Scientific Research Publishing

E-Health Telecommunication Systems and Networks, 2022, 11, 67-84
https://www.scirp.org/journal/etsn
ISSN Online: 2167-9525
ISSN Print: 2167-9517

Consumer Risk Perceptions in Mobile Health Services Adoption: Do They Matter?

Mihail Cocosila[1], Ofir Turel[2]

[1]Faculty of Business, Athabasca University, Athabasca, Canada
[2]College of Business and Economics, California State University, Fullerton, USA
Email: mihailc@athabascau.ca

How to cite this paper: Cocosila, M. and Turel, O. (2022) Consumer Risk Perceptions in Mobile Health Services Adoption: Do They Matter? *E-Health Telecommunication Systems and Networks*, **11**, 67-84.
https://doi.org/10.4236/etsn.2022.112005

Received: March 24, 2022
Accepted: June 26, 2022
Published: June 29, 2022

Abstract

The purpose of this study is to investigate empirically the role of consumer perceived risks in the adoption of mobile health services. A theoretical model including the perceived risk associated with the activity targeted by a mobile health service and the perceived risk associated with the mobile service itself was developed and tested empirically in the context of an application supporting smoking cessation. The model was validated in a cross-sectional experiment conducted with 422 consumers in the UK and Canada. Findings show that while risk triggered by the nature of a health promotion activity is a strong driver of the adoption of the supporting mobile health service, risk related to the actual application targeting that activity is a comparatively weaker obstacle. The two contrasting risk perspectives are highly significant as they together explain over 31% of the variance in consumer intention to use the mobile health service, independently from other adoption factors. Overall, this study demonstrates that consumer risk perceptions alone are a multifaceted and meaningful component in mobile health services adoption, and that this element should not be overlooked in more complex research models.

Keywords

Mobile Service, Information and Communication Technology, Consumer Adoption, Perceived Risk, Healthcare

1. Introduction

Isn't it too expensive?, *What would my friends say*?, or *So what if I don't use it*? These questions look familiar to any individual prospecting a new information and communication technology (ICT) device or application. Such questions are even more legitimate for mobile ICT services where new offers appear almost

every month, so there is not enough feedback from people already using these applications. To further complicate the dilemmas, some newer services such as those encompassed under the domains of mobile health or mobile learning may not have an immediate benefit for their users, and this makes even more acute an individual's quandary: *What is the danger of not using them and what are the threats of using them?*

For instance, mobile health services emerging in various parts of the world are providing health promotion advice for people willing to live a healthier life by exercising more, watching their diet, or quitting smoking [1] [2] [3]. These services are encompassed in a more comprehensive picture of efforts encouraging consumers to monitor their health using newer information technology support [4]. One of the most convenient types of mobile applications offered for health promotion purposes is the popular wireless text messaging or short messaging service (SMS) on cell phones [5]. In contrast to other mobile services where only one SMS transaction is needed to reach an objective (e.g., confirming a medical appointment), just one text message with health promotion advice is implausible to make people adopt a healthier behavior (*i.e.*, perceive an immediate outcome). Therefore, although remote health promotion support provided through text messaging may be beneficial for users, consolidating the healthy activities will take time.

Consequently, some users may be inclined not to adopt such a service or stop using it after certain time because of the lack of visible results. Furthermore, consumers may even perceive various disadvantages associated with subscribing to a novel mobile service before perceiving the actual benefits due to the innovation's very newness [6]. Accordingly, it would be interesting to see what people's perceptions regarding the possible opportunities and obstacles are in using a mobile health service without immediate apparent outcome. The question is important because, beyond technology and business issues, prospective user perceptions are fundamental for any new ICT application [7]. Furthermore, to avoid pricey implementation errors, potential user perceptions should be carefully understood in the early stages of applications' development.

From the discussion above, it appears that there are two broad categories of questions that would capture prospective user doubts on the adoption of a mobile health service without immediate outcome—about the object of the service and about the service itself. A possible approach to express these two types of concerns is through a perceived risk associated with the health activity targeted by the mobile ICT service and a perceived risk generated by the mobile service itself.

This paper reports on an empirical investigation conducted with 422 consumers in the UK and Canada on the influence of risk perceptions alone (*i.e.*, regardless of other factors) on adopting a mobile health service without immediate outcome. The following two sections describe the theoretical background and the research model. Next, research methodology and main findings are presented.

The paper concludes with a discussion section.

2. Theoretical Background

Literature reviews conducted in information systems (IS), consumer behavior, and healthcare research show the potential existence of two distinct types of risk perceptions expressed by people concerning a new ICT service. These two categories of risk are discussed next.

2.1. Technology Perceived Risk

The concept of risk is prevalent in game theory, economics, or psychology, where it denotes potentially positive or negative outcomes following a choice or a decision. Risk perception is also frequently used in consumer behavior, but it has a strictly negative meaning in that domain: it expresses a subjective expectation of loss or disadvantage a consumer may experience, usually in association with a purchase [8] [9].

To better understand perceived risk and mitigate its effects on purchases, consumer behavior research identified several risk types, such as those coming from an unsatisfactory performance, excessive cost, or health hazard of a purchased item. After about half a century of theoretical and empirical research, six facets are widely accepted nowadays as the prominent dimensions of perceived risk in the relevant consumer behavior literature [8] [10] [11]:

- Perceived financial (or economic) risk that expresses a possible waste of money when purchasing a product or service;
- Perceived performance risk that refers to the product not working as expected or working appropriately for too short a period;
- Perceived social risk that encapsulates fears of possible disapproval of purchase by other people essential for the consumer such as family or friends;
- Perceived physical (or health) risk that articulates an individual's anxiety about the possible health hazard posed by the purchased product or service;
- Perceived psychological risk that captures the mental stress on the worthiness of buying a particular product; and,
- Perceived time risk that refers to the feared time waste associated with the purchase.

A trade-off amalgamation of the primary risk facets above may generate an overall risk perception [9]. For instance, browsing various online stores to find a good deal for a smartphone may lead to an increased perception of time risk but, if a suitable product is found, the financial, performance and social risk perceptions associated with the device will decrease and, thus, the overall risk may be acceptable for the purchase. Further, weights of the primary risk facets in the total risk perception may depend on the purchase situation: e.g., the buying of a cheap basic smartphone cable poses different risks than that of a more expensive item like a smartwatch.

Starting with the early 2000s, a multifaceted perceived risk has been increa-

singly used in information systems (IS) studies to capture the subjective threats individuals and, sometimes, organizations may see in association with the adoption and use of ICT devices or applications [12] [13]. Researchers have seen risk perceptions in ICT adoption as being analogous to those when shopping online because the inability to inspect the merchandise before buying generates multi-faceted concerns [14] [15]. These concerns are even more obvious for electronic services provided through ICT applications because of the intangibility of these services. Thus, perceived risk in IS adoption research is conceptualized as an apprehension triggered by using a technology since it captures adverse effects feared by individuals as possibly occurring when using that specific ICT application or device [16]. This risk adapted from consumer behavior was also defined as resistance to adopting an ICT [17] [18] or as inhibitors to adoption [19] resented by the prospective users due to the negative perceptions they developed.

As most research involving perceived risk in IS regards the contexts of new technology adoption or online purchasing, additional risk aspects proved to be necessary to capture all user doubts related to these activities. Thus, several studies have added other facets to the main six risk dimensions adapted from consumer behavior, such as [10] [12] [20] [21]:

- Perceived personal risk that refers to individuals fearing harm as a consequence of their purchase behavior (e.g., risking online identity theft);
- Perceived privacy risk that expresses fear that online businesses may collect customers' personal information and misuse it (e.g., disclose it to third parties); or,
- Perceived source risk, which articulates apprehension of buying online from unknown businesses.

Generally, the main six risk facets coming from consumer behavior knowledge plus the additional dimensions specific to IS form a perceived overall risk triggered by technology use. The weights of the various facets that enter the trade-off aggregated risk depend on the ICT and its use situation since perceived risk is context dependent [9] [22]. Therefore, the concept of *Technology Perceived Risk (TPR)* is proposed as a measure of the overall risk that captures all meaningful perceptions on possible negative consequences of a new ICT use.

2.2. Activity Perceived Risk

Theoretical reasoning also reveals a different type of risk perception that would capture user worries or questions related to not adopting or not using as expected an ICT application specifically designed to help them, nonetheless. This perception would be appropriate to a socially sensitive domain like mobile health, where users may fear an actual or virtual loss by not using a presumably helpful innovative technology application offered to support their health. This reasoning is inspired by the protection motivation theory [23], in which fear feelings developed in response to a perceived threat make an individual follow the recommended procedure to counteract that threat [24].

For instance, users registered in a health promotion program may have anxiety about subscribing to a mobile service providing reminders through cell phones about daily physical exercise. Not subscribing to such a service might make them fall behind the health promotion program and, consequently, not see their health condition improving, although the non-action result would not appear as immediate. These anxieties and doubts regarding the negative consequences of the non or negligent use of a vital ICT application (but with no visible immediate outcome) are associated with the nature of the activity targeted by the ICT application. Therefore, a factor termed as *Activity Perceived Risk (APR)* will be used in this paper to encompass the anxiety about the negative consequences of the non or inappropriate use of a critical ICT application.

Based on the considerations presented so far, this study poses the following research question: *What are the effects of Activity Perceived Risk and Technology Perceived Risk on user intention to adopt a mobile health service without immediate outcome?* Mobile health services are an excellent context for investigating the roles of the two types of risk above due to the social sensitivity of healthcare and the usually gradual nature of the changes occurring in an individual's condition when subjected to a new healthy behavior (e.g., exercising more, changing diet, or smoking cessation).

3. Theoretical Model and Research Hypotheses

This study constructs a parsimonious theoretical model to explore the roles of the two types of risk perceptions in the adoption of a mobile service for a health program without immediate outcome. This model has the general layout of information technology adoption models popular in IS literature [25] [26], thus having the behavioral intention of adopting ICT as the endogenous construct. However, as a *distinct characteristic of this research*, the two types of risk are modeled as the behavioral intention's primary explanatory factors. The resulting theoretical model and the paths hypothesized are captured in **Figure 1** below.

Studies in consumer behavior have demonstrated that consumers' risk is a deterrent of a purchase [8] [9] [11]: the higher the risk people perceive, the less inclined they are to complete the transaction. Similarly, IS studies have shown that perceived risk is an obstacle to adopting an ICT device or application [12] [15]. The risk awareness acting contrary to the intention to use the technology in general (*i.e.*, the mobile service in particular) is captured in this research by the perceived risk associated with technology use or TPR. Accordingly, the following hypothesis is proposed:

*H*1: *Technology Perceived Risk is negatively associated with Behavioral Intention to adopt a mobile health application.*

As consumers usually look at risks from multiple angles before making a buying decision [8] [10], a more granular analysis has to consider TPR as a multifaceted factor. Therefore, similarly to a substantial body of previous research in IS [12] [15], TPR is considered as an aggregated second-order construct with

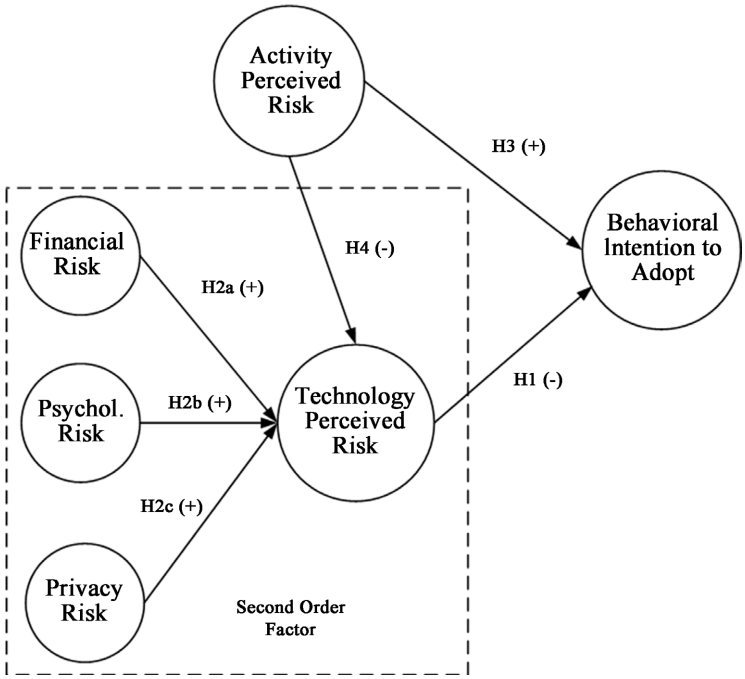

Figure 1. Research model.

individual risk facets (e.g., financial, psychological, etc.) as first-order constructs. Depending on the research context and while seeking to have a parsimonious model, only a few essential risk facets could be considered meaningful, without altering the overall risk perception significantly [9] [22]. For the situation of this research, as explained in the methodology section next, only three perceived risk facets, out of those discussed in the Theoretical Background Section above, are considered relevant: *i.e.*, financial, psychological, and privacy. Consequently, the following hypotheses are proposed:

H2a: *Perceived Financial Risk is positively associated with Technology Perceived Risk of a mobile health application.*

H2b: *Perceived Psychological Risk is positively associated with Technology Perceived Risk of a mobile health application.*

H2c: *Perceived Privacy Risk is positively associated with Technology Perceived Risk of a mobile health application.*

Theoretical reasoning indicates that perceived risk triggered by the activity targeted by the mobile health application, called APR, would act as a motivator for using the ICT service: if people sense some negative consequences of not using a health service designed to help them, they will then perceive a risk for their future condition if not adopting that service. Therefore, the effect of APR would be in the same way as that of an extrinsic motivator for taking action to avoid an undesirable consequence [27] [28] [29]. For instance, consumers interested in receiving advice on following a healthier lifestyle through a mobile phone service would perceive a danger (*i.e.*, of their health condition not improving or, even, getting worse) if they do not subscribe to the service or do not use it. As it is well-known from IS research, extrinsic motivation is associated with the percep-

tions of benefits and usefulness and has a powerful favoring effect on adopting a technology [26] [30] [31].

On the other hand, it is reasonable to assume that if people perceive a threat in not adopting the mobile health service (hence see a motive for adopting it), this feeling will also alleviate to a certain extent their possible concerns sourcing from the actual use of that service, that is encompassed under TPR. This is consistent with previous research in IS that showed that favorable views on technology features tend to decrease the uncertainty, hence perceived risk, associated with its use [12] [32]. Consequently, the following hypotheses are proposed:

*H*3: *Activity Perceived Risk is positively associated with Behavioral Intention to adopt a mobile health application.*

*H*4: *Activity Perceived Risk is negatively associated with Technology Perceived Risk of a mobile health application.*

4. Methods

The research model and hypotheses were tested through a cross-sectional online investigation conducted simultaneously with consumers in the UK and Canada. The artifact of this research was the use of text messaging on cell phones to provide support to smokers willing to quit smoking. Such health promotion initiatives have been gaining popularity worldwide [33] [34] [35], and text messaging is a preferred tool to provide support to people willing to quit smoking due to advantages in terms of convenience and value [36] [37]. However, this type of health promotion support needs time to produce effects since it is unlikely for smokers to quit smoking immediately after receiving a few text messages from health providers. Therefore, this could be considered as a mobile health application without immediate outcome.

For increased realism and feasibility reasons, participants of the study were recruited across UK and Canada through a surveying company having a database of over half a million pre-recruited consumers. Potential participants were required to be 18 years old, to smoke at least occasionally, and to be familiar with wireless text messaging on cell phones.

Consumers who took part in the study watched an online scenario on how they could receive support for quitting smoking through text messaging on their cell phones if they chose to join such a program. Thus, after subscribing for a moderate monthly fee to the mobile service for at least six months, they would receive enjoyable messages of support and encouragement from health providers in a dedicated call center. For increased realism, sample cell phone messages were presented to participants. These sample messages were adapted from experimental studies on using text messaging for health promotion in general [38] [39] [40] and for smoking cessation in particular [41] [42]. The scenario avoided any bias as it did not comment on the effects of smoking and did not urge participants to quit smoking.

After watching the scenario, participants were invited to express their views

through an online survey measuring with seven-point Likert-type scales the constructs of the research model and demographic characteristics. Since all participants had experience with text messaging and cell phones and because the experiment relied on a scenario, only three of the Technology Perceived Risk facets, as discussed in Sections 2 and 3 above, were considered meaningful: financial, psychological, and privacy risk. Aiming to build a parsimonious research model, measuring performance, social, health, and time risks were not considered necessary for consumers already owning cell phones and using text messaging communications, hence already familiar with the technology's basic features.

Survey questions were adapted for Behavioral Intention and Technology Perceived Risk from previously validated measures used in IS [12] [43] and consumer behavior [9] [11]. In accordance with the context of this research, Activity Perceived Risk was measured with a scale adapted from healthcare knowledge. Thus, a measure about the Beliefs about Medicines Questionnaire (BMQ) assessing consumer perceptions on potential benefits of medicines [44] [45] was considered appropriate for this study, assuming that technology may be similar to medicines for individuals willing to quit smoking—*i.e.*, it is likely to bring benefits for those who adhere to the prescribed intervention.

5. Results

Data collection stopped when the surveying company recorded 600 complete responses from participants meeting the including conditions (300 from the UK and 300 from Canada). About one week was necessary to complete the data collection, and all respondents received a small financial compensation from the surveying company. After eliminating the answers with more than 5% missing data, 170 and 252 valid responses were recorded from the two settings, respectively. These responses were part of a larger research project conducted in the two sites. An ANOVA analysis of the averages of all items measured indicated no significant differences between the samples coming from the two countries above ($F(1; 41) = 0.23$; p-value = 0.63). Accordingly, it was reasonable to consider that all the responses in this study came from one homogenous sample of 422 participants.

Demographic analysis indicated that 53.1% of the participants were female, and the sample's average age was 41.2 years. Participants reported 23.7 years of smoking and 93.5 cigarettes smoked per week, on average. Cell phone experience and text messaging experience averaged at 9.4 years and 5.9 years, respectively. Participants reported sending 57.6 text messages and receiving 46.7 every week, on average.

A *first preliminary test* for the data collected was to analyze the possible influence of non-response bias. This was done by comparing the key demographics of early and late responders as suggested by literature [46] [47]. Comparisons done for average values of age, gender, smoking activity, and text messaging activity showed no statistically significant differences between early and late res-

ponders' groups. Therefore, non-response bias was not considered an issue for the sample used in this study.

A *second preliminary tes*t of the data collected was to assess the influence of common method variance (CMV) that may occur when all variables in the theoretical model (both independent and dependent) are collected in the same survey through self-reported measures [48]. A visual inspection of the correlation matrix between factors reported in **Table 2** below showed values below 0.90. Therefore, according to guidelines indicated by Pavlou *et al.* [49], CMV is not a concern for the data used in this study.

Data analysis was conducted with Partial Least Squares (PLS) as this Structural Equations Modelling method is suitable for exploratory models [50] [51], including formative indicators [52]. The second-order construct, Technology Perceived Risk, was measured through a repeated indicators approach [53].

5.1. Measurement Model

PLS analysis was conducted with SmartPLS [54] following the methodology recommended by Gefen and Straub [55] and Hair *et al.* [56]. After eliminating one of the 15 items of the measurement model due to low significance levels and item-to-construct loading values, all items had significant t-values (corresponding to p-values < 0.05) and loadings above 0.7. **Table 1** shows that values for Average Variance Extracted (AVE), expressing the amount of variance captured by a factor in relation to the amount of variance due to measurement error, is above 0.5 for all first-order constructs. Further, composite reliability, and Cronbach's alpha values are above 0.7 for all these constructs. All these values indicate appropriate reliability and convergent validity of the model [57] [58] [59].

Table 2 shows the correlation matrix of first-order constructs having on the diagonal the square root of AVE values. As diagonal elements are more extensive larger than all corresponding non-diagonal elements, discriminant validity is termed as appropriate. This is confirmed by the matrix of loadings and cross-loadings showing that items load more on the constructs they pertain to than on other constructs (**Table 3**), as recommended [55] [57].

A test for possible multicollinearity was conducted for the formative second-order TPR construct. A visual inspection of **Table 3** shows that indicators of the first-level risk factors that form TPR have correlation coefficients below the threshold

Table 1. Statistics of the measurement model for first-order constructs.

Construct	AVE	Composite reliability	Cronbach's alpha
Behavioral Intention	0.950	0.974	0.947
Perceived Financial Risk	0.769	0.869	0.700
Perceived Privacy Risk	0.810	0.928	0.883
Perceived Psychological Risk	0.821	0.932	0.890
Activity Perceived Risk	0.709	0.907	0.864

Table 2. Matrix of correlations and square root of AVE for first-order constructs.

	Behavioral Intention	Perceived Financial Risk	Perceived Privacy Risk	Perceived Psychological Risk	Activity Perceived Risk
Behavioral Intention	**0.97**				
Perceived Financial Risk	−0.33	**0.88**			
Perceived Privacy Risk	0.00	0.32	**0.90**		
Perceived Psychological Risk	−0.16	0.22	0.41	**0.91**	
Activity Perceived Risk	0.53	−0.25	0.09	0.08	**0.84**

Table 3. Item loadings and cross-loadings for first-order constructs.

	Behavioral Intention	Perceived Financial Risk	Perceived Privacy Risk	Perceived Psychological Risk	Activity Perceived Risk
BI1	**0.974**	−0.314	−0.009	−0.164	0.505
BI2	**0.975**	−0.326	0.003	−0.155	0.522
PFR1	−0.388	**0.867**	0.224	0.215	−0.272
PFR3	−0.195	**0.886**	0.329	0.174	−0.170
PPR1	−0.081	0.309	**0.896**	0.438	0.056
PPR2	0.001	0.307	**0.932**	0.348	0.054
PPR3	0.083	0.236	**0.872**	0.307	0.153
APR1	0.538	−0.231	0.025	0.000	**0.846**
APR2	0.460	−0.212	0.105	0.087	**0.894**
APR3	0.374	−0.163	0.129	0.120	**0.858**
APR4	0.362	−0.230	0.075	0.084	**0.765**
PSYR1	−0.219	0.317	0.409	**0.864**	−0.055
PSYR2	−0.131	0.135	0.318	**0.933**	0.123
PSYR3	−0.090	0.140	0.375	**0.919**	0.154

Abbreviations: BI—Behavioral Intention; PFR—Perceived Financial Risk; PPR—Perceived Privacy Risk; APR—Activity Perceived Risk; PSYR—Perceived Psychological Risk; 1…4—item number.

of 0.90 indicated as problematic by literature [60] [61]. Hence, multicollinearity was not considered an issue for this overall risk construct.

5.2. Structural Model

As reliability, convergent, and discriminant validity tests are all satisfactory, the measurement model could be considered valid. Therefore, the next step was to analyze path coefficients, significance, and variance explained levels after run-

ning SmartPLS with a bootstrap with 200 re-samples. Table 4 and Figure 2 capture these results.

Table 4 and Figure 2 show that 5 out of 6 hypotheses are supported at a significance level of 0.05 or better. As hypothesized, all three first-order perceived risk facets significantly contribute to the second-order Technology Perceived Risk. This latter, together with the Activity Perceived Risk, are significant antecedents of the Behavioral Intention to adopt the mobile health service. On the other hand, the proposed mitigating influence of the activity risk over the technology risk was not confirmed by the data analysis outcome. Of all the constructs considered in the model, Activity Perceived Risk had by far the most considerable total effect (0.533 significant at the 0.001 level) on the Behavioral Intention to adopt the service (Table 5). Overall, the proposed model explained 31.2% of the variance of the endogenous construct.

All demographic figures collected about the sample were tested as possible

Table 4. Results of hypotheses testing.

Hypothesis	Path	Coefficient	*t*-value	*p*-value
H1	Technology Perceived Risk -> Behavioral Intention	−0.187	2.101	0.036
H2a	Perceived Financial Risk -> Technology Perceived Risk	0.236	4.306	<0.000
H2b	Perceived Psychological Risk -> Technology Perceived Risk	0.545	10.165	<0.000
H2c	Perceived Privacy Risk -> Technology Perceived Risk	0.528	8.632	<0.000
H3	Activity Perceived Risk -> Behavioral Intention	0.533	6.034	<0.000
H4	Activity Perceived Risk -> Technology Perceived Risk	−0.001	0.673	0.501

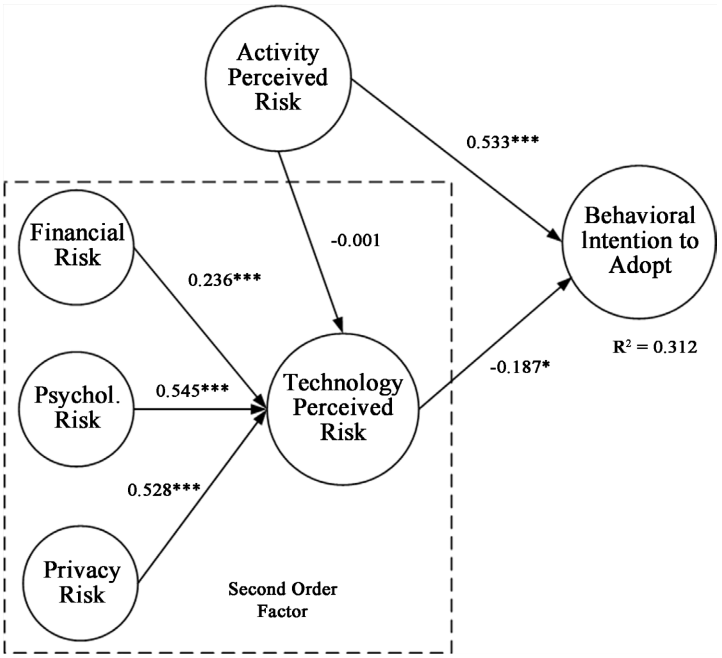

Figure 2. Results of structural model evaluation. Significance levels: * = 0.05; ** = 0.01; *** = 0.001.

Table 5. Total effects on behavioral intention to adopt the mobile health service.

Construct	Coefficient	*t*-value	*p*-value
Perceived Financial Risk	−0.044	1.614	0.107
Perceived Psychological Risk	−0.102	1.963	0.050
Perceived Privacy Risk	−0.099	2.431	0.015
Technology Perceived Risk	−0.187	2.101	0.036
Activity Perceived Risk	0.533	6.042	<0.001

control variables. None of the age, gender, smoking figures, cell phone and text messaging experience and use, or country of the participants (*i.e.*, UK or Canada) caused statistically significant structural model changes.

6. Discussion

The objective of this research has been to understand the influence of two structurally different types of user risk perceptions (one associated with the technology and the other triggered by the activity targeted by the technology, respectively) to adopt a mobile health service application without immediate outcome. The research context is the use of text messaging on cell phones to provide remote support to smokers if they chose to quit smoking. A parsimonious theoretical model comprising the two types of risk was built and tested in an online experiment with 422 participants from the UK and Canada.

This paper's research question was: *What are the effects of Activity Perceived Risk and Technology Perceived Risk on user intention to adopt a mobile health service without immediate outcome?* Consistent with previous research in consumer behavior and information systems [8] [12] [62], this study found that the risk perception sourcing from potentially using a mobile service, *i.e.*, Technology Perceived Risk, has a significant negative influence over the Behavioral Intention to adopt that service (path coefficient = −0.187, p-value < 0.05): if people see risks (no matter if these are real or not), the risks become an obstacle to adoption. Of the facets of risk considered meaningful for this context, Perceived Psychological Risk and Perceived Privacy Risk were the most important (both with path coefficients above 0.5, significant at the 0.001 level).

Therefore, as a *first practical contribution* of this research, it can be affirmed that, in order to increase the chances of success, developers and promoters of mobile health services targeting smoking cessation should try to mitigate potential general user doubts on the justification of such services and the apprehension about disclosing personal data. Concerns about wasting money for subscribing to the service, captured through Perceived Financial Risks, are highly significant as well (at the 0.001 level) but comparatively less important (path coefficient = 0.236).

Confirming the theoretical reasoning proposed in this research, Activity Perceived Risk has a positive influence on the intention to adopt the mobile health

service (coefficient = 0.533, significant at the 0.001 level). This factor is much more critical than technology Perceived Risk, as the total effects value show (**Table 5**). Therefore, people's concerns about their health state deteriorating if not using the ICT service offered to support their efforts act as motivators to avoid negative consequences, similarly to literature findings [29], and are very important in the adoption equation. Accordingly, promoters of mobile health services should consider consumer propensity to avoid threats for their condition even if these services do not have an immediate outcome. This is the *second practical contribution* this research offers. However, future research should investigate why the Activity Perceived Risk was not a significant mitigator of the Technology Perceived Risk, as this study hypothesized.

As a *critical theoretical contribution*, this research enriches scholarly knowledge on technology adoption through a more granular look at user risk perceptions and their actual influence on the adoption equation. Thus, as a step beyond the consolidated body of research in information systems accounting for the influence of a risk perception factor in technology adoption [12] [32], this study identifies two conceptually different risk perceptions, Activity Perceived Risk and Technology Perceived Risk, with opposite effects on the intention to use a mobile health application. Furthermore, the combined influence of the two opposite risk factors *alone* explained 31.2% of the intention to adopt the mobile health service, as **Figure 2** indicates. This appears as a moderately low value, although even smaller values are not uncommon in IS studies [63]. It is, nonetheless, sufficient to demonstrate that these two risk perceptions are significant in the adoption equation of a mobile health service even when this does not lead to immediate consequences for the users. Thus, to remain parsimonious and to demonstrate the *actual* influence of perceived risks, the model proposed by this research did not include other prevalent factors like perceived usefulness or perceived ease of use that traditional adoption research has demonstrated to be strong antecedents of the behavioral intention in most of the studies [26].

Both risk factors proposed by this research, the first-order Activity Perceived Risk, adapted from healthcare research [44] [45], and the second-order Technology Perceived Risk, adapted from consumer behavior and IS research [9] [11] [12], displayed good psychometric properties. Since five out of the six hypotheses proposed were supported and the two categories of risk factors considered were valid and explained almost one-third of the intention to adopt the mobile health service, the risk-only theoretical model proposed by this study could be considered as being validated empirically and reasonably appropriate, according to guidelines from literature [64] [65].

This study also involved some *limitations*, but not more than in similar IS research on ICT adoption. Thus, participants self-selected following the invitation of a surveying company. However, they were recruited from a massive pool of pre-registered individuals across two countries, which added more realism to the research. Risk perception is context dependent [22], so the participants' views

might have been influenced by the nature of the mobile ICT service (*i.e.*, smoking cessation support). Future research may expand this type of research for other ICT applications targeting mobile services in sensitive domains like healthcare or even in other areas like learning. Also, the experiment was based on a scenario, but this is not uncommon in IS studies. The scenario approach is a convenient way of eliciting perceptions about the use in principle of a new ICT application [66] [67] before proceeding to risky deployments. Further, participants were already using the technology that was the object of the scenario, which increased the realism of the experiment.

7. Conclusion

Overall, this study demonstrated that when using mobile Information and Communication Technology to provide health services in relatively lengthy programs with no immediate outcome for consumers, Technology Perceived Risk (expressing the overall risk that captures all meaningful perceptions on possible negative consequences of a new ICT use) and Activity Perceived Risk (encompassing the anxiety about the negative consequences of the non or inappropriate use of a critical ICT application) have opposite effects: the former is an obstacle while the latter is a motivator. Their influence alone in the adoption equation is quite significant, so these factors should not be neglected when constructing more complex ICT adoption and using research models, at least for sensitive human activity domains like healthcare.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Chen, M.F. and Lin, N.P. (2018) Incorporation of Health Consciousness into the Technology Readiness and Acceptance Model to Predict app Download and Usage Intentions. *Internet Research*, **28**, 351-373. https://doi.org/10.1108/IntR-03-2017-0099

[2] Cole-Lewis, H. and Kershaw, T. (2010) Text Messaging as a Tool for Behavior Change in Disease Prevention and Management. *Epidemiologic Reviews*, **32**, 56-69. https://doi.org/10.1093/epirev/mxq004

[3] Okazaki, S., Blas, S.S. and Castañeda, J.A. (2015) Physicians' Adoption of Mobile Health Monitoring Systems in Spain: Competing Models and Impact of Prior Experience. *Journal of Electronic Commerce Research*, **16**, 194-217.

[4] Cocosila, M., and Archer, N. (2018) Modeling Consumer Acceptance of Electronic Personal Health Records. *Journal of Electronic Commerce Research*, **19**, 119-134.

[5] Downer, S.R., Meara, J.G. and Da Costa, A.C. (2005) Use of SMS Text Messaging to Improve Outpatient Attendance. *Medical Journal of Australia*, **183**, 366-368. https://doi.org/10.5694/j.1326-5377.2005.tb07085.x

[6] Wells, J.D., Campbell, D.E., Valacich, J.S. and Featherman, M. (2010) The Effect of Perceived Novelty on the Adoption of Information Technology Innovations: A Risk/

Reward Perspective. *Decision Sciences*, **41**, 813-843. https://doi.org/10.1111/j.1540-5915.2010.00292.x

[7] Venkatesh, V., Speier, C. and Morris, M.G. (2002) User Acceptance Enablers in Individual Decision Making about Technology: Toward an Integrated Model. *Decision Sciences*, **33**, 297-316. https://doi.org/10.1111/j.1540-5915.2002.tb01646.x

[8] Laroche, M., McDougall, G.H.G., Bergeron, J. and Yang, Z. (2004) Exploring How Intangibility Affects Perceived Risk. *Journal of Service Research*, **6**, 373-389. https://doi.org/10.1177/1094670503262955

[9] Stone, R.N. and Grønhaug, K. (1993) Perceived Risk: Further Considerations for the Marketing Discipline. *European Journal of Marketing*, **27**, 39-50. https://doi.org/10.1108/03090569310026637

[10] Lim, N. (2003) Consumers' Perceived Risk: Sources versus Consequences. *Electronic Commerce Research and Applications*, **2**, 216-228. https://doi.org/10.1016/S1567-4223(03)00025-5

[11] Stone, R.N. and Mason, B.J. (1995) Attitude and Risk: Exploring the Relationship. *Psychology and Marketing*, **12**, 135-153. https://doi.org/10.1002/mar.4220120205

[12] Featherman, M., and Pavlou, P. (2003) Predicting e-Services Adoption: A Perceived Risk Facets Perspective. *International Journal of Human Computer Studies*, **59**, 451-474. https://doi.org/10.1016/S1071-5819(03)00111-3

[13] Im, I., Kim, Y. and Han, H.J. (2008) The Effects of Perceived Risk and Technology Type on Users' Acceptance of Technologies. *Information & Management*, **45**, 1-9. https://doi.org/10.1016/j.im.2007.03.005

[14] Lu, X., Li, Y., Zhang, Z., and Rai, B. (2014) Consumer Learning Embedded in Electronic Word of Mouth. *Journal of Electronic Commerce Research*, **15**, 300-316.

[15] Pavlou, P.A. (2003) Consumer Acceptance of Electronic Commerce—Integrating Trust and Risk with the Technology Acceptance Model. *International Journal of Electronic Commerce*, **7**, 69-103. https://doi.org/10.1080/10864415.2003.11044275

[16] Glover, S. and Benbasat, I. (2010) A Comprehensive Model of Perceived Risk of e-Commerce Transactions. *International Journal of Electronic Commerce*, **15**, 47-78. https://doi.org/10.2753/JEC1086-4415150202

[17] Lapointe, L. and Rivard, S. (2005) A Multilevel Model of Resistance to Information Technology Implementation. *MIS Quarterly*, **293**, 461-491. https://doi.org/10.2307/25148692

[18] Lapointe, L. and Rivard, S. (2006) Learning from Physicians' Resistance to CIS Implementation. *Canadian Medical Association Journal*, **174**, 1573-1584. https://doi.org/10.1503/cmaj.050281

[19] Cenfetelli, R.T. and Schwarz, A. (2011) Identifying and Testing the Inhibitors of Technology Usage Intentions. *Information Systems Research*, **22**, 808-823. https://doi.org/10.1287/isre.1100.0295

[20] Tan, X., Qin, L., Kim, Y. and Hsu, J. (2012) Impact of Privacy Concern in Social Networking Web Sites. *Internet Research*, **22**, 211-233. https://doi.org/10.1108/10662241211214575

[21] Zhou, T. (2017) Understanding Location-Based Services Users' Privacy Concern: An Elaboration Likelihood Model Perspective. *Internet Research*, **27**, 506-519. https://doi.org/10.1108/IntR-04-2016-0088

[22] Conchar, M.P., Zinkhan, G.M., Peters, C. and Olavarrieta, S. (2004) An Integrated Framework for the Conceptualization of Consumers' Perceived-Risk Processing. *Journal of the Academy of Marketing Science*, **32**, 418-436.

https://doi.org/10.1177/0092070304267551

[23] Rogers, R.W. (1975) A Protection Motivation Theory of Fear Appeals and Attitude Change. *The Journal of Psychology*, **91**, 93-114. https://doi.org/10.1080/00223980.1975.9915803

[24] Johnston, A.C. and Warkentin, M. (2010) Fear Appeals and Information Security Behaviors: An Empirical Study. *MIS Quarterly*, **34**, 549-566. https://doi.org/10.2307/25750691

[25] Muthitcharoen, A.M., Palvia, P.C. and Grover, V. (2011) Building a Model of Technology Preference: The Case of Channel Choices. *Decision Sciences*, **42**, 205-237. https://doi.org/10.1111/j.1540-5915.2010.00306.x

[26] Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003) User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, **27**, 425-478. https://doi.org/10.2307/30036540

[27] Bock, G.W., Zmud, R.W., Kim, Y.G. and Lee, J.N. (2005) Behavioral Intention Formation in Knowledge Sharing: Examining the Roles of Extrinsic Motivators, Social-Psychological Forces, and Organizational Climate. *MIS Quarterly*, **29**, 87-111. https://doi.org/10.2307/25148669

[28] Gilovich, T. and Medvec V.H. (1995) The Experience of Regret: What, When, and Why. *Psychological Review*, **102**, 379-395. https://doi.org/10.1037/0033-295X.102.2.379

[29] Lowry, P.B., Gaskin, J. and Moody, G. (2015) Proposing the Multi-Motive Information Systems Continuance Model (MISC) to Better Explain End-User System Evaluations and Continuance Intentions. *Journal of the Association for Information Systems*, **16**, 515-579. https://doi.org/10.17705/1jais.00403

[30] Davis, F.D., Bagozzi, R.P. and Warshaw, P.R. (1992) Extrinsic and Intrinsic Motivation to Use Computers in the Workplace. *Journal of Applied Social Psychology*, **22**, 1111-1132. https://doi.org/10.1111/j.1559-1816.1992.tb00945.x

[31] Venkatesh, V., Thong, J.Y.L. and Xu, X. (2012) Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly*, **36**, 157-178. https://doi.org/10.2307/41410412

[32] Featherman, M.S., Valacich, J.S. and Wells., J.D. (2006) Is That Authentic or Artificial? Understanding Consumer Perceptions of Risk in e-Service Encounters. *Information Systems Journal*, **16**, 107-134. https://doi.org/10.1111/j.1365-2575.2006.00211.x

[33] Chung, J.E. (2015) Antismoking Campaign Videos on YouTube and Audience Response: Application of Social Media Assessment Metrics. *Computers in Human Behavior*, **51**, 114-121. https://doi.org/10.1016/j.chb.2015.04.061

[34] Shearer, J. and Shanahan, M. (2006) Cost Effectiveness Analysis of Smoking Cessation Interventions. *Australian and New Zealand Journal of Public Health*, **30**, 428-434. https://doi.org/10.1111/j.1467-842X.2006.tb00458.x

[35] Song, H., Kim, J., Kwon, R.J. and Jung, Y. (2013) Anti-Smoking Educational Game Using Avatars as Visualized Possible Selves. *Computers in Human Behavior*, **29**, 2029-2036. https://doi.org/10.1016/j.chb.2013.04.008

[36] Free, C., Knight, R., Robertson, S., Whittaker, R., Edwards, P., Zhou, W. and Roberts, I. (2011) Smoking Cessation Support Delivered via Mobile Phone Text Messaging (txt2stop): A Single-Blind, Randomised Trial. *The Lancet*, **378**, 49-55. https://doi.org/10.1016/S0140-6736(11)60701-0

[37] Møldrup, C. (2007) Individualised Health Marketing Using SMS—A Smoking Cessation Case. *Journal of Medical Marketing*, **7**, 255-259.

https://doi.org/10.1057/palgrave.jmm.5050087

[38] Chow, C.K., Redfern, J., Hillis, G.S., Thakkar, J., Santo, K., Hackett, M.L., Jan, S., Graves, N., de Keizer, L., Barry, T. and Bompoint, S. (2015) Effect of Lifestyle-Focused Text Messaging on Risk Factor Modification in Patients with Coronary Heart Disease: A Randomized Clinical Trial. *Journal of the American Medical Association*, **314**, 1255-1263. https://doi.org/10.1001/jama.2015.10945

[39] Fjeldsoe, B.S., Marshall, A.L. and Miller, Y.D. (2009) Behavior Change Interventions Delivered by Mobile Telephone Short-Message Service. *American Journal of Preventive Medicine*, **36**, 165-173. https://doi.org/10.1016/j.amepre.2008.09.040

[40] Patrick, K., Raab, F., Adams, M., Dillon, L., Zabinski, M., Rock, C., Griswold, W. and Norman, G. (2009) A Text Message-Based Intervention for Weight Loss: Randomized Controlled Trial. *Journal of Medical Internet Research*, **11**, e1. https://doi.org/10.2196/jmir.1100

[41] Naughton, F., Prevost, A.T., Gilbert, H. and Sutton, S. (2012) Randomized Controlled Trial Evaluation of a Tailored Leaflet and SMS Text Message Self-Help Intervention for Pregnant Smokers (MiQuit). *Nicotine & Tobacco Research*, **14**, 569-577. https://doi.org/10.1093/ntr/ntr254

[42] Whittaker, R., Borland, R., Bullen, C., Lin, R.B., McRobbie, H. and Rodgers, A. (2009) Mobile Phone-Based Interventions for Smoking Cessation. *Cochrane Database of Systematic Reviews*, **11**, CD006611. https://doi.org/10.1002/14651858.CD006611.pub2

[43] Venkatesh, V. and Davis, F. (2000) A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science*, **46**, 186-204. https://doi.org/10.1287/mnsc.46.2.186.11926

[44] Horne, R., Weinman, J. and Hankins, M. (1999) The Beliefs about Medicines Questionnaire: The Development and Evaluation of a New Method for Assessing the Cognitive Representation of Medication. *Psychology & Health*, **14**, 1-24. https://doi.org/10.1080/08870449908407311

[45] Horne, R., Graupnera, L., Frosta, S., Weinmanb, J., Wright, S.M. and Hankins, M. (2004) Medicine in a Multi-Cultural Society: The Effect of Cultural Background on Beliefs about Medications. *Social Science and Medicine*, **59**, 1307-1313. https://doi.org/10.1016/j.socscimed.2004.01.009

[46] Dimoka, A., Hong, Y. and Pavlou, P.A. (2012) On Product Uncertainty in Online Markets: Theory and Evidence. *MIS Quarterly*, **36**, 395-395. https://doi.org/10.2307/41703461

[47] Sun, Y., Bhattacherjee, A. and Ma, Q. (2009) Extending Technology Usage to Work Settings: The Role of Perceived Work Compatibility in ERP Implementation. *Information and Management*, **46**, 351-356. https://doi.org/10.1016/j.im.2009.06.003

[48] Sharma, R., Yetton, P. and Crawford, J. (2009) Estimating the Effect of Common Method Variance: The Method-Method Pair Technique with an Illustration from TAM Research. *MIS Quarterly*, **33**, 473-490. https://doi.org/10.2307/20650305

[49] Pavlou, P.A., Liang, H.G. and Xue, Y.J. (2007) Understanding and Mitigating Uncertainty in Online Exchange Relationships: A Principal-Agent Perspective. *MIS Quarterly*, **31**, 105-136. https://doi.org/10.2307/25148783

[50] Bontis, N., Crossan, M.M. and Hulland, J. (2002) Managing an Organizational Learning System by Aligning Stocks and Flows. *Journal of Management Studies*, **39**, 437-469. https://doi.org/10.1111/1467-6486.t01-1-00299

[51] Chin, W.W. (1998) The Partial Least Squares Approach for Structural Equation Modeling. In: Marcoulides, A., Ed., *Modern Methods for Business Research*, Lawrence

Erlbaum Associates, Mahwah, NJ, 295-336.

[52] Thomas, R.D., Lu, I.R.R. and Cedzynski, M. (2005) Partial Least Squares: A Critical Review and a Potential Alternative. *Proceedings of Administrative Sciences Association of Canada* (*ASAC*) *Conference*, Toronto, 28-31 May 2005.

[53] Lohmoller, J.B. (1989) Latent Variable Path Modeling with Partial Least Squares. Physica-Verlag, Heidelberg. https://doi.org/10.1007/978-3-642-52512-4

[54] Ringle, C.M., Wende, S. and Will, S. (2005) SmartPLS 2.0 (M3) Beta. http://www.smartpls.de

[55] Gefen, D. and Straub, D. (2005) A Practical Guide to Factorial Validity Using PLS-Graph: Tutorial and Annotated Example. *Communications of the Association for Information Systems*, **16**, 91-109. https://doi.org/10.17705/1CAIS.01605

[56] Hair, J.F., Ringle, C.M. and Sarstedt, M. (2011) PLS-SEM: Indeed a Silver Bullet. *Journal of Marketing Theory and Practice*, **19**, 139-152. https://doi.org/10.2753/MTP1069-6679190202

[57] Bontis, N. (2004) National Intellectual Capital Index: A United Nations Initiative for the Arab Region. *Journal of Intellectual Capital*, **5**, 13-39. https://doi.org/10.1108/14691930410512905

[58] Fornell, C. and Larcker, D.F. (1981) Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, **18**, 39-50. https://doi.org/10.1177/002224378101800104

[59] Jarvenpaa, S.L., Shaw, T.R. and Staples, D.S. (2004) Toward Contextualized Theories of Trust: The Role of Trust in Global Virtual Teams. *Information Systems Research*, **15**, 250-267. https://doi.org/10.1287/isre.1040.0028

[60] Cenfetelli, R.T. and Bassellier, G. (2009) Interpretation of Formative Measurement in Information Systems Research. *MIS Quarterly*, **33**, 689-708. https://doi.org/10.2307/20650323

[61] Ou, C.X., Pavlou, P. and Davison, R. (2014) Swift Guanxi in Online Marketplaces: The Role of Computer-Mediated Communication Technologies. *MIS Quarterly*, **38**, 209-230. https://doi.org/10.25300/MISQ/2014/38.1.10

[62] Cunningham, L.F., Gerlach, J. and Harper, M.D. (2004) Assessing Perceived Risk of Consumers in Internet Airline Reservations Services. *Journal of Air Transportation*, **9**, 21-35.

[63] Moon, J.W. and Kim, Y.G. (2001) Extending the TAM for a World-Wide-Web Context. *Information and Management*, **38**, 217-230. https://doi.org/10.1016/S0378-7206(00)00061-6

[64] Bontis, N., Keow, W.C.C. and Richardson, S. (2000) Intellectual Capital and Business Performance in Malaysian Industries. *Journal of Intellectual Capital*, **1**, 85-100. https://doi.org/10.1108/14691930010324188

[65] Hair Jr., J.F., Hult, G.T.M., Ringle, C. and Sarstedt, M. (2017) A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). SAGE Publications, Thousand Oaks, CA.

[66] Hertzum, M. (2003) Making Use of Scenarios: A Field Study of Conceptual Design. *International Journal of Human-Computer Studies*, **58**, 215-239. https://doi.org/10.1016/S1071-5819(02)00138-6

[67] Jarke, M. (1999) Scenarios for Modeling. *Communications of the ACM*, **421**, 47-48. https://doi.org/10.1145/291469.293167