MORE-THAN-VOICE USE OF MOBILE AT THE BOTTOM OF THE PYRAMID: ANALYSIS OF MOTIVATIONAL AND CONTEXTUAL DRIVERS TO MOBILE USE AMONG LOW-INCOME USERS IN SOUTH ASIA

By

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ABSTRACT

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Over the last decade, mobile communication has become increasingly available, affordable and accessible even to the poor and disadvantaged at the Bottom of the Pyramid (BOP) in developing countries. This unprecedented connectivity at the BOP introduces not only an untapped group of media users for communication researchers, but also a new hope among development practitioners of fostering social change through innovative mobile-based intervention services. Despite the mounting interest, however, little is known about how individuals at the BOP adopt and use mobile phones.

This dissertation investigates the factors influencing mobile use behaviors at the BOP in South Asia, with a particular interest in their motivational drives behind the utilization of mobile phones for services other than voice calls. Guided by the well-established technology adoption theories, including the Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM), the dissertation examines the cognitive process behind mobile use involving technological utility (*perceived usefulness*), social influence (*subjective norms*) and contextual conditions (*perceived behavioral control*). The study also extends the model with multiple antecedents addressing '*what makes a mobile useful*' and '*what contributes to the enabling conditions*' pertinent to the context of the BOP users. Furthermore, pointing out the limitations of

the adoption theories in their tendency to overlook socio-demographic effects, the dissertation examines whether and where such demographic effects intervene in the motivational process.

Based on a large-scale multi-country random survey conducted in South Asia by LIRNEasia (N=4,023), the dissertation empirically validates the proposed model using Structural Equation Modeling (SEM). It also takes a novel approach to define a multi-dimensional effect of socio-demographic factors using a two-step cluster analysis method and compares the path differences between the sub-groups. In addition, it provides a supplementary analysis to explore the moderating role of *mobile efficacy* in the actualization of the behavioral intention to mobile use behavior.

The dissertation finds that, first, the western-oriented technology adoption theories successfully explain the formation of behavioral intentions (BI), but they fail to explain the full process of the actualization of behavioral intentions that lead to more-than-voice mobile use among the BOP owners. Second, socio-demographic factors partially moderate the degree of different effects of the motivational factors, indicating that the poor is not a homogenous mass and there exist considerable differences in their cognitive evaluations relating to their socio-demographic conditions. Third, in exploring the additional factors affecting the behavioral intentions to behavior path, the study suggests a tentative finding on the interaction effect of mobile efficacy and behavioral intention on the actualization of BI among the BOP mobile owners.

To my mother

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INTRODUCTION

By 2013, the number of global mobile subscriptions exceeded 6.8 billion driven primarily by double-digit annual growth in developing countries (ITU, 2013). Due to increasing network coverage, low-cost handsets and falling service prices, mobile telephony has become widely available, affordable and accessible even to the poor and disadvantaged at the Bottom of the Pyramid[1] (BOP) (ITU, 2011). Nowadays, it is no longer surprising to find a mobile phone in the hand of rural subsistence farmers in India or slum dwellers in African cities, who were previously unable or unwilling to join other communication services (Aileen et al., 2011).

The BOP, as proposed by Prahalad (2004), refers to the poorest socioeconomic group in the global economy which includes the 4 billion people living on less than USD 2.50 per day, mostly from low- and middle-income nations in Africa, South Asia and Latin America. The concept of the BOP is not just a new reference term for populations below the poverty line, but rather it calls for a shift in our understanding of the poor. Prahalad (2004) perceives the poor as active and sense-making consumers within their economic and social constraints, who have been largely neglected by the private sector. Indeed, mobile phones for the poor were never offered by international aids. Rather, the high penetration of mobile ownership among the poor was enabled by the private sector, that is, mobile operators who acknowledged the business potential at the BOP together with the poor's readiness to own a mobile phone as individual consumers. More and more people at the BOP consider having their own mobile phones, evaluate the cost and benefits, and make their own decisions to purchase their first personal electronic communication device. They now constitute a new group of consumers whose preferences are yet to be defined

[1] Recently the term the 'base' of the pyramid is preferred by some but, as Prahalad notes, the 'bottom' is a more accurate description of their destitute reality (Prahalad, 2010).

as well as new members of media users whose behaviors and related social changes are to be explored by communication researchers.

At the same time, the increasing connectivity among the BOP also invites new hope among the international development communities that a variety of innovative services can be delivered directly to the poor via mobile phones. Encouraged by the prevalence of mobile phones, more and more researchers and development practitioners are interested in finding out the potential of mobile phones for social changes in developing countries. Consequently, initiatives using mobile for development (M4D) are proliferating across the world (InfoDev, 2003, 2013; UNDP, 2012; GSMA, 2012; Donner, 2010). Indeed, the issues relating to mobile communications in developing countries are now shifting from *how to provide access* to *what potential services can be delivered* over the newly introduced mobile connectivity and *how the BOP users adopt and utilize the potentials of mobile phones*.

Nevertheless, little is known about how individuals at the BOP adopt and use mobile phones and how such behaviors yield developmental outcomes. Several critics point out that the access to information communications technologies (ICT) does not automatically lead to socioeconomic development and the evidence documenting tangible impacts are scarce (Toyama, 2011; Chaudhuri, 2012; Heeks, 2002; 2012; Unwin, 2009; Blattman et al., 2003; Thomas & Prayil, 2008; Kleine, 2010). As discussed in chapter 2, the past approach to ICTs for Development (ICTD) was concerned mostly with providing access to technologies, often assuming without critical exploration a two-step process where the provision of technologies (*input*) leads to developmental changes (*output*). Such an assumption may no longer be sustainable to explain the growing number of observations documenting unsuccessful, unintended and unclear outcomes of ICTD projects. The field seems to be in need of a new

framework to explain the complex nature of the development process via the use of ICTs. Hence, the dissertation suggests that it is necessary to deconstruct the ICTD and M4D process into multiple stages and take a step-by-step approach to examine each stage. In doing so, it argues that it is important to fully understand the poor's mobile use behaviors and what factors influence or hinder such behaviors prior to measuring the impacts of ICTD.

Research attempting to understand mobile use behaviors at the BOP is relatively sparse. Most studies tend to take ethnographic or qualitative approaches focusing on their unique behaviors or project success stories (Horst & Miller, 2005, 2006; Sey, 2011; Burrell 2010; Cartier, Castells, and Qui, 2005; Molony, 2006). Analyses of a handful of large-scale surveys on the BOP mobile users have typically been limited to mere description of use patterns or demographic comparisons. In fact, far too little attention has been paid to the motivational drivers or needs behind their behaviors (Heeks, 2012; Banerjee & Duflo, 2011).

This dissertation investigates the factors affecting mobile[2] use behaviors among owners of mobile phones at the BOP in South Asia. It asks what motivational factors drive the BOP owner's decisions to use mobiles, with a particular interest in the utilization of mobile phones for more than making or receiving voice calls. It also attempts to explore how such motivational factors interact with the user's contextual and socio-demographic factors. In doing so, it conceptualizes the poor as rational decision-makers with heterogeneous preferences and behavioral motivations, contrasting the conventional notion of the poor as a vulnerable mass only classified by their income.

[2] In this dissertation, the term 'mobile', 'mobile phone', 'mobile telephony' are used interchangeably referring not only to hardware (i.e. handset) but also to related software and services offered on mobile phones such as voice call, SMS, applications, information services, etc.

Extending on the well-known technology adoption theories such as the Theory of Planned Behavior (TPB) and Technology Acceptance Model (TAM), the dissertation first examines the fundamental drivers behind mobile use, including technological utilities (*perceived usefulness*, PU), social influence (*subjective norms*, SN) and enabling contextual factors (*perceived behavioral control*, PBC). Second, to expand the theories' ability to draw more practical implications relevant to the M4D practitioners (Bagozzi, 2007; Benbast & Barki, 2007), it explores the antecedents to PU and PBC to address '*what makes a mobile phone useful*' and '*what contributes to the enabling contexts*' among the BOP mobile owners. Third, the dissertation points out the limitations of such adoption theories in their tendency to overlook socio-demographic effects and attempts to investigate whether and where such demographic effects intervene in the motivational process.

Using a large-scale multi-country random sample (N=4,023), the dissertation provides empirical evidence on the motivational drivers behind more-than-voice use. It first tests the proposed model simultaneously with structural equation modeling (SEM) technique. It also takes a novel approach to define a multi-dimensional effect of socio-demographic factors using a cluster analysis method to identify four sub-demographic groups. The study analyzes the effects of socio-demographics by comparing the model coefficients between different sub-groups.

The structure of this dissertation is as follows: chapter 1 reviews the research contexts in relation to the structural changes fostering mobile adoption in developing countries. It reviews increasing M4D initiatives and discusses the research gaps in the current mobile use studies as well as the rationales for the current study. Chapter 2 introduces the theoretical framework and hypothesis development based on the reviews on the technology adoption theories as well as discussing the strength and limitations of the TPB. Chapter 3 explains the methodological

approach and the data, followed by empirical results in chapter 4. Chapter 5 discusses the findings, research implications, limitations, and possible directions for future research.

CHAPTER 1: RESEARCH CONTEXTS

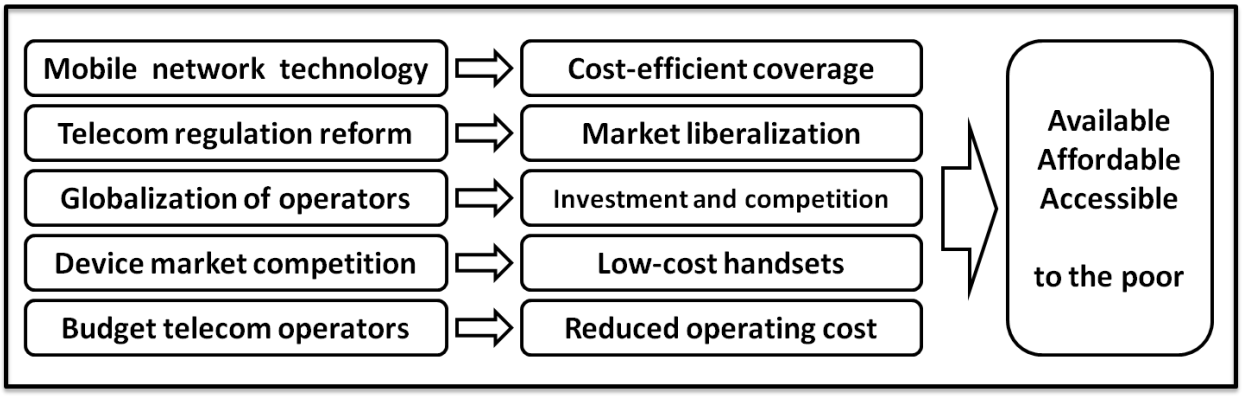
1.1. Mobile Explosion in Developing Countries

Mobile communication has experienced exponential growth in developing countries. Between 2000 and 2010, mobile penetration in low- and middle-income countries surged from a mere 4 per 100 inhabitants to 72 per 100, exhibiting an outstanding total increase of 1,500 percent (World Bank, 2012). The diffusion of mobile telephony in these nations is unprecedented not only for its speed and volume but also for its breadth, reaching to diverse populations (Chaudhuri, 2012; Kalba, 2008).

Such rapid uptake of mobile telephony in Africa, Asia, Middle East and Latin America was not foreseen by many telecommunication scholars who observed complex barriers in fixed telephony provision in developing countries (Sey, 2008). Guttman (1986) once predicted that, at the growth pace of fixed telephony in 1985, Sub-Saharan Africa would have to wait until 2027 to achieve a teledensity of 1 per 100 habitants. He pointed out there exist several fundamental problems inherent in the African telecommunication sector such as over-regulation by central government, low finance and under-investment, a lack of human capacity and large rural areas.

While fixed-telephony and Internet penetration still exhibit sluggish growth in these regions, mobile telephony made a breakthrough in developing countries and became available, affordable and accessible to the majority of the population within the last decade. In fact, how this mobile revolution occurred cannot be explained by pointing to a single cause. Prior to individuals' demand for mobile, there existed several structural changes and innovations from the supply-side involving multiple entities across technology, regulation and business (see Figure 1).

Figure 1: Structural Changes behind Mobile Adoption in Developing Countries



First, in the realm of technology, the commercialization of digitized cellular network technologies in the 1990s provided a cost-efficient means to cover wide rural and sparsely populated areas. Together with mobile phone's unique characteristics of mobility, always-connected and personal device, mobile telephony emerged as a viable new business opportunity in developing countries.

Second, in the realm of regulation, a wave of telecom reforms since the late 1990s has transformed the telecom sector across the world. These changes transformed the telecom sector in many developing countries from state-owned monopolies to a privatized, liberalized and independently-regulated marketplace (Melody, 1999). In case of the fixed-line market, however, incumbent operators often continue to dominate the market even after privatization, by maintaining close links with government or hampering competition with their dominant power. In contrast, the timely introduction of mobile telephony in the midst of telecom reform allowed the effective implementation of the improved regulation and an open and competitive market environment in the mobile services. Important aspects include the lowering of entry barriers for new operators, encouraging competition among multiple operators, and the creation of a dynamic private sector with less state interference (Bauer, 2010). These reformed regulatory and market

environments became essential pre-conditions for declining prices, expanding network coverage and increasing the user base (ITU, 2011; GSMA, 2006).

Third, the liberalized market also opened a door for foreign mobile operators who were seeking opportunities outside the saturated western markets. Several European mobile operators (e.g. Vodafone, Orange, Telefónica) and newly emerged multinational operators from the Global South (e.g. MTN and Bharti Airtel) aggressively expanded their business across Africa and Asia. At the same time, handset manufacturers also came up with low-cost handsets suitable for emerging markets in response to the need of multinational mobile operators while feeling similar pressure to move beyond the saturated Western handset market. Spurred by Nokia, which pioneered a strategy for affordable low-cost phones since 2002 (Nokia Press Release, 2008), the industry quickly expanded its battleground of competition to under USD 100 low-cost phones. The fierce competition between major manufactures sparked various innovations relating to cost reduction involved in product design, manufacturing and distribution, and eventually lowered the cost substantially below USD 30 (Information Week, 2005).

Fourth, mobile operators in developing countries also came up with innovative business strategies, such as the so-called 'budget telecom network model' (Samarajiva, 2010). These budget telecom operators tried to create economies of scale by reducing the transactional cost in handling a large number of customers who typically generate miniscule ARPU (Average Revenue per User). They offered pre-paid plans and calling-party-pays systems which enabled better control over expenditure for the low-income users, and widened the customer base via simplified registration procedures and minimum top-up fees (Samarajiva, 2010; Barrantes & Galperin, 2008; Sey, 2010; ITU, 2011). The budget operators also reduced the capital cost by maximizing network capacity by upgrading the existing base stations with software solutions

instead of investing in building new network infrastructure (ITU, 2011). To reduce the operational cost, they also substituted the distribution channels with pre-existing local kiosks or informal dealers across the country (ITU, 2011).

As a consequence of the interrelated innovations from multiple stakeholders, mobile communication became more available with the expanding network covering over 75 percent of the population in developing countries (ITU, 2012). It also became more affordable with the falling cost of handsets and voice calls. The total cost of ownership (TCO) of mobile service in 77 developing countries continued to decrease from an average annual cost of USD 13.16 in 2007 to USD 10.88 in 2009, with 12 countries offering the service for less than USD 5 (Nokia Research, 2007, 2009; ITU, 2011). Therefore, as connectivity via mobile continues to increase, the issues relating to mobile communication in developing countries are now gradually shifting from *'how to provide access'* to *'what services can be delivered'* over the newly introduced connectivity.

1.2. ICTs and Mobile for Development

The newly introduced connectivity at the BOP invites a new hope that a variety of innovative services can be delivered directly to the hands of the poor. Mobile for Development (M4D) refers to the growing research and practices to utilize mobile services in a way to bring positive impacts on the lives of the poor (InfoDev 2012, GSMA 2011; Duncombe, 2012; Kumar & Svensson, 2012; Donner, 2010).

Indeed, many development agencies and NGOs are exploring the potential of mobile phones as a cost-effective platform to carry development services such as education, healthcare,

financial, and agricultural programs. Spurred by evidence of the mobile phone's positive impact on economic activities (Jensen, 2007; Abraham 2007; Aker, 2008), and successful cases like mobile banking service in Kenya (Hughes & Lonie, 2007; Morawczynski, 2009), mobile phones are increasingly perceived as a smart platform for existing intervention programs. Numerous M4D projects (i.e. m-health, m-education, m-government, m-banking, m-agriculture, m-employment etc.) are currently in trial across the world (UNDP, 2012; IFC 2011; GSMA mWomen, 2012). As of May 2013, there exists over 1,320 live M4D projects and services are offered across the world (GSMA Intelligence, 2013). For instance, mobile phones are used for disseminating agricultural tips and market price information to rural farmers, connecting healthcare workers and patients in remote areas, providing learning materials to children, linking up buyers and sellers or employers and job seekers, and so forth.

In its origin, M4D can be seen as a branch of a broader movement called 'Information and Communication Technology for Development' (ICTD) which explores how new media technologies, including but not limited to computers, Internet and mobile phones, can facilitate socioeconomic development of the disadvantaged communities across the world (Toyama & Donner, 2008; Unwin, 2009; Heeks 2008, 2010). While its target technology has shifted from computing systems to mobile phones in recent years, the M4D activities share much of the basic rationales behind ICTD.

The proponents of ICTD typically address three rationales: first, information and communications technologies possess *intrinsic power* that can foster innovation, efficiency and empowerment in developing societies. Thus providing ICTs in those communities can spur the process of development and poverty reduction. Second, digital ICT networks introduce a new form of capital via boundless dissemination of information and knowledge as well as

opportunities for networking and communications (Castells, 1996). Consequently the gap between those who are connected and those who are disconnected and neglected is increasingly widening. Hence, it is critical to provide the poor with access to ICTs in order to embrace the disconnected in the march towards the *inclusive information society* (WSIS, 2005; ITU 2011, 2012). Third, ICTs appear to be a new means to improve the designs and operations of existing international development programs. It is increasingly acknowledged that mobile applications and computer software can be used to enhance *cost-effectiveness* of development project operation while creating participatory routes for the poor to engage with such programs (UNDP, 2012).

In fact, such rationales are founded on an implicit assumption that access to technologies is bound to create positive impacts and that more access results in more economic and social gains for the poor. Under this assumption on the direct impact of ICT on development, studies found that the ICTs, particularly mobile phones, have positive impacts on national GDP growth in developing countries (Waverman et al., 2005; Qiang et al., 2009; Sridhar & Sridhar, 2006). It can also enhance market efficiency by resolving the problems of asymmetrical information and price dispersion commonly found in developing economies (Jensen, 2007; Abraham, 2007; Aker, 2008). For small and micro- entrepreneurs (SMEs), ICTs are also found to contribute to increased labor productivity (Esselaar et al., 2007) and business growth (Chew et al., 2011).

Nevertheless, research on the impacts of ICT on development is still in a nascent stage. The conceptual and empirical linkage between ICT use and developmental impacts are currently ambiguous as the findings to date are inconclusive and even contradictory. In fact, there are only a handful of studies showing evidence that ICTD projects yield tangible and replicable success in developmental outcomes (Heeks, 2002, 2010; Chaudhuri, 2012). Most impact studies are

typically anecdotal case studies that are too specific to be generalized (Sey & Fellow, 2011; Gomez et al., 2012). On the other hand, several researchers noted that many ICTD projects have been unsuccessful in bringing desired impacts (Heeks, 2002; Warschauer, 2004; Kuriyan et al., 2006; Best & Kumar, 2008; Trucano, 2009; Jackson et al., 2011). In particular, some scholars point out that these failures are often caused by the mismatch between the intended benefits and local needs and the unexpected barriers that ICTs cannot overcome. Blattman, Jensen, and Roman (2003) found that mere provision of market information over ICT had limited impact on improving the livelihoods of rural farmers due to several structural and cultural hindrances. They suggested that '*information is a necessary but not sufficient condition for development*' and the intended benefits can often obscured by local complexity. Thomas and Parayil (2008) also suggested that social development can only be achieved via broader social policy intervention, concluding that "*providing access to ICTs through rural kiosks alone will not bring about development and change"*.

Furthermore, the unintended or even counteractive impacts of ICTs on development are also discussed. Recent studies find that popular uses of Internet in developing countries tend to be entertainment or recreational activities in preference to much hoped informational or business uses (Sey & Fellows, 2009). Similarly, mobiles are mostly used for talking with friends and family rather than business or economically productive uses (Rashid & Elder, 2009; Donner 2006). The adverse effects of ICT provision were also noted even long before the ICTD movement started. Rogers (1995) has rightly conceptualized it as an '*innovation paradox*' where the 'individuals who might need the benefits of innovation are generally the last to adopt an innovation'. In other words, the benefits gained from the ICT access tend to reach first to those who have resources to afford and utilize ICTs and the gap between the ICT-haves and have-nots

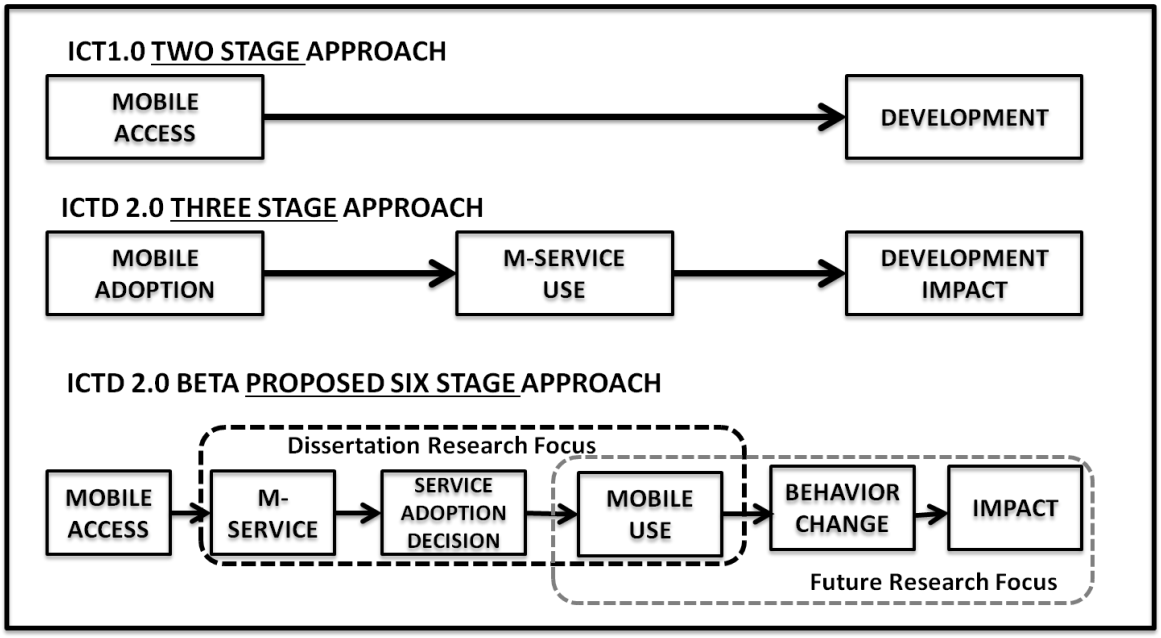
may be worsened. Recent studies indeed reveal that Internet cafes or telecenter users in developing countries tend to be younger males with relatively higher education and income, which indicates the emerging digital divide within developing countries (Sey & Fellows, 2009; Rangaswamy, 2008; Furuholt et al., 2007).

To sum, the early approach to M4D was based on a two-stage model assuming mobile access (*input*) will lead directly to socioeconomic development (*output*). The inconclusive findings on the impact of ICTs on development suggest that the underlying assumption of the two-stage linear model may have been too limited to explain the actual process between ICT uses and development. The findings on ICTD failures and unintended consequences also suggest that the relationship between ICTs and development are far more complex involving multiple paths linking multiple factors.

1.3. Understanding Mobile Use at the BOP

The conceptual framework of M4D needs to be further specified in order to capture the complex path from mobile access to developmental outcomes. In particular, the process needs to be deconstructed into multiple stages including users' m-service adoption decision, use behaviors, behavioral changes and related developmental impacts (Figure 2). In this regard, understanding people's mobile use behavior can hold a *missing link* between access and development. The current M4D research is in need of more studies examining how people actually adopt and use mobile phones and available m-services in their everyday life and how such uses affect behavioral changes.

Figure 2: Multi-Stage Process of Mobile for Development (M4D)



'Mobile use' is a dynamic and multi-faceted concept which changes through constant interactions with user's different needs, motivations and social and contextual influences. Over the last decade, mobile use behaviors in advanced countries have been studied extensively in relation to service adoption (Rice & Katz, 2003; Teo & Pok, 2003; Nysveen, 2005; Kim, 2008; Cho, 2011), gratifications sought (Leung & Wei, 2000; Pedersen, 2005; Peters, 2009), domestication process (Haddon, 2001; Ling, 2005; Ito, 2005; Selwyn, 2003) and appropriation behaviors (Carroll et al., 2002; Bar et al., 2007; Wirth et al., 2008). Nevertheless, relatively little attention has been paid to mobile use in developing countries, particularly among the disadvantaged groups.

James & Versteeg (2007) point out that a considerable discrepancy exists between what we can interpret from the global statistics on mobile penetration and what actually happens in Africa due to the unique behaviors of the local mobile users. These behaviors emerge as part of the survival strategies of the 'information have-less' to avoid the cost burden (Cartier, Castells,

and Qui, 2005; Zainudeen et al., 2006). For instance, studies found that sharing mobile phones is a common practice in many African and Asian countries (Burrell, 2010; Sey, 2009; LIRNEasia, 2009). Some people carry only a SIM card without handset while others own multiple SIM cards to swap networks for cheaper prices or better coverage (InfoDev, 2013; LIRNEasia, 2012). Users in developing countries also employ inventive practices such as 'beeping' which users leave intentional missed-call signs that can be decoded into pre-arranged messages such as 'call me back' or 'I'm doing fine' (Donner, 2007).

Several studies also reveal ambiguous relationships between mobile use and economic development. Molony (2007) finds that Tanzanian traders prefer face-to-face conversations over mobile use when discussing business due to the lack of trust on mobile phones. It was also suggested that mobile phones in these regions are mostly used for chatting with friends and family rather than expanding business relationships (Donner, 2006; Sey, 2011; Chew et al., 2011; Rashid & Elder, 2009; Souters et al., 2006). They caution that it is uncertain whether such personal uses are relevant to economic benefits as the boundary between personal and business or economic uses often blurs in the livelihoods of the poor (Sey, 2011; Donner, 2006). Horst & Miller (2006) also observe how Jamaicans use mobile phones for 'link-up', a short exchange of greetings to maintain social networks which can become economic support networks when necessary. In addition, there exist several studies exploring how mobile phones are used among social minority groups in developing countries, such as among migrants (Madianou & Miller, 2011; Wallis, 2011; Qui, 2008; Lin & Tong, 2008) or political groups (Rheingold, 2002).

Overall, the studies exploring mobile use behaviors in developing countries are still limited not only in their quantity but also in their epistemological and methodological diversity.

Hence, the following section discusses four research gaps in the current mobile for development studies and proposes rationales behind this dissertation research.

1.4. Research Gaps in the Current M4D Studies

The dissertation proposes the following four areas which call for further attention in the current mobile for development research: (a) the need for more quantitative social science approaches, (b) need for shifting the perspective on the poor as individual decision-makers, (c) need for exploring user motivations in the context of socio-demographic constraints, and (d) the need for studying more-than-voice use of mobile at the bottom of the pyramid.

1.4.1. Need for Quantitative Social Science Approaches: So far, most studies on the poor's mobile use tend to employ qualitative or ethnographic approaches (Gomez et al., 2012; Patra et al., 2009). While these qualitative studies offer richer details of mobile use that often reveal emergent behaviors specific to the poor's use contexts, the collection of findings often tend to be anecdotal and scattered across specific research sites. One risk of the limited diversity of methodological approaches can be that, as the research domain is relatively nascent, the M4D researchers in general are thirsty for empirical evidence. Accordingly, a limited quantity of empirical studies in the field may lead to the undesirable situation where the findings conditioned to a specific small sample are over-stretched to describe broader populations in different contexts. In other words, studies based on a small sample of Tanzanian rural farmers may be misappropriated to understand Tanzanian urban students or over-extended to explain Tanzanians, Sub-Saharan Africans or even the African poor in general.

On the other hand, there exist only a few studies employing quantitative methodologies but the analyses mostly remain at a descriptive level. Some of these studies are based on large-

scale industry surveys reporting the poor's mobile access, ownership, usage patterns and related demographic attributes (Souters et al., 2007; LIRNEasia, 2009, 2012; GSMA mWomen, 2011; InfoDev, 2012, 2013). Although these studies provide useful information to understand the current status of mobile use at the BOP, the results are often analyzed in mere counting numbers of users and non-users while the associations beyond demographic attributes are rarely explored.

In this regard, quantitative social science approaches can provide a good guideline for understanding mobile use behaviors in the Global South. Studies with a representative random sampling and rigorous analysis can broaden the generalizablity of research findings to address overall behavioral patterns across countries or regions. It can also theorize causal relationships or valid associations among scattered motivational and behavioral tendencies to explain why and how these behaviors occur and to predict future behaviors.

1.4.2. Conceptual Shift on the Poor: A conventional approach to define the poor is to categorize them by their income level such as those below the poverty line of USD 2 a day or the extreme poverty line of USD 1.25 a day (World Bank, 2011). Alternatively, the poor in developing countries are often perceived as an amorphous mass labeled by geographic regions (e.g. Sub-Saharan Africans) or location of residence (e.g. rural villagers or urban slum dwellers). This simplistic labeling of five billion people mostly serves our convenience to classify the unknown. Indeed, there exists a greater level of variations within the poor not only regarding their demographic factors but also psychological factors such as preferences, motivations and life aspirations. While the mobile users in advanced countries are extensively studied for their demographics and individual preferences, little is known about the poor as individuals especially in countries where national ID, address and accurate census data are unavailable.

In this regard, the dissertation proposes a conceptual shift, looking at the poor as active, independent and rational individuals who possess heterogeneous behavioral motivations, in contrast to the conventional notion viewing them as a mass of heterogeneous victims. It follows the argument made by Prahalad (2004) who calls for a conceptual shift on the Bottom of the Pyramid (BOP) as the untapped market currently ignored by the large private sector as well as on the poor as *rational decision-makers* who are active in sense-making within their given constraints. Similarly, in studying the poor's mobile use, this dissertation argues for the need to perceive the poor as *heterogeneous individuals* who make rational choices based on their cognitive assessment on mobile use and their contextual conditions.

1.4.3. Exploring Motivations within Socio-demographic Constraints: In the current M4D research, a common approach to survey data analysis is to compare the pattern of mobile service users and non-users by demographic attributes and describe the difference in relation to age, gender, income, education, region, and so forth. Others investigate the causal directions from demographics to use behaviors (Wesolowski et al., 2012; Hilbert, 2011; Zainudeen et al., 2010; Guierrez & Gamboa, 2010) and such approaches are also common in the practice of digital divide research (Busy, 2000; Hoffman & Novak, 2000; Van Dijk, 2005; Hargittai & Hinnant, 2008; Hsiesh et al., 2008, 2011; Livingstone & Helsper, 2010; Deursen & Dijk, 2010; Wei & Hindman, 2011).

Analyzing the mobile use patterns in relation to demographic factors certainly provides useful description of what is happening at the BOP. Nonetheless, such an approach involves two potential limitations: one is the effect of demographic attributes can be exaggerated in a way that its interpretation may suggest demographic and structural conditions are major determinants of the current use behaviors without considering individual differences. Another issue lies in its

efficacy of drawing practical implications because, although the research may address the current 'gaps' between gender, education and income, such structural barriers relating to demographic or socioeconomic factors are practically difficult to overcome via short-term M4D intervention programs.

Up until now, in development research, far too little attention has been paid to the poor's psychological reasoning and motivational drives behind their behaviors (Heeks, 2012; Banerjee & Duflo, 2011). In this regard, the behavioral science approaches in communications, psychology and information systems can provide a new direction to the mobile use studies (Pedersen & Ring, 2003). If qualitative approaches explore the range of user motivations by observing their behaviors and questioning the reasons, the behavioral studies delineate the internal functions of multiple user motivations by modeling the process and examine their relative importance within the cognitive process. Defining user motivation can both enrich our understanding of BOP's mobile adoption and use behaviors revealing specific user needs behind M4D programs. For practitioners, such an approach can provide a useful framework for project evaluation as well as suggest the points of intervention that they can influence through service design, promotion and marketing programs.

Nevertheless, the problem lies in that there are largely two groups of researchers in media and IS research focusing only on one side of the coin. Studies exploring user motivations have a tendency to focus mostly on psychological factors while taking insufficient account of the effects of socio-demographic conditions. Although recently scholars examine the moderating effects by one or two demographic effects such as gender or age, it is a common practice to control biological, socioeconomic, and cultural factors in order to maximize the assessments on the

motivational relationships. In contrary, as discussed earlier, there are researchers who see the socio-demographic effects as the primary determinant of the digital social inequality.

Neither approach captures the accurate picture of the reality of mobile use if they focus on only one aspect of the two related issues. Hence, the dissertation aims to look at the interaction of both sides and proposes to examine the relationships between motivational factors in the context of socio-demographic differences. The study posits that it is important to investigate whether and where such socio-demographic factors intervene in the process of individual's cognitive process in mobile use, and how they interact with behavioral motivations.

1.4.4. More-than-voice Use of Mobile: Mobile phones are increasingly becoming multi-functional computing devices. Even the basic mobile phone owned by most of the poor comes with several built-in applications (i.e. alarm clock, calendar, simple games, music players etc.) and it is also open for potential services that can be introduced over the existing phone. Although voice calling is the primary function of mobile phone, it is not the only service that a mobile phone delivers.

Following conventional approaches in media studies, mobile use can be defined largely in four ways, including '*binary acceptance*' in adoption studies (Rogers, 1995; Davis et al., 1989), '*the quantity of exposure*' in uses and gratification studies (Rosengren, 1974; Papacharissi & Rubin, 2000; Ruggiero, 2000), '*taming*' in domestication studies (Silverston, 1994; Haddon, 2001) and '*re-invention*' in appropriation studies (Orlikowski, 1993; Rogers, 2003; Carroll et al., 2002). Overall, in the tradition of mass media research, media use is often defined as the length of time spent on watching television, reading a newspaper or talking on the phone. However, as Wirth et al. (2008) point out, this simplification to technology use fails to embrace the multi-functional and multi-faceted nature of new communications technologies which also have a

potential to evolve with changing needs of the users. For instance, 'time' measurement (i.e. hours using internet) is not sufficient for studying Internet use as the medium offers a venue to a variety of options for different activities that potentially have different effects on individuals. Therefore, several researchers suggested new approaches to understand Internet use including a typology of web activities, the purposes of use, the level of use intensity or the potential impacts of use (Kraut et al., 2004; Howard et al., 2001; Papacharissi & Rubin, 2000; Hargittai & Hinnant, 2008). As the mobile phone is also a multifunctional and multipurpose technology as in the case of Internet, the study proposes alternative ways to define mobile use.

Furthermore, most M4D programs presently employ services beyond voice calls. In fact, Short Messaging Services (SMS) is currently the most popular method employed by such m-services (GSMA Intelligence, 2013). M-banking and m-health services are primarily based on SMS in delivering its services and most m-agriculture services also adopt SMS as a means to disseminate information. Various reasons support its popularity. SMS is available on all mobile phones regardless of manufacturers or network systems. The technology is robust and reliable; it works well even in the rural areas with patchy coverage as SMS messages can be stored in the network's server and can be forwarded when the phone appears within a signal range (Fitzgerald et al., 2010). Moreover, SMS can be easier and more cost-effective to disseminate information to a wide population when compared to a few-minute-long call, voice message or Interactive Voice Response (IVR) system.

Despite the importance of more-than-voice use of mobile phones for M4D, there exist only a limited number of studies exploring mobile use beyond voice calls in developing countries. While the m-services based on SMS and more-than-voice features are proliferating, studies find that user behavior of utilizing mobile services beyond voice calls are still scanty, in particular

among the BOP mobile users. A 2008 survey of South Asian countries reports that around 30 percent of the BOP mobile owners in India and Bangladesh had *ever* sent or received SMS (LIRNEasia, 2008). Similarly, only 37 percent of the BOP women in four developing countries had sent SMS regardless of their literacy levels (GSMA mWomen, 2012). The level of user adoption was found to be low even in the case of SMS-based intervention services designed for the poor. Zainudeen & Ratnadiwakara (2011) point out that the awareness of the BOP users of such information and banking services was less than 20 percent while their actual use was much lower. From an experiment of SMS-based healthcare service in rural Uganda, Chib et al. (2012) found that the response rate to such intervention was again as low as 20 percent despite participation incentives, and the effect on health knowledge was only limited.

Therefore, the dissertation calls for further attention on studying mobile use beyond voice calls. It proposes to conceptualize mobile use in two ways: first, the diversification of mobile use which means the utilization of the given functions available on a mobile phone and the second, voice-only use versus SMS use that distinguish the difference between using mobile phones as a mere telephone or using it a data communication device.

Based on the above rationales, the dissertation addresses the following research questions:

What are the factors affecting mobile use among the mobile owners at the BOP?

RQ1: What are the main motivational drivers of more-than-voice mobile use among the BOP mobile owners?

RQ2: How do BOP mobile owners' motivations behind more-than-voice mobile use interact with their socio-demographic attributes?

CHAPTER 2: THEORETICAL FRAMEWORK

The dissertation's theoretical framework is mainly drawn from the Theory of Planned Behavior (TBP) (Azjen & Fishbein, 1980). This chapter first reviews several theories concerning people's motivational drives and cognitive process in technology adoption. It then discusses the comparative advantages of the TPB to the current study context, followed by some of the remaining limitations in explaining the BOP's mobile use behaviors. It suggests how these conceptual and practical limitations can be supplemented by merging it with other parallel theories and proposes an extended model.

2.1. Review of Technology Adoption Theories

As discussed, behavioral science approaches within the field of communications, social psychology and information systems provide good guidelines to understand the mobile user behaviors. In particular, theories of technology adoption shed much light on deconstructing user need and motivational drives behind user behaviors (Pedersen & Ring, 2003; Wirth et al., 2008). These theories are not only applied to explain adoption behavior but also the continued use of technology. As suggested in the domestication approach (Haddon, 2001), 'technology adoption' is not limited to the initial acquisition of hardware or services, but can encompass the ongoing adaptation of new services offered via the already adopted technology. In its broad sense, therefore, adoption is a part of an ongoing process of technology use. In the context of multi-functional technology such as mobile phones and the Internet, existing theories of technology adoption can provide a useful framework to explain how people use their mobile phones by adopting new services and expanding their use spectrum.

2.1.1. Brief Summary of Technology Adoption Theories: Understanding how and why people accept or reject new technology has been addressed by many researchers in diverse disciplines. Several theories have been developed to explain key drivers behind people's technology adoption. **Diffusion of Innovation** (DOI) is one strong pillar addressing how adoption is determined by an individual's perceptions on the attributes of innovation. Developed by Rogers (1962), the theory proposes five attributes of innovation: *relative advantage, compatibility, trialability* and *observability*. Later, DOI researchers from Information Systems research added three more attributes: *image, voluntariness*, and *result demonstrability* (Moore & Benbasat, 1991). Compared to other adoption theories, DOI offers the most comprehensive framework covering the multifaceted utilities of innovation (i.e. technology), including instrumental and technological utility, social and symbolic utilities and accessibility. It also takes account of social and cultural factors such as interpersonal and mass communication channels, social system and socioeconomic factors (Rogers, 2003, p.170).

From social psychology, the **Theory of Reasoned Action** (TRA) and its subsequent version of the Theory of Planned Behavior (TPB) constitute the second pillar of adoption research. The primary goal of these theories is to explain and predict the process of behavioral change, and it is also widely applied in technology adoption studies since 'technology adoption' can be understood as a type of change in one's own way of acting. The TRA explains that behavior is fundamentally determined by one's intention to perform a target behavior, and this intention is driven by two motivational factors: *Attitude* (A) and *Subjective Norm* (SN). These motivational factors reflect the underlying salient beliefs one may have about the behavior and one's subjective assessment of its relative effects (Ajzen & Fishbein, 1975, 1980). The TRA provides parsimonious and powerful causal explanations to human behavior in general (Conner

& Armitage, 1998). However, its application is limited to behaviors under volitional control. In other words, TRA tends to lose its explanatory power if the behavior requires certain conditions beyond one's own control such as particular skills, resources, information or opportunities that are not freely available all the time (Fishbein, 1993; Conner & Armitage, 1998; Ajzen, 1991).

Hence, Ajzen (1991) added the third variable called *Perceived Behavioral Contro*l (PBC) to the TRA's two motivational factors (A and SN) and introduced the **Theory of Planned Behavior** (TPB). PBC includes one's own evaluations on both internal control factors (e.g. emotion, physical and mental deficiencies, skills, abilities, willpower etc.) and external control factors (e.g. available resources, opportunities, barriers, supports or objections from others etc.). The TPB offers a parsimonious framework with only three constructs that seek to explain all kinds of human behaviors regardless of research context. Its simplicity and the efficacy to explain human behaviors enabled the theory to be widely applied not only in social psychology and communications but also applied research in health communications, technology adoption, environmental research, and other fields. More recently, Fishbein (2000) reviewed several theories predicting behaviors[3] and proposed **the Integrative Model** (IM), which retains the main constructs of the TPB but PBC is replaced with Self-efficacy. In addition, the path between the behavioral intention and behavior is moderated by 'skills & abilities' and 'environmental factors'.

Evolved from the TRA, the **Technology Acceptance Model** (TAM) and its subsequent versions (TAM2, the Unified Theory of Acceptance and Use of Technology) integrate a third pillar developed from the Information Systems (IS) research that specifically addresses technology adoption in the organizational contexts. The TAM is one of the most widely used

[3] The reviewed theories include the TRA, the TPB, the Theory of Subjective Culture and Interpersonal Relations, Transtheoretical Model of Behavioral Change, the Information/Motivation/Behavioral-skills model, the Health Belief Model, Social Cognitive Theory.

theoretical frameworks in explaining user adoption of information technology. Grounded in the tradition of TRA, it shares several key assumptions including that users make a rational assessment, and that adoption behavior is under one's volitional control. It also follows the TRA in that behavior is explained directly by one's *behavioral intention* and that this intention is, in turn, determined by one's attitude about the technology in question, formed by one's salient beliefs. Nevertheless, the TAM departs from the TRA in the specification of the attitudinal factors in a way to be more relevant to the context of technology use. Replacing Attitude in the TRA, TAM postulates two key fundamental concepts that determine users' behavioral intention behind technology adoption: *Perceived Usefulness* (PU) and *Perceived Ease of Use* (PEU). In addition, the TAM assumes that the two fundamental determinants of PU and PEU are universal regardless of types of technology, and their measures are offered *a priori* as an 'off-the-shelf' package (Davis et al., 1989).

However, the closed nature of the TAM with the pre-determined set of variables and measurements made it inevitable for researchers to develop an upgraded version. Researchers soon tested additional variables in different research contexts and began to dispute the TAM's validity (Agarwal & Prasad, 1999; Karahanna et al., 1999; Gefen & Straub, 1997; Karahanna & Limayem, 2000; Hong & Tam, 2006; Yousafzai et al., 2010, Lee et al., 2003). Accordingly, an extended version, named TAM2, was created with seven new variables as antecedents to PU and two moderators borrowed from the TRA and DOI: *Subjective Norms, Image, Job Relevance, Output Quality, Result Demonstrability, Experience* and *Voluntariness*.

In 2003, TAM researchers announced a new model called the **Unified Theory of Acceptance and Use of Technology** (UTAUT) based on thorough analysis of the eight comparable models, including the TRA, TPB, Decomposed TPB, DOI, SCT, Motivational

Model, the Model of PC Utilization (Venkatesh et al., 2003). The UTAUT is the outcome of the TAM scholars' effort to create a holistic and powerful model (Venkatesh et al., 2003). It consists of four key perceptions on technology covering similar constructs in other models: *performance expectancy* (embracing perceived usefulness, attitude, relative advantage, compatibility, outcome expectancy), *effort expectancy* (perceived ease of use, complexity), *social influence* (observability, subjective norms), and *facilitating conditions* (perceived behavioral control, self-efficacy). It also acknowledged the effects of user differences in relation to demographics and specified age, gender, and experience as moderators.

Most recently, Venkatesh et al. (2012) released the UTAUT2 which targets general consumers' adoption and use of end-user technologies and services. The new model retains the four main UTAUT predictors (*performance expectancy, effort expectancy, social influence, facilitating conditions*) and three moderators (*age, gender, experience*). Then, it added three new variables relevant to general consumers (*hedonic motivation, price value, habit*) as predictors to BI. And the effects of the moderators have been adjusted from moderating all the BI predictors in the previous model to affect only FC and three newly added variables. At the same time, the moderator Voluntariness is dropped. Finally, the path from FC is previously directed only to B but now it has both paths to BI and B. Similarly, Habit also exerts influence on both BI and B while experience also moderates BI - B path.

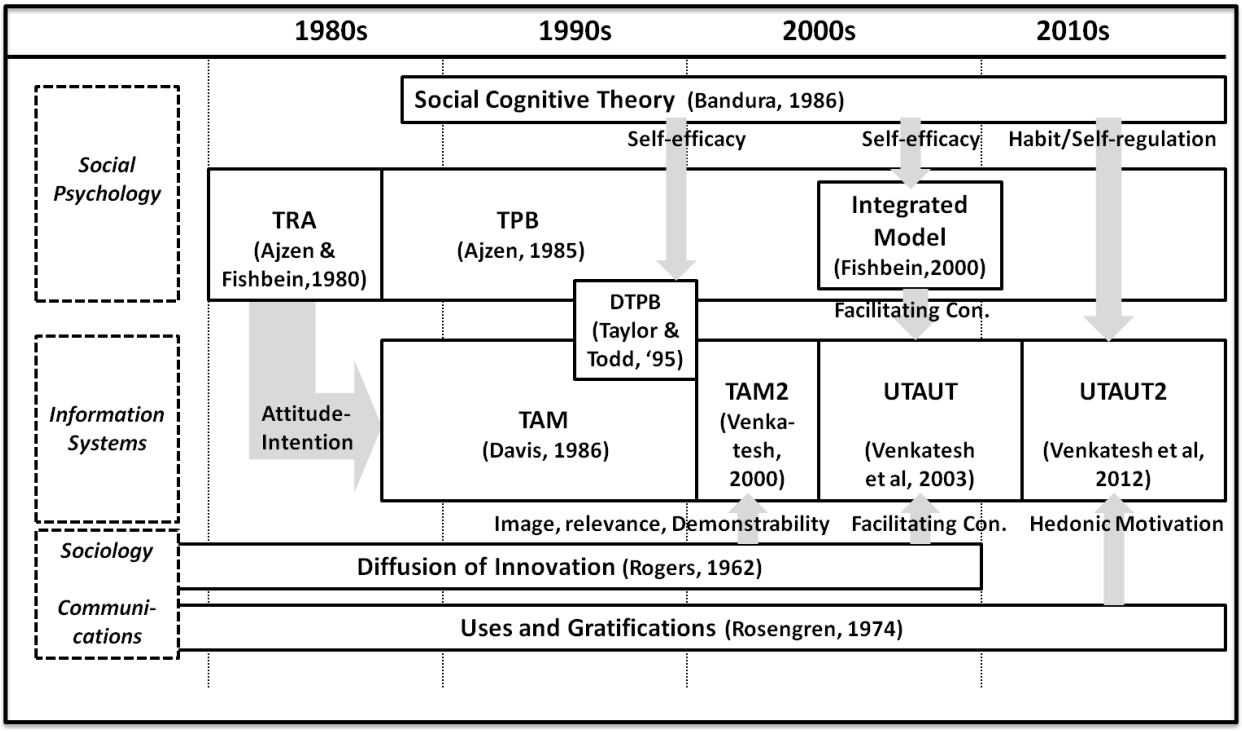
Social Cognitive Theory (SCT) is another social psychology theory influential in technology adoption studies. Founded by Bandura (1986), SCT offers a set of influential conceptualization including triadic reciprocality, self-efficacy, outcome expectations, self-reflection, self-regulation, etc. Among others, *self-efficacy* is the most widely used construct in technology adoption studies. Self-efficacy refers to 'one's belief in capability to organize and

execute a particular course of action' (Bandura, 1986). It is a dynamic self-evaluation formed through four agentic experiences: *enactive learning* (one's own performance), *vicarious experience* (observational learning), *social persuasion,* and p*hysical and emotional status* (Bandura 1997; Pajares, 2002). Unlike self-esteem or self-confidence, therefore, self-efficacy is a form of an optimal balance between one's ability and desire, or a reflection of both personal and sociostructural influences. In the domain of technology use, the concept was further elaborated as 'computer self-efficacy' (Compeau & Higgins, 1995) or 'Internet self-efficacy' (Larose & Eastin, 2004) to measure one's assessment in skills and capability to perform a task on a computer or on Internet.

2.1.2. Comparison of the Adoption Theories: Due to their conceptual similarities, researchers became interested in comparing the theories' explanatory power. Some suggest the TAM explains more variance in intention than the TRA or the TPB (Davis et al., 1989; Mathieson, 1991) while others find that the TPB or DOI performs better than the TAM (Talyor & Todd, 1995; Plouffe et al., 2001). On the other hand, the founders of the UTAUT present that it outperformed the eight competing models. The problem of these comparative analyses is, however, their tendency to obsess with comparing 'R-squared' as if it is the only indicator to theory's power. The competence of theory should be considered from multiple angles while direct comparison may not be possible if the theories are designed for different research domains, behavior in question, research contexts and the population of study. Hence, this study shifts the focus from the competitive power of the theories to the commonalities of the theories and examines which theory can offer the most basic framework to study mobile use at the BOP.

As illustrated in Figure 3, the theories reviewed in this chapter have emerged from different disciplines but became closely inter-related in the process of model validation, extension and maturation. The TAM was derived from the TRA, and its sequential model TAM2 borrowed several constructs from DOI in the efforts to improve the model's explanatory power. Also, the UTAUT attempted to merge the TRA, TPB, TAM and SCT among others. For instance, its facilitating condition (FC) is a mixture of three constructs: PC Utilization Model's FC, TPB's PBC and DOI's compatibility (Venkatesh et al., 2003, p.454). Similarly, Taylor and Todd (1995) introduced the Decomposed TPB (D-TPB) which elaborates the TPB with constructs from the TAM (PU, PEOU), DOI (compatibility) and SCT (self-efficacy). On the

Figure 3: The Evolution of Technology Adoption Theories



other hand, the TPB's PBC is conceptually similar to SCT's self-efficacy as Ajzen himself admitted (Ajzen, 1991) and Fishbein (2000) actually substitutes PBC with self-efficacy in his Integrated Model (IM).

Indeed, these theories share several assumptions. First, they all assume that technology users are active and rational decision-makers. Second, they posit that human behavior is primarily triggered by need, motivation and perception. Third, technology adoption is a deliberative process where the decisions are made based on careful assessment of available information. Finally, except DOI, they all tend to pursue a parsimonious framework explaining the essence of the decision-making process only with a few key constructs. In addition, there exists a degree of conceptual similarity in the key constructs included in these adoption theories. Common factors across these studies can be extracted as four groups: *Technological Utility, Social Influence, Use context under control* and *Contexts beyond user controls*. A more detailed review on the adoption theories and their conceptual commonalities can be found in Appendix 1.

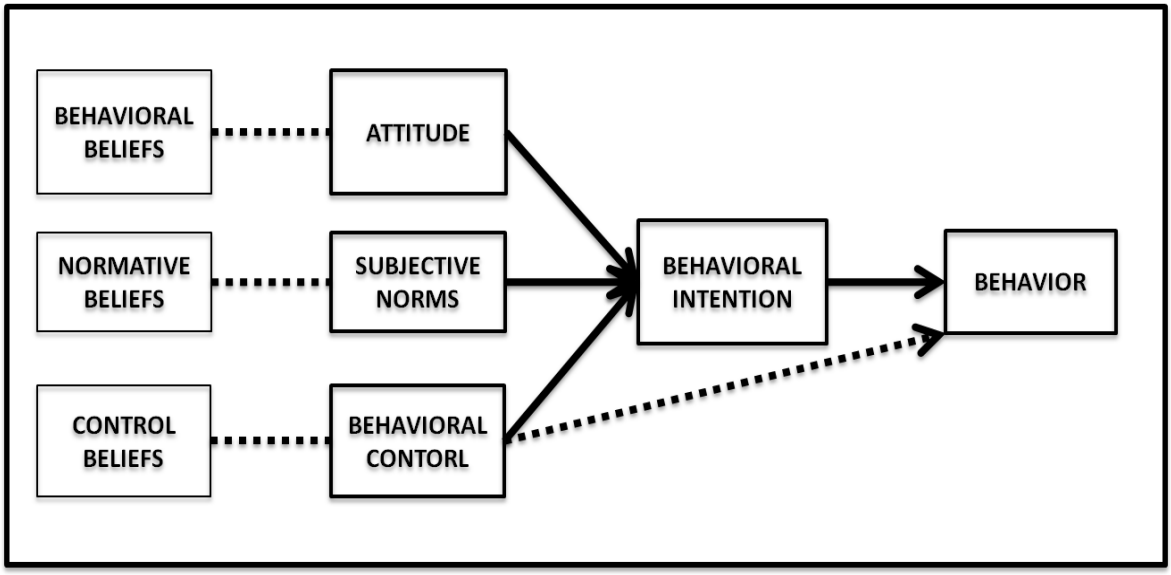
2.2. Theoretical Strengths of the TPB

This study chose the TPB as the baseline framework due to its theoretical advantages of generality, openness and parsimony. First, the TPB framework provides a more general framework to explore users' diverse beliefs on mobile use in everyday settings. The TAM and the UTAUT were originally designed to study technology adoption in organizations where the users share similar purposes (e.g. productivity) and use contexts (e.g. working in offices) while a series of trainings is typically offered before a technology is implemented. Coming from the Information Systems tradition, it also pays more attention on the technology's characteristics (usefulness and ease of use) and relatively less on contextual controls. On the other hand, the

TPB provides a comprehensive set of motivations that can be applied to any kinds of human behavior in diverse setting as long as the behavior in question is specifically defined. Such advantages of generality can be more suitable for a multi-functional use of mobile phones in everyday contexts.

Second, the TPB offers a more open framework that allows researchers to explore any beliefs unique to the target behavior as well as to identify additional variables if they can improve the variance explained in the target population (Ajzen, 1991; Fishbein & Cappella, 2006). This open nature of the TPB is distinct from the TAM-family theories, which aim to offer a set of pre-determined constructs with the off-the-shelf measures. The current study is an initial effort expanding the research to the under-studied population at the BOP in South Asia and their relatively new behavior of mobile use. The open nature of the TPB encourages not only replicating the model onto different samples but also exploring new attributes pertinent to the studied behavior, thus making it suitable for the current study.

Figure 4: Theory of Planned Behavior



Third, the TPB offers the most comprehensive but parsimonious framework to understand technology use. As Fishbein (2000) once put it, 'there are only a limited number of variables that must be considered in predicting and understanding any given behavior' and the TPB explains this general behavior with three comprehensive constructs: attitude, subjective norms and behavioral control. Unlike the TAM-family of theories, it does not specify technical usability but rather embraces it within PBC from a user's perspective.

In fact, it can be suggested that the construct 'ease of use' overlaps both with technology characteristics and contextual controls. Its meaning possesses a degree of duality as it is unclear 'perceived easiness' is intrinsic to a technology's characteristics (as suggested by the TAM) or belongs to user's ability to control a technology (as suggested by the TPB). For instance, a person may find a technology is easy to use if either the technology has a user-friendly characteristics or s/he has sufficient skills and knowledge to handle the target technology. Hence, the study argues that 'ease of use' exists as an underlying belief system rather than a separate main factor, and in this regard, it concludes that the TPB offers the most parsimonious framework.

Recently, scholars in media effect studies began to question whether the TPB is an appropriate framework to study media consumption which is increasingly perceived as habitual, automatic, and driven by spontaneous behaviors rather than rational decision-making processes (Hartmann, 2009; LaRose, 2010). For instance, LaRose (2010) argues that media consumption is likely to be habitual as it becomes repetitive through dual conscious and non-conscious processes, contrary to the conventional assumption of active, goal-directed, and deliberate process. Similarly, Hartmann (2009) specifies that TPB may fail to provide an accurate model for automatic media behavior unless the decision involves a degree of risk and investment (e.g.

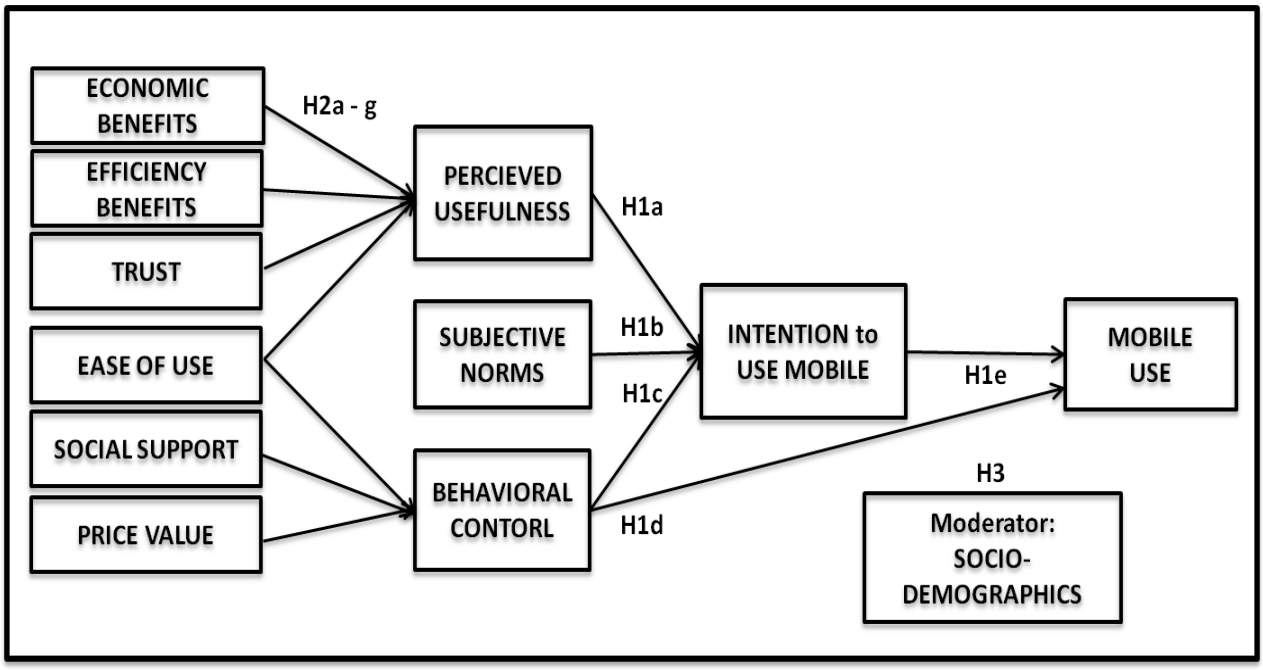
time, cost, resources) or if the user is highly unfamiliar with the choice or anticipated behavioral outcomes.

In this regard, this study assumes that the BOP's mobile use behavior is closer to conscious and goal-directed than habitual and automatic behavior. The boundary may blur when considering mobile use as answering phone calls which requires spontaneous reaction from users. Nevertheless, most BOP mobile users are on pre-paid mobile service so that each call or SMS involves a cost per minute or message, which activates 'executive control' or deliberate consideration between cost and outcome. At the same time, unlike users in the developed world who are surrounded by electronic gadgets, most BOP users are unfamiliar with economic communication devices and therefore trying or learning to use new mobile functions or services may require a degree of time investment and deliberation over its benefits.

2.3. Proposed Model Extension and Hypotheses

Despite the theoretical advantages, there still remain some conceptual and practical limitations of the TPB to fully capture the chosen study contexts. Thus the study proposes the following four areas for model modification by merging the TPB framework with elements from complementary theories and extending it with additional variables. Figure 5 shows the proposed model and the related hypotheses are justified below.

Figure 5: Proposed Research Model



2.3.1. TPB Framework with Perceived Usefulness

As specified in the TPB, the study assesses the three main motivational drives and their relationship with behavioral intention and actual use as the basis of research. However, it proposes that *attitude* in the TPB needs to be further specified in the context of technology use and, in this regard, *perceived usefulness* in the TAM is a more specific and robust construct to capture the attitudinal values related to mobile use.

Attitude refers to '*the degree to which a person has a favorable or unfavorable evaluation of the behavior in question*' (Ajzen, 1991). This conceptualization seeks to be broad and general in order to be applied to all kinds of human behavior. In practice, attitude is usually measured by several bi-polar Likert-scale questions on whether the target behavior is good or bad, favorable or unfavorable, wise or foolish, or satisfying or unsatisfying, and so forth. This form of attitudinal measure is appropriate for most behaviors, such as exercise, recycling,

smoking, drinking, getting a mammogram, etc., on which people may have different judgment based on their personal beliefs or experiences. Hence, *attitude* is a general but useful construct to reflect this varying degree of evaluations among individuals, and especially more so if the behavior in question involves some level of controversy or disagreement.

However, the behavior of 'technology use' is grounded in an instrumental nature where a technology functions as a tool to fulfill users' utilitarian values and such an instrumental attitude is widely shared by most of users. For that reason, unless using the target technology involves considerable harm or cost, it is unlikely that the users form a severely negative or unfavorable attitude. Especially in the current study context where the users have already decided to purchase a mobile phone, it is doubtful whether people possess considerably varying attitude across bi-polar measures (i.e. negative – positive) towards mobile use and whether *attitude* measures appropriately capture the instrumental values inherent to mobile use behavior.

In this regard, *Perceived Usefulness* of the TAM refers to '*the degree to which an individual believes that using a technology will increase his or her performance'*. Originated from the same root of the TRA, PU is a customized version of 'attitude' in the context of technology use. It specifies the instrumental utilities within technology use and aims to measure the degree to which the target technology serves the instrumental needs of the users. Its robustness in predicting technology use has also been proven in extensive empirical studies (Davis et al., 1989; Venkatesh et al., 2003; Hong & Tam, 2006; Yousafzai et al., 2010). Therefore, this study integrates *perceived usefulness* in place of *attitude* in order to define what instrumental utilities of mobile use drive people's behavioral intention.

Subjective Norms (SN) refers to '*the perceived social pressure to perform or not to perform the behavior*'(Ajzen, 1991). Influence from social groups is often confounded with other

similar constructs such as *subjective norms*, *conformity*, *compliance*, *perceived critical mass*, and *perceived network externalities* (Cho, 2012; Cialdini & Goldstein, 2003). In this study, we follow the TPB's narrow definition which specifies one's perceived pressure to conform to the norms perceived from the people who are important or with whom one interacts in proximity (e.g. family, peer, community, opinion leaders, etc.). The efficacy of SN in predicting behavioral intention has been questioned as it is known to be a weak predictor of behavioral intention in the TPB framework (Armitage & Conner, 2001; Manstead, 2011). Although several studies also found social influence as a direct predictor of use intention in mobile services (Nysveen, 2005; Hong & Tam, 2006; De Silva et al., 2011; Kim et al., 2008; Lu et al., 2010), the current study pays relatively less attention to the effect and antecedents to SN.

Perceived Behavioral Control (PBC) refers to '*the perception that performance of a specific behavior is within a person's volitional control*' (Ajzen, 1991). PBC may differ from the actual control which to some extent dictates the occurrences of one's behavior. Nevertheless, as Ajzen (1991) suggests, what matters in the formation of one's intention at the psychological level is his/her perception over the contextual control they believe to possess. In the context of mobile use, people's intention to use mobile services is influenced by their perceived control over the skills, resources and opportunities that they believe to facilitate mobile use.

In addition, the TPB's original model acknowledges the effects of behavioral control on the path between the *intention* and the *behavior*. This indicates the actual availability or constraints of resources and opportunities given in the structural and environmental contexts (Ajzen, 1991). As the *behavioral intention* to *behavior* path is widely supported in empirical findings and hence taken for granted, it is occasionally omitted from explicit examination. In the meta-analysis of the TPB studies from the developed world, PBC is found to add, on average,

only 1 percent of variance explained in behavioral intention (Sutton, 2003). However, considering the potential contextual constraints at the BOP, the study follows the original framework of the TPB specifying the effect of PBC on actual use behavior.

Hence, based on the previous research literature on the TPB and TAM, the following hypotheses are formed as the basis of the study.

H1a: Perceived usefulness is positively associated with behavioral intention to use a mobile phone.

H1b: Subjective norms are positively associated with behavioral intention to use a mobile phone.

H1c: Perceived behavioral control is positively associated with behavioral intention to use a mobile phone.

H1d: Behavioral intention to use a mobile phone is positively associated with actual use of a mobile phone.

H1e: Perceived behavioral control (PBC) is positively associated with actual use of a mobile phone.

2.3.2. Exploring the Antecedents to PU and PBC

Building on the TPB framework, the study aims to explore the antecedents to PU and PBC in order to identify what makes people find a mobile phone useful and what contributes to the enabling contexts for mobile use. The primary concern of the TPB is to predict a behavior in the most parsimonious manner by extracting three fundamental determinants (i.e. A, SN, PBC) of any behaviors. It pays relatively little attention to exploring the factors associated with these fundamental determinants. According to the TPB, such factors preceding A, SN and PBC exist as underlying 'belief systems' and they are assumed to be fully reflected within the three main determinants of behavioral intention. It also assumes that all belief systems are equally weighted

as their relative influences are undefined (Ajzen, 1991). As the TPB became popular in applied research such as health communications, however, a degree of specificity was required to suggest the points of intervention for practitioners. In this regard, the theory suggests for researchers to be specific in defining the target behavior in terms of the action, target, context and time or to identify specific population groups such as high/low intention groups (Ajzen, 1991; Fishbein, 2006).

Nonetheless, the dissertation posits that, in the current study, it is important to explore the belief systems as the antecedents and to examine their relative influences. This is because the population of the current study has been largely ignored and little is known on the behavioral motivations relating to their mobile use. Thus, exploring the antecedents can add much information to our knowledge, which may not be fully captured by the three general determinants. Furthermore, exploring the antecedents to PU and PBC can draw useful implications for M4D practitioners. As critics point out, the pursuit of theoretical simplicity may lead to the loss of useful information, and in this regard, the theory does not pay much attention to what makes the useful service or the enabling contexts (Bagozzi, 2007; Benbasat & Barki, 2007). Suggesting people will use the technology if they find it useful or if they have sufficient controls does not provide much practical information for those who want to design a useful m-service. Therefore, based on the existing literature on the motivations behind mobile use, the study includes the following motivational factors: *perceived benefits*, *trust*, *perceived ease of use*, *social support* and *price value*.

The *perceived benefits of mobile* formed from past experience of using mobile phones can influence a user's evaluation of the instrumental values and specifically the degree of usefulness of mobile phones. Based on the previous M4D literature describing general benefits

of mobile phones in developing countries, this study explores the instrumental benefits of mobile phone in terms of economic and efficiency benefits.

Perceived Economic Benefits refers to the ability to expand one's own economic resources by accessing information, obtaining work/business opportunities, and securing financial resources. It includes benefits such as enhanced communications with financial partners (e.g. banks, money lenders, employers or buyers), which can facilitate the expansion of one's economic resources regardless of activity types (e.g. information, financial, or social uses). Several studies in the ICTD literature suggest the impact of mobile phones on economic gains via dissemination of up-to-date market price information (Jensen, 2007; Aker, 2008). Although evidence on direct economic gains via mobile use is still limited and blurred, a few pilot projects appear to offer success stories, including profit increases among the farmers in Senegal through mobile-based price delivery (Rashid & Elder, 2009). Chew et al. (2010) also showed that using mobile phones has a positive impact on business growth among female micro-entrepreneurs in India.

Perceived Efficiency Benefits refers to one's ability to manage existing – as opposed to obtaining new – resources in a more efficient manner. This includes saving time and cost by reducing the number of trips or their corresponding expenses. Regardless of activities, the concept focuses on ultimate gains in one's efficiency in everyday life, including more efficient use of time, money, knowledge and social capitals as a result of travel reduction or better organization of existing social contacts such as arranging childcare or daily business. Abraham (2007) found that mobile phones increased the efficiency of Indian fishermen by allowing them to coordinate their catch with demand by helping them in finding the underserved markets while reducing their time idling at sea. Boateng (2011) also suggested that mobile phones enable

Ghanaian traders to monitor and schedule their sales activities more efficiently. Not limited to economic activities, we assume that mobile phones introduce an enhanced capability to coordinate one's everyday activities in quicker, cheaper, and better-organized ways. From these arguments, the following two hypotheses are derived:

H2a: Perceived economic benefits are positively associated with perceived usefulness.
H2b: Perceived efficiency benefits are positively associated with perceived usefulness.

Trust is an important factor to take into account when discussing the adoption of technology-enabled communications beyond face-to-face interactions. In the adoption studies from the developed world, *trust* was considered an important motivation behind service adoption mostly in relation to banking or e-commerce (Pavlou & Fygenson, 2006; Luarn & Lin, 2005; Zhang & Mao, 2008). However, for BOP users who are not familiar with electronic communications over technologies, trust and service reliability in mobile phones can affect their level of perceived instrumental values of mobile phones. Indeed, several qualitative studies of mobile use among the poor found that trustworthiness is an important indicator when considering technology adoption. Mittal et al. (2010) found that the quality of information, timeliness and trustworthiness are the three important factors influencing Indian rural farmers' mobile-for-agriculture services. Crandall (2012) also found that trust is an important factor to Kenyan farmers' adoption of SMS. Khodamoradi and Abedi (2011) also discuss that trust in technology influences the adoption of any new technologies among Iranian individuals. Hence, the study forms the following hypothesis:

H2c: Trust in mobile services is positively associated with perceived usefulness.

Perceived ease of use (PEOU) refers to 'the degree to which an individual believes that using a particular system would be free of effort' (Davis et al., 1989). The concept is from the Technology Acceptance Model (TAM) and the theoretical and empirical relationship with PU and PEOU have been extensively supported by TAM research (Davis, et al., 1989; Venkatesh et al., 2003; Hong & Tam, 2006; Yousafzai et al., 2010, Wu & Wang, 2004). However, the TAM conceptualizes PEOU as a part of the characteristics of technology, which has a distinct effect on behavioral intention in addition to its relationship to PU. On the other hand, the TPB does not specify the ease of conducting a behavior as a separate construct and rather embraces it as a user's behavioral control relating to the resources and knowledge to perform a behavior. In this regard, the study posits that, from a user's point of view, PEOU is conceptually linked both with the technology's ease of use (e.g. interface) and the user's perceived level of control (e.g. skills, resources). For instance, users may answer that given software is easy to use because it has a user-friendly interface or because the user has sufficient skills to handle the software. Hence, the study argues that PEOU is a compounded construct involving both instrumental evaluation of technology (convenience) and user's level of behavioral control (skills to use a technology). It conceptualizes PEOU as an antecedent to both PU and PEOU and forms the following hypotheses:

H2d: Perceived ease of use is positively associated with perceived usefulness.
H2e: Perceived ease of use is positively associated with perceived behavioral control.

Although calling or answering a mobile phone is fairly intuitive, other functions on mobile phones may be challenging for users unfamiliar with technology. In this sense, availability of technical assistance is one of the important conditions facilitating technology use (Park et al., 2008; DiMaagio et al., 2001). In the context of mobile use in developing countries,

studies found that technical assistance often occurs in social settings (*social support*), typically through help from family members or friends (LIRNEasia, 2009). Therefore, BOP users who lack skills and literacy are likely to be more comfortable with using mobile services if they have assistance from members of their family or from friends who can help with using various functions on a mobile phone, or know how to resolve technical problems. In developing countries, technical assistance from the service providers or experts also tends to take place through social interactions in local shops or top-up kiosks rather than through help-lines or websites. The presence of these social support systems is a distinctive social influence, which is more relevant to facilitating conditions to use technology. Therefore, the study hypothesizes:

H2f: Social support is positively associated with perceived behavioral control over mobile use.

For the poor, who are often defined as people living under USD 2 a day, the cost of mobile calls and SMS service is likely to play a more important role than for affluent consumers. Studies show that the BOP users employ various strategies to reduce their spending on mobile use, including limiting their outgoing calls or using encrypted signs via 'missed-calls' (Donner, 2007; Sey, 1009; Horst & Miller, 2006). On the other hand, other findings also point out that the BOP users tend to spend a considerable amount of their income on mobile use (Aileen et al. 2011; Galperin & Mariscal, 2007). To estimate the effect of 'cost' scholars may utilize subjective measures such as '*perceived cost*', typically measured by the degree of fiscal expenditure the user perceives with respect to his/her own available fiscal resources. In fact, *perceived cost* is a multi-dimensional construct because it not only depends on one's available budget, but also on whether the value obtained is commensurate with the cost incurred (Dodds et al., 1991;

Venkatesh et al. 2012). In other words, people may perceive the price to be slightly higher than their expectation, but may be willing to use the service if it offers value to them, or vice versa. Therefore, we suggest '*price-value* (PV)' as a more comprehensive measure than '*perceived cost*'. In this study, PV is defined as '*the degree to which individuals perceive the appropriateness of the cost in relation to one's perceived benefits and preference of the service*'. Previous studies also found perceived cost relating to service values to be a significant predictor of technology use (Kim et al., 2008; Hong & Tam, 2006; Venkatesh et al. 2012). Hence, we propose the following hypothesis:

H2g: Price-value is positively associated with perceived behavioral control over mobile use.

2.3.3. The Effect of Socio-demographic Factors

As the primary interest of the TPB lies in the workings of psychological determinants, the theory does not pay much attention to the effects of structural and demographic factors. Such demographic effects are considered as indirect background factors to the extent to which they are reflected in the underlying belief systems. As Ajzen notes (2011), the TPB assumes that the salient beliefs possibly originate from a mixture of background sources such as personality, emotional status, demographic variables, media exposure, and other information sources. Thus the effect of socio-demographic factors is not specified in the theory. Accordingly, it is a common practice for TPB researchers to consider the socio-demographic differences as control variables in their analysis.

Nevertheless, it is questionable whether these perceptions fully embrace the effects of socio-demographic factors especially in the case of the poor who are social and economically constrained. In fact, there are many researchers in the field of digital divide studies who see

socio-demographic factors as primary determinants of the unequal adoption and use of technology. Several studies find that the digital divide is a direct product of the socioeconomic status or demographic factors such as gender, age, race, location, income and education (Busy, 2000; Bimber, 2000; Hoffman & Novak, 1998, 2000; Bonfadelli, 2002). Some studies also find secondary effects of socio-demographical characteristics on motivations to use technology (Hsiesh et al., 2008, 2011) and digital skills and literacy (Deursen & Dijk, 2010; Hargittai, 2005, 2008, 2010; Livingstone & Helsper, 2010) as well as usage patterns (Van Dijk, 2005; Hargittai & Hinnant, 2008; Jung et al., 2001; Wei & Hindman, 2011). Similar findings are also reported by studies in developing countries (Furuholt et al., 2008; Fong, 2009; Sey & Fellows, 2009).

Therefore, to better explain the BOP's mobile use behavior, this dissertation posits that it is necessary to include effects of socio-demographic attributes within the TPB framework. In doing so, it raises two subsequent questions. First, it is important to test *whether* socio-demographic factors moderate the overall workings of the TPB model. Second, it is equally important to examine *where exactly* such effects exist in the given model as the theory does not specify the effects of socio-demographics within the relationship among motivational constructs. In other words, within the three layers of the TPB theory, it is unclear whether such demographic effects influence the underlying layer of belief systems, the workings of the three main determinants on behavioral intention, or the final path from the intention to actual behavior.

Another issue is related to how socio-demographic factors are being defined. Typically, studies tend to consider socio-demographic effects as a moderator by applying one or two one-dimensional demographic variables such as gender, age or education. Yet, in reality, an individual has multiple biological and socioeconomic characteristics that cannot be defined by a single variable. Using a set of multiple demographic variables may improve the accuracy but it

fails to explain the interaction effects or any correlations between the demographic variables. For instance, a female in mid-40s with a high school degree working as secretary in an urban city would be categorized by five separate variables (gender, age, education, location and occupation) and it is practically difficult to consider their overall effects of these inter-related variables. Therefore, the current study attempts to measure the multi-dimensional aspects of socio-demographic factors by grouping observations into sub-samples with a set of multiple demographic variables. And it aims to examine the effects of socio-demographics on the overall model by comparing the group differences. Hence, the following hypothesis is formed:

H3: The effects of the motivational factors are moderated by socio-demographic factors.

CHAPTER 3: RESEARCH METHOD

3.1. Data

This dissertation used the secondary data from the fourth round survey conducted in 2011 as a part of the LINREasia[4]'s Teleuse at the Bottom of the Pyramid (Teleuse@BOP) project. The survey comprises 9,066 respondents of the 'BOP teleusers' from the five Asian countries of Bangladesh, Pakistan, India, Sri Lanka, and Thailand. The 'BOP' is defined as the two lowest strata of socioeconomic classifications (SEC). 'Teleusers' is defined as those who are between age 15 and 60, and have accessed, but do not necessarily own, telephony services in the last three months including fixed-line, mobile, and public phone services.

Countries. While the studied countries are located in the same geo-economic region, they exhibit rather different characteristics in terms of their population, economic and social development status, and their ICT environments (see Table 1). For instance, Bangladesh, Pakistan and India are comparatively poorer with a lower GDP per capita, a large number of people living under the poverty line and a smaller number of ICT users than Sri Lanka and Thailand. As the focus of the current study is the mobile users at the Bottom of the Pyramid (BOP) across the countries, these differences mainly provide context. Although the study does not neglect these varying conditions of mobile use in each country, the primary interest lies in the generalizable pattern of behaviors and motivational drives related to the specific group at the same socioeconomic strata. Rather than comparing country-specific factors between the five nations (which would be difficult to do in a systematic way in a cross-national study of five countries), the research is based on the simplifying assumption that people at a certain socioeconomic stratum within the same geo-

[4] LIRNEasia is a regional think-tank specialized in researching telecommunication policy and regulation across the Asia Pacific region. The first round of Teleuse@BOP was conducted in 2005 followed by 2007 and 2009 surveys investigating ICT access, adoption and use among the low-income populations in multi-countries in Asia.

economic region share similar ways of living and behavioral perceptions[5]. Hence, the study pays more attention on the generalizable behavioral motivations at the BOP mobile users in the South-Asian countries. For analyzing the psychometrics on behavioral motivations, the country-level differences are further controlled in the structural equation modeling.

Table 1: Country Profiles

	Bangladesh	**Pakistan**	**India**	**Sri Lanka**	**Thailand**
Population (million)*	154.7	179.1	1,236.7	20.3	66.8
Income Level*	Low	Lower-middle	Lower-middle	Lower-middle	Upper-middle
GDP per capita, PPP*	597.0	772.9	1106.8	1884.2	3352.5
Human Development Index (rank)**	146	146	136	92	103
Life Expectancy at birth (yrs)**	69.2	65.7	65.8	75.1	74.3
Literacy Rate (adult, %)***	57.7	54.9	62.8	91.2	93.5
Poverty Indicators*					
GINI Index	32.1	30.0	33.9	36.4	39.4
Poverty headcount ratio at $2 a day (PPP) (% of population)	76.5	60.2	68.8	23.9	4.1
Poverty headcount ratio at national poverty line (% of population)	31.5	22.3	29.8	8.9	16.9
Income share held by highest 20%	41.4	40.0	42.8	44.6	46.7
Income share held by lowest 20%	8.9	9.6	8.5	7.7	6.8
ICT Indicators**					
Mobile subscriptions per 100 inhabitants	62.8	67.1	69.9	91.6	127.3
Fixed-telephone subscribers per 100 inhabitants	0.6	2.5	3.2	16.3	9.5
% of Internet users	6.3	10.0	12.6	18.3	26.5

* World Development Indicators (2012), **Human Development Index Report (2012), ***CIA World Factbook (2013), ****Poverty and Equality Database (2012, except Pakistan, 2008), *****ITU ICT Statistics (2012)

[5] As shown in Table 1, although the absolute numbers of people under the poverty line may vary between the countries, the income share held by the lowest 20 percent display relatively similar portions across all five countries (ranged between 6.8 and 9.6 percent of the total income), suggesting the status of relative poverty in each country does not vary to a large degree.

BOP teleusers. Prahalad's notion of the BOP is a conceptual reference to billions of the poor residing in developing countries without discussing a specific definition or measures to identify them. In practice, the poverty threshold of $1 or, more recently, $1.25 a day as established by the World Bank is a common method to define the poor (Ravallion et al., 2009). However, when conducting an individual-level survey, it is practically difficult to identify the poor by self-reported questions on their income and consumptions. Respondents often reject to reveal their actual income or fail to recall the accurate level of their earnings and expenses especially if their income is irregular or miniscule (de Mel, et al., 2009; Chew et al., 2011).

Therefore, the study used the level of education and the type of occupation as a proxy for low socioeconomic status. It employed the socioeconomic classification (SEC), originally

Table 2: Sample SEC Criteria for India

	EDUCATION							
OCCUPATION	Illite-rate	Literate but no formal school	School up to 4 years	School 5 to 9 years	Secon-dary school	Some College but not graduate	Post Graduate - General	Post Graduate - Professional
Unskilled Worker	E2	E2	E2	E1	D	D	D	D
Skilled Worker	E2	E1	E1	D	C	C	B2	B2
Petty Trader	E2	D	D	D	C	C	B2	B2
Shop Owner	D	D	D	C	B2	B1	A2	A2
Businessmen /	D	C	C	B2	B1	A2	A2	A1
Industrialist	C	B2	B2	B2	B1	A2	A1	A1
Of Employees	B1	B1	B1	A2	A2	A1	A1	A1
Self Employed	D	D	D	D	B2	B1	A2	A1
Clerical / Salesman	D	D	D	D	C	B2	B1	B1
Supervisory Level	D	D	D	C	C	B2	B1	A2
Officers / Executives – Junior	C	C	C	C	B2	B1	A2	A2
Officers / Executives – Middle / Senior	B1	B1	B1	B1	B1	A2	A1	A1

* The categories of education level and occupation types were customized for each country's context.

developed by Market Research Society of India (MRSI), which is a widely used marketing and survey framework in developing countries in Asia. It comprises five groups (A to E) based on the education and occupational status of the chief wage earner of the households (see Table 2) and only groups D and E were selected for the survey. In case of rural households where a large number of people are self-employed or unemployed, it used the type of housing – Pucca (stable house made with cement, bricks, and concrete), Semi Pucca and Kaccha (temporary, unstable housing made with straws, mud, bamboo, leaves available in villages) – as a proxy to indicate SEC groups. As discussed in the description in the following section, the current sample displayed a range of characteristics of low socioeconomic status including low education, unstable occupation, irregular or no income. In addition, the average monthly household income was reported as USD 122.02 (SD=53.5) which is below the USD 1 a day criteria when divided by four household members per day.

***Sample Design*.** The study used a multi-stage stratified cluster sampling by Probability Proportionate to Size (PPS). Covering all regions (e.g. states, provinces, districts) of each country, the PPS was used to select a target number of urban and rural centers in each province. Accordingly, urban and rural areas were randomly selected using PPS on a constant population interval on geographically ordered centers within each region. Within each area, a starting point (e.g. a prominent landmark such as a main road, park, hospital, school or well-known building) was randomly selected with a fixed number of interviews to be conducted around each starting point. The number of starting points within each area was determined in proportion to the population of the selected center. From the starting point, the interviewers visited every fourth household following the right (or left)-hand-rule when facing a junction or end of the street. One respondent was chosen from each household for the survey. In households with more than one

valid respondent, a Kish-grid (random number chart) was used to randomly select the next member of the household to be interviewed. For more details on the sampling methods, see De Silva et al. (2008, 2011).

Data Collection. The structured survey questionnaire was first created in English and then translated into local languages. Back-translation and pre-tests were conducted to modify any obscure questions and words. The data collection was carried out from May to June 2011 by a leading market research firm which won the bidding process based on their industry reputation and survey experience. A face-to-face survey was conducted by intensely trained local administrators who read out each question and marked the answers on behalf of the respondents. A set of pictorial and text cards was used for Likert-scale or complex questions.

Sample Characteristics. The dissertation focuses on mobile phone owners only. Of the total 9,047 respondents[6], 54.5 percent owned a personal mobile phone (N=4,924). As shown in Table 3, females accounted for 42.7 percent of the total BOP mobile owners and the mean age of the mobile owners was 32.5 years (SD=11.3). 70.3 percent were married as people in the studied countries tend to marry in their 20s. The sampled BOP owners mostly resided in rural areas (68.7%) as the number of urban areas is growing but still limited in these countries. Another measure of location also indicates that about 40 percent needed to walk more than 30 minutes to the nearest town.

The majority of the BOP mobile owners were educated up to primary school (55.4%) while 19.6 percent received no formal education. 18.3 percent graduated secondary school and 3.6 percent proceeded to higher education. About 10 percent of the BOP mobile owners reported

[6] For descriptive analysis, the data has been weighted by gender, province group and urban-rural populations to correct over- or under-sampling for particular socioeconomic groups.

Table 3: Sample Characteristics

		All	Bangladesh	Pakistan	India	Sri Lanka	Thailand
Demographics		(% of the total 4,924)					
Gender	*Female*	42.7	40.7	44.7	36.2	55.0	49.6
	Male	57.3	59.3	55.3	63.8	45.0	50.4
Mean Age	years (SD)	32.5 (11.3)	30.9 (10.6)	30.8 (10.2)	32.5 (10.4)	34.4 (11.3)	35.5 (12.5)
Location	*Urban*	31.3	35.0	57.0	35.3	34.4	48.8
	Rural	68.7	65.0	43.0	64.7	65.6	51.2
Education	*No formal Education*	19.6	25.3	19.7	25.6	8.7	3.5
	Primary School	55.4	48.8	62.7	45.4	71.4	65.9
	Secondary or more	21.9	25.9	17.6	29.3	20.0	30.5
Occupation	*Unemployed*	36.1	47.7	36.5	34.2	37.7	29.8
	Unskilled laborer	23.3	16.5	19.7	27.3	19.0	37.0
	Skilled laborer	15.3	18.5	35.5	15.5	17.3	12.5
	Self-employed	15.3	16.9	8.3	23.0	26.0	20.7
Household Income	Monthly, USD (SD)	131.8 (60.2)	103.6 (32.8)	127.5 (50.1)	103.0 (54.5)	186.8 (57.8)	188.3 (48.6)
Access to Facilities	*bank account*	53.6	39.9	14.6	55.0	91.6	90.5
	Electricity	92.0	80.4	99.3	85.4	97.8	100.0
	Television	79.8	56.6	90.2	65.7	95.2	99.7
	Radio	38.2	12.4	8.0	27.2	93.0	77.2
	Computers	6.3	1.8	4.4	2.0	8.2	20.5
Mobile Use Behaviors							
Pre-paid Mobile		98.4	100.0	99.9	99.6	94.6	95.8
Years of Mobile Ownership		3.7 (2.5)	3.4 (2.3)	3.1 (2.2)	2.8 (1.9)	3.9 (2.2)	5.9 (3.1)
Monthly Mobile Expenditure, USD (SD)		4.32 (2.7)	3.67 (2.6)	4.27 (2.6)	3.76 (2.5)	4.58 (2.3)	6.80 (2.9)
Type of Use	*making calls*	98.0	100.0	99.0	98.3	92.0	100.0
	missed calls	67.1	86.2	71.1	77.4	60.4	24.4
	SMS	32.7	19.0	37.8	22.7	51.7	36.7

to be illiterate in their own language. The majority of the BOP owners (64%) reported to have some kind of occupation such as unskilled worker (23.3%), skilled worker (15.3%) or self-employed in informal or agricultural business (15.3%). The remaining 36 percent included housewives, students, job seekers and the retired. Only one in three people (33.7%) reported to have regular income while the rest had irregular (23.4%) or no income (42.9%). Hence, the aforementioned demographic characteristics indicate the sample consists of the lower socioeconomic category of the population.

As for the mobile use behavior, almost all mobile owners use it for making or receiving phone calls (99.5%). There was a high use of missed-calls for signaling a caller's intention (68.1%). Nevertheless, the use of non-voice functions was considerably lower than voice-related uses. In relation to the non-voice features on mobile phones, the BOP mobile owners' devices were equipped with an average of eight features on their phone out of the fifteen suggested functions on mobile phones[7] (mean = 8.0, S.D.=3.49) and ever used around three to four features on their mobile phone (mean =3.5, S.D.=2.87).

Overall, the sample characteristics were generally consistent across the five nations except a few notable differences. India had slightly more males than females whereas the Pakistanis sample had more urban residents working as skilled laborers. The household monthly income and general access to facilities were higher in Sri Lanka and Thailand than other three countries. The respondents with no formal education were lower in these two nations but the percentage of people proceeding to secondary school or higher education was similar in all five nations. Regarding mobile use patterns, almost all the respondents used a pre-paid mobile service. The use of missed-call was notably low in Thailand but their use of SMS was close to the

[7] This may include the respondents who may have such features but are unaware their presence on their phone.

average. On the other hand, Bangladesh users tend to use a mobile for mostly voice calls and missed-call signs and their use of SMS was lower than other countries.

As shown in Table 4, the rankings of the most used mobile features other than voice call show a notably different use pattern among the BOP mobile owners to typical Western users. For instance, alarm clock was ranked as the most widely used feature and flashlight as the second most used due to the limited availability of electricity or facilities connected with electricity (e.g. toilet, street lights). On the other hand, multimedia features (e.g. camera, music player, video player) and data-service related features (e.g. downloading, browser, MMS) were either not present or not used by the majority.

Table 4: Ranking of the Most Used More-than-Voice Mobile Features

		Feature Ever Used		Feature Present	
		Counted N	**% Total Respondents**	**Counted N**	**% Total Respondents**
1	**Alarm Clock**	2143	49.4%	4446	92.1%
2	**Flashlight**	1931	44.5%	2310	47.8%
3	**SMS**	1878	43.3%	4177	86.5%
4	**Games**	1819	41.9%	4159	86.1%
5	**Calendar**	1703	39.2%	4344	90.0%
6	**Calculator**	1490	34.3%	4015	83.1%
7	**FM radio**	1459	33.6%	2497	51.7%
8	**Music player**	1308	30.1%	1856	38.4%
9	**Camera**	1166	26.8%	1684	34.9%
10	**Video player**	719	16.6%	1327	27.5%
11	**Connectivity**	495	11.4%	1075	22.3%
12	**MMS**	255	5.9%	1059	21.9%
13	**Download**	183	4.2%	728	15.1%
14	**WEB/WAP browser**	172	4.0%	685	14.2%
15	**Converter**	120	2.8%	767	15.9%
	Total	16841		35127	

* Multiple response questions

3.2. Measures

All measures, except *Perceived Benefits* (PB), were adapted from prior studies with minor changes in wording (Table 5). Rather than contextualizing the measures for the BOP, the study chose to use widely used or sufficiently validated measures from the existing TPB and information systems literature. By doing so, it intended to test the applicability of the Western-origin standard measures as well as to facilitate the comparison of the findings between the over-studied developed world and the under-studied BOP population. Since most BOP respondents are unfamiliar with complex psychometric questions, 5-point Likert scales were used instead of the conventional 7-point ones (1 = *strongly disagree*, 3 = *neither agree nor disagree*, 5 = *strongly agree*).

The measures for *Perceived Benefits* (PB) of mobile phones were constructed based on the previous qualitative studies on mobile use at the BOP by LINREasia (LIRNEasia, 2009). The researchers initially listed 12 exploratory items with 5-point Likert-scales asking about any perceived improvement on various aspects of everyday life including economic, efficiency, information, social benefits (1=*No change*; 5=*Greatly improved*). Exploratory factor analysis (EFA) with varimax rotation was performed to identify the emergent factors with statistical significance. Both *scree plot* and *eigenvalue* criteria clearly indicated two factors: *economic* and *efficiency benefits* made up 60.6 percent of the total variance that was explained. Four items with cross-loadings and weak scores were removed by the recommended rule of thumb (Costello and Osborne, 2005). The EFA results and factor loadings are stated in Table 6.

Table 5: Measurement Items

Construct	Name	Item	Sources
Perceived Usefulness	PU1	I find mobile phone to be useful in my life	Davis et al. (1989)
	PU2	Using mobile phone increases my chances of achieving things that are important to me	
	PU3	Using a mobile phone helps me accomplish things more quickly	
	PU4	I find a mobile phone gives me useful information	
Subjective Norm	SN1	People who influence my behaviors think I should use a mobile phone	Ajzen & Fishbein (1980) Kim et al. (2008)
	SN2	I use a mobile phone because I want to use the same service people around me use	
	SN3	I use a mobile phone because it is common to use it in my community	
Perceived Behavioral Control	PBC1	I have the resources necessary to use a mobile phone	Ajzen & Fishbein (1980)
	PBC2	I have the knowledge and ability necessary to use a mobile phone	
	PBC3	Using a mobile phone is entirely within my control	
Perceived Ease of Use	PEOU1	I find mobile phone easy to use	Davis et al. (1989)
	PEOU2	I think learning how to use mobile phone is easy to me	
	PEOU3	My interaction with mobile phone is clear and understandable	
Trust	TRU1	Based on my experience with mobile phone, I know it provides good service	Kim et al. (2008)
	TRU2	Based on my experience with mobile phone, I know it is trustworthy	
Price Value	PV1	I think mobile services are reasonably priced	Kim et al. (2008); Venkatesh et al. (2012)
	PV2	I think mobile services offer values for money	
Social Support	SUPT1	When I have problems in using a mobile phone I can get help from my friends/family members	Teo&Pok, (2003
	SUPT2	When I have problems in using a mobile phone I can get help from the service providers or experts	
Intention	INT1	I intend to continue using mobile services in the future	Ajzen & Fishbein(1980) Davis et al. (1989)
	INT2	I expect that I would use mobile phone frequently in near future	

Table 6: Exploratory Factor Analysis on Perceived Benefits of Mobile

Factor	Name	Items	Factor loadings	
Economic Benefits	ECB1	Ability to find out about employment/work opportunities	.814	
	ECB2	Ability to save money	.792	
	ECB3	Ability to access finance	.781	
	ECB4	Ability to plan and make decisions relating to your livelihood	.768	
Efficiency Benefits	EFB1	Ability to reduce travel		.820
	EFB2	Ability to act or contact others in emergency		.789
	EFB3	Efficiency in your day to day work		.747
	EFB4	Relationships with family and friends		.638

Dependent Variables: The dependent variable measures the binary division between voice-only use of the mobile device versus SMS use as a proxy for more-than-voice mobile use. SMS is currently the most popular means of delivering mobile for development (M4D) services due to its wide availability, technical robustness and cost-efficiency of the service. However, the low adoption and use of SMS is the biggest barrier to such M4D projects (Kang et al., 2013) and investigating SMS use can draw important practical implications to the M4D practitioners. Second, SMS is a text-based data service which makes a conceptual distinction between multi-functional mobile devices to a portable telephone. Before entering the mass adoption of smartphone, SMS use indicates a stepping stone to more advanced data communication via mobile and it is worth paying attention to its use behavior. Hence, a multiple-response question asked '*which of the following services have you used on your mobile phone?*' including voice calls (99%), SMS to communicate with people (32.1%), SMS to access information and banking services (0.8%), none of above (1%). A binary variable (Mean=0.34, SD=0.47) is created from those who answered voice only and those who used SMS services (voice only=0, SMS use=1).

3.3. Data Preparation

Missing values. Unlike the typical problems in data from developing countries, the level of missing values was relatively low as the data was collected via face-to-face interviews by trained enumerators. The initial missing value analysis (i.e. missing value patterns) revealed 198 cases with no response to all the Likert-scale independent variables. After removing the blank cases, the percentages of missing values were at a negligible level for all variables (average 1.5 percent) except some of the *Perceived Benefits* (PB). Little's MCAR test was conducted to check if the missing values were completely random and, as the test found the missing pattern to be not random (chi-square = 4702.1, *df*=3739, sig=.000), mean replacement was preferred to listwise deletion. On the other hand, 6 out of 10 Perceived Benefit (PB) items had more than 10 percent missing values ranging from 14 to 21 percent of the total sample. It was identified that all the questions with high missing values were related to employment and the patterns of missing values were structured because housewives or the unemployed may have felt ineligible to answer such questions. Hence, multiple imputation was conducted using demographic variables (gender, age, education, employment, have income) and the rest of the relatively complete PB items.

Outliers. Tukey's outlier labeling rules (Tukey, 1977) were applied to eliminate outliers for two continuous variables (monthly mobile expenditure and household income). The inter-quartile range (Q3-Q1) was multiplied by 1.5 to determine the upper and lower boundary (Tukey, 1977). Additionally, the box-plot method was used to screen out the remaining outliers manually. The procedure yielded in the total sample size of 4,062 comprising five countries: Bangladesh (25.3%, N=1,027), Pakistan (24.2%, N=983), India (23.9%, N=969), Sri Lanka (16.5%, N=670) and Thailand (10.2%, N=413).

Country Effects. As for the psychometric measures, Intra-class correlation (ICC) coefficient of all the psychometric scores between the five studied countries was tested. The test shows that the correlation coefficient is in an acceptable range (β=.755, F-test=5.456, p<.000) on the studied measures of motivations among the five countries. At the same time, country effect was further controlled in the analysis using structural equation modeling.

3.4. Reliability and Validity

Confirmatory factor analysis (CFA) using SPSS-AMOS (version 21.0) was employed to assess the dimensionality and validity of all measures and latent factors. Item reliability was assessed by reviewing standardized factor loadings and Cronbach's alpha values for their internal consistency. All items were loaded significantly (p <.000) with the loadings over .60 in general (Table 7). Construct reliability, convergent and discriminant validity are shown in Table 8 and 9. Cronbach's alpha values and composite reliability were all satisfactory, exceeding the rule of thumb of .70 (Churchill, 1979), except *social support* which is a formative construct measuring informal support from friends and family and formal support from service providers.

Convergent validity was assessed by Average Variance Explained (AVE) scores. Most constructs exceed the recommended rule of thumb of .50 while a few are close to the .50 benchmark[8]. Discriminant validity was evaluated by following the rules proposed by Fornell and Larcker (1981) who suggested that the correlation between any two constructs should be lower than the square root of AVE of the individual construct. Table 7 shows the construct correlation matrix with the diagonal of the square root AVE. All factor correlations are lower than the diagonal values, thus the constructs are distinct and safe for further analyses.

[8] It has been suggested that AVE is related to the sample size as it can be improved by dropping cases (Ping, 2009; Efron, 1981). Considering the large sample size, the marginally low AVE scores are accepted in this study.

To assess the overall fit of the measurement model, a set of goodness-of-fit indices are reviewed: RMSEA (.040), CFI (.943), GFI (.954), TLI (.931) and a Chi-square value of 3076.6 (df = 409, p<.000). It should be noted that the Chi-square value is easily distorted by the large sample size and thus an inadequate indicator for a sample size over 400 (Bentler & Bonett, 1980; Kaplan, 2009; Arbuckle, 2011). Following the criteria suggested by Bentler & Hu (1999) and Hooper et al. (2008)[9], a combination of the above fit indices suggests the measurement model has a good fit.

Table 7: Standardized Factor Loadings

Item No.	PU	SN	PBC	ECB	EFB	TRST	PEOU	PV	SUPT	INT
1	.700	.627	.595	.670	.649	.733	.771	.796	.615	.766
2	.721	.840	.708	.617	.663	.750	.788	.821	.730	.774
3	.690	.771	.702	.768	.540		.720			
4	.700			.731	.634					

* PU: Perceived Usefulness; SN: Subjective Norms; PBC: Perceived Behavioral Control; ECB: Economic Benefits; EFB: Efficiency Benefits; TRST: Trust; PEOU: Perceived Ease of Use; SUPT: Social Support; INT: Intention

Table 8: Construct Statistics

	Mean	Cronbach's alpha	Composite Reliability	AVE	√AVE
PU	4.25	.796	.796	.494	.703
SN	3.81	.780	.793	.564	.751
PBC	3.99	.706	.709	.481	.694
ECB	2.39	.791	.791	.488	.699
EFB	3.41	.711	.716	.389	.623
PEOU	4.17	.802	.804	.578	.760
TRST	4.16	.709	.710	.550	.742
PV	3.89	.791	.791	.654	.809
SUPPORT*	3.79	.620	.624	.624	.675
INTENT	4.22	.744	.744	.593	.770

* Formative construct

[9] Among the various fit indices available on structural equation modeling technique, it is generally recommended that Root Mean Square Error of Approximation (RMSEA) value below .06, Comparative Fit Index (CFI) greater than .90, Goodness-of-fit (GFI) above .090, Tucker-Lewis Index (TLI/NNFI) close to .095 are to be used as cut-off criteria for determining how the model fits the sample data (Bentler & Hu, 1999; Hooper et al., (2008); Hair et al. (2010))

Table 9: Factor Correlation Matrix and Discriminant Validity Assessment

	PU	SN	PBC	ECB	EFB	PEOU	TRUS	PV	SUPT	INT
PU	**0.703**									
SN	0.487	**0.751**								
PBC	0.610	0.610	**0.694**							
ECB	0.312	0.356	0.301	**0.699**						
EFB	0.375	0.145	0.281	0.378	**0.623**					
PEOU	0.701	0.489	0.689	0.234	0.294	**0.760**				
TRST	0.642	0.510	0.619	0.291	0.349	0.618	**0.742**			
PV	0.475	0.548	0.577	0.279	0.217	0.466	0.548	**0.809**		
SUPT	0.470	0.378	0.488	0.260	0.148	0.356	0.452	0.558	**0.675**	
INT	0.653	0.653	0.584	0.274	0.324	0.543	0.645	0.483	0.390	**0.770**

CHAPTER 4: ANALYSIS

The empirical analysis consists of three sets of statistical assessments. First, the study examined how the TPB's main behavioral motivations and their related antecedents influence the use intention by testing the proposed model with the full dataset via Structural Equation Modeling (SEM). In fact, the path between use intention and actual use behavior is dropped in the first analysis due to the limitations of cross-sectional data which does not allow time-structure involved in the process[10]. Second, the study evaluated whether there exist variability between different socio-demographic groups. TwoStep Cluster analysis was performed to identify different demographic groups within the BOP, and the differences in path coefficients between multiple sub-groups were analyzed. Third, a supplementary analysis using a logistic regression was conducted to explore the relationship between behavioral intention and actual behavior in the population of the current study.

4.1. Path Analysis

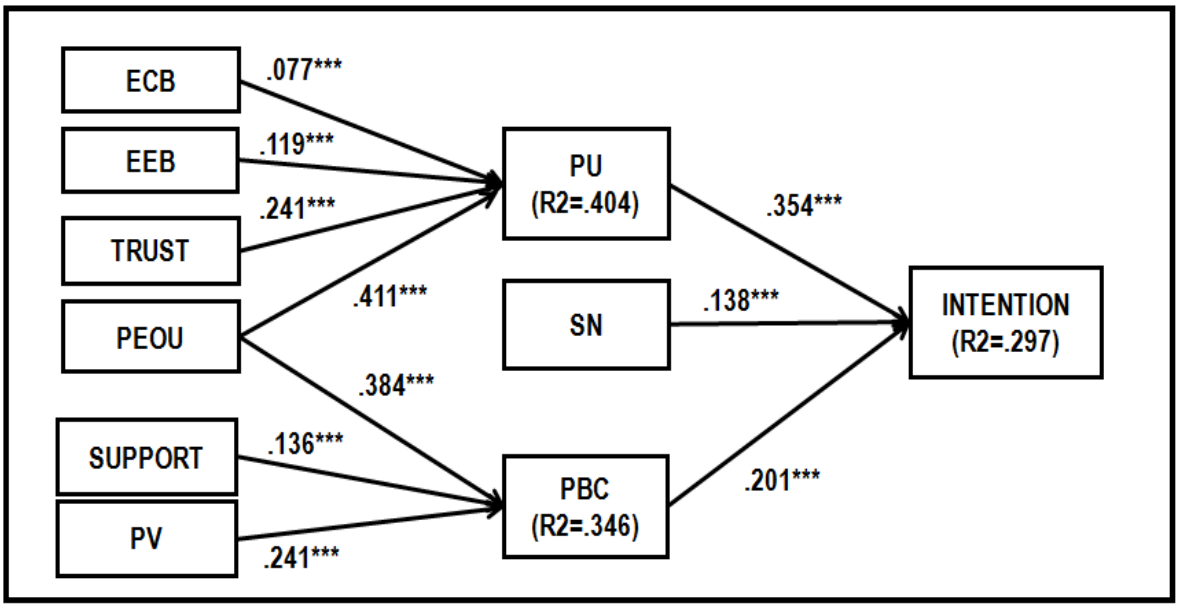
The SEM technique was chosen for this analysis as it allows a simultaneous testing of multiple direct and indirect relationships in a complex model. SEM enables us to examine latent variables such as psychological perceptions and motivations that are difficult to observe with a single measure but common in social sciences. The technique also improves the accuracy of model testing by separating the errors within measurement model and structural path analysis so that the

[10] The intention is measured by user's willingness to continue using a technology and therefore the use behavior should be measured with a time-interval through a follow-up survey. Although it is a widespread practice to examine the intention-behavior path with a cross-sectional data in the field of TAM- or TPB-based studies, the dissertation acknowledges the given limitations and therefore H1d and H1e are tested in a supplementary analysis which explores the intention-behavior relationship using three different variables of more-than-voice use behaviors.

measurement errors are screened out via confirmatory factor analysis before model testing. In addition, when extending the existing theoretical model, SEM helps researchers identify the best fitting model to the given dataset by offering multiple fit indices and tests to compare different model modifications.

The results of the structural model testing are shown in Figure 6. The multiple fit indices suggest a good model fit: CFI=.937, RMSEA=.049, GFI=.966, IFI=.937 and a Chi-square value of 1617.2 (*df*=80, p-value <.001). The model achieved an R^2 value of .404 for *perceived usefulness*, .346 for *perceived behavioral control*, .297 for *intention to use* mobile phone.

Figure 6: Structural Model Testing



Overall, the model explained successfully the multiple direct and indirect factors influencing the formation of behavioral intention. There was strong statistical support for all three TPB constructs, suggesting that the TPB would be a suitable theoretical explanation of the cognitive process behind user's behavioral intention (H1 supported). *Perceived usefulness* (PU) has the strongest effect on the behavioral intention (H1a: β=.359, p-value <.001) while *subjective*

norms (SN) also exhibit direct positive effects (H1b: β=.146, p-value <.001) and *perceived behavioral control* (PBC) (H1c: β=.203, p-value <.001). The results suggest that the BOP mobile owner's intention to use mobile phones is primarily driven by the instrumental values of mobile phones rather than social and contextual factors.

All the proposed antecedents exhibited statistically significant effects on PU and PBC. *Perceived ease of use* (PEOU) exhibited the strongest association with both PU (H2d: β=.411, p-value <.001) and PBC (H2e: β=.384, p-value <.001), indicating 'ease-to-use' feature is the most important factor relating both to the instrumental values and enabling contexts behind mobile use. It also implies that PEOU is empirically associated with both technological utilities and contextual factors, conflicting to the conventional findings of the role of PEOU in the TAM-based studies. PU is also positively associated with the level of trust the users have over mobile services (H2c: β=.241, p-value <.001). Relatively weaker but statistically significant relationships were also found between PU and economic benefits (H2a: β=.077, p-value <.001) and efficiency benefits (H2b: β=.119, p-value <.001) and. PBC was also found to be positively associated with both *social support* (H2f: β=.136, p-value <.001) and *price value* (H2g: β=.241, p-value <.001).

4.2. Multi-Group Comparison

Next, the study examined *whether* and *where* the effect of socio-demographic factors exerts its influence on the given model (H3a and H3b) by applying the model up to behavioral intention into different sub-groups. In identifying the sub-demographic groups, it employs a novel approach to defining a multi-dimensional aspect of demographic characteristics. As discussed earlier, people possess multiple demographic and socioeconomic identities that are inter-related with each other. Defining the sub-group by a single measure, such as gender or age,

would miss out too much information on the user's multi-dimensional demographic characteristics.

In this regard, Two-Step cluster analysis provides an appropriate tool to explore multi-dimensional demographic clusters in the dataset (Nourusis, 2003; Bacher et al, 2004). Cluster analysis is a widely-used exploratory technique to classify the sample groups by similarities in attributes and distance between clusters based on a log-likelihood function. Among the various clustering methods, Two-Step clustering can handle both continuous and categorical attributes and reduces arbitrariness by adopting a clustering criterion such as Schwarz's Bayesian inference criterion (BIC) or Akaike's information criterion (AIC) (Okazaki, 2006; Bacher et al, 2004).

Thus, a Two-Step cluster analysis on SPSS (version 21.0) is performed using the following categorical variables: *gender*, *marital status* (married, single), *age* (teen, young adults, older adults, elders), *education* (no education, primary school, secondary or more), *occupation* (unemployed, unskilled, skilled laborers, self-employed), *literacy*, *walking time to the nearest town* (less than 15 minutes, 15 to 30 minutes, 30 to 60 minutes, more than an hour) and *monthly household income*.

As shown in Figure 7, four distinct groups emerged from the cluster analysis. Overall, the clustering model reached the fair fit with a Silhouette measure of cluster cohesion and separation of 0.5 (Kaufman & Rousseeuw, 1990). First, the *Working Husband* group (N=1,521) was defined with the sharing characteristics of married (82%) males (100%) with an occupation as skilled laborers (35%). Second, the *Housewife* group (N=1,046) consists of married (97%) females (100%), unemployed (70%) with relatively higher household income (USD 140.8). Third, the *Student* group contains unmarried (93%) people or teenagers (50%) who are unemployed (66%) with a higher education of secondary school or more (52%) and also has a

higher household income (USD 140.7). Finally, the *Poorest* group contains illiterate (82%) older adults (53%) with no formal education (100%) with an occupation as unskilled laborers (38%), living in rural (36%) with a considerably lower household income (USD 94.4).

Using the four sub-groups, a multi-group comparison was conducted on AMOS version 21.0 and the statistical differences between the path coefficients were compared by *z-test* (Table 10). First, the study tests *whether* socio-demographic effects moderate the overall model by comparing the coefficient differences between the full-sample model (*default model*) with each socio-demographic group. Table 8 shows the *z-test* results on the co-efficient differences between the default model and the four sub-groups. Overall, the statistically significant differences are found in some of the paths (H1a, H1b, H3d, and H3g) and, therefore, the model is *partially* moderated by the socio-demographic effects (H3a supported).

Figure 7: Four Sub-groups from the Cluster Analysis

	Working Husband (N=1,521)	Housewives (N=1,046)	Students with higher education (N=966)	Poorest of the Poor (N=529)
Gender	*Male (100%)*	*Female (100%)*	*Male (57%)*	*Male (55%)*
Age	Young Adults (47%)	Young Adults (54%)	*Teen (50%)*	*Older Adults (53%)*
Education	Primary (71%)	Primary (71%)	*Secondary +(52%)*	*No education (100%)*
Occupation	*Skilled (35%)*	*Unemployed (70%)*	Unemployed (66%)	Unskilled (38%)
HH Income	131.5 USD	140.8 USD	140.7 USD	*94.4 USD*
Marital	Married (82%)	Married (97%)	*Single (93%)*	Married (85%)
Literacy	Literate (100%)	Literate (100%)	Literate (100%)	*Illiterate (82%)*
Walk time to nearest town	< 15 mins (34%)	< 15 mins (36%)	< 15 mins (35%)	*> 1 hr (36%)*

Supporting the H3b, the moderation effects are partially present in all three parts (antecedents, main constructs and BI-B path). As for the main TPB constructs, the poorest group is less driven by PU (*z-score* = -2.474, p-value <.05) while the student group is more strongly influenced by SN (*z-score* = 2.331, p-value <.05). As for the antecedents, only the effect of PEOU on PU was found to be different among all the sub-groups. Housewives were more strongly influenced by PEOU in their perception on usefulness (*z-score*=3.904, p-value <.001) while the poorest group was least affected by PEOU (*z-score*= -3.011, p-value <.001). On the other hand, the poorest group's perception of their behavioral control was more strongly affected by social support (*z-score*= 2.404, p-value <.05) than other groups. In addition, the model's explanatory power differs between the sub-demographic groups. The R^2 value of BI was the

Table 10: The Path Coefficients and R^2 Difference among Sub-groups[11]

		ALL	**Husband**	**Housewife**	**Student**	**Poorest**
		Estimates	z-score	z-score	z-score	z-score
H1a	PU – BI	0.409***	0.666	1.514	-1.095	***-2.474***
H1b	SN-BI	0.116***	-0.651	-1.215	***2.331***	-0.231
H1c	PBC-BI	0.199***	-0.966	1.278	-0.574	1.002
H2a	EBC-PU	0.011***	-0.136	-0.651	0.012	0.131
H2b	EFB-PU	0.028***	-0.377	-1.075	1.032	0.465
H3c	TRUST-PU	0.214***	-0.292	-0.78	0.447	0.362
H3d	PEOU-PU	0.364***	***1.86****	***3.904*****	***-2.743*****	***-3.011*****
H3e	PEOU-PBC	0.397***	-1.644	1.632	0.316	0.291
H3f	PV-PBC	0.184***	0.04	0.216	-0.505	0.226
H3g	SUPPORT-PBC	0.103***	-0.256	-1.605	0.225	***2.404****
	R^2					
	PU	.404	**.450**	.425	.360	.361
	PBC	.346	.318	.358	.335	**.413**
	BI	.287	.257	**.350**	.301	.256

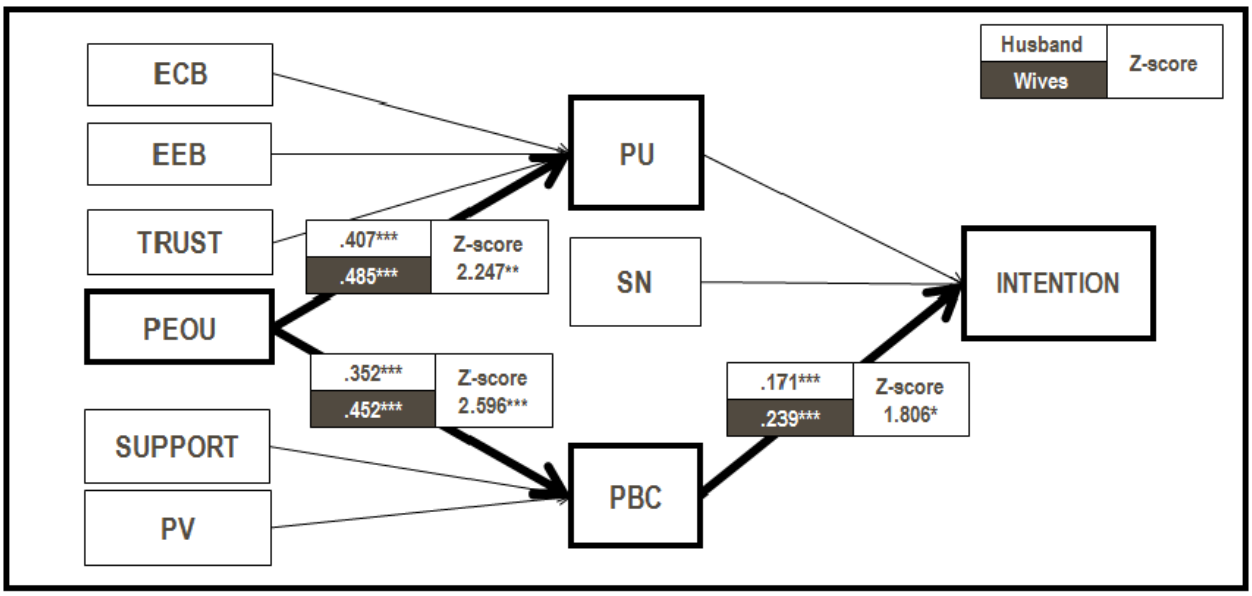
* p<.10, ** p<.05, *** p<.001

[11] z-score values were calculated by the comparison of the path coefficients between the default model and each sub-sample group.

highest among the housewife group (R^2=.350) and the lowest among the poorest group (R^2=.256). The proposed antecedents to PU were most applicable in explaining the variance among the husband group (R^2=.450) while those of the PBC were best suitable to explain the poorest group's motivations (R^2=.413). Hence, the results indicate that the different socio-demographic groups have different workings of their motivations behind PU, PBC and Intention.

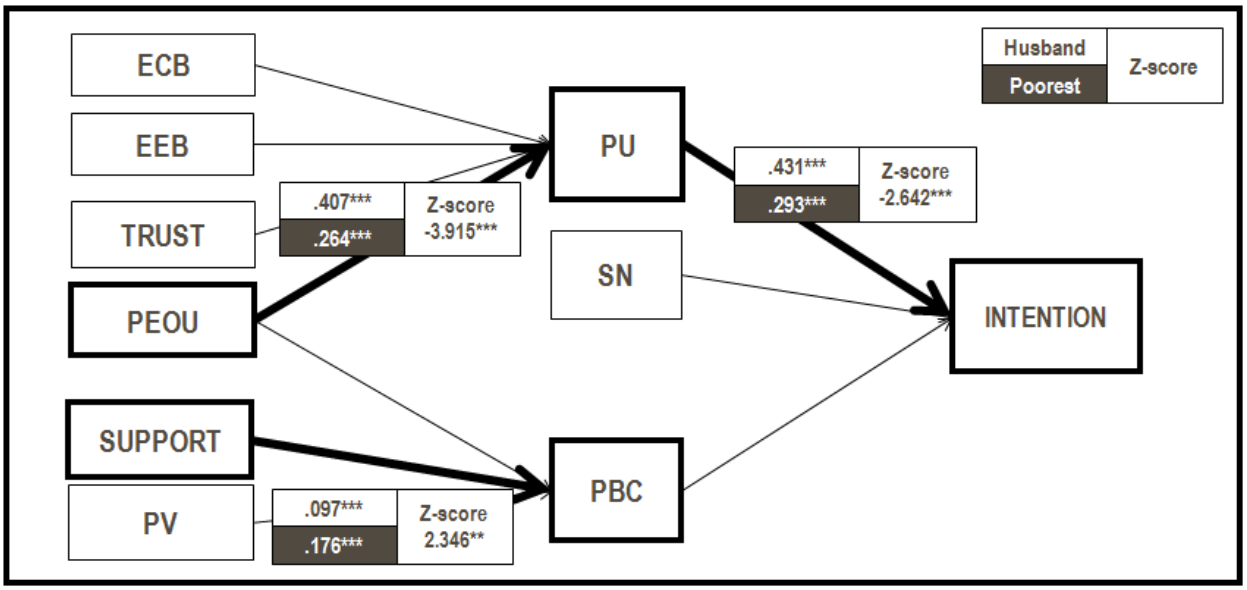
Next, the detailed comparison between the selected sub-groups was analyzed. First, in order to examine the gender-related difference, the husbands and housewife groups are compared in details (Figure 8). Based on the *z-test* scores, four paths were found to be significantly different, particularly regarding the effects of PEOU and PBC. The effects of PEOU on both PU and PBC were stronger among the housewife group than the husbands with *z-score* value of 2.247 ($p < .05$) and 2.596 ($p < .001$), respectively. The effect of PBC was also marginally stronger among the housewives in relation to intention (*z-score*=1.806, $p < .10$).

Figure 8: Path Comparison 1 - Husband vs. Housewife Group



Second, the working husband group and the poorest groups were compared in detail (Figure 9). Overall, three paths were found to be different in a statistically significant way. The husband group was more driven by PU than the poorest group (*z-score*=-2.642, p<.001) and their perception on usefulness was also more strongly affected by PEOU than the poorest (*z-score*= -3.915, p<.001). On the other hand, the poorest group's perception on behavioral control (PBC) was more strongly affected by the degree of social support than the husband group (*z-score*=2.346, p<.05).

Figure 9: Path comparison 2 - Husband vs. the Poorest Group



4.3. Supplementary Analysis: Effects of Behavioral Intention on Behavior

In the above analyses, the dissertation examined the factors influencing the formation of the intention to use mobile phones and how socio-demographic effects intervene in the model. In this supplementary analysis, it examines how the intention is translated into actual use of more-than-voice mobile use. The path between the intention and use was dropped in the main analysis

due to the limitations of the current secondary dataset. The cross-sectional data does not allow the time-interval involved in the actualization of the intention. In other words, the intention, which is measured by user's willingness to continue using a mobile phone, and the actual behavior of mobile use cannot be measured concurrently as it requires a certain time lap for the intention to be realized in the actual use.

When testing the full model with the use, there were only miniscule differences in the fit indices: CFI=.924, RMSEA=.043, GFI=.961, IFI=.924 and a Chi-square value of 2020.4 (*df*=125, p-value <.001) and the model achieved an R^2 value of .404 for *perceived usefulness*, .346 for *perceived behavioral control*, .297 for *intention to use* mobile phone. Nevertheless, the path between the intention and the use was insignificant while there was only a weak but statistically significant effects from PBC (H1e: β=.054, p<.05) on use. The R^2 value for mobile use was limited to .03, suggesting that a potential limitation that the proposed model explains adequately the processes involved in 'the formation of behavioral intention' to use SMS but fail to explain 'the actualization of the intention'.

One possible explanation for this insignificant relationship can be the neglected time-interval involved in the process between the behavioral intentions to be actualized in the use behavior. Another can be that there exist additional factors moderating or hindering the actualization of the behavioral intention. Thirdly there can be a measurement issue of mobile use to the extent to which the measure of actual mobile use (that is, voice only vs. SMS use) may be incongruent to the measure of use intention[12]. Hence, additional analyses were conducted to

[12] In fact, due to the limitation of the secondary data, the measure of the use intention refers to the intention to continue using a mobile phone in general instead of a specific function of mobile phone (i.e. SMS use). However, mobile use includes not only using a voice call but also using different functions available on mobile phones including SMS use. Hence, the current measure of the intention does not conceptually incongruent to the measure of the dependent variable (voice vs. SMS).

investigate these possibilities before accepting the non-significant relationship between BI and B among the BOP mobile owners.

First, in order to examine the measurement issues relating to the use behavior, two additional dependent variables were created to measure the different aspects of mobile use (Table 11). The first new dependent variable operationalizes the ***quantity* of mobile use** in terms of the amount of mobile expenditure per month. The second new variable measures the ***breadth* of use** in relation to the features ever used on their personal mobile phones. These additional variables aim to provide a more accurate measure of mobile use that may be referred in the measure of the intention to use a mobile phone.

Table 11: Summary of Dependent Variables

	Variable	Description	N	Mean	S.D	Median
DV1	SMS Use	Voice only = 0, SMS use = 1	4924	0.34	0.47	0
DV2	Monthly mobile expenditure	Value of monthly top-up amount (see below formula)	4226	4.32	2.74	3.60
DV3	Breadth of use	Features *ever* used on mobile phones when answered functions are present on their own phone	4924	3.48	2.87	3.0

The quantity of mobile use (DV2) was created from three questions relating to the top-up behaviors. Since most of the BOP mobile owners are on pre-paid service plans, there exist no accurate data for monthly mobile expenditure at the level of BOP. The questions include '*what was the amount of your last top up/reload*?', '*considering your normal usage, can you please tell me from the day of your last top up how long do you expect your top-up will last*?, and '*how long do you usually keep your phone with a zero balance before topping up*?'. The local currency was

converted to USD Purchasing Power Parity (PPP) conversion rate for private consumption[13] as of 2011 (World Bank, 2011). Then, the monthly mobile expenditure was calculated by the following formula:

$$Monthly\ mobile\ expenditure = \left[\text{Value of last top up x } \frac{365}{\text{Top up lasting days+Days with zero balance}}\right] / 12$$

The breadth of mobile use (DV3) was created by counting the number of functions they ever used on their mobile phones. As most mobile users in developing countries still own a basic feature phone[14], the researcher created a selected list of 15 most widely available applications on general feature phones, including SMS, alarm clock, calendar, simple games, calculator, converter, camera, video, music player, connectivity (USB slot, Bluetooth, Infra-red), MMS, Web/WAP browser and downloading feature[15]. Since not all of such features are available on the respondents' phone and their usage depends on the availability, two multiple-response questions contained in the survey were used '*which of these features does your mobile handset have*?' and '*which of these features have you ever used?*' Then the number of ever used features was counted contingent upon such a feature being marked as present on their device.

Table 12 shows the correlation table between the three dependent variables. DV1 correlates low with DV2 as most features do not necessarily require additional fees. DV1 also correlates low with DV3 which assumes that SMS use is still low among this population and

[13] PPP conversion factor indicates the number of units of a country's currency required to buy the same amounts of goods and services in the domestic market as US dollar would buy in the US, which is a more accurate approach to compare the cost of the same services and goods. The 2011 PPP rate for the studied countries can be found at http://data.worldbank.org/indicator/PA.NUS.PRVT.PP

[14] The current data shows only 4.5 percent of the total mobile owners possess a phone with touch screen (a proxy for smartphone).

[15] Voice call is excluded as all mobile owners are assumed to receive or make a call.

SMS cost can be cheaper than a few minute long voice calls. The correlation of DV2 and DV3 is .37 which indicates that the two variables are marginally correlated but can still be considered as distinct measures of mobile use.

Table 12: Pearson's Product Moment Correlation among Dependent Variables

	DV1 Voice vs. SMS	DV2 Mobile expenditure	DV3 Used features
DV1	1		
DV2	.151***	1	
DV3	.367***	.177***	1

*** p-value <.001, ** p-value <.05

A structural model was tested using the three dependent variables using the full sample. Table 13 shows only the path coefficients relating to intention to use and the R^2 values of mobile use. The results show that the BOP user's intention is irrelevant to their mobile monthly expenditure (DV2: not supported) while the level of intention has a significant but negative relationship with the diversity of use (DV3: supported but negative). Hence, all three measures of mobile use, including voice/SMS use, the quantity of use, the breadth of use, have failed to explain the positive relationship between the behavioral motivation to use mobile and the actual use of mobile. Hence, the results reduce a potential risk involved in inadequate or inconsistent

Table 13: Model Testing with Multiple Mobile Use Measures

INT – USE	Estimates (p-value)	R^2	Hypotheses
DV1 (voice vs. SMS)	.036 (.215)	.030	Not supported
DV2 (expenditure)	.009 (.943)	.024	Not supported
DV3 (breadth of use)	-.289 (.000)	.010	Supported but negative path

measure of mobile use and suggest that the non-significant path of BI-B may relate to further factors excluded in the proposed model. In other words, at the BOP, even though they have a high intention to use mobile phone, their actual use may be hindered or facilitated by further factors.

Next, the study investigated possible moderation effects between intention and behavior. According to Fishbein (2000) who applied the TPB in the context of HIV/AIDS intervention programs, behavioral intention can be hindered by two factors: skills & ability and environmental constraints. He suggested that people have formed the desired intention but may not be acting on it due to a lack of skills or the presence of surrounding constraints (Fishbein, 2000; Fishbein & Yzer, 2003; Fishbein & Cappella, 2006). Among the various constraints, hence, the study focuses on the lack of skills as a moderating factor in the actualization of behavioral intention to use a mobile phone.

While mobile use appears to be seemingly intuitive and easy for most people, using more-than-voice functions actually requires sequential skills. For instance, to send or receive a SMS message, users need to know how to browse the menu, open the application, type or comprehend the message and manage received messages. However, the level of knowledge and skills to use mobile phones has not yet been fully explored, particularly in the context of the BOP mobile users. In the absence of a comprehensive set of objective measures of the user's technical skills to use a mobile phone, the degree of self-efficacy, which is an indirect measure from one's assessment on their own ability, can be the best available measure of one's own capabilities relating to mobile use. Self-efficacy is originally defined as 'one's own belief in his or her capability to organize and execute a particular course of action' (Bandura, 1997) and. When the concept was transferred in the field of information systems (IS), the notion became adjusted to

more specific measure to address the users' own technical ability to use a certain technology (Compeau & Higgins, 1995). Previous studies found that self-efficacy is a significant factor associated with user adoption of mobile banking (Luarn & Lin, 2005) and SMS advertising (Zhang & Mao, 2008).

Based on this rationale, the study adopts mobile efficacy as an additional factor moderating the relationships between behavioral intention to use SMS and actual use behavior since the construct is a good proxy to indicate the level of user's perceived skills to use mobile phones in relations to their surrounding resources. The measures of mobile efficacy are shown in the Table 14. An interaction term with intention and mobile efficacy was created where mean-centering was used to prevent multicollinearity.

Table 14: Mobile Efficacy Measures and Item Statistics

	Name	Measures	Loading	Mean	Alpha	CR	AVE
Mobile Efficacy	EFF1	I am confident of using a mobile phone if someone showed me how to do it first	.641	3.92	.740	.738	.485
	EFF2	I am confident of using a mobile phone if I could ask someone for help when I got stuck	.706				
	EFF3	I am confident of using a mobile phone if I had a lot of time to try and use it	.739				

Logistic regression was performed with behavioral intention (BI), mobile efficacy (EFF), interaction term (BI x EFF) and control variables (a selection of demographic variables) as well as the dependent variable (SMS use). As shown in Table 15, the intention has a significant but negative relationship with SMS use (β=-.538, p<.05) when all other things are considered equal. Also, mobile efficacy has no significant relationship with SMS use on its own. However, the

interaction term of behavioral intention and mobile efficacy (BI x EFF) has a significant effect on predicting SMS use (β=.129, p<.05). The results indicate that, when a high level of intention is combined with high level of mobile efficacy, people are more likely to use mobile phones for more than just voice (odds ratio =1.138).

Nevertheless, the relatively low pseudo R-square values (Nagelkerke R-square = .175, Cox & Snell R-square=.126) and the large odds ratio of the constant term (*Exp(b)*=161.6) indicate that there can be more factors relating to environmental constraints affecting the BOP mobile owners' more-than-voice use behavior. Further attention should be paid on exploring potential barriers existing between the BOP user's intention and actual use behavior.

Table 15: Effects of Intention, Mobile Efficacy and Interaction on Mobile Use

Variables	Estimates	S.E	Wald	Odds ratio
BI	-0.538**	.222	5.859	.584
EFF	-0.389 (n/s)	.253	2.357	.678
BI x EFF	0.129**	.058	4.893	1.138
Education	0.876***	.082	113.475	2.402
Gender	-0.133 (n/s)	.088	2.287	.875
Age	-0.055***	.004	198.335	.947
Rural	-0.610***	.073	70.021	.543
Employment	0.007 (n/s)	.093	.005	1.007
Constant	5.085**	1.905	7.124	161.646
	Chi-square=16.7 (*df*=8, p<.05), Pseudo R square = .175			

*** p-value <.001, ** p-value <.05

CHAPTER 5: DISCUSSION

5.1. Key Findings

This dissertation examined the motivational factors affecting more-than-voice mobile use among the mobile owners at the Bottom of the Pyramid in South Asia. While mobile ownership is rapidly increasing among the poor in developing countries, there is still a paucity of research exploring their mobile use behaviors. In particular, mobile use of this newly joined user group has been mostly understood at a descriptive level often in relation to their socioeconomic constraints, and their psychological motivations and their internal workings in the cognitive process have been largely unexplored. Furthermore, despite the mounting interests in providing mobile for development (M4D) services using non-voice features of mobile technology, little attention is paid on their more-than-voice use of mobile phones such as SMS or application uses. The dissertation aimed to fill the current research gaps both in communication researchers and M4D practitioners. Guided by the well-known behavioral theory of the TPB and TAM, the dissertation explored the motivational drivers and their relatively degree of influences behind mobile use behavior at the BOP. On top of the three fundamental behavioral motivations (technological utilities, social influence and contextual factors) proposed by the adoption theories, the study also examined the antecedents explaining '*what makes a mobile phone useful*' and '*what contributes to the enabling contexts for mobile phone use*' among the BOP mobile owners. In addition, it investigated whether and where socio-demographic factors intervene in the workings of the motivational drivers by comparing the results between different socio-demographic groups.

Table 16: Summary of Hypotheses Testing

H	From	To	Coefficient	Status
Main TPB Model				
H1a	Perceived Usefulness (PU)	Behavioral Intention (BI)	.359***	Supported
H1b	Subjective Norms (SN)		.146***	Supported
H1c	Perceived Behavioral Control (PBC)		.203***	Supported
H1d	Behavioral Intention (BI)	Use Behavior (B)	n/s	*Not Supported*
H1e	Perceived Behavioral Control (PBC)		.054**	Supported
Antecedents				
H2a	Economic Benefits (ECB)	Perceived Usefulness (PU)	.077***	Supported
H2b	Efficiency Benefits (EEB)		.119***	Supported
H2c	Trust (TRUS)		.241***	Supported
H2d	Perceived Ease of Use (PEOU)		.411***	Supported
H2e	Perceived Ease of Use (PEOU)	Perceived Behavioral Control (PBC)	.384***	Supported
H2f	Social Support (SS)		.136***	Supported
H2g	Price Value (PV)		.241***	Supported
Moderation Effects				
H3	Moderation effects of socio-demographic factors		See Table 8	Supported

* significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level

As shown in the summary of the hypothesis testing in Table 16, the dissertation provides empirical evidence for the following. First, the findings suggest that the overall theoretical power of the TPB extends to the population at the BOP and it successfully explains the factors influencing the formation of behavioral intention. The analysis found that their intention to use a mobile phone (BI) is more strongly driven by the instrumental utility (PU) than social or contextual factors. This contrasts to previous adoption studies in developing countries, which emphasized the importance of subjective norms or skills and knowledge amongst non-western users (Mao et al., 2005; Straub et al., 1997). While the poor's behaviors are commonly assumed to be determined by their structural constraints by the researchers focusing on the demographic conditions, this result suggests that they also make a rational evaluation on the instrumental

utilities of mobile phones and this utilitarian evaluation exerts stronger effects on behavioral intention than the availability of resources or knowledge.

Second, the dissertation extends the TPB framework with several antecedents to PU and PBC, which are specifically related to the BOP mobile use contexts. The analysis of the antecedents found that all hypothesized factors are significantly associated with PU and PBC. In particular, it found ease of use (PEOU) exerts the strongest effects among the hypothesized factors. It also offers a rather unconventional finding on the effect of PEOU in that PEOU is conceptually and empirically related to both perceived instrumental utilities (PU) and contextual control (PBC). In contrast to the conventional TAM studies, the dissertation hypothesized that PEOU is a compounded construct associated with both instrumental evaluation of technology (user friendliness) and users' contextual evaluation of their skills and the resources required to use a technology. By specifying it as the antecedents to both PU and PBC, the analysis proves that PEOU has dual effects on both the level of instrumental evaluation and enabling conditions among the BOP users.

Along with PEOU, the study also identified several other antecedents and their relative importance relating to PU and PBC. Trust in mobile services was also positively related to the level of instrumental utilities. To a lesser degree, the experienced benefits of mobile phones have significant associations with PU where benefits of improved efficiency have a stronger relationship than economic benefits. The findings suggest that the BOP mobile owners in general evaluate mobile phones' usefulness in relation to the easy-to-use features, trustworthiness and efficiency gains in managing everyday events. On the other hand, both the level of perceived cost (price value) and the availability of technical support in social contexts (social support) were found to be statistically significantly associated with the enabling contexts for mobile use.

Third, the study points out the theoretical weakness of the TPB in consideration to the effects of socio-demographic factors. While the TPB assumes that demographic effects exist as a background factor underlying the belief systems, the study found that there exist the moderation effects of socio-demographic factors not only in the belief systems (i.e. antecedents) but also in the paths from the three main determinants (PU, SN, PBC) to BI. The dissertation took a novel approach to identifying the socio-demographic effects by grouping the sample with a multi-dimensional demographic measures using TwoStep cluster analysis. It identified the significant differences in the path coefficients and the model's explanatory powers between the four demographic groups. The findings indicate that the TPB should pay further attention to specifying the characteristics of the studied population and the moderating effects of background factors in order to improve its explanatory accuracy as well as to draw practical implications for the intervention.

In addition, the study examined the degree of different effects of the motivational factors on BI between sub-demographic groups. In comparing the husbands and housewives, it found that the housewives' intention to use mobile is more influenced by the contextual factors (PBC) than the husbands group. And their perceptions on both PU and PBC are more strongly driven by PEOU than their counterpart. When comparing the husbands to the poorest group, the study identified that husbands' intention is more influenced by the level of PU and this PU is in turn also more strongly driven by PEOU than the poorest group. On the other hand, the poorest group found the social support as the stronger indicator to PBC than the husband group. In other words, it suggests that the instrumental utility in relation to the level of easy-to-use convenience are important factor behind the husband group's motivation to use mobile phone while the poorest

group is affected by the contextual factor in relation to the availability of technical support in social settings.

Finally, the study identified that the TPB-based framework is appropriate for explaining the formation of behavioral intention, but is critically limited in explaining the actual use behavior among the population at the BOP. As the relationship from behavioral intention (BI) to behavior (B) has been widely proved in social psychology, researchers in the field of technology adoption studies occasionally omit the BI-B path in their analysis as if it is a given fact (Lee et al., 2003). However, in the population at the BOP, the study found that the user's behavioral intention to use mobile does not lead to the actual behavior of more-than-voice use and the BI-B path might be hindered by external factors. The supplementary analysis reduced the possibility of measurement errors in mobile use behaviors, and explored the potential moderation effects with mobile efficacy. The results found, although tentatively, that only the interaction term with intention and mobile efficacy was significant when all other factors are considered equal. This means that the BOP mobile users tend to use more for more than voice if their high intention to use mobile is combined with high level of efficacy in using mobile phones. Nonetheless, the dissertation concludes that, in the population at the BOP, there may exist further barriers hindering the actualization of the behavioral intention and further studies should pay more attention on exploring external factors moderating the BI-B path.

5.2. Research Implications

The dissertation contributes to the existing literature in communications, information systems and ICT for development research in the following ways. Focusing on the previously untapped populations at the BOP, the dissertation fills the critical research gaps in our

knowledge on the newly joined mobile users from developing countries. The poor's mobile use behaviors have been mostly approached from ethnographic or qualitative methods while a few quantitative studies conducted in developing countries often use the samples from university students or company employees who in general belong to the social elites in low-income countries. By using the large random sample specifically targeting the BOP mobile owners and applying the rigorous statistical analyses, the dissertation provides empirical evidence on mobile use behaviors that are generalizable to the BOP population in South Asia.

In particular, the dissertation explored the understudied topic of psychological motivations and cognitive process behind mobile use at the BOP. By applying the western-oriented technology adoption theories in the context of the BOP, the study identified that the TPB-based framework can be successfully extended to explaining and predicting the mobile users at the BOP but its theoretical power is limited in explaining their actualization of the intention. In particular, it found that, as with the users in the developed world, the poor's intention to use mobile phone is primarily formed by the instrumental utilities than social or contextual factors although this intention is, unlike the Western users, supposed to be hindered by the external barriers. Hence, the dissertation concludes that three constructs specified in the TPB and TAM, in particular the effects of instrumental utilities, can be universal in explaining technology use. However, it draws a caution for researchers who attempt a mere replication of the Western-oriented theories in the context of the poor and calls for further attention on exploring the barriers in the actualization of the behavioral intention.

The study also contributes to the theoretical advancement of the TPB by identifying its theoretical limits in under-estimating the socio-demographic effects as a background factor. In this regard, the study proves that there exist the socio-demographic factors intervene in the TPB

model not only in relation to the belief systems but also to the effects of the main determinants. For the theory's explanatory accuracy and its potential practical implications, the dissertation recommends the TPB researchers to be specific in defining the population characteristics as well as the intervening effects of the socio-demographic factors in their analysis. It also points out a problem in focusing only on one side of coin, in that, the researchers interested in motivational factors often stifle out demographic factors while those interested in policy implications focus only on demographic factors as the key determinants of social inequality. The dissertation calls for researchers to see the both sides of the coin to be closer to the reality.

For the TAM researchers, the dissertation suggests that PEOU can be a compounded construct which embraces both technology's characteristics and user's skills to use a technology and it provides empirical evidence that PEOU is strongly associated with both PU and PBC in the population of the BOP. Further attention is needed to evaluate the conceptual, empirical or measurement issues relating to the PEOU when it is applied to the general users outside organizational contexts. In addition, the dissertation enriched the possible practical implications that can be drawn from the adoption theories by exploring the antecedents to what makes a mobile useful and what contributes to the enabling factors. Accepting the critics (Bagozzi, 2007; Benbast & Barki, 2007), the dissertation suggests that, if the theory exists not for the sake of the theory, it should pay attention less on the theory's parsimoniousness and more on further indicators explaining the main constructs.

The dissertation also draws several implications for the M4D practitioners. First, the dissertation calls for a conceptual shift in perceiving the poor as active, independent and rational individuals. It assumes that the poor also makes decisions based on their own preferences and evaluations of their resources. By investigating the internal functions of their motivations, the

study found that the poor's intention to use mobile phones is mostly driven by the instrumental utilities and less by the contextual constraints. Hence, the practitioners should pay primary attention to providing the useful services from the user's point of view before considering the issues in cost and skills. It also found that easy-to-use features are the fundamental drivers behind their perception on usefulness and contextual control, followed by service reliability and perceived price value.

Second, by identifying a multiple demographic groups and their different functions of the motivational factors, the study found that there exist much socio-demographic variations within the poor and such different affects the functions of the studied motivations within each demographic group. For instance, it found that the husband group is more driven by the instrumental utilities while the housewives are by conceptual control. It also found that the poorest consider the availability of technical support at social settings as an important factor to enabling their mobile use. This draws an important implication for the development community that 'under-2-dollar-a-day' is a simplistic criterion to categorize the poor and further attention is needed to understand the diverse socio-demographic groups comprising the poor. It also suggests that the M4D practitioners should be clear in understanding their target population's characteristics and needs. For instance, if they design a job-search service for working males, it should focus more on delivering outcome utilities of the services. On the other hand, if they target female housewives, the service should consider supporting their technological skills and limited resources. For the services targeting the rural poor, the program should be equipped with technical support in informal and social manner such as hiring a local assistant or campaigner.

5.3. Limitations and Further Research

The dissertation has several limitations. First, although the current study successfully defined the process behind the formation of the behavioral intention, the model fails to explain the full set of factors contributing to more-than-voice mobile uses. Further studies should explore the external and internal barriers hindering the behavioral intention at the level of BOP. Second, the dissertation examined the motivations behind general mobile phone use, which limits the specificity of the practical implications it can draw. Further study may use the proposed framework to assess more specific use behaviors particularly within the practice of targeted M4D intervention programs (mobile banking, mobile for health programs, etc.). Such an approach will enable the practitioners to monitor and evaluate how motivational factors influence the adoption of a specific service. Third, although the dissertation makes an initial attempt to examine the utilities involved in mobile phone use, it limits the scope of the benefits as direct instrumental gains due to the limitations of using a secondary dataset. Further study should include a broader set of utilities perceived from mobile use including entertainment and recreation, emotional support, security, symbolic status and so forth. Finally, the role of social influence needs more attention. The study uses a narrow definition of social influence in relation to everyday interaction in close social relationships. Further research is encouraged to explore the multiple layers of social effects from vicarious learning, mass media and public campaign, community norms, social structure and cultural factors.

5.4. Concluding Remarks

The contour of mobile communications is rapidly expanding across the globe spreading into the lives of the previously unconnected populations at the Bottom of the Pyramid. We are in urgent need of understanding how they adopt and use mobile phones and what it means to have a mobile phone in their everyday lives. Such stories at the BOP can neither be captured from the incomplete statistics we get from the ITU or national census in developing countries, nor be fully understood from scattered case studies. Certainly, there should be more research focusing on this severely under-represented group of users.

This dissertation made a small but new attempt to understand their mobile use behaviors by tackling the untapped topic of the motivational drives behind mobile use and extending a western-oriented technology adoption theory in the context of the BOP. Although the current study is focused on general use of mobile phone (i.e. SMS) in everyday contexts, the research model used in this study can be extended to studying different types of mobile use behaviors. Also it can provide a useful framework for project evaluation if the practitioners wish to examine the factors behind their success or failure of a specific mobile-based intervention programs.

In this regard, the dissertation raises a critical concern towards mere replication of the western-oriented TPB- or TAM-based models in the different socio-cultural contexts of BOP users. As the dissertation reveals, such adoption theories may be adequate to explain the psychological process within the formation of the user intention, but they fail to provide the full picture of how such intention is actualized or hindered among the BOP users. It also shows that the BOP is not a homogenous group and there exist considerable socio-demographic differences, which results in different functions of motivational drives. Hence, further research is encouraged to embrace mixed-methods to discover hidden factors unique to the users at the BOP that can

complement the conventional adoption models. Understanding people precedes establishing a theory and we are still at the very beginning of developing an understanding of these new users at the BOP. Many missing pieces of the jigsaw puzzle remain, leaving it far from completion. The field is in need of more diverse, creative, pro-active studies that can collectively build up evidence helping us understand what is really happening at the Bottom of the Pyramid.

APPENDIX

APPENDIX: Detailed Review of Technology Adoption Theories

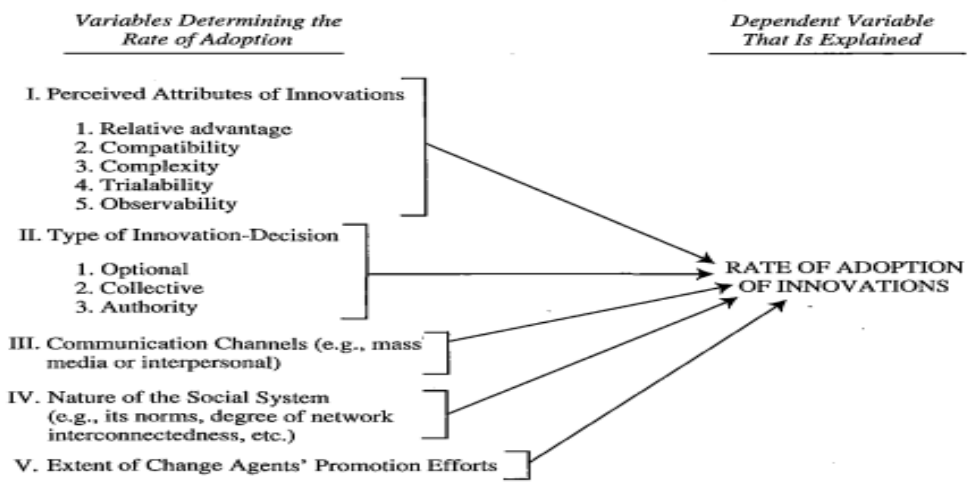
Diffusion of Innovation (DOI)

Diffusion of Innovation (DOI) is one of the most extensively researched and interdisciplinary theories in studying people's adoption behaviors. Diffusion theory originated in anthropology and rural sociology in the 1950s and became refined as a comprehensive theory by Everett Rogers in 1962. Since then, DOI became a dominant paradigm in the adoption research, particularly between the 1970s and 1990s, across several disciplines such as sociology, communications, public health, education, marketing and management, and so forth.

According to Rogers, (1995), **innovation** is referred to as '*an idea, practice or object that is perceived as new by an individual or other unit of adoption*'. Thus, DOI's research topics are not limited to new technology, but cover to a wide range of new ideas, goods and service such as fertilizers, health information, pedagogical approaches, media campaigns as well as ICTs. On the other hand, **diffusion** is '*a process in which an innovation is communicated through certain channel over time among members of a social system*'. Diffusion is also perceived as a special type of communication process in which participants exchange messages about perceived new ideas in order to reach a mutual understanding. In this sense, DOI is primarily interested in the 'process' of how innovation is accepted, communicated and disseminated in personal, interpersonal and social domains. Therefore, DOI has a broader research scope surrounding adoption behavior, including not only the individual's adoption decision makings (i.e. the attributes of innovation and the innovation-decision process), but also the S-curve rate of diffusion in a given society, the adopter characteristics of adopters (e.g. innovators, early-adopters, early-majority, later-majority, laggards), diffusion networks, the role of change agents, and the consequences of diffusion. In sum, DOI theory aims to understand the universal mechanisms behind human behaviors and social changes surrounding innovation.

Regarding the adoption process at the individual level, DoI analyzes user's perceptions on new technology/innovation as fundamental drivers behind adoption decision, which is similar to other theories discussed in this study. However, while others offer a three-stage framework (perception-intention-decision), DOI defines the decision process in five stages over time: *knowledge-persuasion-decision-implementation-confirmation*. This process is largely influenced by five factors, including *perceived attributes of innovations, type of innovation decision, communications channel, the nature of the social system,* and *change agents* (Rogers, 2003, p.222).

Figure 10: The Attributes of Innovation



Relative Advantage	The degree to which an innovation is perceived as better than the idea it supersedes
Complexity	The degree to which an innovation is perceived as difficult to understand and use
Compatibility	The degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters
Trialability	The degree to which an innovation may be experimented with on a limited basis
Observability	The degree to which the results of an innovation are visible to others
Voluntariness	The degree to which adoption is perceived as being an optional innovation decision

Here, what attracted most attentions among the technology adoption researchers is the 'attributes of innovation' as it explains what characteristics of technology lead to adoption or rejection and how to improve technological or service features. Originally, Rogers proposes five attributes of innovation: *relative advantage, compatibility, trialability* and *observability*. Later, DOI researchers from IS research defined three more variables: *image, voluntariness, result demonstrability* (Moore & Benbasat, 1991).

Overall, DOI offers a comprehensive framework to study what perceived characteristics of technology triggers adoption and their relative effects on the decision-making. In contrast to other theories seeking model parsimony, DOI proposes the eight specific factors covering the multifaceted utilities of new technology, including instrumental and technical utility (relative advantages, compatibility, complexity), social and symbolic utility (observability, result demonstrability, image) and accessibility (trialability, voluntariness). It also takes account of social and cultural factors such as interpersonal and mass communication channels, social system and socioeconomic variables (Rogers, 2003, p.170). While other theories are micro-level theories focusing purely on individuals, DOI can be categorized as a '*middle range theory*' which organizes a body of findings from replicated studies into a structured system of principle (Merton, 1968).

However, while Roman (2003) suggests there is room for further diffusion study in the context of ICTD, the theory holds certain limitations to be applicable to the M4D. The DOI theory assumes that adoption is only a matter of time, and the late majority and laggards will eventually follow the adoption process. This is a rather one-dimensional view on technology adoption. It may explain the almost universal adoption of mobile phones or the Internet but fails to explain the varying degree of ICT utilization to the extent of the digital divide of skills and use

(Van Dijk, 2003). As Rogers summarizes the common criticism to DOI, past diffusion research tended to perceive innovation as a positive and beneficial force (Pro-Innovation bias, p. 106). The rejection or reinvention are briefly mentioned but not integrated into the main theory (Al Qeisi, 2009) and, in some cases, the late adopters or laggards are individually blamed as 'irrational' or 'traditional'. Rather than analyzing the social and systemic faults, the research tradition of DOI tend to view an individuals responsible for their own problems (Individual-blame bias, p. 118). Second, the DOI frameworks have been extensively replicated both in developed and developing contexts. The research has entered a static period both theoretically and methodologically to the extent that Rogers himself calls for no "more-of-the-same research" (Wirth et al, 2008; Meyer, 2004; Rogers, 2003). The established findings on the similarity of the adoption process between the developed and developing countries adds no value to the M4D research to discover different mobile use behaviors among the poor. Finally, while the theory involves social and cultural factors within its conceptualization, it is unclear how these surrounding factors are related in the adoption process, which makes simultaneous empirical assessment too challenging.

Theory of Reasoned/Planned Action (TRA/TPB)

Theory of Reasoned action (TRA) is one of the most influential theories explaining primary causes of human behavior. As opposing to the dominant notion in social psychology of the 1970s that 'attitude causes behavior' (Peak, 1955), Ajzen and Fishbein (1975, 1980) explains that behavior is determined by one's behavioral intention to perform a target behavior, and this intention is affected by two motivational factors specific to the behavior in question: *Attitude* (A) and *Subjective Norm* (SN). These motivational factors are estimated by the salient beliefs one may have about the behavior and one's subjective assessment on their relative effects. For

instance, Attitude is a function of the sum of salient behavioral beliefs weighted by the evaluation of the outcome. SN is also the sum of salient normative beliefs about other people's opinions, multiplied by one's motivation to comply with it.

The TRA provides parsimonious and powerful causal explanations to human behavior in general (Conner & Armitage, 1998). However, its application is limited to behaviors under volitional control. In other words, TRA tends to lose its explanatory power if the behavior requires particular skills, resources, information or opportunities that are not freely available all the time (Fishbein, 1993; Conner & Armitage, 1998; Ajzen, 1991).

Figure 11: The TRA and the TPB

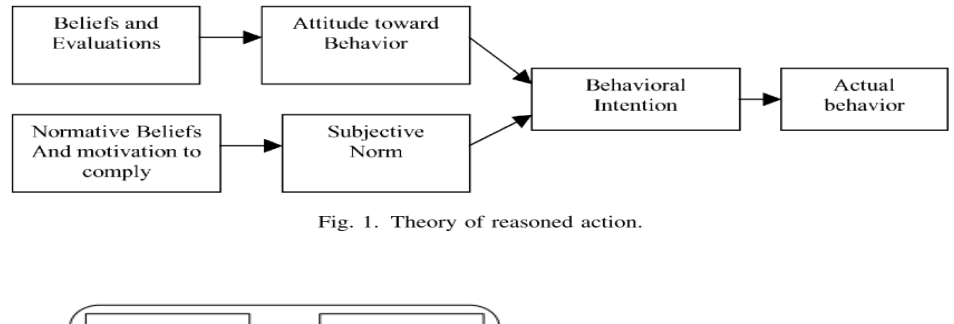
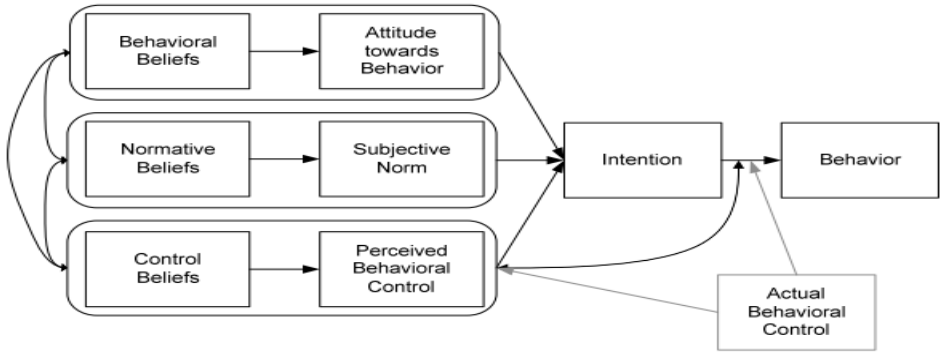


Fig. 1. Theory of reasoned action.



Attitude (A)	The degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question
Subjective Norm (SN)	The perceived social pressure to perform or not to perform the behavior
Perceived Behavioral Control (PBC)	The perception that performance of a specific behavior is within a person's volitional control
Actual Control	The extent to which a person has the skills, resources, and other prerequisites to perform a given behavior

Hence, Ajzen (1991) adds the third variable called *Perceived Behavioral Contro*l (PBC) on top of the TRA's two motivational factors (A and SN) and introduces Theory of Planned Behavior (TPB). PBC is the individual's perception of the degree that behavior in question is easy or difficult to perform (Ajzen, 1991). These perceptions include both internal control factors (e.g. emotion, physical and mental deficiencies, skills, abilities, willpower etc.) and external control factors (e.g. available resources, opportunities, barriers, supports or objections from others etc.). And some of the salient control factors are weighted by the perceived power of each factor to facilitate or inhibit the behavior in question (Ajzen, 1991; Conner & Armitage, 1998).

The TPB has several theoretical advantages. First, the TPB offers a parsimonious framework with only three constructs that can explain all kinds of human behaviors regardless research contexts. Thus, the TPB has been widely applied to study a variety of topics across disciplines such as information systems, social psychology, marketing, health communications, media effects, marketing, environmental studies and so forth. Second, the TRA and the TPB offer an open framework which a set of salient beliefs are unique to each behavior in question (Ajzen 1991; Fishbein & Cappella, 2006). Ajzen (1991) also emphasizes that the TPB is in principle open to additional predictors if it can capture a significant proportion of the variance. Therefore, researchers are encouraged to explore different behavioral, normative, control belief systems surrounding a particular behavior and customize the model specific to their research topics.

Nevertheless, the TRA and the TPB are also without its criticism. First, as they assume that individuals are rational decision-makers, they fail to take account of irrational, automatic or habitual behaviors (LaRose, 2011; Hartmann, 2009; Ajzen, 2011). Second, they also assume that

everyone is motivated to perform a certain behavior and thus fails to explain non-adoption or reject of behavior (Talyor & Todd, 1995; Al-Qeisi, 2009). Third, it presents insufficient conceptual understanding and measurement to SN and PBC as well as affective motivations (Manstead, 2011; Ajzen, 2011, Armitage & Corner, 2001).

Technology Acceptance Model (TAM/TAM2/UTAUT)

The Technology Acceptance Model (TAM) is one of the most widely used theoretical frameworks in explaining user adoption of information technology. It is also one of the most critically debated frameworks within the IS research (Lee et al, 2003; Bagozzi, 2007). Since its inception by Fred Davis in 1986, the TAM has undergone a series of major theoretical advancement throughout model introduction, validation, extension and elaboration (Lee et al. 2003). Due to relentless efforts to expand its theoretical power, the model has continued to evolve into succeeding models such as the TAM2 (2000) and the UTAUT (2003).

Its research domains were also expanded from a word processor system at work to various information end-user technologies and mass market services such as personal computers, mobile phones, emails, e-commerce and banking, e-government, 3G mobile services, etc. (Lu et al, 2008; Yousafzai et al, 2010, Park et al, 2011). Its target population has also expanded from employees at a firm level to households and individual consumers (Yousafzai et al, 2010; Lopez-Nicolas et al, 2008) while the geographic area of interest has broadened from the US to other regions, including developing countries (Brown, 2002; Park et al, 2009).

The TAM aims to understand "*what causes people to accept or reject information technology*" (Davis, 1989), and explains the cognitive process of decision-making in user adoption behavior. Among the various theoretical foundations (Davis, 1989), the TAM is most firmly grounded in the tradition of TRA and shares several key assumptions (Ajzen & Fishbien,

1980; Davis et al, 1989). First, the TAM accepts the TRA's underlying assumption that users make a rational assessment, and adoption behavior is under one's volitional control (Ajzen, 1991). Second, it accepts the fundamental assumption of the TRA that behavior (B) is explained directly by one's *behavioral intention* (BI) to use the given technology (*Assumption 1*: B → BI). Third, it agrees that this intention is, in turn, determined by one's attitude about the technology in question, formed by one's salient beliefs and motivational factors.

Figure 12: The Original TAM

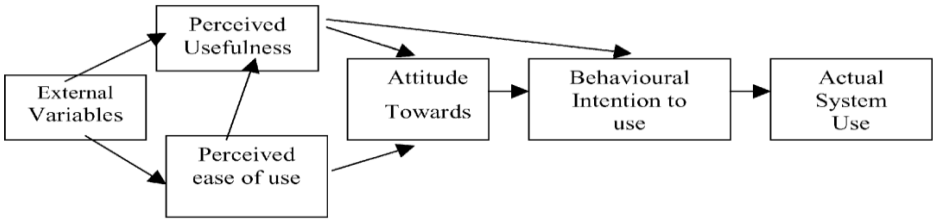


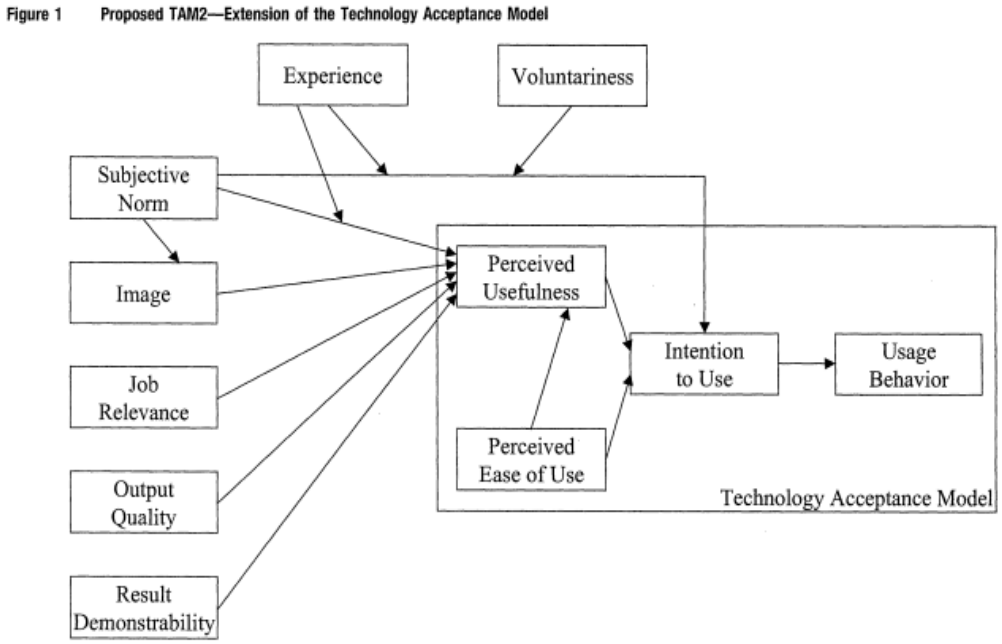
Fig. 2. Original technology acceptance model.

Perceived Usefulness (PU)	the user's subjective probability that using a specific application system will increase his/her job performance
Perceived Ease of Use (PEOU)	the degree to which the user expects the target system to be free of efforts

Nevertheless, originally developed in an organizational setting with a newly introduced information technology, the TAM departs from the TRA in the specification of the attitudinal factors. Replacing Attitude in the TRA, TAM postulates two key fundamental concepts that determine user's BI: *Perceived Usefulness* (PU) and *Perceived Ease of Use* (PEU). The TAM posits that BI is a joint function of PU and PEU (*Assumption 2*: BI = PU + PEU), while ease of use can enhance perceived job performance or save time, thus affects the degree of PU (*Assumption 3*: PEU→PU). In addition, the TAM assumes that the two fundamental determinants of PU and PEU are universal, and are offered *a priori* (Davis et al, 1989).

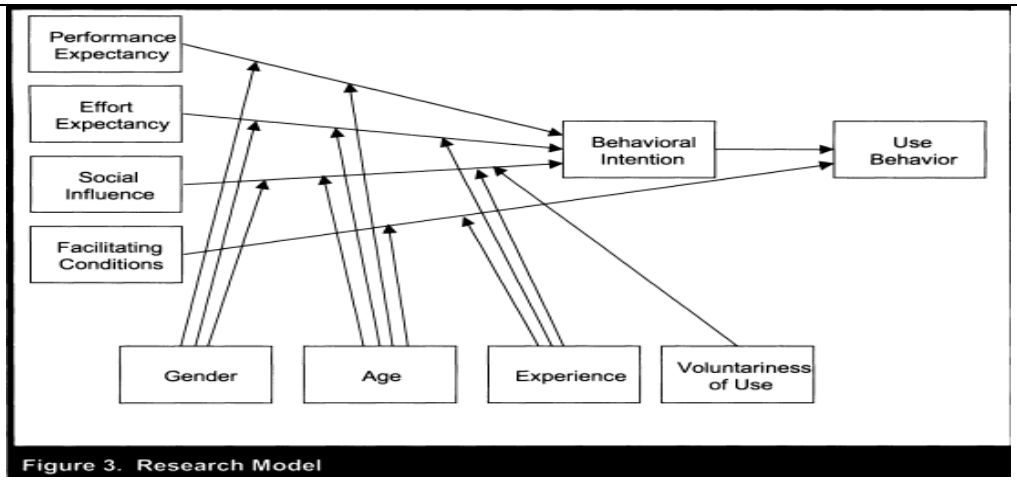
However, the closed nature of the TAM with the pre-determined set of variables and measurements made it inevitable for researchers to release an upgraded version. Researchers soon tested additional variables in different research contexts and began to dispute the TAM's validity (Agarwal & Prasad, 1999; Karahanna et al, 1999; Gefen & Straub, 1997; Karahanna & Limayem, 2000; Hong & Tam, 2006; Yousafzai et al, 2010, Lee et al, 2003). For instance, Venkatesh & Morris (2000) found significant effects of gender and experience. They also restored Subjective Norm back in the model, which was intentionally omitted in the original model due to the weak theoretical foundations and empirical evidence (Davis et al, 1989; Venkatesh & Davis, 2000). Accordingly, the extended version named as the TAM2 was created with seven new variables as antecedents to PU and two moderators borrowed from the TRA and DOI: Subjective Norms, Image, Job Relevance, Output Quality, Result Demonstrability, Experience and Voluntariness.

Figure 13: TAM2 Extension



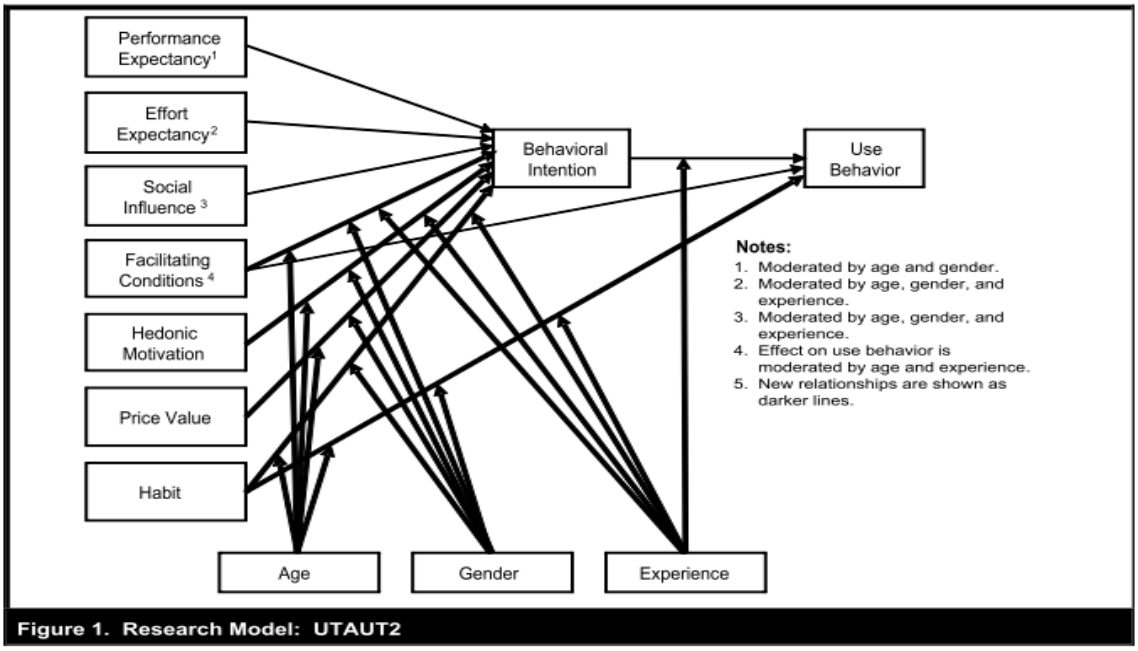
Similarly in 2003, TAM researchers announced a new succeeding model called the Unified Theory of Acceptance and Use of Technology (UTAUT) based on thorough analysis of the eight comparable models, including the TRA, TPB, Decomposed TPB, DOI, SCT, Motivational Model, the Model of PC Utilization (Venkatesh et al. 2003). The UTAUT is the outcome of the TAM scholars' effort to create a holistic and powerful model (Venkatesh et al, 2003). It consists of four key perceptions on technology covering similar constructs in other models: *performance expectancy* (embracing perceived usefulness, attitude, relative advantage, compatibility, outcome expectancy), *effort expectancy* (perceived ease of use, complexity), *social influence* (observability, subjective norms), and *facilitating conditions* (perceived behavioral control, self-efficacy). It also acknowledged the effects of user differences in relation to demographics and specified age, gender, and experience as moderators. Based on longitudinal

Figure 14: The Unified Theory of Acceptance and Use of Technology (UTAUT)



Performance Expectancy	the degree to which an individual believes that using a specific system will increase his or her performance
Effort Expectancy	the degree to which an individual believes that using a particular system would be free of efforts
Social Influence	degree to which an individual perceives that important others believe he/she should use the new system
Facilitating Conditions	the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system

Figure 15: The UTAUT2



fieldworks in multiple settings, the UTAUT was proven to outperform other models by explaining 69 percent of the variance in behavioral intention and about 50 percent for the behavior (Venkatesh et al, 2003).

Most recently, Venkatesh et al. (2012) released the UTAUT2 which targets general consumers' adoption and use of end-user technologies and services. The new model retains the four main UTAUT predictors (Performance expectancy, Effort expectancy, Social Influence, Facilitating Conditions) and three moderators (age, gender, experience). Then it re-specified the model with the following three points: first, it added three new variables relevant to general consumers (Hedonic Motivation, Price Value, and Habit) as predictors to BI. Second, the effects of the moderators have been adjusted from moderating all the BI predictors in the previous model to affect only FC and three newly added variables while PE, EE, SI are intact from the moderators. At the same time, the moderator Voluntariness is dropped. Third, the path from FC

is previously directed only to B but now it has both paths to BI and B. Similarly, Habit also exerts influence on both BI and B while experience also moderates BI - B path.

The 20 year long survival of the TAM in the fast-moving IS research demonstrates the theoretical strength of the model. First, unlike other comparable theories discussed in this study, the TAM is specifically tailored for the context of information technology. Second, the original TAM offers an intuitive and parsimonious framework to understand a complex nature of technology adoption. Third, it is also a powerful and robust theory which consistently outperformed other comparable theories in terms of the explanatory power (Talyor & Todd, 1995; Bagozzi, 2009; Yousafzai et al, 2010). Fourth, the TAM also provides a set of sound measurement scales that are well-proven in terms of item reliability as well as convergent, discriminant, factorial, and nomological validity. All these advantages allow researchers to replicate the study easily to other domains, and thus enable the accumulation of empirical findings and the generalization of the theory. Overall, the TAM and its successors brought significant contribution to the adoption research by uniting several comparable theories and enhancing research rigors with consistency and standardization (Lee et al, 2003).

Nevertheless, as the TAM created a dominant research paradigm in the 1990s and 2000s, the theory raised several criticisms. These criticisms are noteworthy if the TAM/UTAUT to be an appropriate vehicle to explain mobile adoption among the poor in developing countries. First, except the recent UTAUT2, critics caution on replicating the model for different contexts other than organizational setting (Bouwman & Wijngaert, 2009; Karahanna & Limayem, 2000; Moon & Kim, 2001). Originally designed for employees' adoption of company IT systems, these theories assume training and open access that are usually offered free of charge while the task is primarily related to one's profession. On the other hand, a mobile phone is a multi-purpose

consumer technology used in everyday context. Unlike company employees or university students, BOP users may lack material resources, skills, and prior experience with relevant technology (Musa, 2006; Park et al, 2009). Second, the TAM-based models are limited in their relevance for practitioners since they do not explain '*what actually makes a system useful*' (Benbasat & Barki, 2007; Lee et al, 2003), nor do they explain what contributes to the facilitating conditions of a technology's adoption. Suggesting that people will adopt a technology if they find it useful and easy or if enabling conditions are present does not provide actionable implications to practitioners who want to understand how to build a system with optimal results in terms of both adoption and continued optimal use. Third, most TAM studies use convenient samples of university students whose lifestyles tend to be congruent whereas their perceptions on technology may differ from the general public (Legris et al, 2003; Lee et al, 2003). Fourth, the extensions of the TAM have been also criticized for being over-crowded with concepts borrowed from other theories in a way of mere 'patchwork' which fails to provide sufficient theoretical grounds for such addition (Bagozzi, 2007; Benbasat & Barki, 2007). At the same time, the simplistic view on technology use as a mere quantity of time or frequency does not help us understand the consequence of such use (Benbasat & Barki, 2007).

Social Cognitive Theory

Social Cognitive Theory (SCT) is another social psychology theory to understand the overall functioning of human motivation, belief systems and behavior. Founded by Bandura (1986), SCT offers a set of influential conceptualization including triadic reciprocality, self-efficacy, outcome expectations, self-reflection, self-regulation, etc. These constructs are now widely adopted in media effect studies, marketing and technology adoption. According to Bandura (2001), SCT assumes human is a proactive actor who constantly tries to make sense of his

thoughts, actions and life circumstances by organizing, regulating and evaluation their own action. It also takes a holistic approach (i.e. *reciprocal triadic determinism*) that any behavioral or social phenomenon is a form of continuous bidirectional interactions between personal factors, behaviors and environmental influences (Pajares, 2002). In other words, rather than ruling out socio-structural influences (e.g. class, gender, race, value, culture etc), SCT posits that such structural and contextual factors are naturally internalized by each individuals over time and reflected in one's own perceptions (i.e. self-efficacy). In addition, SCT explains human incentives consist of five factors: sensory/novel, social, monetary, activity and status incentives, which creates *expected outcomes* of future behaviors.

Among others, *self-efficacy* is the most widely used construct in technology adoption studies. Self-efficacy refers to 'one's belief in capability to organize and execute a particular course of action' (Bandura, 1986). It is a dynamic self-evaluation formed through four agentic experiences: *enactive learning* (one's own performance), *vicarious experience* (observational learning), *social persuasion*, and p*hysical and emotional status* (Bandura 1997; Pajares, 2002). Self-efficacy then influences the expected outcomes of one's future behavior. According to Bandura, experiencing these four sources occurs within a tight network of sociostructural system and, throughout this iterative process, people internalized the sociostructural influences. Unlike self-esteem or self-confidence, therefore, self-efficacy is a form of an optimal balance between one's ability and desire, or a reflection of both personal and sociostructural influences. In the domain of technology use, the concept was later further elaborated as 'computer self-efficacy' (Compeau & Higgins, 1995) or 'Internet self-efficacy' (Larose & Eastin, 2004) to measure the one's assessment in skills and capability to perform a task on computer or the Internet.

SCT is a comprehensive framework that captures not only human motivations but also environmental factors influencing behaviors. In particular, by measuring self-efficacy as a proxy, it enables us to estimate the immeasurable operation of biological, social, political and cultural factors which affected an individual throughout his or her lifetime. In the absence of accurate measures of the objective skills and ability, self-efficacy also provides the most accurate estimation of one's own capability. In this sense, the self-reported measures have more validity than other approaches.

Nevertheless, the main constructs and assumptions of SCT are not delineated in one comprehensive model while most paths are bi-directional or multi-directional. Also, the theory does not offer sufficient guidelines on measurements and apart from self-efficacy, much of theoretical conceptualizations are still in the process of development particularly in the context of technology use. Thus, it is still theoretically challenging to apply the full scope of SCT in explaining a particular behavior.

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