Understanding Mobile Internet Diffusion:
The Case of Jamaica

by

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INTRODUCTION

Worldwide it is estimated that there are over 5.3 billion mobile subscribers of which almost 4 billion are in the developing world (ITU, 2010b). For developing countries, the digital divide in terms of access has begun to close with the flow of digital information through core mobile services (e.g. voice, SMS) even in the poorest of countries. This offers the potential to capitalize on the economic benefits and improvements in quality of life that can come about with improved communications (Abraham, 2007; Rashid & Elder, 2009). In addition the rapid spread of this innovation in developing countries also paves the way for greater connectivity and access to the Internet via mobile devices and diffusing of value-added services such as mobile banking. However, uptake of more advanced mobile services other than basic telephony has lagged behind expectations, even for trendsetters like Finland (Bouwman et al., 2008). In developing countries the lag may be due in part to the affordability of access and the underdeveloped nature of basic services such as Internet access and mobile banking. However, where these services are more affordable and accessible (and increasingly so) it is important to investigate why persons have been slow to adopt mobile Internet.

Jamaica, labeled as a developing country by the World Bank has a population of just over 2.7 million (2010) and is the largest island of the Commonwealth Caribbean. Since the liberalization

of the telecommunication sector in 1999, there has been a startling increase in mobile phone subscribers. For rural areas lacking basic telephone line infrastructure, mobile phones have enabled vast improvements in communications, access to health services, and the way in which people interact and do business. In 2000, the ITU (2010a) reported over 360,000 mobile subscribers; by 2010 this had grown to over 3 million.

Internet usage has also grown over this time. Since 2000 the number of Internet users in Jamaica has increased from 60,000 to over 1.5 million users in 2010 (Internet World Stats, 2011). With only 4.2% fixed Internet subscriptions (as at 2009), most persons gain access to the Internet through business or work (PIOJ, 2005). Affordability and lack of a computer are cited as the main factors inhibiting Internet access from home (JAMPRO, 2003). However, there is growing interest in Internet access via the mobile phone, especially at lower socio-economic levels (JAMPRO, 2003; Miller & Horst, 2004), where access via business or work may not be a 'ready' option.

In recent years, increased competition in Jamaica's telecommunication market has meant that mobile providers have been offering mobile services at reduced rates. Although the conditions appear to be more favorable for the diffusion of mobile Internet and related services, uptake has been slow. For developing countries especially this lack of or slow uptake may result in an erosion or slow deployment of value-added services. To address the problem of slow uptake, this study aims to identify key factors that enable (or inhibit) mobile Internet uptake by individuals, focusing on the developing country setting.

This problem of how to accelerate the diffusion of a technology has long been a key focus of IS research (Davis et al., 1989; Taylor & Todd, 1995; Venkatesh et al., 2003). Although a great deal of work has been done on understanding how technology perceptions impact adoption in the workplace (e.g. Internet, websites, e-commerce, IS/IT, communication), far less attention has been paid to understanding the uptake of mobile technologies (Williams et al., 2009). In the case of developing countries, there have been some studies of various mobile Internet services such as mobile banking in South Africa (Brown et al., 2004), mobile phone use in China (Wei & Zhang, 2008), mobile Internet use in China (Liu & Li, 2010) and in Korea (Cheong & Park, 2005). However, the importance and potential impact of the Internet for four-fifths of the world's population living in developing countries (Madon, 2000) is neglected. Relatively little attention

has been paid to the deployment of ICTs in developing countries and the factors and mechanisms that enable such deployment, with calls for further research (Walsham & Sahay, 2006).

To address the issue of the diffusion of ICTs, diffusion researchers have discussed at length the importance of the social network into which an innovation is diffused (Rogers, 1995; Bass, 1969). These models suggest that in the initial stages of diffusion of a new technology some adopters (i.e. Innovators) will choose to adopt a technology independently of the decision of others within the social system. Beyond these first-movers the timing of adoption by others in the social system (e.g. early adopters, early majority, late majority) is likely to be influenced by the decisions of others in the social system (Bass, 1969). This increasing pressure from the social system on new adopters is said to be influenced to a large extent by two aspects of the social system (Roger, 1995): external influences (e.g. mass media, expert opinion), and interpersonal influences that derive from interactions with peers and relevant others in the social system. Rogers (1995) further proposes that these sources of influence are likely to function as key channels of communication in the social system, and as such are likely to play a dominant role in the diffusion of an innovation, and in the development of perceptions about that innovation.

Consistent with Innovation Diffusion Theory (IDT), the IT literature also supports the notion that social influences may play a vital role in forming individual perceptions and by extension influencing the adoption of mobile Internet services (Teo & Pok, 2003). However, the role of interpersonal and external influences as key communication channels in the diffusion of new technologies (Rogers 1995) has been understudied, in particular their role in determining how information is obtained about an innovation and how this impacts the development of core beliefs about innovations and the adoption decision (Agarwal & Prasad, 1998; Venkatesh & Bala, 2008).

This study will therefore examine the impact of social influence on mobile Internet adoption including its role in forming perceptions about key innovation characteristics (i.e. perceived usefulness, perceived enjoyment), which are likely to have a direct impact on adoption intentions (Bhattacherjee, 2001; Venkatesh & Bala, 2008). In particular, this study focuses on mobile Internet adoption in Jamaica and the factors that influence intention to use mobile phones to access the Internet and other mobile services.

The remainder of this paper is as follows. The next section reviews the literature and presents the research model. The research method is then outlined and findings presented. The paper closes with a discussion of the findings, limitations, and implications for future research.

LITERATURE REVIEW

An innovation is as an idea, practice or object that is perceived as new to an individual (Rogers, 1995, p. 132). Diffusion of an innovation refers therefore to the process by which an innovation is communicated through certain channels over time among the members of a social system. Innovation Diffusion Theory (IDT) suggests elements such as perceived characteristics of the innovation, communication channels, and the nature of the social systems through which an innovation is diffused will influence innovation diffusion (Rogers, 1995).

In IS research one of the earliest models to achieve widespread popularity for understanding technology adoption is the Technology Acceptance Model (TAM). Bringing together key perceptions of technology, in its basic form TAM and its precursor – the Theory of Reasoned Action (TRA), suggest that beliefs about an innovation (e.g. perceived usefulness) are key factors that inform attitude and behavior toward the technology, including initial acceptance and use of the technology (Ajzen & Fishbein, 1980; Davis et al., 1989). TAM (and its variants) has been used to explain technology adoption in developing countries; however, the results have varied. For example, Brown et al. (2004) and Liu & Li (2010) did not find support for a direct link between perceived usefulness and adoption intention, suggesting that the basic tenets of TAM may not be sufficient for explaining technology adoption in developing contexts.

Although early versions of TAM did not include social influence, later models and extensions (e.g. TAM2, TAM3 and UTAUT) incorporated other IDT, TRA and Theory of Planned Behavior (TPB) elements including the links with social influence proposed by the TRA and IDT (Ajzen, 1991; Taylor & Todd, 1995; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000; Venkatesh et al., 2003). However, many studies of technology adoption have been inconclusive concerning the role of social influence in the diffusion process with some showing strong support for a link between social influence and behavior intentions (Taylor & Todd, 1995; Teo & Pok, 2003; Venkatesh et al., 2000), and others finding no such link (Lewis et al., 2003). Still others found that social influence may vary between men and women, and over time with experience (Nysveen, et al., 2005; Venkatesh & Bala, 2008). Given the contradictions a more in-depth

examination of social influence and its role in affecting behavior through other elements is warranted. In this study the focus is on two key elements of communication identified in the IDT literature: interpersonal influence and external (media) influence (Rogers, 1995).

Social influence (also referred to as subjective norms) is a fundamental element of the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB). These theories suggest that intention to perform a behavior is in part a function of social influence, that is, an individual's beliefs that particular groups or persons would think that he/she should perform (or not perform) a particular behavior (Ajzen, 1991; Ajzen & Fishbein, 1980).

Social influence is also a key concept in the diffusion of innovations (Fulk et al., 1990; Rogers, 1995) and adoption of IT (Agarwal & Karahanna, 2000; Taylor & Todd, 1995; Teo & Pok, 2003; Venkatesh & Davis, 2000). In IS research, the two communication elements identified in IDT are linked to concepts related to social influence: interpersonal influences from persons known to the individual (e.g. family friends) as well as external influences that derive from external sources such as mass media and expert opinions (Bhattacherjee, 2001). Both influences are suggested as key factors in the innovation-decision process that inform behavior through their impact on social influence (Ajzen & Fishbein, 1980; Bhattacherjee, 2001), and on beliefs about the characteristics of a technology such as perceived usefulness (Venkatesh & Bala, 2008)

While IT research has more readily considered interpersonal sources of social influence when examining adoption intentions (Taylor & Todd, 1995; Teo et al., 2003), very few consider the impact of external influences on adoption intentions (Bhattacherjee, 2001). However, media research suggests that these external sources may have the greater influence compared with interpersonal influence particularly in the early stages of the diffusion cycle when fewer persons have adopted the innovation (Rogers, 1995), and there are fewer referents within the social group to draw on in forming or validating individual beliefs.

RESEARCH HYPOTHESES

This study builds on a well-established body of theory, in particular Innovation Diffusion Theory (Bass, 1969; Rogers, 1995), the Theory of Planned Behavior, and its precursor the Theory of Reasoned Action (Ajzen 1991; Ajzen & Fishbein, 1980) and the Technology Acceptance Model

and its successors to explain the diffusion of mobile Internet (Davis et al., 1989; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000; Venkatesh et al., 2003).

Drawing on key theoretical perspectives from these theories this study proposes a model of mobile Internet adoption that incorporates core innovation characteristics of mobile Internet (i.e. perceived usefulness and perceived enjoyment), the social influences that derive from interpersonal and external channels, and perceived behavioral control (Ajzen, 1991; Davis et al. 1992; Taylor & Todd, 1995; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000; Venkatesh et al., 2003). In particular, the framework suggests an individual's intention to use a mobile Internet phone is a function of perceptions about the innovation, the social influences that help to form those perceptions, as well as factors that constrain behavioral intention.

Innovation Characteristics

Perceived Usefulness. Several IS studies have examined perceived usefulness and found it to be an important predictor of intention to use a technology (Agarwal & Prasad, 1998; Davis et al., 1989; Taylor & Todd, 1995; Venkatesh & Bala, 2008). Perceived usefulness has been a key factor explaining the adoption of mobile Internet and related services. For example, Kim (2008) found that perceived usefulness predicted adoption of a Smartphone. In the case of mobile Internet, Cheong and Park (2005) found a significant link between perceived usefulness and adoption intention. Hence to the extent that potential adopters believe an Internet mobile phone is a useful way to access the Internet, they are more likely to adopt the innovation.

> H1:   Perceived usefulness is positively related to intention to use mobile Internet.

Perceived Enjoyment. Several studies provide strong support for the relationship between perceived enjoyment and intention (Davis et al., 1992; van der Heijden, 2004). For example, Davis et al (1992) found that intentions to use a computer were influenced in part by the enjoyment experienced when using the computer. Nysveen et al. (2005) also found that perceived enjoyment was a significant factor determining intention to use mobile chat services. Particularly in the case of hedonic technologies and mobile Internet services, research suggests perceived enjoyment may be the stronger predictor of intention to use compared with perceived usefulness (Nysveen et al., 2005; van der Heijden, 2004).

> H2:   Perceived enjoyment is positively related to intention to use mobile Internet.

Social Influence

Ajzen and Fishbein (1980) note that social influence in the form of interpersonal influence, may not have a significant impact on behavioral intention across all circumstances. Consistent with these observations, findings in IS research have been mixed (Lu, et al., 2005; Teo & Pok, 2003). Nonetheless, it is generally suggested that interpersonal influence is likely to impact adoption intentions (Taylor & Todd, 1995; Teo & Pok, 2003) unless the results show otherwise. In the case of mobile technologies and Internet services, Teo and Pok (2003) observed a positive relationship between subjective norms (in the form of interpersonal influence) and intention to use WAP-enabled phones. However, others found the influence of interpersonal influence on behavioral intentions may vary over time (Venkatesh & Morris, 2000), as well as by gender and experience (Hsu et al., 2007; Karahanna et al., 1999; Nysveen et al., 2005).

Although many IT studies have considered the impact of interpersonal influences on adoption intentions (Taylor & Todd, 1995; Teo & Pok, 2003) only a few have extended the scope of social influence to include external influences (e.g., media influence, expert opinions). For example, Leung (1998) identified a significant link between newspaper reading and technology adoption. Wei and Zhang (2008) also found a significant link between media exposure and perceptions about mobile phone usage. It is therefore expected that:

> H3:   Interpersonal Influence is positively related to intention to use mobile Internet.

> H4:   External influence is positively related to intention to use mobile Internet.

Research further suggests that social influence may impact perceptions of a technology by way of the information and cues that persons receive from the social environment through interpersonal and external channels (Rogers, 1995). For example, Lopez-Nicolas et al. (2008) in a study of advanced mobile services found that interpersonal influence impacted perceptions of perceived usefulness of these services. Likewise, Verkasalo et al. (2010) in a study of Smartphone adoption also found a positive link between social norm and perceived usefulness for adopters and non-adopters.

In the case of perceived enjoyment, Verkasalo et al. (2010) found a positive link between interpersonal influence and perceived enjoyment. Dirkinger et al. (2010) also found that social

influence impacted perceptions about enjoyment from using Push-to-talk mobile communication technology. It is expected that:

H5: Interpersonal Influence is positively related to perceived usefulness.

H6: Interpersonal Influence is positively related to perceived enjoyment.

External influences such as the mass media and expert opinion are also expected to impact people's perceptions of a technology particularly in the initial stages of the diffusion of a technology (when there are few adopters) as these channels are an effective means of creating knowledge-awareness among potential adopters (Rogers, 1995). Prior research supports these suggestions. For example, Agarwal and Prasad (1998) in a survey of potential adopters found that mass media channels were more important than interpersonal channels for creating knowledge-awareness of the technology. Pederson (2005) also found that for early adopters of mobile Internet services external influences had a significant impact on perceived usefulness. However none of the studies identified to date have examined the impact of external influences on perceived enjoyment. Yet it is reasonable to expect that just as external sources can be drawn on for information about the utility of a technology, they can also be used to convey information about hedonic elements (Fulk, et al., 1990; Rogers, 1995). Hence, it is expected that:

H7: External influences are positively related to perceived usefulness.

H8: External influences are positively related to perceived enjoyment.

Perceived Behavioral Control.

Perceived behavioral control refers to the control that an individual believes he/she has over performing a particular behavior (Ajzen, 1991). Perceived behavioral control considers the resources and opportunities (e.g. time, money, skills) that enable a person to perform an intended behavior as a precursor of intention to use and actual use (Mathieson, et al., 1991; Taylor & Todd 1995). For example, research suggests the more confident an individual is in their ability to use a technology the greater their behavioral intention (Agarwal & Karahanna, 2000). Wang et al (2006) in a study of m-service acceptance in Taiwan found that higher self-efficacy and perceived financial resources led to higher intentions to use m-services. Perceived behavioral control was also shown to be positively related to intention to use WAP-enabled phones (Teo & Pok, 2003). Perceived behavioral control is likely to be a key factor impacting technology

adoption in developing countries due to limited access to resources (Brown et al., 2004). Hence, the extent to which the necessary skills, resources and opportunities are in place is likely to be positively linked to intention to use mobile Internet:

H9:   Perceived behavioral control is positively related intention to use mobile Internet.

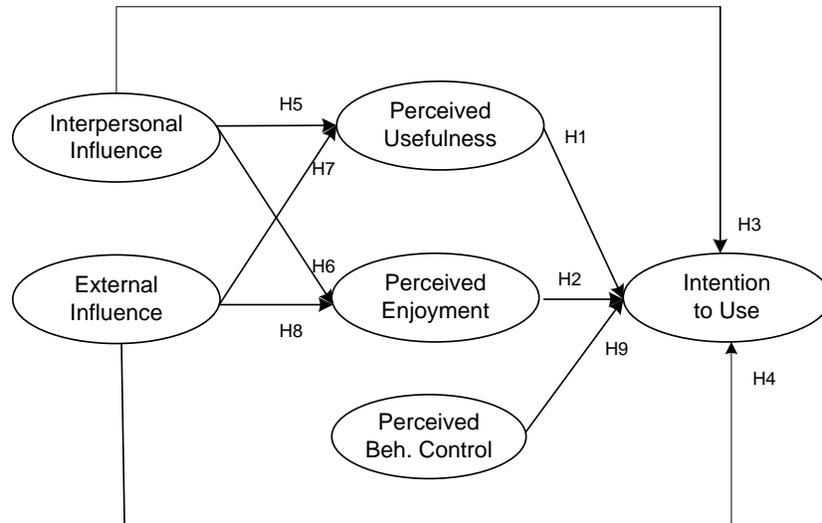Figure 1 summarizes the research hypotheses.

Figure 1: Research Model

METHODOLOGY AND RESULTS

Data for this study was collected using a paper-based field survey conducted in communities and places (e.g. malls, government service centers) most likely to yield the target sample. Only persons who had not yet used mobile Internet, but intended to acquire an internet-capable mobile phone were included. Of the 750 surveys administered, 166 usable surveys were received from non-adopters reflecting a usable response rate of 22.1%. Of these, 65.8% were female and 34.2% were male (5 missing). Most respondents (67.1%) were 34 years and under (5 missing). 71% had used the Internet but none had used mobile Internet.

The measurement model consisted of multi-item constructs adapted from existing scales (Agarwal & Karahanna, 2000; Ajzen & Fishbein, 1980; Bhattacherjee, 2001; Davis et al., 1992; Mathieson et al., 1991; Taylor & Todd, 1995): perceived usefulness (5 items), perceived enjoyment (3 items), interpersonal influence (3 items), external influence (3 items), perceived

behavioral control (4 items), and intention to use (3 items). All constructs were measured using 9-point Likert scales, anchored with 'Strongly Agree' and 'Strongly Disagree'.

This study used a single method to collect the data (i.e. a self-report survey). To assess whether common method bias may be a significant issue, Harman's one-factor test (Podaskoff & Organ, 1986) was used. All 21 items in the measurement model were included in a principal components factor analysis. The results showed there was no single factor accounting for most of the covariance in the variables, suggesting common method bias was not a key issue in this study.

In this study, SPSS version 17.0 and PLS-Graph 3.0 (Build 1130) were used to assess the research model, with bootstrap estimation (using PLS-Graph with 500 resamples) used to evaluate the paths in the structural model. The research model was tested using the Partial Least Squares (PLS) approach to structural equation modeling (Chin, 2010), a second generation multivariate data analysis technique that allows for the simultaneous assessment of the measurement model (i.e. the reliability and validity of the measures of theoretical constructs) and the relationships among these constructs (Chin, 2010). It has emerged as a powerful approach to examining causal models involving multiple constructs and multiple measures, and is widely used in IS research (Agarwal & Karahanna, 2000; Venkatesh & Bala, 2008).

First, the measurement model was assessed. Item loadings ranged from 0.788 to 0.970, exceeding recommended thresholds of 0.707 (Chin, 2010). The measurement models were also assessed in terms of convergence and discriminant validity (Chin, 2010). Composite reliabilities ranged from 0.891 to 0.971 and average variance extracted (AVE) from 0.672 to 0.916, exceeding recommended cut-offs of 0.70 and 0.50 respectively. Construct AVEs were also greater than the variance shared between the constructs satisfying the criteria for discriminant validity.

Next, the structural model was examined. The results (Table 1) showed the model accounted for accounting for 0.380 of the variance observed for adoption intention. More specifically, the results showed perceived enjoyment (β=0.419, $p\leq$0.01) and perceived behavioral control (β=0.183, $p\leq$0.01) had a significant impact on adoption intention; Hypotheses H2 and H9 were therefore supported. However, contrary to expectation perceived usefulness (β=0.004), interpersonal influence (β=0.027) and external influence did not have significant effects on intention to use; H1, H3 and H4 were therefore not supported.

Turning to the role of social influence in forming perceptions about the mobile Internet use, both interpersonal influence and external influence had significant impacts on perceived usefulness (β=0.428, p≤0.0 01; β=0.295, p≤0.0 1 respectively), and on perceived enjoyment (β=0.229, p≤0.001; β=0.328, p≤0. 001 respectively). Hypotheses H5, H6, H7 and H8 were supported. Interpersonal influence and external influence collectively explained for 0.339 and 0.297 of the variance observed for perceived usefulness and perceived enjoyment respectively (Table 1).

Table 1: Model Results

Hypotheses	Path	Sig
H1: Perceived Usefulness → Intention to Use	0.004	-
H2: Perceived Enjoyment → Intention to Use	0.419	≤ 0.001
H3: Interpersonal Influence → Intention to Use	0.027	-
H4: External Influence → Intention to Use	0.102	-
H5: Interpersonal Influence → Perceived Usefulness	0.428	≤ 0.001
H6: Interpersonal Influence → Perceived Enjoyment	0.229	≤ 0.001
H7: External Influence → Perceived Usefulness	0.295	≤ 0.01
H8: External Influence → Perceived Enjoyment	0.328	≤ 0.001
H9: Perceived Behavioral Control → Intention to Use	0.183	≤ 0.01
R-Squared (Variance Explained)		
Perceived Usefulness	0.339	
Perceived Enjoyment	0.297	
Intention to use	0.380	

DISCUSSION AND CONCLUSION

This research examined the relative importance of the perceived characteristics of a technology, social influence and perceived behavioral control in relation to intentions to use a mobile Internet phone to access the Internet. Altogether the research model accounted for 0.380 of the variance observed for adoption intention. The findings suggested that social influence through interpersonal and external influences impacted beliefs about the usefulness and likely enjoyment of using mobile Internet. Perceived behavioral control and perceived enjoyment also had direct

impacts on adoption intention. However, perceived usefulness, interpersonal influence and external influence did not have a direct influence on adoption intention.

Altogether, it was somewhat surprising to find perceived usefulness was not significant this is not a unique outcome as prior studies have shown similar outcomes (Brown et al., 2004; Nysveen et al., 2005). For example, Brown et al. (2004) found that perceived usefulness did not impact adoption intention in South Africa; a similar observation was made by Liu & Li (2010) in their study of mobile Internet in China, which also did not find a significant link between relative advantage and mobile Internet use.

Altogether these findings suggest that in certain contexts, TAM may not explain adoption intentions well. One possible explanation for the case of developing countries may lie with the limited availability of value-added mobile services coupled with high media coverage promoting Internet mobile phones as a 'fun' technology. Indeed prior research shows that for technologies that are considered hedonic in nature (rather than utilitarian) perceived enjoyment is likely to have the greater impact on adoption intentions than perceived usefulness (van der Heijden, 2004; Verkasalo et al., 2010). Even so, given the limited resources in many developing countries enjoyment is unlikely to be a priority for many, limiting the actual uptake of the technology. The creation and deployment of more affordable, accessible and clearly value-added utilities is therefore clearly needed to improve uptake in these settings.

Consistent with prior research, interpersonal influence and external influence both impacted perceptions of the technology confirming the importance of these channels of communication in conveying knowledge about a technology (Rogers, 1995). However, the results showed that for adoption intention, neither external influence nor interpersonal influence had a direct impact. This may be problematic when it comes to the accelerating technology diffusion. For example, while Rogers (1995) suggested that in the early stages of diffusion of a technology, external channels such as the mass media are likely to play a greater role in creating knowledge-awareness of the technology, interpersonal influences in particular are considered the key to persuading potential adopters to take up a technology (Rogers, 1995); their absence may therefore inhibit uptake.

Issues of affordability and accessibility have often been cited as key inhibitors of technology adoption in developing countries (Cheong & Park, 2005). As mobile Internet and services

become cheaper and more accessible in developing countries, the high awareness and interest shown in mobile Internet (Miller & Horst, 2004) coupled with opportunities for economic enhancement and other societal impacts (Madon, 2000) suggest countries need to place more emphasis on enabling value-added services that are perceived as worthwhile. For example, while actions such as the liberalization and deregulation of the telecommunications sector can play a key role in increasing access to mobile Internet (Aker & Mbiti, 2010) leveraging the appropriate communication channels through interpersonal networks and the media is key for enabling uptake beyond first-movers in the social system (Bass, 1969).

The aim of this research was to examine the role of social influence in the diffusion of mobile Internet. The outcomes confirmed the importance of social influence in conveying knowledge about the uses and benefits of mobile Internet. Even though the impact on intention to use was not significant in this study, their role in communicating opportunities for economic enhancement, addressing uncertainties and encouraging actual technology uptake (Aker & Mbiti, 2010; Fulk et al., 1990; Rogers, 1995) should not be overlooked.

Finally, and notwithstanding the insights that this work provides into mobile adoption into developing countries, there are some limitations to consider when applying the findings elsewhere. For example, as a middle-income developing country with a high mobile phone density and high Internet awareness, Jamaica may be atypical of other developing countries particularly when compared to those in Africa and South-East Asia. Even within national bounds the data was drawn from a largely urbanized segment of the population limiting the representativeness of the sample; results may therefore differ for a rural population or a dominantly high- or low- socio-economic segment. Research also shows that findings may vary based on gender and experience (Hsu et al., 2007; Nysveen et al., 2005); these were not addressed in this study, suggesting opportunities for further work. Second, a key aim was to understand the role of social influence in forming beliefs and affecting the diffusion of ICTs. The study therefore did not include factors such as compatibility, perceived price, and internet experience which may be especially relevant to mobile adoption in developing countries (Brown et al., 200; Cheung & Park, 2005; Liu & Lu, 2010). Altogether these elements provide opportunities for future research to extend this study in other developing settings, and incorporate other elements that may impact behavioral intention.

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