Role of user a priori attitude in the acceptance of mobile health: an empirical investigation

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Abstract The objective of this research is to investigate the role of user attitude toward the activity supported by a mobile health application in the overall technology acceptance equation. For that, a perceived risk-motivation theoretical model integrating user attitude on quitting smoking was developed and tested empirically with 170 participants from the UK for the context of using cell phones to support smoking cessation interventions. Results show an attitude favourable to quitting smoking has a negative effect on the perceived risk, no significant effect on the motivation, and a small positive influence on the behavioural intention associated with using the mobile health service. Overall, having a positive a priori attitude toward a healthy activity is not a sufficient reason to make users accept a mobile service supporting that activity.

Keywords Mobile health · User acceptance · Cell phone · Smoking cessation · Attitude

JEL classification · M150

Introduction

It is well-known from technology adoption literature in information systems (IS) that user perceptions and views are a key element for the success of any information technology (IT) deployment (Venkatesh et al. 2002). If users are not motivated by the usefulness of an IT application, by its ease of use, or by its attractiveness, that technology has poor chances of success. Moreover, user perceptions are of the

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outmost importance when considering the use of IT in a sensitive field like healthcare.

As a result of the concerns on the consequences of user negative perceptions on the technology use, a number of technology acceptance studies in IS have been also including factors such as resistance to adoption or perceived risk of using IT (Featherman and Pavlou 2003). Unsurprisingly, a growing body of these studies have been done in the context of applying IT in healthcare due to the social weight of this field (Cocosila et al. 2009; Lapointe and Rivard 2005; Lapointe and Rivard 2006).

While the most suitable approach to measure and incorporate resistance to IT use in models of technology acceptance is still under debate, an additional question that is being discussed nowadays regards the influence on adoption exerted by individuals' characteristics not directly related to an IT under scrutiny. The "relatively mutable subset of personal factors" like individual perceptions (e.g., perceived usefulness and perceived ease of use) have been traditionally popular in the adoption equation for decades (McElroy et al. 2007). However, more recent studies considered the effect of personality traits to be also important (Wixom and Todd 2005) because these traits could make individuals behave differently even if they are exposed to the same context (Devaraj et al. 2008). Research demonstrated, for instance, the significant role played in the adoption of mobile commerce by some of the personality traits like extraversion, agreeableness, openness to new experience, conscientiousness, and neuroticism (Junglas et al. 2008; Zhou and Lu 2011) or like personal innovativeness, individual playfulness, and individual's optimum stimulation level (Mahatanankoon 2007). Consumer personality was found to be significant for the success of new online banking (Khare et al. 2010) and a pre-existing traditional shopping behaviour was found to be important for the success of online purchasing in an early stage market (Liebermann and Stashevsky 2009).

In the same line of thinking, previous research also discussed the possible role in the technology acceptance equation of another category of factors pertaining to the individual and independent from the technology under scrutiny: the user a priori views on the activity targeted by the technology. Some of these views have been conceptualized in recent studies as emotional attachment (Read et al. 2011), multiple attitudes (Pramatari and Theotokis 2009) or as an *attitude toward the activity* supported by the IT application (Cocosila and Archer 2010; Cocosila et al. 2009). The a priori attitude is not dependent on the technology investigated and, therefore, should not be confounded to the attitude developed with the actual use of the IT or IT application that was included in early studies on the Technology Acceptance Model (Davis 1989).

As the role of user a priori views on the activity targeted by a new IT application is under-researched in the available literature, this study attempts to fill that void by investigating the effect of the attitude on a health promotion activity on the user acceptance of a mobile service meant to support that activity. The framework chosen for this scope is the relatively recent use of cell phones to support smoking cessations initiatives.

Quitting smoking is one of the best things people can do to improve their health and life (Health Canada 2011). Consequently, individuals and society have become more and more concerned with helping smokers cease this habit and there have been various initiatives integrated in the unanimous societal efforts to encourage quitting smoking. Among these, an innovative approach of recent date is to use mobile IT to provide individual support to people willing to quit smoking (Møldrup 2007). Cell phones are particularly interesting for this scope due to their recognized advantages in terms of anytime-anywhere capabilities, flexibility, popularity, entertainment provision, and individual use that is suitable to the delivery of tailored, confidential, and inexpensive advice (Obermayer et al. 2004; Whittaker et al. 2007). Due to these characteristics, cell phones may be an appropriate path of distribution of smoking cessation educational materials that proved to be effective through other channels as well as for novel interventions (Rodgers et al. 2005).

Before investigating the feasibility and benefits of using cell phones in smoking cessation programs or the business aspects of such initiatives, a key question regards targeted users' perceptions and, among these, pre-existing attitude on smoking cessation. Thus, a question that can be asked is whether the attitude regarding quitting smoking would be capable, by itself, to discriminate between users who are positive to accepting the IT supporting the smoking cessation and those who are not. For instance, if attitude regarding quitting smoking proves to be decisive for the success of the IT service, mobile health applications supporting smoking cessation should target only individuals having a positive view on this activity.

To investigate these aspects and the role of attitude toward the activity in particular, an empirical study involving 170 participants was conducted across the UK. The research included attitude toward smoking cessation in a theoretical model of user acceptance of cell phones in smoking cessation programs. This paper reports on the above study as follows: next two sections present the theoretical background followed by the development of the research model and hypotheses. Next, research methodology and main findings are presented. The paper concludes with a discussion and conclusions section.

Theoretical background

Researchers in information systems have proposed and successfully tested a number of models and theories examining factors that would make individuals to accept and use a new information technology (for a comparison review see Venkatesh et al. 2003). One of the established theoretical approaches to study the acceptance of an IT is the motivational model that was first used in IS by Davis et al. (1992) and further validated by the studies of Venkatesh et al. (Venkatesh and Speier 1999; Venkatesh et al. 2002) and Igbaria et al. (Igbaria et al. 1996). This is a basic model positing that the behavioural intention (BI) to use an IT has only two antecedents: extrinsic motivation (EM), expressing a perception of usefulness of that technology, and intrinsic motivation (IM), capturing an enjoyment feeling when using that technology (Davis et al. 1992). Motivational model is thus suitable for examining user perceptions when discussing the use *in principle* of an IT in a new direction since it captures closely the two broad categories of reasons to use a technology: external to the user (i.e., extrinsic motivation to attain a certain goal or reward) and internal to the user (i.e., intrinsic reasons or motivation coming from the technology use itself).

The motivational model, as other popular theories and models of technology acceptance, examine factors that would make users accept and use a certain IT or IT application (Venkatesh et al. 2003): e.g., the technology is useful, easy to use, enjoyable, etc. However, in recent years there have been growing concerns among segments of users about the IT becoming more and more costly, complicated and difficult to use or, even, intruding. Accordingly, users would perceive such negative features as obstacles to adoption. To reflect these views, new concepts called *resistance to adoption* (Lapointe and Rivard 2005; Lapointe and Rivard 2006) or, more often, *perceived risk* of using (Cocosila et al. 2009; Featherman and Pavlou 2003; Pavlou 2003) were studied.

Perceived risk in IS studies was adapted from consumer behaviour research and has a negative connotation. It reflects user fears on possible (yet, not necessarily real) losses or disadvantages sourcing from the use of an IT. To better capture the various types of negative perceptions of risk, researchers generally agree that risk is in fact a multi-dimensional construct (Lim 2003). For instance, perceived risk in IT acceptance may reflect fears of wasting money to buy a technology or subscribe for an IT service, fears of wasting time with a complicated technology, fears of sharing private data through a certain technology service, etc. Perceived risk constructs have been incorporated in models of technology acceptance and empirical research showed that, as expected, risk negatively affects user intention to accept a technology directly or indirectly (Cunningham et al. 2004; Featherman and Pavlou 2003).

In addition to the above two large categories of factors favouring and disfavouring an IT adoption, respectively (i.e., motivation and risk perception), previous research also discussed the potential effect on these two categories exerted by some a priori user factors. One of these was called *attitude toward the activity* (Cocosila et al. 2009) and reflects user existing views on the activity targeted by the technology and *not* on the technology itself. Such factors could be very important in sensitive fields like healthcare where, for instance, if users do not perceive the necessity of a medication, this would also negatively affect their views on the IT application designed to remind them about taking that medication. Therefore, an interesting topic of research is to investigate the influence of pre-existing attitudinal factors about an activity on the perceptions regarding the use of an IT to support that activity.

A scientific investigation of user perceptions on the use of cell phones in quitting smoking programs is an excellent opportunity to test the influence of attitude toward smoking cessation on the two categories of factors discussed above: positive to acceptance and negative to acceptance. Hence, this research tests the role of pre-existing attitude regarding smoking cessation (e.g., 'quitting smoking may be a good thing') and not of the attitude on using cell phones for smoking cessation support (e.g., 'using mobile phones to support quitting smoking may be a good thing'). Consequently, this study formulates the following research questions:

> What is the influence of motivation and perceived risk on user intention to adopt a mobile health application for smoking cessation?

> What is the effect of user attitude on smoking cessation on user intention to adopt a mobile health application for smoking cessation?

Model and hypotheses development

To investigate the influence of the opposite (i.e., positive and negative) user perceptions on the adoption of a mobile health application for smoking cessation, a theoretical model to be validated empirically, as depicted in Fig. 1, is built. The model is an extension of the motivational model (containing extrinsic and intrinsic motivation as factors favourable to adoption) with the risk perceptions (hence, the factors disfavourable to adoption). This balanced approach is necessary as the theoretical model is an exploratory investigation of the role of a priori attitude toward the activity (i.e., smoking cessation). The attitude construct is integrated, based on recommendations of previous studies and, especially, on theoretical reasoning, as an antecedent of both motivational factors and perceived risk.

Consumer behaviour literature consistently shows that perceived risk has six main facets that capture various sides of apprehension people feel regarding the consequences of a purchase (Laroche et al. 2004; Lim 2003): (1) loss of money, (2) waste of time, (3) getting a poor performance object, (4) facing social embarrassment, (5) being harmed physically, and (6) facing psychological concern on the worthiness of the purchase. The relative influence of these facets on the overall risk perception is influenced by the specific product/service (Conchar et al. 2004). However, due to a compensation effect, the outcome on the overall risk should be approximately similar (Stone and Grønhaug 1993). As an example, a cheaper product implies less financial risk but a higher risk of not performing well compared to a more expensive product.

This study follows the example of previous IS research that considered perceived risk as a second-order construct composed through various risk facets seen as first-order constructs (Cocosila and Archer 2010; Featherman and Pavlou 2003). In the context of this research (i.e., using mobile phones to support those smokers who would decide to quit smoking) only the following four risk facets out of the six mentioned above are considered meaningful:

- Financial risk (i.e., fear of wasting money for a non-necessary service);
- Time risk (i.e., fear of wasting time with a bothering service);
- Social risk (i.e., fear of negative reactions from family and friends if subscribing to such a service);
- Psychological risk (i.e., general anxiety about subscribing to a useless service).

Performance risk was not considered a significant issue for individuals already using cell phones if offered a quitting smoking support service on their phones. In addition, as previous research demonstrated, cell phone users are not concerned about a possible physical harm caused by these devices (Cocosila et al. 2007).

Fig. 1 Theoretical model attitude-perceived risk-motivation
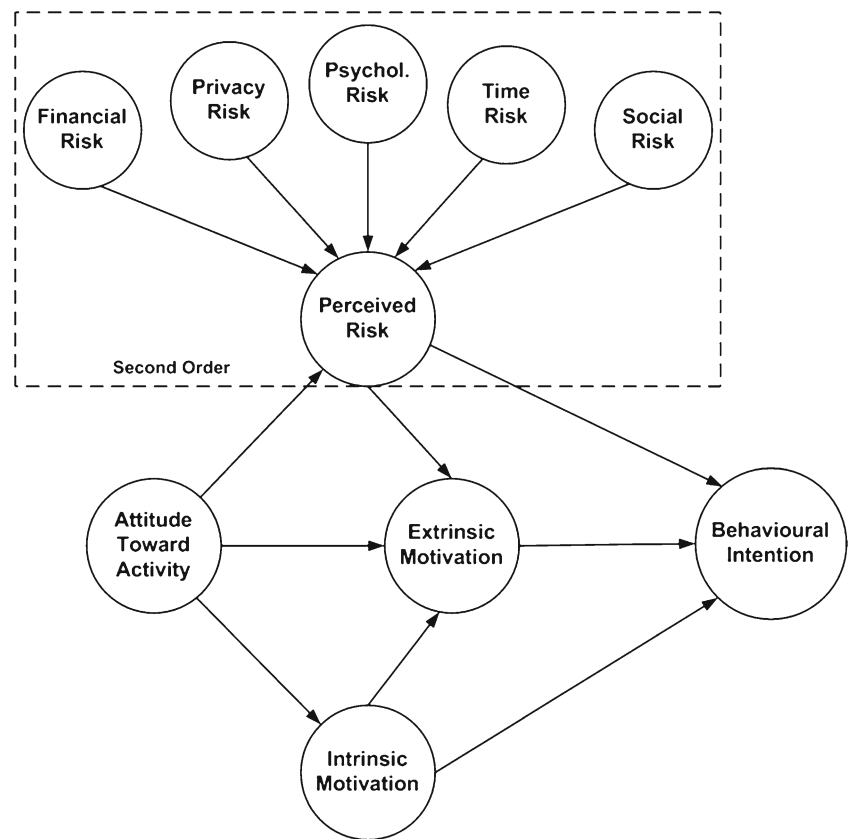
On the other hand, previous research in IS added privacy risk as a new dimension to those six adapted from consumer behaviour when discussing adoption of e-commerce activities (Cocosila and Archer 2010; Featherman and Pavlou 2003). Privacy risk perception would capture apprehension of disclosing personal data to an unknown service provider (e.g., the provider of a mobile service support for smoking cessation in this case).

Taking into account the above, we consider the four significant facets of perceived risk coming from consumer behaviour (financial, time, social, and psychological) plus the privacy risk to be important for this research. Accordingly, we hypothesize that:

H1a: *Perceived financial risk positively impacts perceived overall risk of using mobile phones as a support in smoking cessation.*

H1b: *Perceived privacy risk positively impacts perceived overall risk of using mobile phones as a support in smoking cessation.*

H1c: *Perceived psychological risk positively impacts perceived overall risk of using mobile phones as a support in smoking cessation.*

H1d: *Perceived time risk positively impacts perceived overall risk of using mobile phones as a support in smoking cessation.*

H1e: *Perceived social risk positively impacts perceived overall risk of using mobile phones as a support in smoking cessation.*

This study introduces as an innovative construct attitude toward the activity targeted by the technology. Previous research (Cocosila and Archer 2010; Cocosila et al. 2009) and theoretical reasoning show that if attitude toward the activity (hence quitting smoking in this case) is favourable, then it is more likely users also perceive the benefits of using the technology for that activity. Following the same line of thinking, if attitude is positive, users may perceive less risk associated with the use of that technology. This is similar to previous research that, as shown in the introduction section above, integrated personality traits, pre-existing behaviour, emotional attachment or multiple attitude as antecedents of the classical technology-related perceptions in technology acceptance models. Accordingly, we formulate the following hypotheses:

H2: *Attitude toward smoking cessation negatively impacts overall risk of using mobile phones as a support in smoking cessation.*

H3: *Attitude toward smoking cessation positively impacts extrinsic motivation of using mobile phones as a support in smoking cessation.*

H4: *Attitude toward smoking cessation positively impacts intrinsic motivation of using mobile phones as a support in smoking cessation.*

Previous work investigating motivation theory and model shows that when people perceive an activity as being more enjoyable they also tend to see more clearly the usefulness side of that activity (Ryan and Deci 2000; Venkatesh et al. 2002). Therefore, there is a positive link between intrinsic motivation and extrinsic motivation. On the contrary, previous IS studies have shown that perceived risk has a negative effect on perceived usefulness or extrinsic motivation (Cocosila et al. 2009; Featherman and Pavlou 2003): if people are apprehensive about some disadvantages of using a technology, they tend to see less usefulness in that technology. Further, similar to consumer behaviour situations, when people perceive a risk associated with a purchase this tends to negatively influence their decision to buy (Laroche et al. 2004). Theoretical reasoning in a parallel way leads to a negative link between perceived risk of using an IT application and behavioural intention to use that application. Consequently, we hypothesize that:

H5: *Perceived overall risk negatively impacts extrinsic motivation of using mobile phones as a support in smoking cessation.*

H6: *Intrinsic motivation positively impacts extrinsic motivation of using mobile phones as a support in smoking cessation.*

H7: *Perceived overall risk negatively impacts behavioural intention to use mobile phones as a support in smoking cessation.*

Previous IS research demonstrated consistently that perceived usefulness is a strong and significant antecedent of the behavioural intention to use a technology (Venkatesh et al. 2002). Intrinsic motivation is also a determinant of behavioural intention, usually of a lesser importance, but not to be neglected especially when acting in combination with perceived usefulness, or extrinsic motivation (Davis et al. 1992; Venkatesh 1999). Accordingly, we propose the hypotheses:

H8: *Perceived extrinsic motivation positively impacts behavioural intention to use mobile phones as a support in smoking cessation.*

H9: *Perceived intrinsic motivation positively impacts behavioural intention to use mobile phones as a support in smoking cessation.*

Figure 1 above represents a diagram of the theoretical model and hypotheses.

Methodology

The research questions proposed by this study were answered following a cross-sectional fully online experiment conducted with a sample of subjects from the UK. For increased realism, participants were recruited from the individuals across all the UK counties pre-registered with a company conducting Web-based surveys, Research Now (www.researchnow.com). Potentially interested participants were required to be at least 18 years old, smoke at least occasionally and currently use cell phones and wireless text messaging.

Subjects meeting the including conditions and consenting to participate were first presented a Web scenario on how wireless short messages (SMS) could be used to support them quitting smoking, if they were interested in that. Thus, if they subscribed to a quit smoking support service delivered through their cell phones, they would receive funny SMS messages of support reminding and encouraging them on their path. Messages would come at random times, one per day on average, and would be sent by health providers from a smoking cessation call centre. If willing to contact the call centre, participants were told they could do it by SMS and be answered the same way as early as possible. For increased realism, participants were provided screenshots of cell phone displays with samples of actual messages. The sample messages were designed following concrete examples of pilot studies reporting positive outcomes in health promotion activities when sending participants enjoyable SMS reminders and, even, one-line jokes in a colloquial and friendly style (Franklin et al. 2003; Neville et al. 2002; Rodgers et al. 2005).

According to the scenario, the cell phone service was to be provided for 6 months and the users were supposed to pay for their SMS activity. The use of such scenarios is a well-established approach in IS research (Jarke 1999; Hertzum 2003) and has the advantages of cost effectiveness and lower risk, especially for sensitive fields like health services.

After the Web scenario, participants were asked to complete an online survey on their impressions regarding cell phone use for smoking cessation. The survey contained questions to measure the multi-item constructs in the theoretical model and associated hypotheses as well as demographic questions. Items were measured with 7-point Likert-type scales adapted from validated previous research in IS (Featherman and Pavlou 2003; van der Heijden 2004; Venkatesh and Davis 2000; Venkatesh et al. 2002) and consumer behaviour (Laroche et al. 2004; Stone and Grønhaug 1993). As this study was about an IT application in healthcare and since a measurement for attitude toward activity could not be found in the existing IS literature, as a first attempt to measure it, this multi-

item construct was adapted from previously validated healthcare studies (Horne et al. 1999).

Nowhere during the experiment were participants told that smoking would be harmful. They were not asked about their willingness to quit smoking either and the questions on their behavioural intent to accept the mobile service contained the condition "if I decided to quit smoking". Appendix A presents measurement scales for the theoretical model.

Results

A number of 300 invitations to the experiment were sent to potential participants all across the UK. The number of invitations was thought as a contingency measure to obtain at least the minimum number of participants required by the data analysis statistical method. A total of 170 valid complete responses meeting all the including conditions were recorded. These were part of a larger experiment conducted in that setting.

Analyses indicated that 50.0 % of the respondents were female and the average age of the sample was 41.16 years. Participants reported smoking 84.19 cigarettes per week, on average, and having a past of 23.91 years of smoking, on average. In terms of cell phone and SMS experience, participants reported an average of 10.28 and 8.81 years, respectively. Regarding SMS current usage, subjects reported sending more messages per week, on average, than receiving: 57.50 compared to 46.08.

Subsequent data analysis was done with Partial Least Squares (PLS) modelling due to its suitability for complex exploratory models (Bontis et al. 2002). Further, PLS is suitable for formative indicators (Thomas et al. 2005). Thus, perceived overall risk was measured as a second-order construct through a repeated indicators approach (i.e., through the indicators of the five first-order risk constructs, as presented in Fig. 1) (Lohmoller 1989; Turel et al. 2007; Turel et al. 2010). The sample size of 170 was larger than the minimum recommended by the literature (Chin 1998): 150 for this case, i.e., ten times the number of indicators of the formative construct (perceived overall risk).

Measurement model

SmartPLS (Ringle et al. 2005) was used as PLS analysis software. The general approach recommended by Gefen and Straub (2005) for evaluating validity was followed closely. A first analysis of the PLS results showed Cronbach's alpha, composite reliability and Average Variance Extracted (AVE) values for all first-order constructs were above the recommended limits of 0.7, 0.7 and 0.5, respectively (Bontis 2004; Fornell and Larcker 1981;

Jarvenpaa et al. 2004). Factor loadings were generally high, above 0.7 for almost all items. These data, shown in Table 1, allow the conclusion that the constructs had appropriate reliability and convergent validity.

The following analysis was a test for discriminant validity. This latter was assessed through a visual examination of the matrix of loadings and cross-loadings of first-order constructs. Since items load more on the constructs they are supposed to load on than on other constructs, as shown in Table 2, it can be concluded that constructs have appropriate discriminant validity. This conclusion is strengthened by Table 3 that shows that square roots of AVE values for all constructs (the diagonal elements) are larger than correlations with the other constructs (the off-diagonal elements). Consequently, since reliability and construct (i.e., convergent and discriminant) validity conditions were met, all items were retained in the measurement model and the PLS analysis continued with the structural part.

Structural model

Structural analysis consisted in evaluating path coefficients and significance levels after running SmartPLS with a bootstrap with 200 re-samples. Results are presented in Fig. 2 and Table 4.

Figure 2 and Table 4 indicate that 10 out of 13 hypotheses were supported. As expected, all first order perceived risk constructs have a significant contribution to the second-order perceived overall risk. The two sides of motivation (extrinsic one, especially) are strong and significant positive antecedents of the behavioural intention while perceived risk is a negative significant antecedent. Perceived overall risk did not have a significant effect on extrinsic motivation. The only significant effect of attitude toward activity (i.e., attitude on quitting smoking) was a negative link to perceived risk.

The proposed model showed relatively high explanatory power for two of the endogenous constructs: the variance explained was $R^2=0.525$ for extrinsic motivation and $R^2=0.591$ for behavioural intention. Perceived overall risk had a much lower coefficient of determination ($R^2=0.080$) but small values are not uncommon in IS studies (Moon and Kim 2001). Logically, intrinsic motivation had a coefficient close to zero since the only antecedent tested (attitude toward activity) had no significant effect.

In terms of the total effect on the behavioural intention to use the mobile health application, the influence of attitude toward smoking cessation was comparatively smaller than that of motivation or risk perceptions, as provided by SmartPLS output. Table 5 presents total effect values.

Table 1 Statistics of the measurement model

Item	Mean	Standard deviation	Factor loading	Error	Composite reliability (Cronbach's alpha; AVE)
PFR1	4.43	1.60	0.832	0.044	0.859 (0.763; 0.672)
PFR2	5.46	1.41	0.721	0.108	
PFR3	5.12	1.44	0.898	0.028	
PPR1	3.65	1.66	0.917	0.020	0.912 (0.854; 0.776)
PPR2	4.02	1.67	0.919	0.026	
PPR3	3.76	1.78	0.803	0.050	
PSYR1	3.77	1.64	0.907	0.026	0.954 (0.928; 0.875)
PSYR2	3.42	1.64	0.961	0.010	
PSYR3	3.34	1.66	0.938	0.016	
PTR1	3.74	1.60	0.927	0.019	0.950 (0.921; 0.864)
PTR2	3.52	1.69	0.940	0.019	
PTR3	3.30	1.75	0.922	0.018	
PSR1	3.42	1.71	0.859	0.035	0.937 (0.899; 0.834)
PSR2	3.02	1.66	0.949	0.013	
PSR3	2.72	1.57	0.930	0.018	
ATA1	4.51	1.58	0.518	0.274	0.884 (0.815; 0.667)
ATA2	6.14	1.17	0.836	0.220	
ATA3	6.02	1.28	0.939	0.180	
ATA4	5.77	1.38	0.905	0.175	
EM1	3.82	1.45	0.802	0.054	0.890 (0.835; 0.672)
EM2	4.21	1.42	0.692	0.096	
EM3	3.95	1.56	0.916	0.017	
EM4	4.22	1.55	0.854	0.028	
IM1	3.85	1.38	0.899	0.024	0.910 (0.851; 0.771)
IM2	3.99	1.34	0.887	0.031	
IM3	3.38	1.41	0.848	0.051	
BI1	4.15	1.62	0.962	0.011	0.960 (0.917; 0.923)
BI2	4.14	1.62	0.960	0.015	

PFR Perceived Financial Risk, *PPR* Perceived Privacy Risk, *PSYR* Perceived Psychological Risk, *PTR* Perceived Time Risk, *PSR* Perceived Social Risk, *ATA* Attitude Toward Activity, *EM* Extrinsic Motivation, *IM* Intrinsic Motivation, *BI* Behavioural Intention, 1…4 - scale items

Control variables

Age, gender, smoking figures and cell phone and SMS experience and use were tested as possible control variables. SmartPLS was run for each of them. No changes in the measurement model were noticed. Hence the small increases of the variance explained for the endogenous variables recorded in some situations had structural causes only (Table 6). However, no significant path from any control variable to any endogenous construct was noticed.

Discussion and conclusions

The main scope of this work has been to understand the role of pre-existing attitude toward the activity in an IT application acceptance model for mobile health combining positive factors and negative factors. The context of this research is the user acceptance of mobile phones as a support tool in smoking cessation interventions. A theoretical model built by expanding the motivational model with a multi-dimensional perceived

risk and having as common antecedent the attitude toward the activity was built and empirically tested with a sample of 170 respondents from the UK.

The first research question we proposed was: *What is the influence of motivation and perceived risk on user intention to adopt a mobile health application for smoking cessation?* Similar to previous research in IS, we found that both sides of motivation have a positive and significant influence, with a stronger role for extrinsic motivation or perceived usefulness (Cocosila et al. 2009; Davis et al. 1992; Featherman and Pavlou 2003): path coefficient to behavioural intention 0.451 compared to 0.289 for intrinsic motivation. This allows the conclusion that, despite the enjoyment, or fun, side of the SMS messaging, users also saw its 'serious' part in this context. Participants, thus, judged the technology in terms of its usefulness: a support for smoking cessation if they decided to quit smoking. However, as results show, intrinsic motivation plays a non-negligible role, consistent with previous research (Childers et al. 2001), especially through the strong influence on extrinsic motivation. Moreover, intrinsic motivation has the largest total effect on the

Table 2 Loadings and cross-loadings of first order constructs

|	ATA	BI	EM	IM	PFR	PPR	PSR	PSYR	PTR
ATA1	0.52	0.18	0.14	0.20	−0.07	−0.06	−0.02	−0.17	−0.11
ATA2	0.84	0.04	−0.01	−0.08	−0.16	−0.20	−0.24	−0.18	−0.17
ATA3	0.94	0.07	0.03	0.01	−0.18	−0.22	−0.26	−0.28	−0.24
ATA4	0.90	0.10	0.08	0.06	−0.17	−0.12	−0.23	−0.15	−0.16
BI1	0.14	0.96	0.69	0.65	−0.29	−0.24	−0.22	−0.38	−0.32
BI2	0.07	0.96	0.68	0.63	−0.33	−0.24	−0.15	−0.35	−0.33
EM1	0.08	0.58	0.80	0.51	−0.12	−0.10	−0.11	−0.30	−0.31
EM2	0.11	0.41	0.69	0.46	−0.18	−0.08	−0.13	−0.26	−0.22
EM3	0.05	0.64	0.92	0.66	−0.12	−0.11	−0.06	−0.34	−0.19
EM4	0.01	0.67	0.85	0.69	−0.21	−0.13	−0.09	−0.26	−0.18
IM1	0.03	0.59	0.66	0.90	−0.19	−0.21	−0.07	−0.31	−0.20
IM2	0.04	0.58	0.64	0.89	−0.18	−0.16	0.00	−0.30	−0.18
IM3	0.03	0.59	0.59	0.85	−0.19	−0.11	−0.05	−0.27	−0.22
PFR1	−0.17	−0.38	−0.20	−0.28	0.83	0.26	0.24	0.26	0.43
PFR2	−0.05	−0.11	−0.04	−0.02	0.72	0.16	0.12	0.08	0.15
PFR3	−0.19	−0.25	−0.18	−0.17	0.90	0.41	0.28	0.22	0.39
PPR1	−0.18	−0.30	−0.14	−0.24	0.37	0.92	0.40	0.54	0.56
PPR2	−0.15	−0.23	−0.14	−0.18	0.33	0.92	0.39	0.50	0.53
PPR3	−0.19	−0.11	−0.05	−0.04	0.24	0.80	0.39	0.42	0.45
PSR1	−0.26	−0.11	−0.05	0.00	0.29	0.36	0.86	0.50	0.58
PSR2	−0.23	−0.21	−0.12	−0.04	0.22	0.44	0.95	0.53	0.63
PSR3	−0.19	−0.21	−0.13	−0.09	0.24	0.43	0.93	0.50	0.63
PSYR1	−0.21	−0.39	−0.36	−0.35	0.29	0.53	0.48	0.91	0.59
PSYR2	−0.21	−0.36	−0.32	−0.29	0.22	0.50	0.53	0.96	0.58
PSYR3	−0.28	−0.31	−0.31	−0.28	0.20	0.52	0.56	0.94	0.59
PTR1	−0.20	−0.37	−0.28	−0.23	0.44	0.52	0.63	0.54	0.93
PTR2	−0.20	−0.31	−0.22	−0.22	0.43	0.52	0.62	0.59	0.94
PTR3	−0.20	−0.26	−0.24	−0.19	0.32	0.60	0.64	0.62	0.92

behavioural intention to use the IT application, out of all direct and indirect antecedents, as seen in Table 5. Therefore, developers of mobile health applications, such as those using cell phone support for quitting smoking, should take into account the enjoyment side to increase the acceptance by potential users, although these are not primarily hedonic IS applications as investigated by van der Heijden (2004).

Similar to some of the previous research (Cocosila and Archer 2010), perceived overall risk had a negative influence on behavioural intention but not a significant influence on extrinsic motivation. An explanation could be that risk perceptions associated with the use of a technology are an inhibitor of using it, similar to perceived risk for an intended purchase (Laroche et al. 2004). However, the fact that

Table 3 Correlations and square roots of average variance extracted

	ATA	BI	EM	IM	PFR	PPR	PSR	PSYR	PTR
ATA	0.82								
BI	0.11	0.96							
EM	0.07	0.72	0.82						
IM	0.04	0.67	0.72	0.88					
PFR	−0.18	−0.32	−0.19	−0.21	0.82				
PPR	−0.20	−0.25	−0.13	−0.18	0.36	0.88			
PSR	−0.25	−0.19	−0.11	−0.05	0.27	0.45	0.91		
PSYR	−0.25	−0.38	−0.35	−0.33	0.25	0.56	0.56	0.94	
PTR	−0.22	−0.34	−0.26	−0.23	0.43	0.58	0.67	0.63	0.93

Fig. 2 Structural evaluation of the model of cell phone adoption in smoking cessation. (Significance levels: *=0.05; **=0.01; ***=0.001)
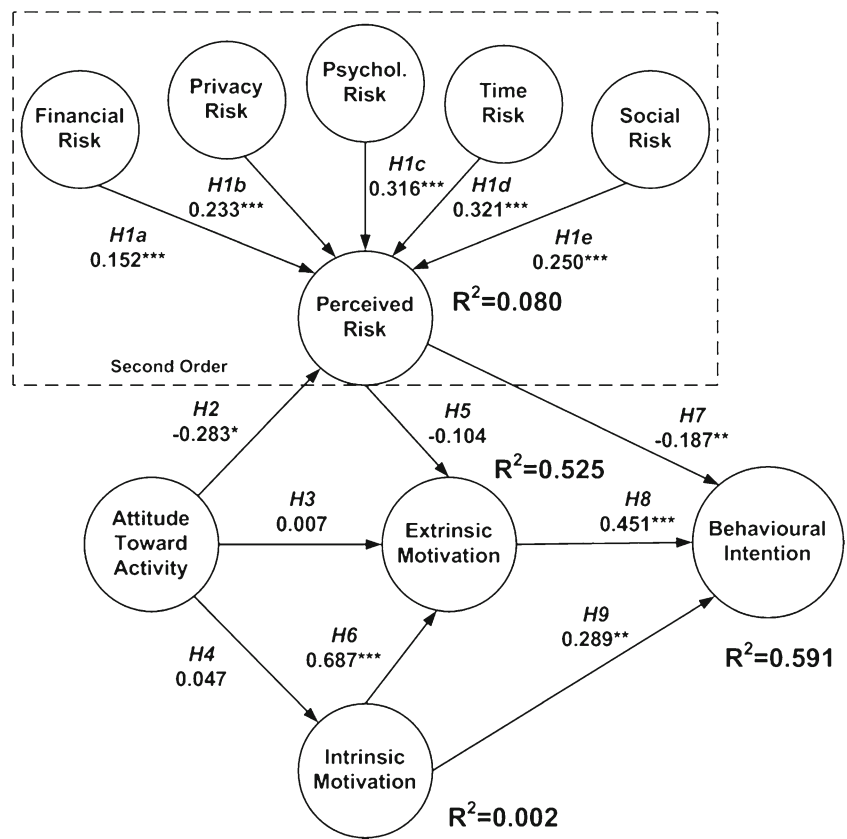
quitting smoking is perceived as a health promotion activity, hence of no obvious immediate usefulness, may lead to the lack of influence on extrinsic motivation. All risk sides considered were important in the general risk perception and should be addressed in practical implementations.

The second research question we posed was: *What is the effect of user attitude on smoking cessation on user intention to adopt a mobile health application for smoking cessation?* We found that the only significant effect of the pre-existing

attitude toward smoking cessation was on perceived risk and this happened at a low level. Thus, a priori attitude explained only 8 % of the variance of perceived risk. Hence, if smokers are favourable to smoking cessation, they tend to see less risk in using a technology designed to help them quit smoking, if they decided to quit this habit. Overall, the total effect of attitude on behavioural intention was manifested through the perceived risk path and was relatively small: 0.097. This effect had the same direction as the

Table 4 Hypothesis test results

Hypothesis	Path	Path coefficient	t-Value	p-Value	Outcome
1a	Perceived Financial Risk - > Perceived Overall Risk	0.152	4.453	<0.001	Supported
1b	Perceived Privacy Risk - > Perceived Overall Risk	0.233	9.310	<0.001	Supported
1c	Perceived Psychological Risk - > Perceived Overall Risk	0.316	11.548	<0.001	Supported
1d	Perceived Time Risk - > Perceived Overall Risk	0.321	13.302	<0.001	Supported
1e	Perceived Social Risk - > Perceived Overall Risk	0.250	12.265	<0.001	Supported
2	Attitude Toward Activity - > Perceived Overall Risk	−0.283	2.246	<0.05	Supported
3	Attitude Toward Activity - > Extrinsic Motivation	0.007	0.087	n.s.	Rejected
4	Attitude Toward Activity - > Intrinsic Motivation	0.047	0.278	n.s.	Rejected
5	Perceived Overall Risk - > Extrinsic Motivation	−0.104	1.457	n.s.	Rejected
6	Intrinsic Motivation - > Extrinsic Motivation	0.687	12.311	<0.001	Supported
7	Perceived Overall Risk - > Behavioural Intention	−0.187	2.744	<0.01	Supported
8	Extrinsic Motivation - > Behavioural Intention	0.451	3.740	<0.001	Supported
9	Intrinsic Motivation - > Behavioural Intention	0.289	2.611	<0.01	Supported

Table 5 Total effects on behavioural intention

Construct	Total effect on behavioural intention
Attitude toward activity	0.097
Perceived overall risk	−0.234
Extrinsic motivation	0.451
Intrinsic motivation	0.598

motivational factors: hence, if people have a favourable attitude toward smoking cessation, they are also receptive to using a mobile health support for that. However, the lack of implication on motivation (and especially on extrinsic motivation) deserves further investigation.

All these lead to the conclusion that a favourable pre-existing user attitude relative to the activity targeted by a mobile health application is not a sufficient reason to make users accept that service and, hence, cannot be used as a reliable indicator of success for that IT. Thus, user a priori attitude on a health activity has a comparatively weaker effect than factors sourcing effectively from the use of a technology meant to support that activity (e.g., motivation and perceived risk). As user attitude is unlikely to ensure the success of mobile health applications by itself, marketers and developers of such technologies should focus on reducing risk perceptions, and, especially, increasing motivational factors such as usefulness and enjoyment perceptions, without discriminating between individuals based on their a priori attitude on the targeted health activity.

This study introduces, as a major contribution, attitude toward the activity (i.e., smoking cessation) with the purpose of assessing whether it matters in the adoption equation. If it did, it would have required that IT applications supporting smoking cessation to be directed only to people favourable to quitting smoking. As this attitude resulted to not have a significant role, the conclusion is that the way the IT application is designed is more important than the people pre-existing attitude. If a priori attitude proved to not influence significantly the acceptance of a mobile health application, it is very likely this ingredient would be even less important for other domains having a lower social sensitivity (e.g., m-learning or m-banking). In a broader view, the conclusions of this study may be relevant for educational purposes using IT support in various domains. Thus, it appears that the way education is delivered is more important than the people pre-existing views on an educational activity. Therefore, IT mobile services supporting educational activities in various areas (e.g., m-health or m-learning) should address all categories of potential users, no matter their pre-existing views on those activities since these views will not influence the ultimate success of the technology.

As virtually any similar research in information systems, this study had some limitations. The most important was the use of a convenience sample recruited from individuals pre-registered with a Web-surveying company. However, as participants were from various demographic categories all over an entire country (the UK), the sample could be termed as being more realistic compared to drawing it from one location (e.g., an university). In addition, there are no reasons to believe subjects differed from the general population meeting the conditions of this study in terms of using mobile information technology if they wish to quit smoking. Given the level of granularity and the focus of this study, the research may not have detected whether some of the participant perceptions (e.g., regarding intrinsic motivation) were also influenced by the actual content of the sample SMS messages presented to participants. Further research involving several groups of participants exposed to various types of messages (e.g., more or less enjoyable, more or less persuasive, more or less frequent) should examine these aspects in detail. The use of a scenario-based online study might induce a certain degree of bias in the results since participants are exposed to a hypothetical situation, as described in the survey, rather to a concrete IT application. However, this approach is not uncommon in IS research (Jarke 1999; Hertzum 2003). Scenarios are, undoubtedly, highly recommended before deploying a real IT application in a sensitive social field (such as healthcare) due to the unforeseen consequences for the human subjects. Further, it is important to predict future trends based on participant

Table 6 Variance explained by endogenous constructs in the controlled and uncontrolled model

Control variable	Perceived overall risk	Extrinsic motivation	Behavioural intention
Uncontrolled model	0.080	0.525	0.591
Age	0.080	0.535	0.596
Gender	0.080	0.529	0.596
Years of smoking	0.088	0.532	0.591
Number of cigarettes smoked	0.097	0.526	0.594
Cell phone experience	0.081	0.535	0.601
SMS experience	0.080	0.536	0.593
Number of SMS received	0.082	0.531	0.595
Number of SMS sent	0.081	0.530	0.593

current perceptions regarding the use in principle of a technology (Cocosila et al. 2009; Lee et al. 2001) - e.g., the mobile health to support smoking cessation in this case.

This study made a first attempt to conceptualize and measure attitude toward activity in connection to the domain targeted by the IT application (i.e., healthcare in this case). Although the measure was adapted from validated studies in the domain and although it proved to have appropriate psychometric properties, its content validity is expected to be confirmed and enhanced by future research. Other research should also attempt to refine this measure to make it broadly applicable for other domains as well. Another possible direction for future research is to study the link between the pre-existing attitude on an activity and the sought behavioural changes regarding that activity, following the use of an IT for educational purposes.

Overall, this study is one of the first empirical investigations on the role of attitude toward the activity targeted by the technology in IT acceptance studies. Although this research found a priori attitude to have a weak positive effect on the behavioural intention to adopt a mobile health application, the possible role of this attitude in the acceptance equation deserves further investigation in other contexts.

Appendix A - measurement scales for the theoretical model

Perceived financial risk

Signing up for the quit-smoking SMS service would be a poor way to spend my money.

I would be concerned about how much I would pay if I subscribed to the quit-smoking SMS service.

If I subscribed to the quit-smoking SMS service, I would be concerned that I would not get my money's worth.

Perceived privacy risk

My use of the quit-smoking SMS service would cause me to lose control over the privacy of my information.

Signing up for and using the quit-smoking SMS service would lead to a loss of privacy for me because my personal information could be used without my knowledge.

Internet hackers (criminals) might take control of my information if I used the quit-smoking SMS service.

Perceived psychological risk

The thought of signing up for the quit-smoking SMS service makes me feel uncomfortable.

The thought of signing up for the quit-smoking SMS service gives me an unwanted feeling of anxiety.

The thought of signing up for the quit-smoking SMS service causes me to experience unnecessary tension.

Perceived time risk

Using the quit-smoking SMS service could lead to an inefficient use of my time.

Using the quit-smoking SMS service could involve important time losses.

The demands on my schedule are such that using the quit-smoking SMS service concerns me because it could create even more time pressures on me that I don't need.

Perceived social risk

My friends and colleagues' negative opinions about my signing up for the quit-smoking SMS service would cause me to feel concerned.

If signing up for the quit-smoking SMS service, I would be concerned about what people whose opinion is of value for me would think of me, if I made a bad choice.

My subscribing to the quit-smoking SMS service would cause me concern about what my friends would think of me, if I made a bad choice.

Attitude toward activity

People who smoke should stop smoking for a while every now and then.

Most smoking is addictive.

Smoking can do more harm than good.

Smoking is poison.

Extrinsic motivation

Using the quit-smoking SMS service would help me to refrain from smoking every day, if I decided to quit smoking.

Using the quit-smoking SMS service would help me not to forget about smoking cessation, if I decided to quit smoking.

Using the quit-smoking SMS service would help me to stop smoking, if I decided to quit smoking.

I expect to find the quit-smoking SMS service useful in supporting me to quit smoking, if I decided to quit smoking.

Intrinsic motivation

I expect to find the quit-smoking SMS service enjoyable.

The actual process of using the quit-smoking SMS service would be pleasant.

I would have fun using the quit-smoking SMS service.

Behavioural intention

Assuming I had access to the quit-smoking SMS service, I would intend to use it, if I decided to quit smoking.

Given that I had access to the quit-smoking SMS service, I predict that I would use it, if I decided to quit smoking.

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