings. These organizations can be local, national, or international agencies, funding organizations and governments.

- As the Terms of References (TOR) organizations : deciding the terms of agreement about who needs to be trained, what needs to be trained
- As liaison between the local teams , events, travel, arrangements like finding hotels for boarding, seminar rooms or venues for trainings
- As recruiter or employer of the potential organizations
- As deciding factor on the formality and informality or ad-hoc nature of trainings
- In deciding what is covered on ground and what is covered in in person or online trainings.
- Providing any local data or information which is needed to build the applications, translate the training or
- In case of funders and government agencies they also provide the digital devices and connectivity to the end user to be able to use the software application or tools being trained

7.4 Becoming a Trainer:

In order to understand their skill set as well as the relevance to job roles, job titles, as well as evaluations, we inquired the trainers about their experience and journey of becoming trainers. While all trainers mentioned that training has become a part of their job role, many did not have training as a part of their original/initial job title or job description and was mostly through evolution of job requirements..

7.4.1 Role of Trainers:

Most of the trainers mentioned that they started out with different roles like training their peers, or designing content or strategy for the training but their roles evolved over the years to actually conducting the training. Some trainers evolved into trainers from the software roles - either they configured tools, wrote specifications, customized the tools or had some understanding of the internal workings or setting up servers etc.

> *"A need evolved to for training to happen and how it would be done was really an afterthought. My senior managers or direct managers seem to think that I was capable of doing the training. And so it was just a matter of 'yeah, can you show these other people how to do what you do?' The thinking behind it never was never more advanced than that really."*

Trainers also shared that after some years of developing and leading these training, they and their peer trainers in the organizations started developing expertise for various components of training or various components of the digital system. This division was then used to lean on an area expert to divide and design sections based on what they are good at training for. As one trainer said,

> *"And there are people who are really good for data collection and all the sessions about that. There are people, for example, I can set[up] a server but I don't love doing that. So I would rather that there is someone with this expertise, who like know how to do it and they love to teach or to have this presentation."*

Some of our trainer participants had done formal certifications and training on how to train other individuals, or how to do an effective training. Many of them reported that they learned on the job or learned as the need arose by shadowing existing trainers and observing how to train individuals. One participant explained how they shadow trainers or act as co-facilitators and only then are allowed to train on their own.

> *"The thing is that when you get your certificate as a facilitator, you wont go to conduct a training by yourself the first time. You are going to be a co-facilitator who has the experience. Then you start getting experience."*

Even with the expertise, all trainers are expected to be familiar with all other modules of a software since they might be required to travel alone or perform all components of the training themselves.

Trainers were also inquired about the training that they received to become trainers. Aspects covered in the training include developing and delivering training, planning and budgeting around training and project programs. One trainer shared about his training experience.

> *"We've brought in an outsider around to give us some information about style, techniques and structures to learning modules. That amounted to two full day conferences, you know, that type of thing where everyone gets together in a hotel conference room. But that's about the extent of my formal training."*

Another shared,

> *"We did one week there, and so that kind of training, advocacy training, that was a skill building training, [anonymized], gender discrimination, gender based budgeting, So how do you do any program if you build any program or budget or anything. So how to incorporate gender in that. So, are you balancing your program with gender component that kind of youth friendly health services, [anonymized] and all that, it was a very rich experience."*

7.4.2 Properties of a Good trainer:

All of the trainers share a common interest in teaching, helping people and training in general. All trainers believe that skill is more important than a degree to be a trainer. While trainers had done certifications or training to excel in their areas of specialization or training activities, all of them believed that skill and ability to deliver and engage content is more important as training is about engaging with the participants and a performance in front of an audience.

> *"Even if you have degrees, if you have certificates and the people whom you are training are not able to understand what you are trying to tell them what are you trying to convey to them. So then all your degrees and certificate don't work."*

The trainers believed that the trainer should come to the level of the trainees and make sure they connect and learn with them.

> *"[The trainer] he would have [an] understanding of .... level of the participants. And their level of understanding. They would not come to your level, but you have to raise your level or you what you call take your level down to their level, then you will be able to connect to that kind of thing"*

When he asked about the qualities of a good trainer, a participant shared this story about properties of great trainers that were explained to him by his trainees about how words, voice, and style makes a good trainer.

> *"We were chatting [about] that with the participants doing some brainstorming and all that, 'Who is a good trainer? What do you think should be a good trainers' quality? and [a] person from I think I still remember our district [anonymized] who is near [city name anonymized], so he stood up and told so "Sir a good trainer is one whose Awaz - meaning good voice, Andaaz means style and Alfaaz means words. If these three qualities are there in a trainer, s/he is a good trainer. I was amazed how correct was that, awaaz(voice), andaaz(style) and alfaaz(words) - if all three are there in a person he is a good trainer and decide that he should have a what you call subject knowledge and all"*

7.4.3 Job Role and Responsibilities of Trainers:

We inquired about the profiles and job responsibilities of the trainers in their organizations including the participants. While most of the participants and their peer trainers had formal job roles with a component of training as a part of their job descriptions, they shared that there are other roles at the organizations as well which end up doing training. These include those hired as software engineers, application developers, data managers, or GIS specialists also providing user trainings. The reason for this distinction is that some of these roles are neither guided nor measured on the performance of their training.

The responsibilities of the trainers include:

1. Reviewing and validating learning tools and the learning management tools explained later
2. Onsite and online training
3. The design of various learning modules and training courses
4. Implementation of training courses
5. Library documentation of development response
6. Manage the information management systems - which includes developing procedures for collecting, organizing and classifying information

Some organizations have in house development teams which not only make the issues raised in the trainings more easier and sometimes the developers or the business analysts are able to go back and share the bugs and problems from the field to be included as features and improvements in the future versions.

Local Person for support :

Based on the existing skill of the trainees as well as the time they are able to spend with the trainees, they change what they cover and how they train. They usually train someone local who is then able to train the end-users.

Organizations prefer hiring someone local who is able to liase, speak the local language, and communicate with the local. The duties of the local person varies based on how the program and management was set up. But trainers mentioned that having a local person on ground is beneficial to for the regional teams to have independence and quick support.

> *"The way the system is set up, we think this was the best way of doing it to have someone you know situated locally, who would be able to do all the Data Analysis and system administration and troubleshooting .. mainly troubleshooting because there's a lot that can go wrong with the software and better to have someone locally, who can do it, who Knows the context speaks the language. "*

Preparation for Training:

Trainers are responsible for not only preparing the agenda of the training but detailed planning of the content, methodology and aids to be used during the training sessions.

> *"The trainers are supposed to prepare a training agenda. what all sessions will be there, whatever content will be covered. What will your methodology of training [be] and ... what audiovisual aids will [be] use[d] and all that kind of special planning is being done. As for the session plan, you prepare some distribution notes or some PowerPoint presentation, or some manual you have or some reference material, you have that kind of all preparations. "*

Liaising with partner organizations

Trainers explain that there are different extent and levels of responsibility that they have to undertake and support they have to provide in working with partner organizations for training. Sometimes the training organization already exists while at other times, things need to be set up from scratch.

> *"There's many ways that that happens. Sometimes we partner with an organization that already exists, and then it's just a matter of knowledge transfer between those two organizations. Sometimes we go into a country and build a team from*

scratch and in those situations, we need to buy them Android devices, laptops, these sorts of things. And often, I end up getting tasked with the management and administration of that."

Trainers also have to do a lot of coordination with the software teams and the field workers who need to be trained. The trainers need to stay updated on any changes being made to the training software.

"There's a lot of meetings as well to keep things coordinated because the software that I am responsible for teaching that's changing all the time and new site members. And I need to be kept in the loop of new updates a lot of the time. I'm the driving force behind those updates."

Trainers also act as a feedback loop to the software team and inform them of the needs of the trainees on site based on their interactions and training sessions.

"A lot of the improvements and development in the software is coming from needs occurring in the sites and I'm in a position where I'm working quite closely with some of the sites. So yeah, I'm involved with the development cycle of the software as well. Which often takes up some of my time. Almost in a quasi-BA kind of a role. I mean, I'm not formally directing developers to do anything but I'm collecting a lot of the use case stories for particular problems. We might be having or suggesting improvements...I guess it's a two-way collaboration. Like there's teaching and support that I provide to the sites and then from the experience of doing the work in the sites, we get feedback about the software which needs then to be fed into the development cycle. So that's probably where the other 50% of my time goes."

Trainers also share that even though their colleagues observe the issues in software in the field they are not always comfortable with sharing their feedback with the software developers because of lack of confidence on their linguistic skills or understanding of the software.

"Often my colleagues working locally in the sites, they're all excellent, sometimes they're not fully confident to raise issues in the software. Maybe they're not confident that their English is strong enough to articulate it or they simply don't have the full picture. "

7.5 Participant Profile:

7.5.1 Need for a Participant profile:

Since each training is aimed at a specific tool requiring specific hardware and software, it requires the trainees or field workers to have skillsets, basic knowledge or education to be able to learn these tools. These competencies can include knowledge and previous use of a smartphone, ownership of a smartphone, ability to use Android, ability to use the internet on devices or knowledge about the area.

7.5.2 Determining current capability/skill of participant:

There are various ways used by the participants and their collaborating organization to gauge the participant profiles.

- **Giving Out Ads:** Some organizations publish ads to seek field workers and interview the candidates who respond to ads and thus know the competencies. They give ads where the preferred participant profiles are shared. However, at times it is hard to find the participants with the desired profile.

- **Admissions and Entry Tests:** They also have admission or entry tests or consider previous accreditation or training, or even the participant resume. As one trainer summarized:

  "Yeah, sometimes. Yes. And it depends if I am paying a trainee and if I am offering [the training]. So I require this profile and also there is sometimes like an admission test. If you want to be a part of this [training], you must do and we would have a list and we sometimes do a test for being accepted

or we request the resume. So we see if they have been involved in this [training] or are involved in the other [training] to see the profile. So we have an application form which is really useful."

- **Basic Leveling Training:** Some trainers do not know the user profile of their trainees and conduct basic training to match the competencies required for that particular training. This means that out of three days, the first day would be used to bring everyone to the same level of competency.

- **Working with what they have:** There is an ideal profile but in times of an emergency [e.g., In hurricanes or disasters] trainers have to work with whoever is available. Therefore, they have to increase the number of trainers since they cannot increase the time of the training. Moreover, emergencies require quick training so increasing time is not an option.

- **Pre-reading Material or Webinars:** There is a possibility that the participants do not match the intended profile, either due to the situation (e.g., emergency) or due to shortage of resources and trained individuals in the target country. Thus trainers use techniques like pre-reading material or webinar etc. to try to bring all participants at same level of competency.

"We also share the required profile [with the countries or organizations inviting for training]. And they will know that there will be a challenge if they don't have that profile. So even though we have to carry on with the training, but we can do some activities ahead [of the training]. So there are some face-to-face training that we have, like, pre-reading material. So we know that they don't know things. So we send our one hour webinar. So we touch base and we are at the same level [on] the first face-to-face day training so that are like a different ways to put everybody on the same level."

7.6 Preparing for the Training:

Contract or agreement - where they explain what needs to be trained, the goals and the scope, at this stage they also inform of participants if possible.

> *"TOR that is, called or terms of reference and that kind of thing, so that is clearly defined that what are we trying to train, so the issues and the topics are very clear"*

7.6.1 Creating the Agenda of the Training:

The agenda on the training depends on a combination of four things: feedback from trainees, participant profiles, demand of the entity funding the training and the software for which the training is being conducted.

Feedback from trainees

Trainers use two types of feedback from current training to develop the agenda of future training. The first type of feedback is collected directly from the trainees. As training moved online during the pandemic, trainers have started using Google forms to take attendance and collect feedback from training participants. One trainee explained the format of collection of this feedback:

> *"We have done lots of online training using zoom, team and all. That time we used [both] pre and post [training evaluations] also in some training, but that was not very effective. But the feedback which we used to take only after the training, we used to circulate a Google form for attendance and then the Google form for filling the training feedback...that was very useful to plan our next sessions."*

The feedback is collected on various aspects of the training like time spent on different topics, preferred or effective language for instruction. They use this feedback to plan sessions, provide trainees with supplementary or reference material or manuals, use of demos and practice sessions for learning. One trainer explained the kinds of feedback they have been collecting and how it has been used to improve training.

> *"[Asking questions like]: What was good? What was not? What do you understand? What was difficult? On what topic would you like to get training again in future? That was very useful to plan our next sessions. [They would give feedback like] change your plan of strategy in training [for example] that give more time to this topic, and you can skip [this topic next time] or you have to give some demonstration [in the training] there, and you have to give some practice sessions [at that point] there... [Or about] language that 'you should speak in [local language anonymized]'*

The second type of feedback is collected by the trainer in the form of observation of trainee performance on various activities and used to determine what needs to be repeated.

> *"I just try to come up with like the goals of what I'm trying to accomplish that day and then just activities to have them go through to get a sense of where they are a lot like a classroom setting, in that sense"*

Participant Profile

Trainers also determine agenda of the training based on the available or lack of information on participant profile.

In some scenarios, trainers are not aware of the profile of the trainees and they work with the assumption that none of the trainees know anything. This happens when the size of the trainee pool is so large, it is not possible to collect information on their skill level or if the training is funded by a government employing a top-down approach for decision making and requiring everyone to be trained, regardless of their skill level.

> *"If Government of [country anonymized] has planned to train all the [anonymized job role], we have to train, irrespective [of whether] they know or they don't know. So we think that they dont know. [I: Okay] So we start from the introduction and give a brief [overview] and then come to those who know, it is good, it is a repetition for them. But those who don't know, we consider that nobody knows anything. We start from [the assumption] there is a mix of people that*

some will know, some will don't know. But it is hard to get this information prior the training. If there is 160,000 people in the [state anonymized], as [job role anonymized] or 170,000 people. So how will you profile the entire group to be trained. And they have 40,000 [anonymize job role] doctors and 60,000 [anonymize job role], so it is not possible to get this profile done. What we [then] consider [is] that this is their minimum qualification, and this is their experience. We try to tend to in our training take it from the basic. We give them basic information and then we come to the technical parts and all that. Suppose somebody knows something then they will ignore and those who are not knowing anything they will pick up and they will try to listen to it."

Trainers have to adjust their training according to not only the digital literacy of their trainees but also the cultural and organizational contexts of the trainees. One trainer elaborated on this:

"Usually in more highly developed economies, there's a high level of digital literacy. You know, partnering with an organization who are fully competent in using cloud-based systems to store their documents and [for them] using the Google credentials to log into apps is not a weird concept to them. It's something that they already do. But then we'll also go to countries where that's not the case. So yeah, digital literacy is a big one. There's also how hierarchical the organization is and also just the general culture of the different countries that we go into."

One trainer while explaining the requirements for a low-resource and low-skilled trainee group mentioned how she changed her technique to using smaller sentences and demonstrating the use directly on the device rather than through a presentation.

"For [location name anonymized], simple language, smaller sentences. Um, and then the third thing I felt was with the PowerPoint slides. If I show them the actual device and the options on the screen of the actual device that worked really well for them. Because many times SOPs and guidelines had been sent to them,

> *but they didn't see them, even when I was training on site I had that user manual kind of thing. Which had all the How-Tos, SOPs, and guideline documents and I actually provided them with a printed copy of that. But that was also not of any use, they prefer a training - a one on one training, they prefer looking at the actual thing, and they prefer to take their own notes. [I: Okay] so these three four thing, I felt like why to waste time on a very fancy PowerPoint slide when they are more comfortable if I show them the device on the camera."*

Trainer Style

The format and style of the training adopted also depends on the training style of the trainer. One trainer who was an engineer conducted both the usability testing of the app and training of the trainees. Work of engineer in training is different than just trainers:

> *"just because it was developing the manual and creating the presentation and then going through that. And, testing [the content] out with [internal employees] getting their feedback and then being in the country and doing it, but I guess it's more like a month and a half because .. and then the week of doing it, and then coming back Well, so we did that with the user testing. We also did usability testing with the [anonymized] engineers. That was probably like a week of work to, you know, create a presentation to them set up the server, set up the app, and again lead them through tasks, and then see what their feedback was regarding the usability of the app."*

Another trainer was using a pre-defined set of presentation slides and content that they had perfected over time. While the planning aspect of the training tends to change because of the unpredictability of the exact conditions in which training will be done due to Covid, the content is pre-defined depending on who the trainees are and what skills do they need to be trained for, what aspects of managing the hardware and software they will need to be responsible for.

> *"We definitely have a set of slides that we developed for the first training. We keep updating them for both the research assistants and external audiences. Um,*

in terms of planning, it tends to be very heterogeneous and more so in this Covid era, because you're planning one thing and then you end up doing another thing. So I don't think I have a very standard planning approach of drafting an agenda. I keep in mind kind of what our constraints are but then in terms of the training itself, we think through sort of an overview and then a sequence of skills people need depending on whether we're training, for example, the people were in the back end who are managing the server, they'll get different training for sure than the people who are on the implementation so often create sort of a format."

Trainers also consult with the staff in the organizations who have requested the training. Sometimes they are the permanent staff of the organizations and sometimes they are the project specific staff or high level government employees. Trainers consult with these staff members to design training agenda.

"Those folks are permanent staff there also is usually at least one or two permanent staff, although sometimes project specific staff. It's been hired for the duration of the project, who are in charge of the training in some way. So they're overseeing the training structure and implementation within the organization, though, they're usually permanent staff, a project manager, the Vice President, whoever. So they are the ones we usually correspond with to develop the agenda, make the plan sort of make any decisions that need to get made."

7.6.2 Hiring of trainers

In many contexts, like in the Middle East, Ashas in India, the last mile field workers were women because they had to go inside the houses and interact with women and children. Young women are most commonly recruited as field staff because people are more comfortable interacting with women in cultures where the sociocultural norms make people sensitive towards the gender of the interviewer when topics of discussion are concerning women's and children's health.

"Interestingly, a lot of the projects, they've done the have hired almost exclusively

> *women. Working in the Middle East and North Africa, you have to be really sensitive of who's interviewing other people. So having women interview men is actually tends to be acceptable, but you can't have men interview women. So we frequently hire all women staff and the same for like early childhood settings, people are much more comfortable with a woman interviewing a five year old."*

In such contexts, the gender of the field worker is more important than their skill level and threshold for technical skill is low. Moreover, the younger women field workers tend to be more tech savvy than older women and also teach older women on how to use the software.

> *"And these are usually younger women often with bachelor's degrees or they are teachers. It depends a little bit on the project, what makes sense. I'm on the younger side. They don't necessarily have huge tech skills, but one of the things we do during staff recruitment interviewing is we check that they can press buttons on a tablet. We definitely recruit more people than we need because there's a certain amount of testing and attrition. That happens during training and one of the dimensions is this topical knowledge, but one is [that] can you follow the directions on the tablet. So that's kind of the recruitment pool and process. We definitely make sure there's practical training. They get introduced to part of the questionnaire and then they try it on the tablet and get trained through that. We make sure [that] they can fairly correctly hit all the buttons and follow the directions and kind of work through that software."*

Language & Training:

Trainers were asked about how they plan differently for different languages of trainees or the impacts of language on delivery and planning of training. Trainers mentioned that there is a limit to the languages that they or their peers might know and thus they rely on translators to help them translate the training. However, the process of trainers first telling the translators what to say and then translators conveying them to the trainees is very time consuming. Trainers rely on the translators for translating content to the local

language, relay the questions from participants to the trainers, and relay trainers' answers back to the participants. Translators also act as the social connections and translators to social norms, language barriers, and jokes.

Trainers depend heavily on the local translators but they are unsure if the translators do justice to the translation as they are unable to assess the quality of the translation. They are also at the mercy of the translators to make sense and connect the content. Expert trainers hire local master trainers and data administrators in the hope that they are familiar with the local norms, local language and people might feel comfortable asking them questions or reaching out to them.

7.6.3 Training Team:

We asked the trainers about how they form their training team and if they try to balance the skills of the training team or trainer-to-participant ratio to manage the conversation? Trainers try to manage the team especially for in-person training where trainers have to go around the room and possibly answer questions, they want to balance the trainer-to-trainee ratio. They also try to manage the skill set but it is less frequent since travel is costly and basic skills can be transferred or learned by the trainers as well.

For balancing the *skill level*, trainers are given basic training to be able to do all the training related activities like troubleshooting, basic IT setup etc., and answer questions on their own, so even if they have to perform these training alone they are able to manage.

For the *Participant-to-Trainer ratio*, the trainers try to manage based on the number of participants, activities, expertise of the trainers and even budget.

> *"Depends on the number of participants. Ideally, we say that we need three facilitators. Or at least a facilitator and two co-facilitators depending on the profile. But it depends on the number of participants, it depends on the budget, it depends where is this [training], so there are many variables. But on the ideal world, there will be three facilitators per training."*

7.6.4 Mobile Device Management:

Mobile Device Management or MDM tools and applications are being used to manage which applications can be installed on the phones - to avoid any other applications or social media being used on the devices, to avoid use of personal devices for work related items, to uniform the login credentials process, to log and monitor behavior of the workers and also to push any updates or security updates automatically without relying on the users. It also helps manage the large number of devices and workers without needing to coordinate with all of them about updates.

7.7 During Training: Execution of Training

7.7.1 Keeping participants engaged:

Trainers used many techniques to keep the participants engaged as training can be long and boring if the trainees are not kept engaged. Trainers mentioned that they try to limit the training to a few days, usually 7 days or less. As one trainer mentioned that after 7 days no one would learn anything.

Trainers also change the type of modules and content to keep the trainees engaged. Thus, they do not continue to look at one topic or one type of activity. Lastly, trainer also mentioned that they change the classroom or the learning environment, thus there is a sense of change for the trainees.

Learning Management Systems are used for hosting courses and content for educational purposes such as courses by educational institutions.

7.7.2 Incorporating Videos:

Using the learning management systems to host videos and training

Trainers use videos and GIFs to aid their training. Using the MDMs, videos are already added to the applications installed on their phones. Trainers make and use small GIFs to show trainees where they can find a particular interaction – e.g., scroll down , click and enter – is a GIF that enables the users to show that the option will be visible once you scroll

down and then click this icon. This quick GIF enables users to see exactly what they need to do to achieve that.

Since in-person training requires travel and arrangements, most trainers mentioned that they prefer trying to do some comprehensive training agenda and try to cover most of the components there, since it is not convenient to make multiple trips. One trainer explained travel constraints:

> *"It's more like today, a part of it's driven by travel rate. If you're going. You want to make sure you don't ever do anything. And just one day."*

Videos for guidance

Trainers have also created videos for troubleshooting various commonly encountered problems and confusions during the training.

> *"At our end we have developed reference material, or trouble shooting materials in video form [I:okay] so suppose there is a login problem. You have a login ID and you have a password. And then you enter your CAPTCHA and then you have to enter the OTP . . . people get confused about what to do here. What is the OTP, where will I get the OTP from. If the server is not getting with our OTP and the provider is saying that there is some network connection problem and how to fetch the OTP and also, we have created a short video for login process. "*

7.8 Cultural Aspects and Impact on Training

Culture plays an important role in training. Most participants mentioned one or more ways in which the sociocultural norms of the local places where the training were being conducted impacted the training activities and the behavior around training. Here I share a few of those aspects:

7.8.1 Hesitation to ask questions

Culture affects the way participants interact with the trainers and with each other. Trainers mentioned that they observed cultural differences where participants would not talk among themselves, or ask any follow-up questions. Some cultures are not tolerant of mistakes and so people do not want to lose face by asking questions and making it known to others that they did not know or understand something.

> *"I don't know whether there was a culture or not. But there was something that each and every person within our team has observed that they do not talk to each other and then eventually they do not ask what the confusion is in their minds."*

7.8.2 Ceremonial nature of trainings and nepotism

Training is more ceremonial and formal in some cultures. Because of their ceremonial nature in some cultures, supervisors might also want to attend training. Although they are not one of the participants receiving training, they are there because it is an important event. To avoid looking incompetent in front of their supervisors, trainees do not ask questions. Trainees think that if they ask questions, their supervisors will think that they do not know how to do their jobs [208].

> *"But actually in carrying it out, we find that maybe it has to be a lot more ceremonial. Maybe there are more senior people that need to be present. Even though they're not really doing any of the work. Those were the sorts of things we were taking into consideration."*

Trainers also shared that some people have government jobs because they knew someone in the organization. These people tend to perform poorly on the tasks because they cannot get fired. Moreover, in some cultures it is considered as a privilege or source of prestige to be part of a training especially training from a foreigner, people also use their connections in government organizations to become participants in training. This prestige supplemented with the fact that per diems are associated with training, many Government employees request for their relatives to be included in the training.

"One thing I've noticed is that if we've hired people specifically to do field activities, specifically for the role, they tend to be quite diligent and respond quite well to our lead's instructions. If we're dealing with people that are already working for the government, and we're now just asking them to fill out an app directly, sometimes enforcing compliance can be difficult. Often people with rather cushy government jobs in a lot of the places we work, you know, getting a job in the government often isn't that meritocratic, it might simply be that your family is well connected. So it's a delicate balance. I mean, it's not that they're trying to sabotage what we're doing, or anything, it is often you get people they don't care. They don't complete their Job. Or, you know they'll turn up a day later than we thought they were going to."

7.8.3 Culture of Hierarchy

As mentioned earlier, there is a strong culture of establishing and maintaining hierarchy in some countries or organizations. Trainers have to familiarize themselves with the norms in these countries to be able to work with the people who hold authority positions and make decisions.

"Hierarchy matters a lot. I can't give a lot of details but I remember I was emailing something to Indonesia. And one of my colleagues told me that you have to put this name first, and this name second, for example. I was, I think, Dear A and B so it should be B and A. Because in many of these areas, this hierarchy matters a lot."

Trainers explain how the culture of hierarchy in these countries affects training. One trainer compared the culture of hierarchy in emerging markets to Western cultures. In Western countries training is treated as utilitarian, serving the purpose of training people. The focus is on what do trainees know and what is it that they don't know, how to design the training module structure to address the skill gap.

"There's a sort of a culture [in emerging markets] of working, which is, I mean,

it's still a hierarchy. [Compared to this] The culture of working [in the West] is quite flat and open right now; it's similar in [anonymized country name] where it's a highly networked way of organizing ourselves and running our project...so we'll go in thinking of training in a very utilitarian way like all right here is the group of people, here are the skills that we need to know. Let's just do that. What don't they know? Let's just make sure that they know it and think about them. The structure module."

However, in emerging markets you also have to pay attention to the norms about the hierarchy. They need to do this to be able to maintain relationships with the members in partner organizations. These include the people who work with trainers to arrange and carryout the training, the participants but most importantly the senior members of the organization who have a lot of power and can make things easy or difficult for trainers.

But not all societies are as open to . . . some are more hierarchical and have to be more deferential to people who are older or just higher up in the ladder. When we go to places like Sri Lanka, for example, [that is] something that we really had to take into account while training... What is sort of deemed proper because we have to maintain the relationship with the partner organization, I mean not only the people doing the actual work or who we need to be in touch with and who we need to train, but the people further up the hierarchy have a lot of power to make life difficult for us, if we do not stay on their good side. It's just being trying to become as aware as we can because you know what, we're all outsiders to the society."

7.9 Post Training Activities:

7.9.1 Evaluation:

After training, field workers evaluate the trainees' ability to train by either doing post-training tests or by asking to demonstrate their capability to train. This is because sometimes they might be great as field workers but might not be good at teaching or relaying

information.

Skill-based Training

As mentioned in earlier section, most of the skill-based training are followed by an activity session where actual demonstration or mock activities are done. The trainers use various indicators to gauge if training goals have been met. Trainers mentioned that when the users are able to complete the tasks, they know that the content delivery was successful and they can move forward. In remote and online training, trainers also look at the data uploaded from the activities and training. If the data is uploaded they can tell that they have received data from all users and thus everyone has successfully completed the activity task.

> *"So there are some competencies that you can know by a tool or by an instrument to know if they have learned or not, but some of them are easy to know if they were able to upload data to the server and everybody has a different user. So when I don't know data from the server, I can get all the user. And if I get data from this name or this user, I know that this person was able to install the app. To configure the app, they were able to submit a form, they were able to synchronize. So there are many different competencies that I can evaluate at the end of a process, but sometimes they will need like an evaluation instrument."*

Once they do training of trainers, they sometimes also observe the trainers' conduct the training to determine if they are following whatever they have learned.

> *"I have trained the trainers and they have in turn trained the [Anonymized, field workers]. We have monitored those trainings, and we were [also] there as support trainers and [to see] when they are going to train people, are they doing right or wrong. "*

Knowledge-based Training

After training, trainees are evaluated using tests to determine how much knowledge has been successfully transferred to the trainees. These tests contain multiple choice and open

ended questions.

> *"There are multiple choice type of questions. Suppose [after] an immunization training, so we asked that 'how how many vaccines should [a child] receive for a full immunization from birth to one year of age?' There will be 3,4,5,7 that kind of option, When we take qualitative feedback, then there that open ended [questions e.g.,] what was good, what was not good, with what you what would you like to recommend, to make our training better for future. Then there is a one or two liner or three liner question, so it is a mix of multiple choice and open ended questions."*

7.9.2 Post Training Follow-up calls

Sometimes trainers also arrange follow-up Zoom calls, following a digital or in-person training, to do some troubleshooting, to check-in, and also to answer any remaining questions that may be unanswered or come up since the training. The Zoom call can also be used to complete the content that was missed or left in the actual training. Giving the example of data admin, one trainer explained that these follow up calls are very important as they overestimate how much can be covered in a week.

> *"Yeah, on paper, it's supposed to be just troubleshooting... So the first couple of times I have to do a new process. They've never done it before. We'll get on a Zoom call and screen share. And I'll just make sure that they're on the right track. That's sort of how it's supposed to work. How it often works is that it will be that [follow-up questions and check-in], plus all the [training content] we didn't get time to do while I was in the country delivering the training. So there's often a lot of catch-up that needs to be done. Perhaps we usually overestimate how much we can get done in a week."*

7.9.3 Training is not just an in-class event

Training is a combination of in-class learning and out-of-class experience and the trainers try to manage that experience both inside and outside of class. Trainers also mentioned

that inviting trainees to one place where everything is provided is much more useful than traveling each day.

> *"It will be a regional training. We invite people from different countries to any specific country. So we move them to a [single] place and then everything is included. They have the whole event, the accommodation. The motivation is completely different, the approach is different. And the results are much better than having people traveling to their house every day or coming from the city. So even the agenda is different."*

As mentioned earlier, training and the learning does not only happen in the training rooms and halls, but is also an active event outside the training. For in person training, the trainers mentioned that since they are able to share the physical space in the form of lunch breaks, hotel or accommodation places etc., they are able to communicate and bond with the participants. Another important outcome of this space sharing is that the shy participants are able to ask questions or inquire more in private. As one trainer explained:

> *"Many people who do not ask questions in the hall. They come separately in the break and ask you which they feel that I don't know, if my question is wrong or right, or so that others don't laugh at me at what a silly question I asked. So they come individually and they discuss and they don't want to discuss in the group. So those people come and ask. And they are answered."*

7.10 Comparison of In-person & Online Training

7.10.1 Benefits of Online Training:

- **Translations** Zoom allows for easy translations and simultaneous translation is easy. The participants can choose the language they want to hear in or can read the translation.

- **Time Saving** If you needed a translator, it adds more time since you have to say something and then the translator repeats it (where virtual training reduce that time

barrier).There are some other limitations of relying on translators in in-person training which are avoided in online training because of reliance on automated translations. These limitations have been explained in the section 'Language and Training'. Another way time is saved in the online format is there are no formalities like tea breaks and social gathering.

- **Division into smaller chunks** Since there is no limit of traveling back and forth and staying in one place to complete training, they can divide online training into smaller sessions across many days to keep people engaged.

7.10.2 Flaws of Online Training:

Hesitation to ask questions or interrupt:

During in-person training, the trainers can explain a concept and they or their co-facilitators circle the room to see the progress of each participant if there are any issues or questions as well as to ensure that everyone has successfully completed a module or step before moving to the next one. However, online participants sometimes are shy and don't share that they are left behind or are unable to follow the instructions and upload the wrong data.

> *"For example, [when trainers ask online] did you get as such, did you succeed in this, or did you get the result. And they said yes. And then three steps ahead, they are not getting the result because they have not done the previous steps. Moreover, digitally [when we ask them to upload] this folder and they say yes and later they synchronize and they upload wrong data because they didn't follow instructions. So this is really a challenge because people don't tell you [if they do not understand]. They don't have that confidence for saying the truth, for saying that they have not gotten to the point yet. So it depends on the participants. There are some participants who are not shy. And they tell you, hey, wait, I'm still not there. So it will depend on the participants. But it's not the same."*

Trainers also shared other limitations of online training such as the inability of trainers to see or shoulder surf everyone to determine who is listening or attentive or how much progress has been achieved by every individual trainee. If trainers attempt to check progress over cameras, it is not scalable. Locals in low income countries might not have devices or bandwidth to switch on their camera which further limits trainers ability to determine progress. Moreover, the opportunity for social bonding, meeting outside of the training room, eating and chatting is lost.

> *"First of all, It is hard to connect with people online. Normally I tried to to use the camera at least for a moment, but then maybe [if] all cameras [are] on, [it] will be a problem for the network. So we try to switch them off and I don't have any feedback at the moment of what I am saying is really being understood. According to what I have read and also what the learning officer has taught us, there is an approximate of one hour and 30 minutes tops where a person can pay attention online. And we have also experienced that it is kind of complicated to have long trainings online. People get bored. We don't have a way to have breaks on the same day because it is complicated for the person to connect again. So while we try to do [breaks] in case the training requires more than three hours, for example. We try to have sessions all along the week, like two three sessions during the week. But still, it reduces a lot [of time] because we had, in face-to-face training, it was three days like eight Hours per day with long breaks and maybe lunch time and time to talk with people and everything. But then that 24 hour training has become a top nine hour, ten hour training online. So, we have to try to summarize a lot of things to be able to put everything that we want to show to put those [content] in that amount of hour."*

Trainers also report that shy participants do not ask questions in online sessions because you have to almost interrupt the session to ask the question unless the question pauses are built into the session and the instructors pause and ask about asking questions. One trainer shared how they were having a lot of errors because of the limitations of online training.

> *"We started having a massive amount of errors. Massive amount of errors. So, those errors were coming for things for which we had already done the training for them. And we were training them again and again. So one thing we figured out that this remote training probably is not working and because a lot of errors have already piled up, It's better to go on site, resolve them all and then start from a blank page."*

7.10.3 Peer-based:

Participants consult their more tech savvy peers during the training and seek help. In online trainings, participants belonging to remote areas are asked to come to training location where video calls are hosted on single computer shared b/w trainees. Even if trainees have devices, they end up sharing laptops in groups, relying even more on their peers than in-person training as trainer is remote.

> *"I'll say something and then it usually has to be translated and then there's a lot of discussion that goes around the room and then It might be that I say a sentence. And then there's two minutes of discussion in the local language that goes around the room back and forth. And then it comes back to me and then I'll say another sentence. So it's that sort of dynamic and very much used too. But it's not because I've been super clever and tried to set up the environment. For peer-based learning, it's more, it's more just recognizing when it happens and allowing it to happen."*

7.10.4 Programs and endeavors falling on the last mile workers:

Another important observation shared by the trainers were about the conditions and the work load on the last mile workers. They shared that all the applications or data collection or information dissemination efforts, no matter their type, fall on these field workers because they have to do all the field activities and at times part of more than one program or intervention. Thus, this also was mentioned as a reason for the need for their refresher training.

"There are several programs going on [job title anonymized] .. you see every national program vertical ultimately goes on what you call [job title anonymized]'s shoulder only. [job title anonymized] is the last unit, where we have to reach, and they will take it to the community. So [job title anonymized] have to understand."

One trainer shared that because of this burden on last mile workers of being part of numerous programs, they also receive numerous trainings and are burdened with alot of information. They, therefore, tend to forget what they were taught and need refresher training. Trainers also make case for these refresher training with the funders.

"So we also keep on telling them that you put some money for refresher trainings because people, this is one people is implementing 20 programs and he's receiving 20 trainings. Family planning also, immunization also, polio also, there is a home based newborn care also, multiple programs. People usually tend to forget, so that is why we always try to keep a refresher trainings. "

7.10.5 Effects of technology adoption on training:

With the reduction in smartphone costs and internet access costs, many users including the trainees had smartphone access. Previous studies show that in olden times, when smartphones were not so prevalent among low-income populations, the ownership or provision of smartphone from governments or for these development projects was considered as *honor*. With the pervasiveness of smartphones, one side effect was that high income trainees with access to devices e.g., doctors requested if the applications could be installed on their phones instead rather than using organizational phones, so that they do not have to use two phones. As one trainer explained :

"Now the medical officers have demanded that can we get our application on mobile also, because that will be useful for us and, most of us are operating this .. this android phones, so it will be good that you give us portal on the phone"

However, due to various reasons, the trainers mentioned that they could not use the trainee phones.

1. Due to the lack of uniformity of devices and specifications that were required for the apps.

2. Due to the security and privacy concerns, as well as due to the lack of monitoring on personal devices.

3. The organizations used MDMs to deploy the applications on the devices and with personal devices, these MDMs could not be used.

4. When another application is used with the company email, it prompted that maybe the action or activity is being done from the organization's behalf. Thus to avoid any such miscommunication, they avoided allowing use of company devices and company email for anything else.

Similarly, some trainers reported that the workers now asked for mobile applications instead of web and desktop since they could use the devices anywhere and get their work done, without being forced to work from one place.

7.11 Discussion

Training is an important part of any technology deployment. In the context of ICTD, these trainings become more important due to the varied and at times limited digital access, knowledge, and skills of its end users. Thus the role of the trainers then tries to leap frog some of these gaps in the trainings. I present a qualitative study through interviews with 8 expert trainers who have conducted 230+ trainings in 24 countries around the globe for various technology for social good applications and tools.

Most, if not all, ICTD project deployments try to bridge the gaps in physical access by providing the infrastructure and devices to the end-users e.g., digital initiative which also includes the distribution or use of smartphones or tablets by the field workers. Similarly, the ICTD projects try to bridge the gap in learning and understanding of the users by

providing them with the training required to understand and use these services and thus perform their jobs.

These training are more critical since the performance in these is associated with the job performance and the time it takes for these workers to complete their jobs. However, the presence of sociocultural factors like sense of hierarchy where the senior and juniority of rank and cadre make it hard for participants to raise any concerns or ask questions. Similarly, we see that this act of saving face or avoiding questions in public then pushes the trainees to ask questions in private after the training or during the lunch breaks or more casual environments. Researchers can further explore how we can work around such complex sociocultural norms and devise ideas to collect participant questions and concerns (e.g., by anonymization or on paper) to avoid such hesitations.

This work also highlights the need for training profile or profile of the participants and its impact on the content and design of training. The trainers mentioned that while all of them prefer having a knowledge or a formalized profile for their trainees, situations such as collaborating organizations, sociocultural norms, and shortage of profile matching participants limits the number of participants that meet a certain criteria.

Trainers also highlighted that due to this lack of participants' profile, trainers have to assume a lack of knowledge and start from the basics. They incorporate concepts about initial basic device feature content and then build on the applications and tool training. They use the training as a way to try to bring individuals with diverse technological expertise to the same level of understanding. This is highly unique and critical to the programs success. Currently the trainers used pre-reading material, small videos and gifs to improve understanding and consumption of training content. Future works can look at the various ways to gauge participant technological skills and also how technology can supplement the training of diverse expertise. Trainers can also be informed of the current progress or status of the participants, even in remote settings, by adding various logs and information about participant progress.

Most of the data collection, data creation, or pilot projects with field workers add more work to the last mile workers. This addition of work not only creates negative emotions and resistance and resentment against these systems but also makes it difficult for these workers

to retain all the information about multiple programs that they are a part of. Thus, the trainers urged the need to support the last mile trainers as well as empathize with them and their learning needs in these trainings. Many of these last mile workers are close to their job retirement stage and do not know the technologies required to do their jobs. They also feel embarrassed to ask their younger peers to help them with tasks. Thus, this can point to ways in which their tasks can be made easier without requiring help from humans such as Interactive Device Training [163]. One of the most interesting factors shared by trainers was the impact of local cultural norms on training. These norms played a role in how the trainees behaved with their peers as well as their supervisors, how trainings were conducted e.g., how many and what ceremonies were included as a part of training, and how the participants perceived trainings. Trainers reported that in some cultures training by a foreign or known individual was considered as a sense of pride and honor and thus requests to train or unwilling trainees with little to no motivation of using the training content were also seen in their experience.

In terms of training delivery post-pandemic, the majority of respondents (56 percent) indicated they plan to return to some classroom training while maintaining some of the remote learning instituted during the crisis [152]. In this work, we also see the trainers mentioning that while there are limitations due to Covid as well as some benefits like real-time translator or ability to achieve scale due to simultaneous training of large number of trainees, all trainers prefered the in-person training. Reasons such as the ability to know the attentiveness of the participants, ability to move across the rooms and understand the progress and concerns of users, as well as the ability to socialize and answer questions or over spend time to accommodate the pace of learning were some of the reasons mentioned by trainers to want to go back to in-person classroom setting.

With the pervasiveness of technology and cheap mobile phones, there is smartphone ownership and use among some of the low-resource workers that these trainers work with. This was seen with trainers reporting that the workers now questioned if the tools and applications could work on their personal devices. Trainers then went on to explain the reasons for specific hardware, privacy concerns, and the use of Mobile Device Management (MDM) tools to remotely push and monitor applications and work uploaded by the field

workers. Future works can look at these opportunities to design better integration between convenience and organizational processes.

7.12 Conclusion

I conducted qualitative interviews with eight training experts who have designed and led training around the globe in various socio-cultural settings and modes (such as in-person and online) before and during Covid. I highlight the various forms of training and their division based on the types of participants, the timing of training, or the content of the training. The training mediums used e.g., in-person, online, or hybrid training and their impact on the design and execution of the training content. This work shows the pros and cons of in-person and online training and the implications of socio-cultural norms, regional differences in customs, respect, and work hierarchies that impact training. We discuss the design, planning, and execution of the training activities and their differences based on the content, medium, and situation and the role played by the trainer, profiles of trainees, and the partner organizations such as donors, governments, and regional support organizations.

Chapter 8

CONCLUSION

Technology access and ownership have become essential to the availability and use of basic services around us and have embedded themselves in every field, from simple ridesharing and food ordering, to health care, etc. However, there remain populations who cannot access and use these technologies. Existing research has focused on the lack of infrastructure, connectivity, and low-cost options and devices for users in low-resource settings. However, it is crucial that we also question what this access looks like, and once these users can access these devices and services, what are the factors enabling or limiting a meaningful use of these devices and services?

In this thesis, I look at the impact of social access (in the form of socio-cultural support) and cognitive access (in the form of users' understanding) in enabling or limiting low-income populations' ability to access, understand, learn, and use technological devices and services. In social access, I describe how social structures and social factors like gender, religion, socio-cultural norms, socioeconomics, and the implementation of social values by families form the social access for low-income users, especially women. I share how the cognitive access that is enabled or limited by these social actors and how technologists and trainers try to bridge this cognitive access gap by enabling training as family members at home or formal trainers at work. My work is the first to draw attention to the role of religion on technology use and start a conversation about the impacts of religious and cultural values on Human-Computer Interaction - on its users and the researchers.

Most digital inclusion models assume physical access as a prerequisite for social access and cognitive access. However, my work shows how users overcome physical access and cognitive access limitations using their social access.

8.1 Contributions

My research aimed to understand the factors impacting and limiting the increase of technological and financial inclusion for low-resource users. In working towards this goal, I have presented six projects that highlight the role of these factors on technology access, understanding, and usage. In Chapters 2, 3, 4 and 5, I share the role of gender, socioeconomics, religious values and family's implementation of them, and the role of religion respectively to form the social access for low resourced users. In Chapters 6 and 7, I share how the learnability of the applications, various forms of learning needs of the users, and user training combine to provide cognitive access for these users.

In Chapter 2, I highlight the role of gender in impacting low-income women's access to and use of Digital Financial Services. I highlight how socio-cultural norms and beliefs impact women's technological access, social access, and financial access that together enable or limit a user in using a particular technology. To understand, how this impact of gender increases or reduces across socioeconomic segments, in Chapter 3, I share how gendered barriers exist across socioeconomic classes in a conservative patriarchal culture. However, the work also highlights the knowledge and affordances available to women in each socioeconomic segment and the resources they can put to use to bypass or overcome some barriers faced due to their gender.

Once a technology is available to a user, overcoming all the above-listed barriers, I have also mapped what the technology access and use look like. In Chapter 4, I share the various stages of technological inclusion and the various actors who play roles at these stages. I present the "Technology Engagement Framework" that explains and details the role of family and its interaction with religious and socio-cultural values in a conservative society. These actors from immediate and extended family in a user's technology usage - e.g. introducers or buyers of the technology, trainers, sharers, troubleshooters, and maintainers, as well as gatekeepers and monitors - together form a user's technology experience [115]). These actors, their motivations, and roles evolve throughout the life of these women. There are supporting actors in their environment, that enable users to increase their technological inclusion by improving their learning as well as negative actors such as limiters and

gatekeepers who monitor or prohibit the use of technologies.

Given the strong component of religious values that form the foundation of gendered norms and societal values discussed in the first three chapters, in Chapter 5 I reflect on the impacts of religion impacting research methods, research data collection and presentation and its understanding by the community. My work is the first to bring attention to the impacts of religion on the data collection, methods, data analysis, and presentation, as well as reviewing HCI research concerning religion and the impact of religion on the use and non-use of digital systems and services.

Based on existing literature, users' inability to utilize mobile wallets was a reason for the lack of adoption of Digital Financial Services (DFS) [156]. Thus, I explored the initial learnability of smartphone-based mobile wallets in Pakistan. In Chapter 6, I share the results that showed that while time spent on the system extends its understanding; there still exists domain-specific or device interaction knowledge that needs to be known or explicitly taught to the end-users [113]. I define the various levels of learning e.g., users' knowledge – about a) how a device and its hardware configuration and buttons work; b) how an operating system behaves and the various interactions and settings; c) what are the various tasks supported by any application e.g., sending money, paying bills, etc., or d) what are the various steps or screens I need to do to complete a particular task and what are the various ways to do one task – come together to enable a user's successful interaction with devices and systems.

In Chapter 7, I explore how various forms of users' learning needs are incorporated into the formal training provided to the last mile field workers in ICTD. In low-resource settings, other individuals' training and support to low-resourced users are critical in enabling access, use, and understanding. Through these pilot projects and project training, the trainers leapfrog the access, understanding and use by providing these users with the devices, the use cases to use these devices, as well as the formal training needed to learn and experiment with these devices before they go out in the field to perform their jobs. These trainers are similar to the role played by family members in supporting end-users to access, learn and use technologies, as seen in Chapter 4.

8.2 Final Remarks

This dissertation provides a detailed account of the impacts of gender and the associated socio-cultural norms about gender, the impact of religion in forming the social norms and societal values in conservative contexts, and their implementation inside the homes by families to form the social access and cognitive access for low-income users. My work also shows how some of these values and norms transcend economic boundaries e.g., gender norms and their interaction with socioeconomic class.

My research focus has been to explore barriers and opportunities to solutions to increase the use of technological and financial services. By increasing users' understanding, and ability to benefit from these services, we can broaden the technological and financial inclusion. I argue that future works that design with and design for marginalized communities need to go beyond the classification of haves and have-nots. The *Theory of Readiness* or the *Technology Engagement Framework* presented in this thesis can help understand the spectrum of user access and the challenges and opportunities to achieve meaningful use.

As mentioned at the start of this thesis, most development efforts focus on the physical access to hardware, devices, and infrastructure as the first step toward bridging the digital divide. However, my work also shows the technology access model presented and questioned by [44] and introduced in Chapter 1 is non-linear, and users use their social circle to gain access to physical devices and overcome cognitive barriers. I also highlight that when we see mention of readiness or a percentage of users have access, we need to take a deeper view into what that readiness looks like, the various actors, the socio-cultural contexts, and the norms surrounding those users and their technology use.

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