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OPEN STANDARDS AND LICENSE CHOICE IN OPEN SOURCE SOFTWARE

Shuo Chen, State University of New York at Geneseo

ABSTRACT

Open standards are important in markets for Internet technology to ensure interoperability of software components across the Internet. Many applications of the Internet technology experience network effects.Owners of open source software may benefit from network effects and influence future standards development through their license choice. This study analyzes the data of 118 open source software projects that develop Internet technology to explore the relationship between open standards and the license choice made by software owners. It tests the hypothesis of standardization and the hypothesis of commercialization. Results of the statistical analysis show that programmers devote more efforts to Internet projects using nonrestrictive licenses due to the importance of network effects and standards development in Internet technology. Further investigation of a larger sample of all open source software projects shows that projects with the topic of Internet are more likely to choose nonrestrictive licenses than the restrictive ones, especially when the intended audience is developer or system administrator. The results lend support to the theory of network effects and the standardization hypothesis.

INTRODUCTION

Technological standards are technical specifications that determine the compatibility or interoperability of different technologies. Open standards, as opposed to proprietary standards, are standards that are freely and publicly available for implementation and use. Open standards enable interoperability of software components so that different devices and applications can work together across the Internet. Open standards have stimulated innovations in the Internet technology and have led to the growth of new business areas such as e-Commerce, automation of data processing, and cloud services.

Many products and services of the Internet technology experience network effects. Network effects occur when the value of a product to an individual user increases with the number of the other users. The existence of network effects makes standards particularly important in markets for Internet technology. According to the Internet Society, a non-profit and professional organization that determines and publishes many open standards for the Internet (http://www.internetsociety.org, accessed on November 5, 2015), a technology is more likely to become a standard if it is widely used. And a technology will gain more users after it is established as a standard. The additional benefits of becoming a standard include the capability to affect the direction of future standards development (Gamalielsson et al., 2015).

Open standards and open source software are closely related. The source code of open source software is free for users to access, modify, and redistribute. Open standards reduce the risk of lock-in among different open source technologies and enable collaborative development within open source communities. It is widely recognized that open source communities have

contributed significantly to the establishment of key standards for the Internet (see e.g. Bresnahan & Yin, 2007; Friedrich, 2011).

Ghosh (2005) argues that owners of an interoperable technology can control the development of the standard through licensing conditions that discriminate or exclude certain groups of users. Owners of an open source software can choose to release the software under an open source license that is approved by the Open Source Initiative (OSI). The open source licenses can be divided into two categories: restrictive and nonrestrictive. The restrictive license requires that modified versions of the open source code remain open and prohibits the mixing of open and proprietary code. That is, if a proprietary project incorporates code released under a restrictive license, then this project must also be distributed under the terms of the same license. This is called the "viral" nature of the restrictive license (Feller & Fitzgerald, 2002, p. 19). In contrast, the nonrestrictive license may or may not require the modified versions of the open source code be open and allows the mixing of open and proprietary code. Code released under nonrestrictive licenses can be incorporated into other code without affecting the openness of the incorporating project (see, e.g., Lerner & Tirole, 2002). GPL (General Public License) is an example of restrictive license and LGPL (Less General Public License) is an example of nonrestrictive license.

In the existing literature there are studies that discuss the relationship between open standards and licensing terms of technology. Gamalielsson et al. (2015) argue that permissive licensing terms involving zero royalty of patents are crucial for increasing software interoperability. Ghosh (2005) analyzes the use of LGPL license in an open source word processing software, OpenOffice, to argue that open standards should be compatible with open source licenses to promote competition in the market. Lerner and Tirole (2005) suggest that standards might be an important concern to open source projects in the area of Internet.

There are empirical studies that investigate the relation between license type and the success of open source software. The findings are mixed. Lerner and Tirole (2005) find that the restrictiveness of open source license has a negative impact on developer input. Stewart et al. (2006) find that nonrestrictive licenses tend to stimulate greater user interest. Subramaniam et al. (2009) find that restrictive licenses have a negative impact on developer input, but a positive impact on user interest.

This study explores the impact of open standards and network effects on the license choice made by open source software owners. It investigates a sample of open source projects that develop Internet technology since open standards and network effects are important to the market of Internet technology.This study finds a negative relationship between the restrictiveness of license and the developer effort in these projects.

The main contribution of this study is to provide empirical evidence to cast light on the impact of standards development on license choice in open source software. Prior studies have not tested the relations between standards and open source license. This study uses a unique sample of open source software aimed at developing Internet technology, which complements the prior empirical work on open source software.

We begin the next section by discussing hypotheses: the standardization (or network effects) hypothesis and the commercialization (or competitive advantage) hypothesis. We then present an empirical analysis of the projects focusing on Internet technology to test the above hypotheses. We further investigate how license choice in all open source projects might respond to project topic and intended audience. The paper is organized as follows. Section 2 discusses the

hypotheses that lay foundation for the empirical analysis. Section 3 describes the data. Section 4 presents results of regression analysis and section 5 concludes.

HYPOTHESES

In this section we develop competing hypotheses of programmer efforts as a response to the license choice of open source projects.

Internet technology is subject to network effects: the value of a technology to a user increases with the number of other users of the same technology. For example, the value of a social network website to a single user is limited if there are not many other users of the same website.

The network externality not only exists among users, but also exists between developers and users (Bresnahan & Yin, 2007). All else equal, a user will choose a technology with the most associated applications. A large number of developers indicates greater availability of future applications of the technology. Thus the user's utility increases with the number of developers. Similarly, developers will tend to put their effort into a technology that have the largest user group. A larger number of users increases the probability that a technology becomes a standard. The developers get rewards from standardization through increase in software usage, improvement in software interoperability, and influence on future development direction. The developers' utility thus increases with the number of users.

For open source software projects that develop Internet technology, the benefits of standardization are significant. For websites, e-Business, and cloud services to work, there must be compatibility and interoperability of different software modules and components. Open standards, by making standards freely available to the public, have reduced the hold-up problem between different technologies and greatly boosted innovations in the Internet technology.

The network externality between users and developers also exists in that developers of open source projects get feedback such as bug reports from users and fix the bugs. The quality of the projects therefore increase as more people use the software. Both the programmers and the users benefit from the continued improvement of the program. Some studies further argue that users of open source projects are also developers. In many cases, programmers create open source software for their own direct use (see Lundvall & Vinding, 2004; Von Hippel, 2002; Raymond, 2000).

Friedrich (2011) argues that the owner of a new technology can keep it private to gain competitive advantage, or to share it with the public by making it into a standard. Similarly, owners of open source projects can strategically choose license type to achieve their goals. They can choose restrictive licenses to keep all future contributions to the project open, preventing private firms from "hijacking" the open source technology (see Tirole & Lerner, 2002). The restrictive licenses thus gives the original innovators competitive advantage if they want to commercialize the open source project in the future. Alternatively, the owners can choose nonrestrictive licenses so that the spread and market acceptance is faster, which is crucial to establish a standard. The costs are that the earlier innovators may not receive contributions from private firms because they can keep their subsequent work private when incorporating open source code released under nonrestrictive licenses. For open source projects in Internet technology, the benefits of standardization may exceed the costs of lost contributions. For open source projects where commercialization is a more important goal, the benefits of fast spread may be smaller than the costs of being hijacked by private firms. To summarize, the creators of

open source technology will choose nonrestrictive licenses for the projects that are essential for establishing or implementing standards and choose restrictive license for projects that they plan to commercialize.

H1 The standardization hypothesis. Programmers contribute more efforts to open source projects with nonrestrictive licenses to gain network externality and facilitate standards establishment.

H2 The commercialization hypothesis. Programmers contribute more efforts to open source projects with restrictive license to gain competitive advantage and facilitate future commercialization.

DATA

The dataset are selected from projects listed on freshmeat.net. The website was started in year 1997 and had been the largest index of Linux, UNIX, and cross-platform software, mostly released under an open source license. In year 2009, all freshmeat.net projects were integrated into sourceforge.net, which is another repository of open source software. Subsequently freshmeat.net was renamed to freecode.com and is no longer updated since June 2014 due to low traffic levels (see http://freecode.com/about and https://sourceforge.net/blog/freshmeat-integration/ , accessed on December 1, 2015). This study uses the freshmeat data as of year 2009 to remove the impact of the lower activity level on freshmeat.net after the integration with sourceforge.net.

As of August, 2009, freshmeat.net contained approximately 44,000 projects, most of which conform to the Open Source Definition. Both qualitative and quantitative information is available for each of the projects. The qualitative variables include project title, author, license type, intended audience, programming language, development status, and topic of program. The topic of a program can be games/entertainment, Internet (including browsers, HTTP servers, and site management, etc.), Software Development (examples are compilers, bug tracking tools, and libraries), and Systems (examples are operating systems, system administration, and networking). The intended audience includes End user, Developer,System administrator, and others. According to the terms and provisions of each license, the license is restrictive if it is GPL (General Public License), and nonrestrictive otherwise.

The quantitative variables include age of the project, date of last update, date of last release, vitality score, popularity score, rating, and number of subscribers. The vitality score for a project is formulated to reward the number of releases and to punish the days elapsed since last release. The popularity score takes into account of the number of record hits, the number of URL hits, and the number of subscriptions, where record hits is the number of accesses to the project page hosted at Freshmeat.net, and URL hits is the number of accesses for every URL associated with a project that leads off of freshmeat.net to the download site of the project.

A lot of projects are listed with multiple intended audience and multiple topics. We select the projects with single intended audience and single topic. Thus 16442 projects are left in the sample, among which 118 projects have the topic of Internet. Table 1 lists the means and standard deviations of the quantitative variables.

Table 1
DESCRIPTIVE STATISTICS

	Sample of all projects		Subsample of Internet projects	
	Mean	S. D.	Mean	S. D.
Added (days ago)	1139	634	787	474
Last release (days ago)	1033	639	589	384
Vitality score	2.99	4.2	4.7	5.2
Popularity score	102	84	141	91
Number of subscriptions	2.7	4.2	4.8	4.7

METHODOLOGY AND RESULTS

We first investigate the sample of 118 open source projects developing Internet technology. We want to know in the area of Internet technology whether innovative efforts are allocated towards the projects using nonrestrictive licenses, controlling for age, current popularity, and intended audience of the projects.

To test the relation between programmer efforts and license choice, we estimate the following equation:

$$Vitality = \beta_0 + \beta_1 Age + \beta_2 Popularity + \beta_3 SA + \beta_4 EU + \beta_5 DE + \beta_6 License, \quad (1)$$

where Age is the days between the date of the first publication of the project and August 1, 2009 and Popularity is the score reflecting the number of hits and subscriptions. SA, EU, and DE represent three types of intended audience: System Administrator, End User, and Developer. License is equal to one if the project uses a restrictive license (GPL) and zero otherwise. The vitality score, which reflects the frequency of new releases, is a proxy for the programmer efforts devoted to the project. The vitality score for a project is calculated as:

$$\text{vitality score} = \frac{\text{number of releases} * \text{age}}{\text{days since last release}}$$

Table 2 lists the results of three regressions. Regression 1 in Table 2 shows the results of the regression of vitality score against age and popularity score. The estimated coefficient of Popularity is 0.02 (significant at the 1% level), indicating that the vitality of a project is positively related to its popularity. This suggests that more effort is devoted to the more popular projects. Therefore innovative effort is distributed efficiently towards widely used software.

Table 2
REGRESSION OF PROGRAMMER EFFORT AGAINST LICENSE TYPE [a]

	Regression 1	Std Error	Regression 2	Std Error	Regression 3	Std Error
Intercept	-0.19	(1.05)	-1.08	(1.13)	-0.11	(1.25)
Age	0.003*	(0.0009)	0.003*	(0.0009)	0.003*	(0.0009)
Popularity	0.02*	(0.001)	0.02*	(0.005)	0.02*	(0.005)
System Admin			3.59**	(1.62)	3.64**	(1.60)
End User			1.28	(1.06)	1.54	(1.06)
Developer			1.05	(1.46)	0.87	(1.45)
License					-1.59***	(0.90)

R^2	0.18	0.22	0.25
Adjusted R^2	0.17	0.19	0.21

*Significant at the 1% level **Significant at the 5% level ***Significant at the 10% level

a. These regressions use the subsample of 118 projects, for which the topic is Internet. The dependent variable is vitality score; standard errors are reported in parentheses.

Regression 2 in Table 2 includes three intended audience dummies: System Administrator, End User, and Developer to check if there is a difference in the effort devoted to projects geared toward different audiences among all Internet projects. The estimated coefficient of System Administrator is 3.59 (significant at the 5% level), indicating that there are more releases if the Internet project is aimed at system administrators. Programmers developing Internet technology publish more releases to system administrators than to audience in the baseline group, which includes advanced end users, quality engineers, and other audiences.

Regression 3 in Table 2 includes the license dummy to check the relationship between license type (equal to one if restrictive) and programmer effort. By the standardization hypothesis, there should be a negative relationship between license type and vitality. Contrarily, by the commercialization hypothesis, the relationship should be positive. In Regression 3 the estimated coefficient of the license dummy is significant and negative (-1.59). The results lend support to the standardization hypothesis. More effort is allocated to Internet projects under nonrestrictive licenses. This indicates that getting a larger number of users might be more important for these projects, even if there are risks of being "hijacked" by the private firms. For projects developing Internet technology, getting market acceptance is important for future standardization.

Next we use the whole sample of 16,442 open source projects to investigate the relation between various project topic and license choice. By the standardization hypothesis, projects with the topic of Internet tend to use nonrestrictive licenses. We use logistic regressions to test the hypothesis, where the dependent variable is the license dummy that is equal to one if the project is under a restrictive license (GPL), and zero otherwise. Table 3 lists the regression results.

Table 3
REGRESSION OF LICENSE TYPE AGAINST TOPIC AND INTENDED AUDIENCE [a]

	Regression 1	Std Error	Regression 2	Std Error	Regression 3	Std Error
Intercept	0.58*	(0.04)	0.46*	(0.04)	0.63*	(0.04)
Age	0.0003*	(0.00004)	0.0007*	(0.00003)	0.0003*	(0.00004)
End User	0.92*	(0.05)			0.96*	(0.05)
Developer	-1.11*	(0.06)			-1.17*	(0.06)
System admin	0.03	(0.09)			0.01	(0.09)
Desktop			-0.68*	(0.17)	-1.07*	(0.22)
Internet			-0.52*	(0.19)	-0.48***	(0.26)
Utility			0.07	(0.11)	0.23	(0.20)
Software			-1.27*	(0.12)	-1.53*	(0.37)
EU*Desk					0.07	(0.35)
EU*Int					-0.41	(0.47)
EU*Uti					-1.07*	(0.24)
Dev*Desk					1.35	(1.43)

Dev*Int		0.68	(0.62)
Dev*Uti		0.64	(0.51)
Dev*Soft		1.78*	(0.39)
SA*Int		0.06	(0.70)
SA* Uti		-0.18	(0.47)
*Significant at the 1% level **Significant at the 5% level ***Significant at the 10% level			
a. The regression uses the full sample of 16,442 projects. The dependent variable is a dummy that is equal to one if the project is under a restrictive license (GPL), and zero otherwise; standard errors are reported in the parentheses.			

Regression 1 in Table 3 reports the results of a logistic regression of license type against three Intended Audience dummies: System Administrator, End User, and Developer. The estimated coefficients of End User and Developer are 0.92 and -1.11, respectively (both significant at the 1% level), showing that projects geared towards end user tend to use restrictive licenses, while projects geared towards developer tend to use nonrestrictive licenses. This indicates that commercialization might be a more important goal for owners of open source projects aimed at end users, while network effects might be stronger for projects aimed at developers.

Regression 2 in Table 3 shows the results of a logistic regression of license type against four topic dummies: Desktop Environment, Internet, Utility, and Software Development. By the standardization hypothesis, there should be a negative relationship between license type and the topic of Internet. By the commercialization hypothesis, the relationship should be positive. In Table 3 Regression 2 the estimated coefficient of the Internet dummy is significant and negative (-0.52), providing support to the standardization hypothesis. Compared to projects in the baseline group with topics such as communications, multimedia, and others, projects with the topic of Internet are less likely to use restrictive licenses. The estimated coefficients of the Desktop dummy and the Software dummy are also significant and negative (-0.68 and -1.27, respectively), indicating that projects with topics of desktop environment and software development tend to use nonrestrictive licenses as well.

Regression 3 in Table 3 shows the results of a logistic regression of license type against intended audience, topic, and the interaction terms between them. The estimated coefficient of the topic of Internet is significant and negative (-0.48), indicating that projects with the topic of Internet is more likely to choose nonrestrictive licenses.

We summarize the results of Regression 3 in Table 3 to show the total effect of each variable on license choice. We get -0.97 for an Internet project aimed at developers by adding the coefficients of three variables: Internet (-0.48), Developer (-1.17), and the interaction term between Internet and Developer (0.68). Similarly, we get -0.41 for an Internet project aimed at system administrators, and 0.07 for an Internet project aimed at end users. This indicates that projects developing Internet technology tend to use nonrestrictive licenses when the intended audience is developer or system administrator. This finding is consistent with the standardization hypothesis. Internet projects tend to use restrictive licenses only when the intended audience is end user. This might be because projects aimed at end users have higher probability of future commercialization and will try to prevent the source code from being “hi-jacked” by private firms.

CONCLUSION

This study finds that for open source projects developing Internet technology, programmers devote more efforts to projects using nonrestrictive licenses. It also finds that projects with the topic of Internet are more likely to use a nonrestrictive license, especially when the intended audience is developer or system administrator. Both findings support network effects theory and the standardization hypothesis.

The main contribution of this research is in empirically testing the theory of the impact of open standards on open source license choice. It also complements earlier studies by analyzing a sample of open source projects focusing on Internet technology. It further uses logistic regressions to examine a larger sample of open source projects with various topics.

There are several limitations in this research that should be addressed in the future work. First, there are alternate theories to explain the license choice of open source projects, for example, the theory of signaling effects, i.e., programmers may get peer recognition and future job offers by working on open source projects (Lerner & Tirole, 2002). The regression results show that projects aimed at developers tend to use nonrestrictive licenses. This might indicate the existence of signaling effects. However, it is difficult to distinguish these effects using current data. Second, to understand the motivations behind programmers' decisions to devote their effort to a certain open source project, future research may need to collect subjective data. Third, future research need to better understand the mechanism for the emergence and establishment of new standards and the interactions between standards institutions and open source communities.

REFERENCES

Bresnahan TF & PL Yin (2007) Standard setting in markets: The browser war. In S. Greenstein & V Stango (Eds), *Standards and Public Policy* (pp. 18-59). Cambridge: Cambridge University Press.

Feller J & B Fitzgerald (2002) *Understanding open source software development*. London: Addison-Wesley.

Friedrich J (2011) Making innovation happen: the role of standards and openness in an innovation-friendly ecosystem. *Proceedings of the 7th International Conference on Standardization and Innovation in Information Technology*, 1-8.

Gamalielsson J, B Lundell, J Feist, T Gustavsson & F Landqvist (2015) On organisational influences in software standards and their open source implementations. *Information and Software Technology*, 67, 30-43.

Ghosh RA (2005) Open standards and interoperability report: An economic basis for open standards. Retrieved December 5, 2015, from http://www.flosspols.org/deliverables/FLOSSPOLS-D04-openstandards-v6.pdf

Lerner J & J Tirole (2002) Some simple economics of open source. *Journal of Industrial Economics*, 52, 197-234.

Lerner J & J Tirole (2005) The scope of open source licensing. *Journal of Law, Economics, and Organization*, 21(1), 20-56.

Lundvall B & AL Vinding (2004) Product innovation and economic theory-User-producer interaction in the learning economy. In JL Christensen & B. Lundvall (Eds), *Product Innovation, Interactive Learning and Economics Performance, Research on Technological Innovation and Management Policy (*pp.101-128). Vol.8. Bingley: Emerald Group Publishing Limited.

Raymond ES (2000) The cathedral and the bazaar (Revision 1.57)Retrieved November 20, 2015, from http://www.catb.org/esr/writings/cathedral-bazaar/cathedral-bazaar/

Stewart KJ, AP Ammeter & LM Maruping (2006) Impact of license choice and organizational sponsorship on success in open source software development projects. *Information System Research*, 17 (2), 126-144.

Subramaniam C, R Sen & ML Nelson (2009) Determinants of open source software project success: A longitudinal study. *Decision Support Systems*, 46(2), 576-585.

Von Hippel E (2002) Open source projects as horizontal innovation networks - By and for users. MIT Sloan Working Paper No. 4366-02.

MOBILE TELEPHONY: WHAT ARE THE INFLUENCING FACTORS OF USING A MOBILE PHONE IN CAMEROON?

Gérard Fillion, University of Moncton
Jean-Pierre Booto Ekionea, University of Moncton

ABSTRACT

Individual adoption of technology has been studied extensively in the workplace (Brown & Venkatesh, 2005). But far less attention has been paid to adoption of technology in the household (Brown & Venkatesh, 2005). Obviously, mobile phone is now integrated into our daily life. Indeed, according to a forecast from International Data Corporation (IDC), the market was supposed to grow from 26% to reach 1.288 billion mobile phones sold in the world in 2014 (ZDNet, 2015). But the carriers made better than the IDC's forecast with 1.3 billion mobile phones delivered in the world in 2014, that is, an annual growing of 27.6% (ZDNet, 2015). In 2013, the carriers delivered more than one billion mobile phones in the world, representing a 38.2% growth comparatively to 2012 (725.8 millions) (ZDNet, 2015). In addition, according to Cisco, one of the greatest global networking companies, there will be 5.2 billion mobile phone users in the world by 2017 while the population will be reaching 7.6 billion people (Ferland, 2013). The purpose of this study is then to pursue the investigation on the determining factors that make such people around the world are so using the mobile phone. On the basis of the moderator-type research model developed by Brown and Venkatesh (2005) to verify the determining factors in intention to adopt a computer in household by American people, this study examines the determining factors in the use of mobile phone in household by Cameroonian people. Data were randomly gathered from 505 Cameroonian people (from Yaounde and Douala; the two more important cities in Cameroon) who own a mobile phone. Data analysis was performed using the structural equation modeling software Partial Least Squares (PLS). The results revealed, among others, that half of the variables examined in the study showed to be determining factors in the use of mobile phone by Cameroonian people.

INTRODUCTION

Since numerous years, mobile phone is used for different professional purposes, particularly by senior managers in the workplace. And this technology is more and more used in the workplace since mobile applications have been integrated to enterprise business strategies. Individual adoption of technology has been studied extensively in the workplace (Brown & Venkatesh, 2005). But far less attention has been paid to adoption of technology in the household (Brown & Venkatesh, 2005). Obviously, mobile phone is now integrated into our daily life. Indeed, according to a forecast from International Data Corporation (IDC), the market was supposed to grow from 26% to reach 1.288 billion mobile phones sold in the world in 2014 (ZDNet, 2015). But the carriers made better than the IDC's forecast with 1.3 billion mobile phones delivered in the world in 2014, that is, an annual growing of 27.6% (ZDNet, 2015). In 2013, the carriers delivered more than one billion mobile phones in the world, representing a 38.2% growth comparatively to 2012 (725.8 millions) (ZDNet, 2015). In addition, according to Cisco, one of the greatest global networking companies, there will be 5.2 billion mobile phone

users in the world by 2017 while the population will be reaching 7.6 billion people (Ferland, 2013). So about 70% people worldwide will be using a mobile phone by 2017.

Few studies have been conducted until now which investigate the intention to adopt a mobile phone by people in household (in the case of those who do not yet own a mobile phone) or the use of mobile phone in the everyday life of people in household (in the case of those who own a mobile phone). Yet we can easily see that mobile phone is actually completely transforming the ways of communication of people around the world. It is therefore crucial to more deeply investigate the determining factors in the use of mobile phone by people in household. The purpose of this study is then to pursue this investigation of the determining factors that make such people around the world are so using the mobile phone. The related literature on the actual research area of mobile phone is summarized in Table 1.

Table 1
RELATED LITERATURE SURVEY
(ADAPTED FROM ISIKLAR AND BÜYÜKÖZHAN, 2007, P. 267; AND UPDATED)

Research Areas	***References***
Mobile phone diffusion and its impacts on people's daily life.	LaRose (1989) Kwon & Chidambaram (2000) Botelho & Costa Pinto (2004) Funk (2005) Andonova (2006) Centrone et al. (2007) Ehlen & Ehlen (2007) Fillion & Berthelot (2007) Fillion & Le Dinh (2008) Kurniawan (2008) Abu & Tsuji (2010) Sripalawat et al. (2011) Abdul-Karim et al. (2010) Fillion & Booto Ekionea (2010) Glajchen (2011) Kuznekoff & Titsworth (2013) Kwun et al. (2013) De Matos et al. (2014) Suyinn et al. (2014) Takao (2014) Velmurugan & Velmurugan. (2014) Paul et al. (2015)
Mobile phone ownership and usage.	LaRose (1989) Kwon & Chidambaram (2000) Palen et al. (2000) Aoki & Downes (2003) Selwyn (2003) Davie et al. (2004) Mazzoni et al. (2007) Peters et al. (2007) Tucker et al. (2007) Sohn & Kim (2008) Wessels & Drennan (2010) Chong et al. (2010) Fillion & Booto Ekionea (2010) Gebauer et al. (2010) Wesolowski et al. (2012)

	Kwun et al. (2013) De Matos et al. (2014) Kim & Park (2014) Saaksjarvi et al. (2014) Suyinn et al. (2014) Takao (2014) Velmurugan & Velmurugan (2014) Paul et al. (2015)
Mobile phone ownership and usage from a behavioral and psychological perspective.	Karjaluoto et al. (2003) Wilska (2003) Davie et al. (2004) Liljander et al. (2007) White et al. (2007) Butt & Phillips (2008) Abu & Tsuji (2010) Kimiloglu et al. (2010) Lane & Manner (2011) Kim & Park (2014) Suyinn et al. (2014) Takao (2014)
Effects on human health and daily activities.	Repacholi (2001) Salvucci & Macuga (2002) Weinberger & Richter (2002) Sullman & Baas (2004) Treffner & Barrett (2004) Westerman & Hocking (2004) Balik et al. (2005) Balikci et al. (2005) Eby et al. (2006) Rosenbloom (2006) Törnros & Bolling (2006) Cocosila & Archer (2010) Kuznekoff & Titsworth (2013) Suyinn et al. (2014) Paul et al. (2015)
Evaluation and design of mobile phone features for user interface and user satisfaction.	Chuang et al. (2001) Chen et al. (2003) Han & Wong (2003) Chae & Kim (2004) Han et al. (2004) Lee et al. (2006) Kimiloglu et al. (2010) Haverila (2011) Saaksjarvi et al. (2014)
Analytical evaluations of mobile phone-related observations.	Tam & Tummala (2001) Campbelland Russo (2003) Han & Wong (2003) Wang & Sung (2003) Lai et al. (2006) Haque et al. (2010) Liu (2010)
Comparative analysis on the use of mobile phone according to the cultures.	Zhang & Maruping (2008) Lee & Lee (2010) Wesolowski et al. (2012) Kim & Park (2014)

	Takao (2014) Velmurugan & Velmurugan (2014)
New mobile phone generation on the form of mobile computer and virtual life.	Brown (2008) Hurlburt et al. (2011) Murugesan (2011) Kwun et al. (2013) De Matos et al. (2014)

In addition to the summary of literature on the actual research area of mobile phone presented in Table 1, other researchers have identified some factors which may increase the use of mobile phone by people in household. For example, in a large study conducted in 43 countries of the world, Kauffman and Techatassanasoontorn (2005) noted a faster increase in the use of mobile phone in countries having a more developed telecommunications infrastructure, being more competitive on the wireless market, and having lower wireless network access costs and less standards regarding the wireless technology. Another study involving 208 users by Wei (2007) showed that different motivations predict diverse uses of mobile phone. According to the Wei's findings, mobile phone establishes a bridge between interpersonal communication and mass communication. A large study conducted by Abu and Tsuji (2010) in 51 countries classified by the *Banque Mondiale* revealed that, in general, income is a very important factor to adopt a mobile phone in the countries having a fix telephone infrastructure. And, in a study examining the effect of peer influence in the diffusion of the iPhone 3G across a number of communities sampled from a large dataset provided by a major European Mobile carrier in one country, De Matos et al. (2014) found that, during a period of 11 months, 14% of the iPhone 3Gs sold by this carrier were due to peer influence.

As we can see in the summary of literature related to mobile phone presented above, few studies until now examined the determining factors in the use of mobile phone by people in household. Thus, the present study brings an important contribution to fill this gap as it allows a better understanding of the impacts of mobile phone usage into people's daily life. It focuses on the following research question: What are the determining factors in the use of mobile phone by people in household?

The paper builds on the conduct of hypothetico-deductive scientific research in organizational sciences (see Fillion, 2004) and it is structured as follows: first, the theoretical approach which guides the study is developed; second, the methodology followed to conduct the study is described; finally, the data analysis and the results of the study are presented and discussed.

THEORETICAL DEVELOPMENT

This study is based on the theoretical foundations developed by Venkatesh and Brown (2001) to investigate the factors driving personal computer adoption in American homes as well as those developed by Brown and Venkatesh (2005) to verify the determining factors in intention to adopt a personal computer in household by American people. In fact, Brown and Venkatesh (2005) performed the first quantitative test of the recently developed model of adoption of technology in households (MATH) and they proposed and tested a theoretical extension of MATH integrating some demographic characteristics varying across different life cycle stages as moderating variables. With the exception of behavioral intention (we included user satisfaction instead given people investigated in this study already own a mobile phone), all the variables

proposed and tested by Brown and Venkatesh (2005) are used in this study. And we added two new variables in order to verify whether people are using mobile phone for matters of security and mobility. The resulting theoretical research model is depicted in Figure 1.

Figure 1
Theoretical Research Model

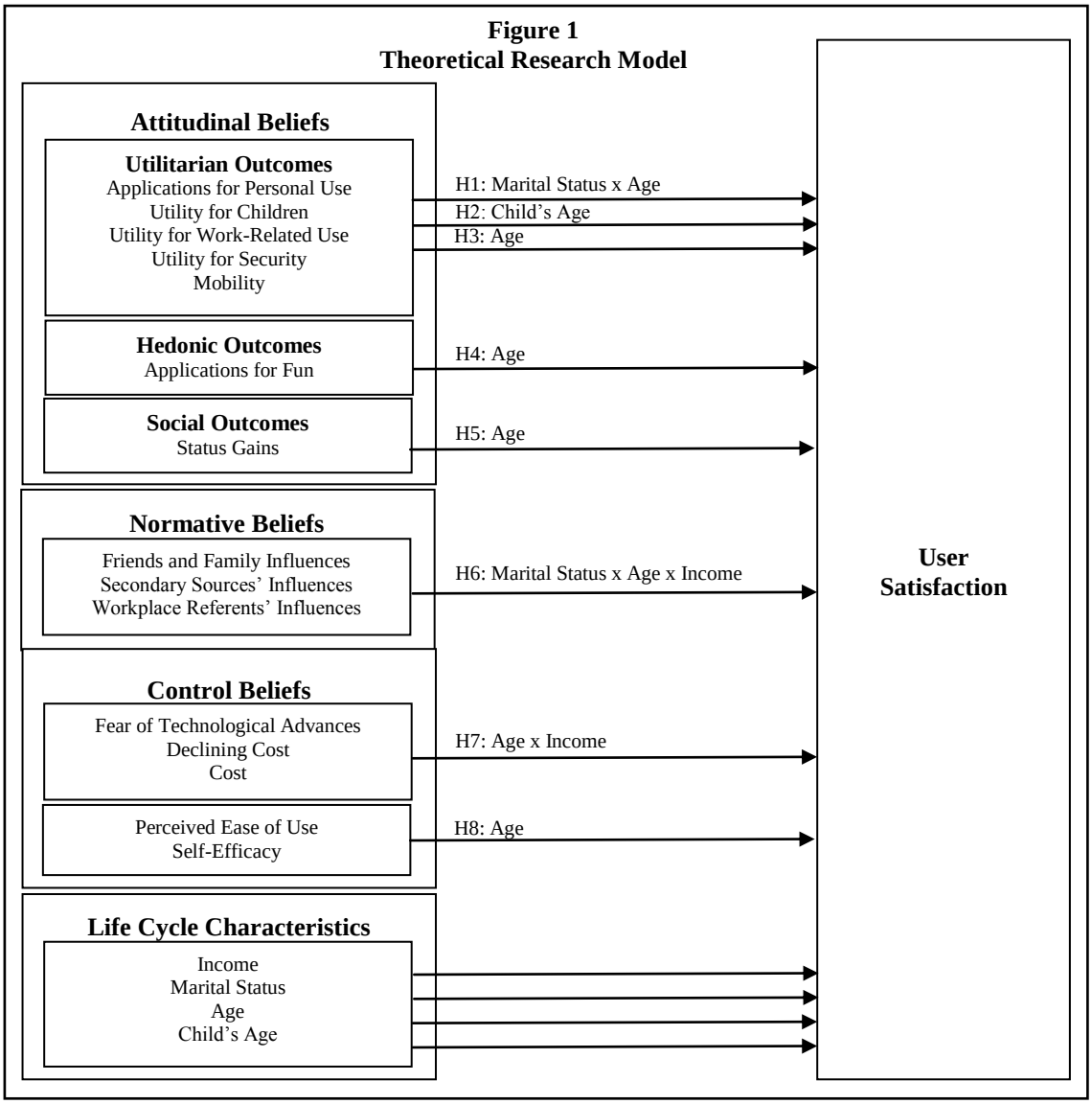

Figure 1 shows that Brown and Venkatesh (2005) integrated MATH and Household Life Cycle in the following way. MATH presents five attitudinal beliefs grouped into three sets of outcomes: *utilitarian*, *hedonic*, and *social*. Utilitarian beliefs are most consistent with those found in the workplace and can be divided into beliefs related to *personal use*, *children*, and *work* (we added beliefs related to *security* and *mobility*). The extension of MATH suggested and tested by Brown and Venkatesh (2005) presents three normative beliefs: *influence of friends and family*, *secondary sources*, and *workplace referents*. As for control beliefs, they are represented in MATH by five factors: *fear of technological advances*, *declining cost*, *cost*, *perceived ease of use*, and *self-efficacy*. And, according to Brown and Venkatesh (2005), integrating MATH with a life cycle view, including *income*, *age*, *child's age*, and *marital status*, allows to provide a richer

explanation of household personal computer (PC) adoption (household mobile phone usage in this study) than those provided by MATH alone. Finally, as shown in Figure 1, the dependant variable of the theoretical research model developed is related to *user satisfaction* (satisfaction in the use of mobile phone by people in household). All the variables integrated into the theoretical research model depicted in Figure 1 are defined in Table 2.

We can see in Table 2 that the definitions of MATH variables integrated into the theoretical research model proposed in Figure 1 are, in the whole, adapted from the theoretical foundations developed by Venkatesh and Brown (2001) to investigate the factors driving personal computer adoption in American homes. As for the definitions of the variables related to the household life cycle, they were taken from Danko and Schaninger (1990) as well as Wagner and Hanna (1983), respectively. And the definitions of the two new independent variables that we added to the model are from Fillion and Berthelot (2007).

In the reminder of the section, we develop eight research hypotheses (H1-H8) related to the theoretical research model suggested in Figure 1. It is important here to note that these eight research hypotheses are adapted from the Brown and Venkatesh (2005) paper. In fact, in the present study, we test the same research hypotheses than Brown and Venkatesh (2005) did in their study, but using a different technology (mobile phone instead of personal computer), a different dependent variable (user satisfaction instead of behavioral intention), a different methodology (an in-person randomized survey instead of a nationwide survey with the assistance of a market research firm and an electronics retail store), and a different sample (African people instead of American people).

As mentioned previously, MATH presents five attitudinal beliefs grouped into three sets of outcomes: *utilitarian*, *hedonic*, and *social*. Utilitarian beliefs are most consistent with those found in the workplace and can be divided into beliefs related to *personal use*, *children*, and *work*. Personal use related to mobile phone can include tasks such as personal calls, Internet browsing, files, videos, or photos sharing or downloading, discussions on social media (Facebook, Twitter…), and so on. A focus on household utility is suggestive of a more well-established, responsible household. Brown and Venkatesh (2005) showed that marital status moderates the relationship between applications for personal use and intention to adopt a PC for household use. Another study by Fillion and Booto Ekionea (2010) revealed that marital status has an influence on the relationship between applications for personal use and satisfaction of using a mobile phone by people in household. So we would expect to see also an influence of the marital status on the relationship between applications for personal use and household satisfaction of using a mobile phone in the present study.

Table 2
VARIABLES AND DEFINITIONS

Beliefs and Characteristics	***Variables***	***Definitions***
Attitudinal Beliefs (independent variables)	Applications for Personal Use	The extent to which using a mobile phone enhances the effectiveness of household activities (adapted from Venkatesh & Brown, 2001).
	Utility for Children	The extent to which using a mobile phone enhances the children's effectiveness in their activities (adapted from Venkatesh & Brown, 2001).
	Utility for Work-Related Use	The extent to which using a mobile phone enhances the effectiveness of performing work-related activities (adapted from Venkatesh & Brown, 2001).

	Utility for Security	The extent to which using a mobile phone increases the security of its user and his/her family (Fillion & Berthelot, 2007).
	Mobility	The extent to which a mobile phone allows to use only this telephone to perform all personal and professional activities (Fillion & Berthelot, 2007).
	Applications for Fun	The pleasure derived from mobile phone use (adapted from Venkatesh and Brown, 2001). These are specific to mobile phone usage, rather than general traits (adapted from Brown & Venkatesh, 2005; see Webster & Martocchio, 1992, 1993).
	Status Gains	The increase in prestige that coincides with the purchase of a mobile phone for home use (adapted from Venkatesh & Brown, 2001).
Normative Beliefs (independent variables)	Friends and Family Influences	"The extent to which the members of a social network influence one another's behavior" (Venkatesh & Brown, 2001, p. 82). In this case, the members are friends and family (Brown & Venkatesh, 2005).
	Secondary Sources' Influences	The extent to which information from TV, newspaper, and other secondary sources influences behavior (Venkatesh & Brown, 2001).
	Workplace Referents' Influences	The extent to which coworkers influence behavior (Brown & Venkatesh, 2005; see Taylor & Todd, 1995).
Control Beliefs (independent variables)	Fear of Technological Advances	The extent to which rapidly changing technology is associated with fear of obsolescence or apprehension regarding a mobile phone purchase (adapted from Venkatesh & Brown, 2001).
	Declining Cost	The extent to which the cost of a mobile phone is decreasing in such a way that it inhibits adoption (adapted from Venkatesh & Brown, 2001).
	Cost	The extent to which the current cost of a mobile phone is too high (adapted from Venkatesh & Brown, 2001).
	Perceived Ease of Use	The degree to which using the mobile phone is free from effort (Davis, 1989; also adapted from Venkatesh & Brown, 2001).
	Self-Efficacy (or Requisite Knowledge)	The individual's belief that he/she has the knowledge necessary to use a mobile phone. This is closely tied to computer self-efficacy (Compeau & Higgins, 1995a, 1995b; see also Venkatesh & Brown, 2001).
Life Cycle Characteristics (moderator variables)	Income	The individual's year gross income (see Wagner & Hanna, 1983).
	Marital Status	The individual's family status (married, single, divorced, widowed, etc.) (see Danko & Schaninger, 1990).
	Age	The individual's age (see Danko & Schaninger, 1990). In this case, age is calculated from the individual's birth date.
	Child's Age	The age of the individual's youngest child (see Danko & Schaninger, 1990). In this case, age is represented by a numeral.

Further, research as shown that age is significantly positively associated with a greater emphasis on *utilitarian outcomes*, while *income* is not (Morris & Venkatesh, 2000). The study from Brown and Venkatesh (2005) concluded that age moderates the relationship between applications for personal use and intention to adopt a PC for household use. And the study conducted by Fillion and Booto Ekionea (2010) showed that age has an influence on the relationship between applications for personal use and satisfaction of using a mobile phone by people in household. Thus, as for marital status, we expect that applications for personal use will also interact with age to impact household satisfaction of using a mobile phone.

HYPOTHESIS 1 (H1). *Marital status and age will moderate the relationship between applications for personal use and satisfaction of using a mobile phone at home.*

Children's needs differ from those of adults and will likely change as children age. For products that are important to them and about which they have knowledge, children can exert significant influence on the purchase decisions (Foxman et al., 1989). Further, child's age is positively correlated with the degree of influence in purchase decisions (Atkin, 1978; Mangleburg, 1990; Nelson, 1978; Ward & Wackman, 1972). Likewise, as children enter school and progress through their education, their needs change. In their study, Brown and Venkkatesh (2005) found child's age as a moderator of the relationship between utility for children and intention to adopt a PC for household use. So, we expect that utility for children will also interact with child's age to impact household satisfaction of using a mobile phone.

HYPOTHESIS 2 (H2). *Child's age will moderate the relationship between utility for children and satisfaction of using a mobile phone at home.*

Generally, as people age their position within the organization tends to raise (Schaninger & Danko, 1993; Wells & Gubar, 1966). A by-product of the rising organizational position is increased e-mail use (Rice & Shook, 1988). Increasingly, these work-related tasks are performed at home (Feldman & Gainey, 1997; Morrow, 1999; Venkatesh & Vitalari, 1992), whether using a PC or a mobile phone. The study conducted by Brown and Venkatesh (2005) indicated that age moderates the relationship between utility for work-related use and intention to adopt a PC for household use. Further, the study performed by Fillion and Booto Ekionea (2010) showed that the moderator variable age has an influence on the relationship between utility for work-related use and satisfaction of using a mobile phone by people in household. Thus, in the present study, we expect that utility for work-related use will also interact with age to impact household satisfaction of using a mobile phone.

HYPOTHESIS 3 (H3). *Age will moderate the relationship between utility for work-related use and satisfaction of using a mobile phone at home.*

Beyond utilitarian applications, as for household PC use, mobile phone use could be for *hedonic purposes*. The role of fun has received some concern in the technology adoption literature via constructs such as enjoyment (Davis et al., 1992; Venkatesh, 2000) and playfulness (Webster & Martocchio, 1992). Although in workplace settings the role of fun has been downplayed, applications for fun (*hedonic outcomes*) have been shown to be particularly relevant in the context of household PC adoption (Malone, 1981; Venkatesh & Brown, 2001). As mentioned by Brown and Venkatesh (2005), age is expected to moderate this relationship given the evidence that younger people tend to be likely using technology as an end in itself (Assael, 1981; Brancheau & Wetherbe, 1990) when compared to older people who evaluate utility more closely (Morris & Venkatesh, 2000). Using technology for its own sake is an indication that an individual is intrinsically motivated to use the technology (Davis et al., 1992). The tendency to use technology for its own sake ties closely to the affective components which are the essence of enjoyment and fun. So, in their study, Brown and Venkatesh (2005) found age as a moderator of the relationship between applications for fun and intention to adopt a PC for household use.

Therefore, we expect that it will be the same regarding the relationship between applications for fun and satisfaction of using a mobile phone at home.

HYPOTHESIS 4 (H4). *Age will moderate the relationship between applications for fun and satisfaction of using a mobile phone at home.*

As pointed out by Brown and Venkatesh (2005), while results have been mixed, earlier technology adopters are generally younger than later adopters (Brancheau & Wetherbe, 1990; Rogers, 1995). According to Rogers (1995), innovators are more strongly influenced by *status outcomes* than are later adopters. So this assertion from Rogers take a great importance in the present study given, as mentioned earlier, according to Cisco, one of the greatest global networking companies, there will be 5.2 billion mobile phone users in the world by 2017 while the population will be reaching 7.6 billion people (Ferland, 2013). In their study, Brown and Venkatesh (2005) found an opposite direction to those predicted in their hypothesis, that is, the observed relationship was such that the influence of status gains on intention to adopt a PC in household increased with age. And, contrary to their expectations, the moderator variable age had not an influence on the relationship between status gains and satisfaction of using a mobile phone by people in household in the study conducted by Fillion and Booto Ekionea (2010). But, as these studies have been performed with American and Canadian people, respectively, we expect that it will be different with African people so that the independent variable status gains will interact with the moderator variable age to impact their satisfaction of using a mobile phone at home.

HYPOTHESIS 5 (H5). *Age will moderate the relationship between status gains and satisfaction of using a mobile phone at home.*

The extension of MATH, such as proposed by Brown and Venkatesh (2005), presents three normative beliefs: *influence of friends and family*, *secondary sources*, and *workplace referents*. Childers and Rao (1992) suggest that socially proximal referents are important for the consumption of luxury goods. Since luxury goods are those not commonly owned or necessary (Childers & Rao, 1992), and only about half of the households own a PC (Venkatesh & Brown, 2001) [it is important to note that the percentage of households owning a PC is a lot higher actually, probably near from 100%, given household people are more and more active on the Internet (Facebook, Twitter, YouTube, Skype, e-mail, buying goods and services, and so on), and the PC cost has dramatically decreased since few years], Brown and Venkatesh (2005) classify PCs as luxuries. For these reasons, we think that PCs can no longer be classified today as luxuries. On the other hand, in our view, mobile phones can be classified as luxuries given their costs are higher than PCs and their monthly operation costs are also very expensive. But, it is a different scenario regarding African people (people which are investigated in the present study). Indeed, as the fix telephone infrastructure is very bad in Africa, African people must own a mobile phone. It is absolutely necessary to communicate with their families, friends, and other people. So, it is why more and more, if not all, African people have a mobile phone. Hence, although it can be considered as luxury, African people must own a mobile phone to communicate.

Thus, influence of friends and family members should be important in satisfaction of using a mobile phone at home. Secondary sources are thought to play a role throughout the

adoption and diffusion process (Rogers, 1995). We think that it will be the same regarding workplace referents. In terms of the life cycle variables, age, marital status, and child's age have each moderate the impact of social referents on intention to purchase a PC for home use (Brown & Venkatesh, 2005). In our view, it will be the same regarding the mobile phone. We also think that income will moderate the impact of social referents on satisfaction of using a mobile phone at home. The study performed by Brown and Venkatesh (2005) showed that age, marital status, and income moderated the relationship between friends and family influences and secondary sources' influences, and intention of American people to adopt a PC for household use. And those conducted by Fillion and Booto Ekionea (2010) concluded that age, marital status, and income moderated the relationship between secondary sources' influences and workplace referents' influences, and satisfaction of using a mobile phone at home by Canadian people. So, we expect that it will be the same in the present study involving the mobile phone household use by African people.

HYPOTHESIS 6 (H6). *Age, marital status, and income will moderate the relationship between the normative beliefs ((a) friends and family influences; (b) secondary sources' influences; and (c) workplace referents' influences) and satisfaction of using a mobile phone at home.*

Control beliefs are represented in MATH by five factors: *fear of technological advances, declining cost, cost, perceived ease of use*, and *requisite knowledge*. Control beliefs include external and internal factors depending on whether they are constraints tied to the environment or cognitive/ability effort (Venkatesh, 2000). The first three factors (*fear of technological advances, declining cost*, and *cost*) are external, and the latter two (*perceived ease of use* and *requisite knowledge*) are internal. The external constraints reflect the reactions to technology change and cost characteristics and are, in essence, characteristics of the PC (or mobile phone) and its environment. Overall, we would expect that income has an impact on the cost-related issues due to the price sensitivity and overall price/deal consciousness (Vakratsas, 1998). Age also plays a role on issues of obsolescence due to heightened price sensitivity. Brown and Venkatesh (2005) found in their study that age and income moderated the relationship between fear of technological advances, declining cost and cost, and intention to adopt a PC for household use by American people. Surprisingly, the study conducted by Fillion and Booto Ekionea (2010) showed no significant moderating effect of age and income on the relationship between fear of technological advances, declining cost and cost, and satisfaction of using a mobile phone at home by Canadian people. So, we expect that it will be different in the present study involving African people.

HYPOTHESIS 7 (H7). *Age and income will moderate the relationship between the external control beliefs ((a) fear of technological advances; (b) declining cost; and (c) cost) and satisfaction of using a mobile phone at home.*

As noted earlier, perceived ease of use and requisite knowledge (or self-efficacy) are internal factors. Consistent with MATH (Venkatesh & Brown, 2001), perceived ease of use and self-efficacy reflect perceptions of the individual's relationship with the technology: Is it easy to use and do they know enough to use it well? The effects of perceived ease of use and self-efficacy on the intention to adopt a PC by American people have been moderated by age in the study performed by Brown and Venkatesh (2005). And, in the study conducted by Fillion and

Booto Ekionea (2010), age moderated the relationship between self-efficacy and satisfaction of using a mobile phone by Canadian people. The theoretical rationale for the increasing importance of perceived ease of use and self-efficacy with age is related to the difficulty of processing visual cues (Kline & Schieber, 1982) and functioning in complex information environments (Plude & Hoyer, 1985). So, as Brown and Venkatesh (2005) as well as Fillion and Booto Ekionea (2010), we expect that the last two control beliefs, that is, perceived ease of use and self-efficacy, will be moderated by age in the present study involving African people.

HYPOTHESIS 8 (H8). *Age will moderate the relationship between the internal control beliefs ((a) perceived ease of use; and (b) self-efficacy) and satisfaction of using a mobile phone at home.*

In the next section of the paper, we describe the methodology followed to conduct the study.

METHODOLOGY

This study was designed to gather information on mobile phone adoption decisions in Cameroonian households. Indeed, the focus of the study is on individuals who own a mobile phone. So we conducted in-person survey research with individuals of the two more important cities in Cameroon, Yaounde and Douala. In this section, we describe the instrument development and validation, the sample and data collection, as well as the data analysis process.

Instrument Development and Validation

To conduct the study, we used the survey instrument developed and validated by Brown and Venkatesh (2005) to which we added three new scales, the first two measuring other dimensions in satisfaction in the use of mobile phone by people in household, that is, utility for security and mobility, and the last one measuring user satisfaction as such. The survey instrument was then translated in French (a large part of the population in Cameroon is speaking French) and both the French and English versions were evaluated by peers. This review assessed face and content validity (see Straub, 1989). As a result, changes were made to reword items and, in some cases, to drop items that were possibly ambiguous, consistent with Moore and Benbasat's (1991) as well as DeVellis's (2003) recommendations for scale development. Subsequent to this, we distributed the survey instrument to a group of 25 MBA students for evaluation. Once again, minor wording changes were made. Finally, we performed some adjustments to the format and appearance of the instrument, as suggested by both peers and MBA students. As the instrument was already validated by Brown and Venkatesh (2005) and showed to be of a great reliability, that we used the scale developed by Hobbs and Osburn (1989) and validated in their study as well as in several other studies to measure user satisfaction, and that we added only few items to measure the new variables utility for security and mobility, then we have not performed a pilot-test with a small sample. The evaluations by both peers and MBA students were giving us some confidence that we could proceed with a large-scale data collection.

Sample and Data Collection

First, in this study, we chose surveying people in household over 18 years taken from the two more important cities in Cameroon Africa (Yaounde and Douala) who own a mobile phone. To do that, a graduate student studying at the Faculty of administration of the University of Moncton, one of our colleagues from the University of Yaounde I, and a friend of our colleague in Yaounde were collecting data in-person. One at a time over a 3- to 4-hour period, the three responsible to collect data were soliciting people in-person to answer our survey. And, in order to get a diversified sample (e.g., students, retired people, people not working, people working at home, people working in enterprises, and so on), data were collected from 9 a.m. to 9 p.m. Monday through Friday over a 6-week period. People answering our survey were randomly selected in the streets, in the stores, and in the houses of the two Cameroonian cities chosen for the study by the three responsible to collect data. The sample in the present study is then a randomized sample, which is largely valued in the scientific world given the high level of generalization of the results got from such a sample. Once an individual had the necessary characteristics to answer the survey and was agreeing to answer it, a responsible was there to guide him/her to rate each item of the survey on a seven points Likert-type scale (1: strongly disagree… 7: strongly agree). In addition, the respondent was asked to answer some demographic questions. Finally, it is important here to mention that no incentive has been used in order to try increasing the response rate of the study. So, following this data collection process, 505 people in household answered our survey over a 6-week period.

Data Analysis Process

The data analysis of the study was performed using a structural equation modeling software, that is, Partial Least Squares (PLS-Graph 3.0). Using PLS, data have no need to follow a normal distribution and it can easily deal with small samples if the sample is at least 10 times greater than the number of items measuring the variable having the greatest weight in terms of items into the model (Barclay et al., 1995; Fornell & Bookstein, 1982). Recently, some authors (see Goodhue et al., 2012) tried to refute this evidence but, in our view, they did not succeed well. In addition, PLS is appropriate when the objective is a causal predictive test instead of the test of a whole theory (Barclay et al., 1995; Chin, 1998) as it is the case in this study. And, to ensure the stability of the model developed to test the research hypotheses, we used the PLS bootstrap resampling procedure (the interested reader is referred to a more detailed exposition of bootstrapping (see Chin 1998; Chin et al. 2003; Efron & Tibshirani, 1993)) with an iteration of 100 sub-sample extracted from the initial sample (505 Cameroonian people). Some analyses were also performed using the Statistical Package for the Social Sciences software (SPSS 13.5). The data analysis and the results follow.

DATA ANALYSIS AND RESULTS

In this section of the paper, the data analysis and the results of the study are presented. We begin to provide some characteristics of the participants. Then we validate the PLS model developed to test the research hypotheses. Finally, we describe the results got from PLS analyses to test the research hypotheses and we discuss about some implications.

Participants

The participants in this study were not relatively aged, with a mean of 30 years and a standard deviation of 11 years. More than half of the participants were male (54.2%). More than 80% of the participants were single (57.9%) or married (28.5%). The gross yearly income of the respondents in the study was in the range of $0 to $5 445 (0 to 2 750 000 CFA francs). Indeed, 78.9% of the respondents were winning between $0 and $1 979 (0 and 1 000 000 CFA francs), and, from this percentage, 67.6% were winning between $0 and $989 (0 and 500 000 CFA francs). And only 3% of the respondents in the study were winning between $4 950 and $5 445 (2 500 000 and 2 750 000 CFA francs). Concerning the level of education, 15.4% of the participants in the study got a high-school diploma, 11.1% had a college degree, 36.6% completed a baccalaureate, 23.6% got a master, and 5.7% got a doctorate. The percentage of participants having a doctorate is very surprising here since it is three times higher than in a similar previous study conducted in Canada (see Fillion & Booto Ekionea, 2010). Finally, the respondents were mainly students (36.4%), full-time employees (19.7%), self-employed (13.1%), unemployed (12.9%), part-time employees (10.5%), and volunteers (3%).

Validation of the PLS Model to Test Hypotheses

First, to ensure the reliability of a construct or a variable using PLS, one must verify the three following properties: individual item reliability, internal consistency, as well as discriminant validity (Yoo & Alavi 2001; see the paper for more details).

To verify individual item reliability, a confirmatory factor analysis (CFA) was performed on independent and dependent variables of the theoretical research model. A single iteration of the CFA was necessary given all loadings of the variables were superior to 0.50 and then none item was withdrawn nor transferred in another variable in which the loading would have been higher. Indeed, in the whole, items had high loadings, which suppose a high level of internal consistency of their corresponding variables. In addition, loadings of each variable were superior to cross-loadings with other variables of the model. Hence the first criterion of discriminant validity was satisfied.

And to get composite reliability indexes and average variance extracted (AVE) in order to satisfy the second criterion of discriminant validity and to verify internal consistency of the variables, we used PLS bootstrap resampling procedure with an iteration of 100 sub-sample extracted from the initial sample (505 Cameroonian people). The results are presented in Table 3.

Table 3
MEANS, STANDARD DEVIATIONS, COMPOSITE RELIABILITY INDEXES, CORRELATIONS, AND AVERAGE VARIANCE EXTRACTED OF VARIABLES

Variables	*M*	*SD*	*Relia-bility Indexes*	*Correlations and Average Variance Extracted*[d]																		
				1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
1. Applications for Personal Use	4.17	2.17	**0.85**	**0.81**																		
2. Utility for Children	4.21	2.10	**0.95**	.32	**0.93**																		
3. Utility for Work-Related Use	4.07	2.19	**0.86**	.45	.46	**0.82**																	
4. Utility for Security	4.71	2.03	**0.89**	.25	.23	.32	**0.86**																
5. Mobility	3.68	2.18	**0.93**	.36	.25	.29	.24	**0.90**															
6. Applications for Fun	4.75	2.03	**0.89**	.19	.08	.15	.23	.09	**0.82**														
7. Status Gains	2.87	2.07	**0.92**	.22	.25	.31	.35	.39	.20	**0.89**													
8. Friends and Family Influences	4.49	2.05	**0.93**	.25	,21	.25	.29	.28	.20	.33	**0.87**												
9. Secondary Sources' Influences	4.26	2.00	**0.93**	.26	.30	.30	.38	.33	.17	.31	.54	**0.90**											
10. Workplace Referents' Influences	4.65	2.06	**0.97**	.31	.33	.38	.23	.26	.10	.26	.53	.44	**0.97**										
11. Fear of Technological Advances	4.50	2.25	**0.89**	.19	.13	.22	.26	.24	.17	.28	.30	.30	.27	**0.89**									
12. Declining Cost	5.54	1.72	**0.86**	.18	.04	.09	.20	.16	.26	.05	.16	.12	.12	.18	**0.82**								
13. Cost	4.64	1.93	**0.66**	.18	.17	.20	.29	.24	.26	.16	.26	.34	.21	.24	.13	**0.66**							
14. Perceived Ease of Use	5.56	1.63	**0.88**	.16	.12	.19	.21	.16	.22	.03	.23	.13	.15	.13	.37	.20	**0.81**						
15. Self-Efficacy	5.82	1.61	**0.87**	.24	.15	.23	.25	.18	.21	.03	.29	.18	.20	.14	.35	.16	.64	**0.83**					
16. Income[a]	NA	NA	**NA**	.01	.22	.02	.05	.06	-.08	-.03	.07	.03	.11	.10	.03	.04	.10	.14	**NA**				
17. Marital Status[a]	NA	NA	**NA**	-.02	-.21	-.02	.04	.01	.17	-.04	-.07	-.05	-.15	-.01	.02	-.02	.04	-.01	-.02	**NA**			
18. Age[b]	30.13	10.63	**NA**	.06	-.01	.07	.05	.11	.14	.07	.17	.08	.06	.09	.05	.09	.06	.08	.04	-.02	**NA**		
19. Child's Age[c]	8.31	6.87	**NA**	0.0	.21	.03	.03	.03	-.11	.00	.13	.09	.10	.09	.00	.09	-.02	-.02	-.02	-.37	-.02	**NA**	
20. User Satisfaction	4.92	1.87	**0.88**	.29	.28	.31	.31	.40	.33	.29	.39	.39	.38	.28	.30	.30	.47	.46	.08	-.02	.08	.08	**0.73**

[a]This variable was coded as a nominal variable. It was measured in terms of non quantified distinct categories.
[b]This variable was coded as a continuous variable. It was measured using the respondents' birth date.
[c]This variable was coded using the age of the respondents' youngest child.
[d]Boldfaced elements on the diagonal of the correlation matrix represent the square root of the average variance extracted (AVE).
For an adequate discriminant validity, the elements in each row and column should be smaller than the boldfaced element in that row or column.

As shown in Table 3, PLS analysis shows that all square roots of AVE (boldfaced elements on the diagonal of the correlation matrix) are higher than the correlations with other variables of the model. In other words, each variable shares more variance with its measures than it shares with other variables in the model. As a result, discriminant validity is verified. Finally, as supposed previously, we can see in Table 3 that PLS analysis showed high composite

reliability indexes for all variables of the theoretical research model. The variables have therefore a high internal consistency, with composite reliability indexes ranging from 0.66 to 0.97.

Hypothesis Testing

first, to get the significant variables in the study and the percentage of variance explained (R^2 coefficient) by all the variables of the research model, we developed a PLS model similar to those of Fillion (2005), Fillion and Booto Ekionea (2010), Fillion et al. (2010), Limayem and DeSanctis (2000), and Yoo and Alavi (2001). And to ensure the stability of the model, we used the PLS bootstrap resampling procedure with an iteration of 100 sub-sample extracted from the initial sample (505 Cameroonian people). The PLS model is depicted in Figure 2.

Figure 2
PLS MODEL TO GET SIGNIFICANT VARIABLES AND PERCENTAGE OF VARIANCE EXPLAINED (ONE-TAILED TEST)

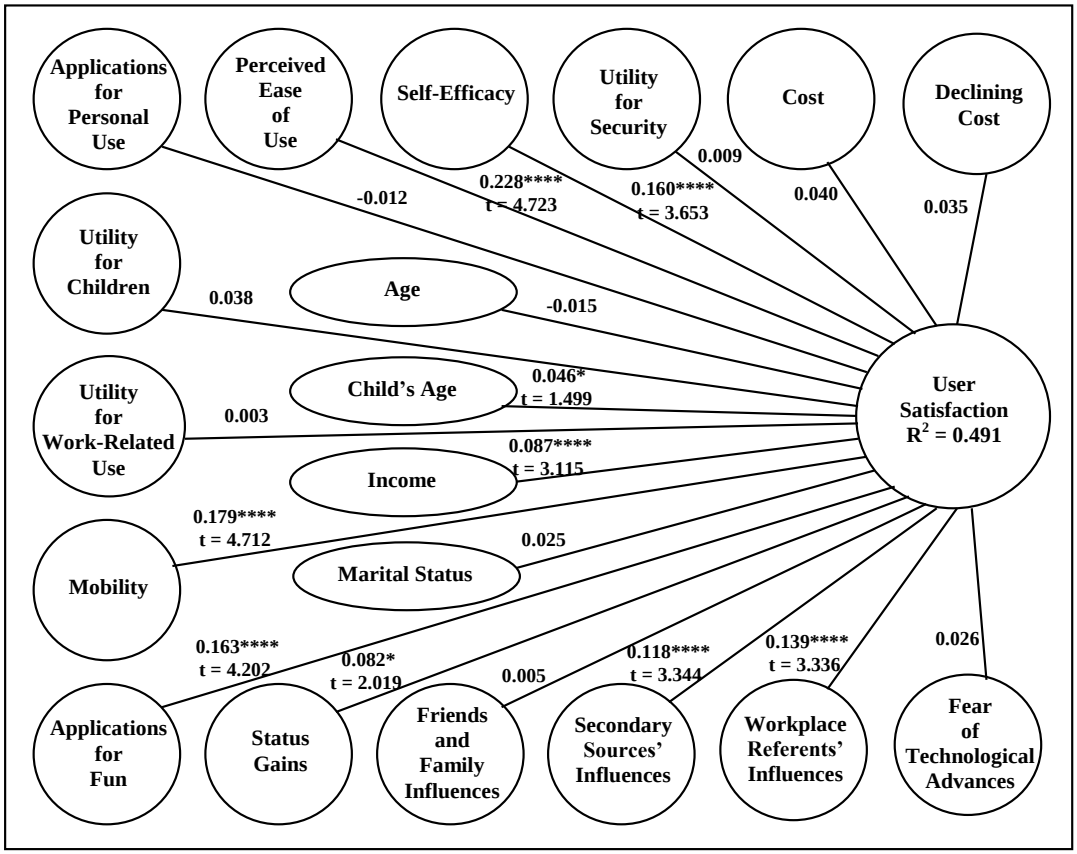

Figure 2 shows that all the variables of our theoretical research model, used as independent variables, are explaining 49.1% of the variance on the dependant variable user satisfaction. And half of these variables are significant, that is, they are determining factors in satisfaction of using a mobile phone by people in household. More specifically, the seven more significant variables are perceived ease of use ($t = 4.723$, beta = 0.228, $p < 0.001$), mobility ($t = 4.712$, beta = 0.179, $p < 0.001$), applications for fun ($t = 4.202$, beta = 0.163, $p < 0.001$), self-efficacy ($t = 3.653$, beta = 0.160, $p < 0.001$), secondary sources' influences ($t = 3.344$, beta =

0.118, $p < 0.001$), workplace referents' influences ($t = 3.336$, beta = 0.139, $p < 0.001$), and income ($t = 3.115$, beta = 0.087, $p < 0.001$). And two other variables are significant at the level of significance requested in this study, that is, $p \leq 0.05$. These are status gains ($t = 2.019$, beta = 0.082, $p < 0.05$) and child's age ($t = 1.499$, beta = 0.046, $p < 0.05$).

Finally, to measure interaction effect of moderator variables (e.g., the life cycle stage characteristics: income (I), marital status (MS), age (A), and child's age (CA)) in order to verify hypotheses 1 to 8, we used the PLS procedure proposed by Chin et al. (2003) (see the paper for more details). On the other hand, in a review of 26 papers assessing interaction effect of moderator variables published between 1991 and 2000 into information systems (IS) journals, Carte and Russell (2003) found nine errors frequently committed by researchers when they estimate such an effect, and provided solutions (see their paper for more details). So we tried to avoid these nine errors in applying their solutions to test hypotheses 1 to 8. Indeed, among others, in the verification of hypotheses 1 to 8 that follows, interaction effect of a moderator variable is significant if, and only if, the path between the latent variable (the multiplication of items of independent and moderator variables forming interaction effect) and the dependent variable is significant, as well as if the change in R^2 coefficient (the difference between the R^2 calculated before the addition of interaction effect and those calculated after the addition of interaction effect (ΔR^2, pronounced delta R^2)) is greater than 0.

For a matter of space, given that the test of hypotheses 1 to 8 required the development of several PLS structural equation models (two models per hypothesis, that is, 16 models), we summarize PLS analyses to test each hypothesis. And, as for the PLS model developed to get the significant variables in the study and the percentage of variance explained by all the variables of the theoretical research model previously (see Figure 2), for each PLS model developed, we used the PLS bootstrap resampling procedure with an iteration of 100 sub-sample extracted from the initial sample (505 Cameroonian people) to ensure the stability of the model.

Concerning hypothesis 1 related to the independent variable applications for personal use (APU), the path from the latent variable APU*MS*A to the dependent variable user satisfaction is significant ($t = 1.808$, beta = 0.156, $p < 0.05$) and there is a change in R^2 ($\Delta R^2 = 0.015$). Thus, as we expected, the moderator variables marital status and age have an influence on the relationship between applications for personal use and satisfaction of using a mobile phone by people in household. Also hypothesis 1 is supported. The scenario is similar for hypothesis 2 related to the independent variable utility for children (UC). The path from the latent variable UC*CA to the dependent variable user satisfaction is very significant ($t = 2.836$, beta = 0.181, $p < 0.001$) and there is a substantial change in R^2 ($\Delta R^2 = 0.014$). So, as we formulated in the hypothesis, the moderator variable child's age has an influence on the relationship between utility for children and satisfaction of using a mobile phone by people in household. As a result, hypothesis 2 is supported. For hypothesis 3 related to the independent variable utility for work-related use (UWRU), the path from the latent variable UWRU*A to the dependent variable user satisfaction is significant ($t = 2.333$, beta = 0.180, $p < 0.01$) and there is a change in R^2 ($\Delta R^2 = 0.015$). Then, as we thought, the moderator variable age has an influence on the relationship between utility for work-related use and satisfaction of using a mobile phone by people in household. Hypothesis 3 is therefore also supported. Regarding hypothesis 4 related to the independent variable applications for fun (AF), the scenario is different. The path from the latent variable AF*A to the dependent variable user satisfaction is not significant ($t = 0.106$, beta = 0.010) but there is a small change in R^2 ($\Delta R^2 = 0.002$). Contrary to our expectations, the moderator variable age has not an influence on the relationship between applications for fun and

satisfaction of using a mobile phone by people in household. As a result, hypothesis 4 is not supported. And the scenario is similar for hypothesis 5 related to the independent variable status gains (SG). The path from the latent variable SG*A to the dependent variable user satisfaction is not significant (t = 0.148, beta = 0.149) but there is a change in R^2 ($\hat{}R^2$ = 0.012). Then, contrary to what we thought, the moderator variable age has not an influence on the relationship between status gains and satisfaction of using a mobile phone by people in household. Consequently, as hypothesis 4, hypothesis 5 is not supported.

In the case of hypothesis 6-a related to the independent variable friends and family influences (FFI), the path from the latent variable FFI*MS*A*I to the dependent variable user satisfaction is significant (t = 2.265, beta = 0.096, p < 0.01) and there is a substantial change in R^2 ($\hat{}R^2$ = 0.028). So, as we expected, the moderator variables marital status, age, and income have an influence on the relationship between friends and family influences and satisfaction of using a mobile phone by people in household. Hypothesis 6-a is then supported. Concerning hypothesis 6-b related to the independent variable secondary sources' influences (SSI), the path from the latent variable SSI*MS*A*I to the dependent variable user satisfaction is very significant (t = 2.843, beta = 0.090, p < 0.005) and there is a huge change in R^2 ($\hat{}R^2$ = 0.033). Thus, as we thought, the moderator variables marital status, age, and income have an influence on the relationship between secondary sources' influences and satisfaction of using a mobile phone by people in household. And hypothesis 6-b is also supported. But the scenario is different for hypothesis 6-c related to the independent variable workplace referents' influences (WRI). The path from the latent variable WRI*MS*A*I to the dependent variable user satisfaction is not significant (t = 0.035, beta = 0.002) but there is a substantial change in R^2 ($\hat{}R^2$ = 0.026). Then, contrary to what we formulated in the hypothesis, the moderator variables marital status, age, and income have not an influence on the relationship between workplace referents' influences and satisfaction of using a mobile phone by people in household. As a result, hypothesis 6-c is not supported.

Regarding hypothesis 7-a related to the independent variable fear of technological advances (FTA), the path from the latent variable FTA*A*I to the dependent variable user satisfaction is very significant (t = 3.364, beta = 0.186, p < 0.001) and there is a huge change in R^2 ($\hat{}R^2$ = 0.039). Thus, as we expected, the moderator variables age and income have an influence on the relationship between fear of technological advances and satisfaction of using a mobile phone by people in household. Hypothesis 7-a is therefore supported. And the scenario is similar for hypothesis 7-b related to the independent variable declining cost (DC). The path from the latent variable DC*A*I to the dependent variable user satisfaction is significant (t = 1.766, beta = 0.123, p < 0.05) and there is a substantial change in R^2 ($\hat{}R^2$ = 0.027). So, as we thought, the moderator variables age and income have an influence on the relationship between declining cost and satisfaction of using a mobile phone by people in household. Consequently, hypothesis 7-b is also supported. But the scenario is different for hypothesis 7-c related to the independent variable cost (C). The path from the latent variable C*A*I to the dependent variable user satisfaction is not significant (t = 0.795, beta = 0.040) but there is a substantial change in R^2 ($\hat{}R^2$ = 0.027). Thus, contrary to our expectations, the moderator variables age and income have not an influence on the relationship between cost and satisfaction of using a mobile phone by people in household. As a result, hypothesis 7-c is not supported.

Finally, concerning hypothesis 8-a related to the independent variable perceived ease of use (PEU), the path from the latent variable PEU*A to the dependent variable user satisfaction is significant (t = 1.635, beta = -0.098, p < 0.05) and there is a small change in R^2 ($\hat{}R^2$ = 0.003).

So, as we formulated in the hypothesis, the moderator variable age has an influence on the relationship between perceived ease of use and satisfaction of using a mobile phone by people in household. And hypothesis 8-a is then supported. The scenario is similar regarding hypothesis 8-b related to the independent variable self-efficacy (SE). The path from the latent variable SE*A to the dependent variable user satisfaction is significant ($t = 1.644$, beta = 0.137, $p < 0.05$) and there is a change in R^2 ($\hat{}R^2 = 0.004$). So, as we thought, the moderator variable age has an influence on the relationship between self-efficacy and satisfaction of using a mobile phone by people in household. Consequently, hypothesis 8-b is also supported. Table 4 below presents a summary of the test of hypotheses.

Table 4
SUMMARY OF THE TEST OF HYPOTHESES

Hypotheses	***Results***	***Software (beta sig.)***
H1- Marital status and age will moderate the relationship between applications for personal use and satisfaction of using a mobile phone at home.	Supported	PLS (0.156*)
H2- Child's age will moderate the relationship between utility for children and satisfaction of using a mobile phone at home.	Supported	PLS (0.181****)
H3- Age will moderate the relationship between utility for work-related use and satisfaction of using a mobile phone at home.	Supported	PLS (0.180**)
H4- Age will moderate the relationship between applications for fun and satisfaction of using a mobile phone at home.	Not supported	PLS (0.010)
H5- Age will moderate the relationship between status gains and satisfaction of using a mobile phone at home.	Not supported	PLS (0.149)
H6- Age, marital status, and income will moderate the relationship between the normative beliefs ((a) friends and family influences; (b) secondary sources' influences; and (c) workplace referents' influences) and satisfaction of using a mobile phone at home.	a- Supported b- Supported c- Not supported	PLS (0.096**) PLS (0.090***) PLS (0.002)
H7- Age and income will moderate the relationship between the external control beliefs ((a) fear of technological advances; (b) declining cost; and (c) cost) and satisfaction of using a mobile phone at home.	a- Supported b- Supported c- Not supported	PLS (0.186****) PLS (0.123*) PLS (0.040)
H8- Age will moderate the relationship between the internal control beliefs ((a) perceived ease of use; and (b) self-efficacy) and satisfaction of using a mobile phone at home.	a- Supported b- Supported	PLS (-0.098*) PLS (0.137*)

*p < 0.05; **p < 0.01; ***p < 0.005; ****p < 0.001 (one-tailed test).

In summary, as shown in Table 4, nine hypotheses (including sub-hypotheses) have been supported in our study, that is, H1, H2, H3, H6-a, H6-b, H7-a, H7-b, H8-a, and H8-b. Thus, the moderator variables (e.g., the household life cycle) age, marital status, income, and child's age had several moderating effects in this study since practically all hypotheses we formulated have been supported. On the other hand, the moderator variable age had not a significant moderating effect on the relationship between applications for fun and satisfaction of using a mobile phone at home, as well as between status gains and satisfaction of using a mobile phone at home. Hence hypotheses H4 and H5 were not supported.

In the next and last section of the paper, we discuss about some implications of the more important findings of the study.

DISCUSSION AND CONCLUSIONS

This last section is devoted to a discussion about the more important findings of the study and some conclusions. And, to support our discussion and conclusions, we provide the reader with a more detailed view of the PLS structural equation model developed to get the significant variables in the study, including the percentage of variance explained by each variable (see Table 5).

Table 5
BETA PATH COEFFICIENTS, T-VALUES, AND PERCENTAGES OF VARIANCE EXPLAINED OF VARIABLES

Variable	*Beta*	*t*	R^2
Applications for Personal Use	-0.012	0.237	0.001
Utility for Children	0.038	0.866	0.000
Utility for Work-Related Use	0.003	0.071	0.000
Utility for Security	0.009	0.263	0.000
Mobility	0.179****	4.712	0.024
Applications for Fun	0.163****	4.202	0.067
Status Gains	0.082*	2.019	0.088
Friends and Family Influences	0.005	0.113	0.025
Secondary Sources' Influences	0.118****	3.344	0.029
Workplace Referents' Influences	0.139****	3.336	0.020
Fear of Technological Advances	0.026	0.719	0.002
Declining Cost	0.035	0.943	0.002
Cost	0.040	1.003	0.003
Perceived Ease of Use	0.228****	4.723	0.175
Self-Efficacy	0.160****	3.653	0.024
Income	0.087****	3.115	0.008
Marital Status	0.025	0.672	0.015
Age	-0.015	0.540	0.000
Child's Age	0.046*	1.499	0.008

*p < 0.05; ****p < 0.001 (one-tailed test).

As shown in Table 5 (and Figure 2), the nineteen independent variables examined in the study explained 49.1 percent (R^2 = 0.491) of the variance in satisfaction in the use of mobile phone by people in household. And we can also see in Table 5 that the nine variables who showed to be significant (see also the significant beta path coefficients in Figure 2), that is, mobility, applications for fun, status gains, secondary source's influences, workplace referents' influences, perceived ease of use, self-efficacy, income, and child's age explained alone 44.3 percent of the variance in satisfaction of using a mobile phone by people in household. Thus, these nine variables are assuredly very important factors to take into account in future studies on the mobile phone and on the part of mobile phone providers, and more particularly perceived ease of use, status gains and applications for fun which explained alone 33 percent of this variance (see Table 5). It is very interesting to see here that one of the two new variables that we added to the Brown and Venkatesh's (2005) theoretical research model, that is mobility, showed to be very significant (p < 0.001) in satisfaction of using a mobile phone by people in household. Indeed, the present study showed that people are, to some extent, using a mobile phone for a matter of mobility (the mobile phone provides them with the possibility to use only this telephone to perform all their personal and professional activities). So here are a new variable that we can add to the integrated research model of MATH and household life cycle

characteristics suggested by Brown and Venkatesh (2005) to test in future studies. In addition, this new variable may be included in the sales marketing plan of mobile phone providers.

In the large-scale study in which Brown and Venkatesh (2005) integrated MATH and some household life cycle characteristics (as moderating variables), the integrated model explained 74 percent of the variance in intention to adopt a personal computer for home use, a substantial increase of 24 percent over baseline MATH that explained 50 percent of the variance. In the present study, we used the integrated model proposed by Brown and Venkatesh (2005). We also added two new independent variables to the model, that is, utility for security and mobility. And we used the household life cycle variables as moderating variables in the research model as did Brown and Venkatesh (2005). Finally, given that we investigated the perceptions of people already using a mobile phone instead of those having the intention to adopt a mobile phone, as did Brown and Venkatesh (2005) for the personal computer, we used the dependent variable user satisfaction instead of behavioral intention. And the model explained 49.1 percent of the variance in satisfaction of using a mobile phone by people in household (see Table 5 and Figure 2). As a result, in this study, our theoretical research model explained the same percentage of variance than those explained by MATH alone (without the household life cycle characteristics and using behavioral intention as dependent variable).

Further, in a previous study in which we investigated the intention to buy a mobile phone by people in household (see Fillion & Berthelot, 2007), we also used the theoretical research model suggested by Brown and Venkatesh (2005) to which we added the same two independent variables utility for security and mobility than we included in the present study in which we investigated satisfaction in the use of mobile phone by people in household. And our model explained 50 percent of the variance in intention to buy a mobile phone, exactly as in the present study where our model explained 50 percent of the variance in satisfaction of using a mobile phone. Of course, the dependent variable was different in the two studies. Indeed, we used behavioral intention in the previous study and user satisfaction in the present study. Hence we can conclude that the variable user satisfaction is as much appropriate as dependent variable in the theoretical research model suggested by Brown and Venkatesh (2005) than is behavioral intention. In addition, in the model we used in this study, more independent variables showed to be good predictors in satisfaction of using a mobile phone by people in household than did independent variables in the model we used in the previous study in intention to adopt a mobile phone for household use. Finally, in the present study, we found several interesting things to help advance knowledge in this new and exciting field of adoption and use of technology in households.

First, we found nine very important variables that seem to be good predictors in satisfaction of using a mobile phone by people in household, and more particularly perceived ease of use, status gains and applications for fun, as well as one of the two new variables that we added to the Brown and Venkatesh's (2005) model, mobility (see Table 5). These nine variables are also very important to take into account by mobile phone providers to design new mobile phones still better adapted to people's needs and to perform their sales marketing. Second, we found that people are, to some extent, using a mobile phone for a matter of mobility, given our new variable mobility showed to be very significant (see Table 5). Third, we found that it is as much appropriate to use the dependent variable user satisfaction than the dependent variable behavioral intention in the research model proposed by Brown and Venkatesh (2005), given the percentage of variance explained in intention to adopt a mobile phone for household use in our previous study is similar to those of using a mobile phone in household in this study. The

dependent variable *use behavior* proposed by Thompson et al. (1991) may also be tested in future studies. Also, we suggest the test of new independent variables that may explain a greater percentage of variance in satisfaction of using a mobile phone by people in household in future studies. To that end, we recommend three new independent variables in the next paragraph. Finally, the results of this study provided the evidence that it is far better to use the household life cycle variables as moderating variables in the research model, as did Brown and Venkatesh (2005), given the percentage of variance explained in intention to adopt a new technology in household by the model tested by these authors was significantly higher. Indeed, we used the household life cycle variables as moderating variables in the theoretical research model of this study instead of independent variables, as we have made in two previous study (see Fillion & Berthelot, 2007; Fillion & Le Dinh, 2008; Fillion & Booto Ekionea, 2010), and the percentage of variance explained by the model both in intention to adopt a mobile phone and in satisfaction of using a mobile phone by people in household has been each time higher (up to 4 percent higher).

It would be interesting in future studies to add some other new variables to the actual theoretical research model (those suggested by Brown and Venkatesh (2005) augmented with the two new variables we tested in several previous studies (see Fillion & Berthelot, 2007; Fillion & Le Dinh, 2008; Fillion & Booto Ekionea, 2010), depending on the technology examined naturally, in order to try to explain still more variance in satisfaction of using a new technology in household. For example, the variable *attention* may be added in social outcomes (a lot of people, particularly young and old people, are feeling to be alone in our actual stressing world, in which both men and women are working and get very busy, so the mobile phone may be an excellent way to communicate with other people every time and everywhere to get the feeling to be less alone), the variable *social norm* may also be added in social outcomes (who knows, people may be using a mobile phone just to do as everybody!), and the variable *control* may be added in utilitarian outcomes (some people may be using a mobile phone to control other people in their family or others; may be another kind of Big Brother!). It would be also interesting to test the actual theoretical research model in other situations and with other populations.

Regarding the limitations of this study, as pointed out by Brown and Venkatesh (2005), the primary limitation is the reliance on a single informant. It is possible that other members of the household would have provided different responses concerning the motivations to use a mobile phone at home. Future research in household use of technology should incorporate responses from multiple members of the household to truly assess the nature of household use. A second limitation of the study is that it was conducted in a limited area of Cameroon. If the study would have been carried out in the whole Cameroon, its results would be of a higher level of generalization. But the fact that the sample of the study was a randomized sample allows a high level of generalization of its results. Another limitation of the study is the administration of the survey instrument in-person by three different research assistants. Some respondents may have differently understood some items of the survey instrument depending on different explanations from the part of the three research assistants and then provided more or less precise ratings on these items, introducing the possibility of some response bias. But the method we privileged in this study to administer the survey instrument is not an exception to the rule. Each method has its strengths and its limitations.

To conclude, much more research will be needed on the use of technology in households in order to better understand its impacts on people's daily life. The research will allow, among others, at least to minimize, if not to remove, some negative impacts of technology in people's

daily life in the future and to develop new technologies still better adapted to people's needs. So we will continue to inquire into this very exciting field.

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REFERENCES

Abdul-Karim, NS IO Oyebisi & M Mahmud (2010) Mobile phone appropriation of students and staff at an institution of higher learning campus. *Campus-Wide Information Systems*, *27*(4), 263-276.

Abu ST. & M Tsuji (2010) The determinants of the global mobile telephone deployment: An empirical analysis. *Informatica Economica*, *14*(3), 21-33.

Andonova V (2006) Mobile phones, the Internet and the institutional environment. *Telecommunications Policy*, *30*, 29-45.

Aoki K & EJ Downes (2003) An analysis of young people's use of and attitudes toward cell phones. *Telematics and Informatics*, *20*(4), 349-364.

Assael H (1981) *Consumer behavior and marketing action*. Kent: Boston.

Atkin CK (1978) Observation of parent-child interaction in supermarket decision making. *Journal of Marketing*, *42*, 41-45.

Balik HH, D Turgut-Balik, K Balicki & IC Özcan (2005) Some ocular symptoms and sensations experienced by long term users of mobile phones. *Pathologie Biologie*, *53*, 88-91.

Balikci K, IC Özcan, D Turgut-Balik & HH Balik (2005) A survey study on some neurological symptoms and sensations experienced by long term users of mobile phones. *Pathologie Biologie*, *53*, 30-34.

Barclay D, C Higgins & R Thompson (1995) The partial least squares (PLS) approach to causal modeling, personal computer adoption and use as an illustration. *Technology Studies*, *2*(2), 285-309.

Botelho A & L Costa Pinto (2004) The diffusion of cellular phones in Portugal. *Telecommunications Policy*, *28*, 427-437.

Brancheau, JC & JC Wetherbe (1990) The adoption of spreadsheet software: Testing innovation diffusion theory in the context of end-user computing. *Information Systems Research*, *1*(2), 115-143.

Brown S (2008) Household technology adoption, use, and impacts: Past, present, and future. *Inf Syst Front*, *10*, 397-402.

Brown SA & V Venkatesh (2005) Model of adoption of technology in households: A baseline model test and extension incorporating household life cycle. *MIS Quarterly*, *29*(3), 399-426.

Butt S & JG Phillips (2008) Personality and self-reported mobile phone use. *Computers in Human Behavior*, *24*, 346-360.

Campbell SW & TC Russo (2003) The social construction of mobile telephony: An application of the social influence model to perceptions and uses of mobile phones within personal communication networks. *Communication Monographs*, *70*(4), 317-334.

Carte TA & CJ Russell (2003) In pursuit of moderation: Nine common errors and their solutions. *MIS Quarterly*, *27*(3), 479-501.

Centrone F, A Goia & E Salinelli (2007) Demographic processes in a model of innovation diffusion with a dynamic market. *Technological Forecasting & Social Change*, *74*, 247-266.

Chae M & J Kim (2004) Do size and structure matter to mobile users? An empirical study of the effects of screen size, information structure, and task complexity on user activities with standard Web phones. *Behaviour & Information Technology*, *23*(3), 165-181.

Chen CH, LP Khoo & W Wan (2003) Evaluation of multicultural factors from elicited customer requirements for new product development. *Research in Engineering Design*, *14*, 119-130.

Childers TL & AR Rao (1992) The influence of familial and peer-based reference groups on consumer decisions. *Journal of Consumer Research*, 19, 198-211.

Chin WW (1998) The Partial Least Squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern Methods for Business Research* (pp. 295-336), Mahwah, NJ: Lawrence Erlbaum Associates.

Chin WW, BL Marcolin & PR Newsted (2003) A Partial Least Squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information Systems Research*, *14*(2), 189-217.

Chong AY., K Ooi, N Darmawan & V Lee (2010) Determinants of 3G adoption in Malaysia: A structural analysis. *The Journal of Computer Information Systems*, *51*(2), 71-80.

Chuang MC, CC Chang & SH Hsu (2001) Perceptual factors underlying user preferences toward product form of mobile phones. *International Journal of Industrial Ergonomics*, *27*, 247-258.

Cocosila M & N Archer (2010) Adoption of mobile ICT for health promotion: An empirical investigation. *Electronic Markets*, *20*(21), 241-250.

Compeau DR & CA Higgins (1995a) Application of social cognitive theory to training for computer skills. *Information Systems Research*, *6*(2), 118-143.

Compeau DR & CA Higgins (1995b) Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly*, *19*(2), 189-211.

Danko WD & CM Schaninger (1990) An empirical evaluation of the Gilly-Enis updated household lifecycle model. *Journal of Business Research*, *21*, 39-57.

Davie, R., C. Panting & T. Charlton (2004). Mobile phone ownership and usage among pre-adolescents. *Telematics and Informatics*, *21*(4), 359-373.

Davis FD (1989) Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319-340.

Davis FD, RP Bagozzi & PR Warshaw (1992) Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology*, *22*(14), 1111-1132.

De Matos MG, P Ferreira & D Krackhardt (2014) Peer influence in the diffusion of iPhone 3G over a large social network. *MIS Quarterly*, *38*(4), 1103-1133.

DeVellis RF (2003) *Scale development: Theory and applications* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Eby DW, JM Vivoda & RM St-Louis (2006) Driver hand-held cellular phone use: A four-year analysis. *Journal of Safety Research*, *37*, 261-265.

Efron B & RJ Tibshirani (1993) *An Introduction to the Bootstrap*. New York: Chapman and Hall.

Ehlen J & P Ehlen (2007) Cellular-only substitution in the United States as lifestyle adoption. *Public Opinion Quarterly*, *71*(3), 717-733.

Feldman DC & TW Gainey (1997) Patterns of telecommuting and their consequences: Framing the research agenda. *Human Research Management Review*, *7*, 369-388.

Ferland JF (2013) Données mobiles: un trafic mondial de 135 exaoctets en 2017. Accessed May 31, 2013 from *Direction Informatique.com*, http://www.directioninformatique.com/donnees-mobiles-un-trafic-mondial-de-135-exaoctets-en-2017/17249.

Fillion G (2004) Publishing in the organizational sciences: An extended literature review on the dimensions and elements of an hypothetico-deductive scientific research, and some guidelines on "how" and "when" they should be integrated. *Academy of Information and Management Sciences Journal*, *7*(1), 81-114.

Fillion G (2005) *L'intégration des TIC dans la formation universitaire : une étude des résultats éducationnels des étudiants dans les contextes de présence et de non présence en classe*. Doctoral Thesis (Ph.D.), Faculty of Administration, Laval University, Quebec.

Fillion G & S Berthelot (2007) An extended model of adoption of technology in households: A model test on people's intention to adopt a mobile phone. *Management Review: An International Journal*, *2*(2), 4-36.

Fillion G & T Le Dinh (2008) An extended model of adoption of technology in households: A model test on people using a mobile phone. *Management Review: An International Journal*, *3*(1), 58-91.

Fillion G & JP Booto Ekionea (2010) Testing a moderator-type research model on the use of mobile phone. *Academy of Information and Management Sciences Journal*, *13*(2), 59-82.

Fillion G, M Limayem , T Laferrière & R Mantha (2010) Onsite and online students' and professors' perceptions of ICT use in higher education. In N. Karacapilidis (Ed.), *Novel Developments in Web-Based Learning Technologies: Tools for Modern Teaching* (Chapter 6), Hershey, PA: IGI Global Publishing.

Fornell C & F Bookstein (1982) Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research, 19*, 440-452.

Foxman E, P Tahsuhaj & KM Ekstrom (1989) Adolescents influence in family purchase decisions: A socialization perspective. *Journal of Business Research*, *15*, 482-491.

Funk J (2005) The future of the mobile phone Internet: An analysis of technological trajectories and lead users in the Japanese market. *Technology in Society, 27*, 69-83.

Gebauer J, JM Shaw & ML Gribbins (2010). Task-technology fit for mobile information systems. *Journal of Information Technology, 25*, 259-272.

Glajchen D (2011) *A comparative analysis of mobile phone-based payment services in the United States and South Africa*. Doctoral Thesis (Ph.D), Graduate Faculty of the School of Business and Technology Management, Northcentral University, Arizona.

Goodhue DL, W Lewis & R. Thompson (2012) Does PLS have advantages for small sample size and non-normal data? *MIS Quarterly*, *36*(3), 981-1001.

Han SH & SW Wong (2003) A systematic approach for coupling user satisfaction with product design. *Ergonomics, 46*(13/14), 1441-1461.

Han SH, KJ Kim, MH Yun, SW Hong & J Kim (2004) Identifying mobile phone design features critical to user satisfaction. *Human Factors and Ergonomics in Manufacturing*, *14*(1), 15-29.

Haque A., S Rahman M & Rahman (2010) Factors determinants the choice of mobile service providers: Structural equation modeling approach on Bangladesh consumer. *Business and Economics Research Journal*, *1*(3), 17-34.

Haverila M. (2011) Mobile phone feature preferences, customer satisfaction and repurchase intent among male users. *Australasian Marketing Journal*, *19*(4), 238-246.

Hobbs VM & DD Osburn (1989) Distance learning evaluation study report II: A study of North Dakota and Missouri schools implementing German I by satellite. ERIC ED 317 195.

Hurlburt HE, EJ Metzger, J Sprintall, SN Riedlinger, RA Arnone, T Shinoda & X Xu (2011) Circulation in the Philippine archipelago simulated by 1/12° and 1/25° global HYCOM and EAS NCOM. *Oceanography*, *24*(1), 28-47.

Isiklar G & G Büyüközhan (2007) Using multi-criteria decision making approach to evaluate mobile phone alternatives. *Computer Standards & Interfaces*, *29*(2), 265-274.

Karjaluoto H, J Pakola, M Pietilä & R Svento (2003) An exploratory study of antecedents and consequences of mobile phone usage in Finland. *Proceedings of the AMA Conference* (pp. 170-178), Chicago, August 15-18.

Kauffman RJ & AA Techatassanasoontorn (2005). Is there a global digital for digital wireless phone technologies?. *Journal of the Association for Information Systems*, *6*(12), 338-382.

Kim MJ & J Park (2014) Mobile phone purchase and usage behaviours of early adopter groups in Korea. *Behaviour and Information Technology, 33*(7), 693-703.

Kimiloglu H, VA Nasir & S Nasir (2010) Discovering behavioral segments in the mobile phone market. *The Journal of Consumer Marketing*, *27*(5), 401-413.

Kline D & F Schieber (1982) Visual persistence and temporal resolution. In *Aging and human visual function*, R. Sekuler D Kline and K Dismokes (Eds.), New York: Liss.

Kurniawan S (2008) Older people and mobile phones: A multi-method investigation. *International Journal of Human-Computer Studies, 66*(12), 889-901.

Kuznekoff JH & S Titsworth (2013) The impact of mobile phone usage on student learning. *Communication Education, 62*(3), 233-252.

Kwon HS & L Chidambaram (2000) A test of the technology acceptance model: The case of cellular telephone adoption. *Proceedings of HICSS-34*, Hawaii, January 3-6.

Lai HH, YC Lin, CH Yeh & CH Wei (2006) User-oriented design for the optimal combination on product design. *International Journal of Production Economics*, *100*(2), 253-267.

Lane W & C Manner (2011) The impact of personality traits on smartphone ownership and use. *International Journal of Business and Social Science*, *2*(17), 22-28.

LaRose R (1989) Advances in telecommunications. In H. Sawhney & G. Barnett (Eds.), *Understanding Personal Telephone Behavior, Progress in Communication Science*, 15.

Lee H & S Lee (2010) Internet vs mobile services: Comparisons of gender and ethnicity. *Journal of Research in Interactive Marketing*, *4*(4), 346-375.

Lee YS, SW Hong, TL Smith-Jackson, M.A. Nussbaum & K Tomioka (2006) Systematic evaluation methodology for cell phone user interfaces. *Interacting with Computers, 18*, 304-325.

Liljander V, P Polsa & K Forsberg (2007) Do mobile CRM services appeal to loyalty program customers?. *International Journal of E-Business Research, 3*(2), 24-40.

Limayem M & G DeSanctis (2000) Providing decisional guidance for multicriteria decision making in groups. *Information Systems Research*, *11*(4), 386-401.

Liu, T. (2010) Moderating influence of perceived risk on relationships between extrinsic cues and behavioral intentions. *Journal of Global Business Management*, *6*(2), 1-15.

Malone TW (1981) What makes computer games fun? *Byte*, December 1981, 258-276.

Mangleburg TF (1990) Children's influence in purchase decisions: A review and critique. *Advances in Consumer Research*, *17*, 813-825.

Mazzoni C, L Castaldi & F Abdeo (2007) Consumer behavior in the Italian mobile telecommunication market. *Telecommunications Policy*, *31*, 632-647.

Moore GC & I Benbasat (1991) Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, *2*(3), 192-222.

Morris MG & V Venkatesh (2000) Age differences in technology adoption decisions: Implications for a changing workforce. *Personnel Psychology*, *53*, 375-403.

Morrow IJ (1999) An organizational guide to telecommuting: Setting up and running a successful telecommuter. *Personnel Psychology*, *52*, 229-232.

Murugesan S (2011) The rise of emerging markets: Opportunities and challenges for IT. *IT Professional*, *13*(1), 6-8.

Nelson JE (1978) Children as information sources in the family decisions to eat out. *Advances in Consumer Research*, *6*, 419-423.

Palen L, M Salzman & E Youngs (2000) Going wireless: Bevavior & practice of new mobile phone users. *Proceedings of ACM CSCW* (pp. 201-210), Philadelphia, December 2-6.

Paul B, S Indranil, S Kumar & SS Ferdows (2015) Mobile phones: Time to rethink and limit usage. *Indian Journal of Public Health*, *59*(1), 37-41

Peters C, CH Amato & CR Hollenbeck (2007) An exploratory investigation of consumers' perceptions of wireless advertising. *Journal of Advertising*, *36*(4), 129-145.

Plude D & W Hoyer (1985) Attention and performance: Identifying and localizing age deficits. In *Aging and human performance*, N. Charness (Ed.) (47-99), New York: Wiley.

Repacholi MH (2001) Health risks from the use of mobile phones. *Toxycology Letters*, *120*, 323-331.

Rice RE & DE Shook (1988) Access to, usage of, and outcomes from an electronic messaging system. *ACM Transactions on Office Information Systems*, *6*(3), 255-276.

Rogers EM (1995) *Diffusion of innovations (4th ed.)*. New York: The Free Press.

Rosenbloom T (2006) Driving performance while using cell phones: An observational study. *Journal of Safety Research*, *37*, 207-212.

Saaksjarvi M, K Ellen & T Tuunanen (2014) Design features impacting mobile phone upgrading frequency. *Journal of Information Technology Theory and Practice* (JITTA), *15*(1), 33-46.

Salvucci DD & KL Macuga (2002) Predicting the effects of cellular phone dialling on driver performance. *Cognitive Systems Research*, *3*, 95-102.

Schaninger CM & WD Danko (1993) A conceptual and empirical comparison of alternative household life cycle models. *Journal of Consumer Research*, *19*, 580-594.

Selwyn N (2003) Schooling the mobile generation: The future for schools in the mobile-networked society. *British Journal of Sociology and Education*, *24*(2), 131-142.

Sohn SY & Y Kim (2008) Searching customer patterns of mobile service using clustering and quantitative association rule. *Expert Systems with Applications*, *34*, 1070-1077.

Sripalawat J., M Thongmak & A Ngramyarn (2011). M-banking in Metropolitan Bangkok and a comparison with other countries. *The Journal of Computer Information Systems*, *51(*3), 67-76.

Straub DW (1989) Validating instruments in MIS research. *MIS Quarterly*, *13*(2), 147-169.

Sullman, M.J.M. & P.H. Baas (2004). Mobile Phone use amongst New Zealand drivers. *Transportation Research Part F*, *7*, 95-105.

Suyinn L, CL Tam & QT Chie (2014) Mobile phone usage preferences: The contributing factors of personality, social anxiety and loneliness. *Social Indicators Research*, *118*(3), 1205-1228.

Takao M (2014) Problematic mobile phone use and big-five personality domains. *International Journal of Community Medecine*, *39*(2), 111-113.

Tam MCY & VMR Tummala (2001) An application of the AHP in vendor selection of a telecommunications system. *Omega*, *29*, 171-182.

Taylor S & PA Todd (1995) Understanding information technology usage: A test of competing models. *Information Systems Research*, *6*(2), 144-176.

Thompson RL, CA Higgins & JM Howell (1991) Personal computing: Toward a conceptual model of utilization. *MIS Quarterly*, *15*(1), 124-143.

Törnros J & A Bolling (2006) Mobile phone use--Effects of conversation on mental workload and driving speed in rural and urban environments. *Transportation Research Part F*, *9*, 298-306.

Treffner PJ & R Barrett (2004) Hands-free mobile phone speech while driving degrades coordination and control. *Transportation Research Part F*, *7*, 229-246.

Tucker C, JM Brick & B Meekins (2007) Household telephone service and usage patterns in the United States in 2004: Implications for telephone samples. *Public Opinion Quarterly*, *71*(1), 3-22.

Vakratsas D (1998) Household cost effects on purchase timing decisions: Do demographics matter? *Journal of Consumer Marketing*, *15*(1), 6-22.

Velmurugan MS & MS Velmurugan (2014) Consumer Behaviour toward information technology adoption in 3G mobile phone usage in India. *Journal of Internet Banking and Commerce*, *19*(3), 1-18.

Venkatesh V (2000) Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, *11*(4), 342-365.

Venkatesh V & SA Brown (2001) A longitudinal investigation of personal computers in homes: Adoption determinants and emerging challenges. *MIS Quarterly*, *25*(1), 71-102.

Venkatesh V & NP Vitalari (1992) An emerging distributed work arrangement: An investigation of computer-based supplemental work at home. *Management Science*, *38*(12), 1687-1706.

Wagner J & S Hanna (1983) The effectiveness of family life cycle variables in consumer expenditure research. *Journal of Consumer Research*, *10*, 281-291.

Wang SE & YC Sung (2003) Mobile phone consumption behavior analysis. *Proceedings of the Asia Pacific Management Conference* (pp. 1-11), China, April 23-25.

Ward S & DB Wackman (1972) Children's purchase influence attempts and parental yielding. *Journal of Marketing Research*, *9*, 316-319.

Webster J & JJ Martocchio (1993) Turning work into play: Implications for microcomputer software training. *Journal of Management*, *19*(1), 127-146.

Webster J & JJ Martocchio (1992) Microcomputer playfulness: development of a measure with workplace implications. *MIS Quarterly*, *16*(2), 201-226.

Wei R (2007) Motivations for using the mobile phone for mass communications and entertainment. *Telematics and Informatics*, *25*(1), 36-46.

Weinberger Z & ED Richter (2002) Cellular phones and effects on the brain: The head as an antenna and brain tissue as a radio receiver. *Medical Hypotheses*, *59*(6), 703-705.

Wells WD & G Gubar (1966) Life cycle concept in marketing research. *Journal of Marketing Research*, *3*, 355-363.

Wesolowski A, N Eagle, AM Noor, RW Snow & CO Buckie (2012) Heterogeneous mobile phone ownership and usage patterns in Kenya. *PLoS ONE*, *7*(4), e35319.

Wessels, L. & J Drennan (2010) An investigation of consumer acceptance of m-banking. *The International Journal of Bank Marketing*, *28*(7), 547-568.

Westerman R & B Hocking (2004) Diseases of modern living: Neurological changes associated with mobile phones and radiofrequency radiation in humans. *Neuroscience Letters*, *361*, 13-16.

White MP, JR Eiser, PR Harris & S Pahl (2007) Who reaps the benefits, who bears the risks? Comparative optimism, comparative utility, and regulatory preferences for mobile phone technology. *Risk Analysis*, *27*(3), 741-753.

Wilska T (2003) The role of m-services in the well-being of young people. *Journal of Consumer Policy*, *26*(4), 441-463.

Yoo Y & M Alavi (2001) Media and group cohesion: Relative influences on social presence, task participation, and group consensus. *MIS Quarterly*, *25*(3), 371-390.

ZDNet (2015) Key data: mobile and smartphone sales, Thursday, February 19, 2015, Accessed May 4, 2015 from http://www.zdnet.fr/actualites/chiffres-cles-les-ventes-de-mobiles-et-de-smartphones-39789928.htm.

Zhang X & LM Maruping (2008) Household technology adoption in a global marketplace: Incorporating the role of espoused cultural values. *Inf Syst Front*, *10*, 403-413.