Factors Affecting the Acceptance of Mobile Based Multi-Feature Service For Smoking Cessation Using UTAUT

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Abstract

With the growing demand for mobile based interventions in healthcare, use of smartphone applications for disease management and prevention, especially non communicable diseases like chronic respiratory diseases, diabetes, and hypertension are on the rise. Tobacco use or smoking is the leading preventable risk factor for NCDs (Non Communicable Diseases). Although an innovative mobile based multi-feature service can be a potential tool for smokers to help them quit smoking, it is also necessary to investigate the level of acceptance as well as the factors leading to the acceptance of such a service. This study identifies some of the factors that influence acceptance of such a smartphone based multi-feature service for smoking cessation. The study utilizes the Unified Theory of Acceptance and Use of Technology (UTAUT) as the theoretical model, along with Partial Least Square (PLS) analysis. The findings indicate that factors like "performance expectancy", "facilitating conditions", "effort expectancy" and "Social influence" are significant determinants of intention and use of the smartphone based multi-feature service.

Keywords

Smoking cessation; Smartphone application; UTAUT; Technology acceptance; Multi-feature

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1 Introduction

Mobile phones have been proven effective in delivering interventions for various diseases and health conditions [1, 2, 3, 4]. Over the past few decades, various studies have been conducted on how users accept or adopt information technology. With varying needs, complexities of individuals as well as requirements by healthcare professionals, it is imperative to investigate factors that impact the success or failure of a new multi-feature service for smoking cessation. Failure in acceptance or adoption can place enormous burdens on institutions and individuals responsible for implementing as well as using it. It may also impact healthcare quality and cost among others.

Today, healthcare without information systems and technology is unimaginable, especially for disease identification, management and prevention. Various healthcare applications and systems have been developed for management and prevention of non-communicable diseases like smoking, hypertension, diabetes, obesity among others [5, 6]. These applications are supposed to improve the disease management process by bettering the quality as well as safety of the service and reduce time and error in the meantime. Thus, for success of any new technology or service, it is imperative to understand the factors that influence the acceptance or adoption of that service or technology. Few research studies are available to help understand the factors that affect acceptance of mobile based smoking cessation services.

The objective of this study is to evaluate the factors that can affect the acceptance of a newly developed mobile based multi-feature service for smoking cessation using the Unified Theory of Acceptance and Use of Technology (UTAUT) model. The paper provides information on a new mobile based multi-feature service, a theoretical background, followed by the methodology. The data and the findings have been presented at the end of the paper.

2 Multi-feature Service for Smoking Cessation

The smartphone based multi-feature application service brings together tested interventions in smoking cessation and provides a framework that adheres to Persuasive System Design model by Kukkonen [7]. The new mobile application uses PSD design principles namely Tunneling, Tailoring, Personalization, Self-monitoring and Simulation. The application also provides

dialog support using PSD principles of praise, rewards, reminders, suggestion through in-app messages. This innovative app provides a multipronged approach to smoking cessation and includes an intervention with the following five features: (1) Motivational messages, (2) Progress tracking, (3) Instant games, (4) Informational video links for distraction and (5) Real time instant peer support through chat facilities. The features included in the new mobile application are shown in the Figure 1 below.

The various features of the new mobile application for smoking cessation are described below:

Motivational messages - A pre-compiled list of messages is pushed at regular intervals as push notifications to the user's phone. These messages (Figure 2 below) are targeted to participants for providing motivation for quitting smoking or preventing relapse. Messages are personalized using the participant's user name or display name and may also include his progress or current cigarette consumption rate.

Progress tracking - A user can view current progress in line with progress of other users in the system. A comparative analysis is provided to users. The progress can be shared with peers for receiving recognition or support in case of cigarette reduction or relapse. A screen shot of progress tracker on the app is given in Figure 3.

Disease awareness - The application has embedded videos that provide information on various non communicable diseases (NCD) and how smoking increases the risk of NCDs. Users would also receive MMS with similar content for creating NCD awareness.

Distractions - The Smartphone application has embedded games and videos content sorted by "likes" and "views" that uses collaborative filtering (Figure 4). Distractions provided might not be relevant to smoking but the purpose is to provide instant distraction to the user by leading him to games and inspirational videos.

Instant peer support - The users are provided real-time chat support where they can chat with other members who are also in the quitting phase (Figures 5 and 6). In the system default groups are created for different purposes.

- **Group chats:** As soon as a user registers, he/she is automatically added to the relevant support group(s). For example, if a user has already quit, he/she is added to a set of groups that are most relevant to him/ her.
- **Creating new user groups:** User can also create new groups and invite others to join.
- **Real-time notifications:** Notifications are sent when a new message is received. User can notify a group when they are craving or have relapsed to get help in real-time from their peers.

3 Theoretical Framework

Success of a new service or technology depends heavily on the user acceptance, although it is difficult to predict how a new service or technology will be adopted by the users. It is however important for service designers and developers to comprehend the users' expectations for developing an application to cater to their needs. Several models have been established for determining user acceptance of a service or technology. One of the most commonly used models is the Unified Theory of Acceptance and Use of Technology (UTAUT) that was designed to unify the multiple existing theories about how users accept technology [8]. UTAUT is created from the following eight notable theories: Theory of Reasoned Action (TRA) [9]; Technology Acceptance Model (TAM) [10]; Motivation Model (MM) [11], Theory of Planned Behavior (TPB) [12], Combined TAM and TPB (C-TAM-TPB) (1995); Model of PC Utilization (MPCU) [13], Innovation Diffusion Theory (IDT) [14], and Social Cognitive Theory (SCT) [15]. The UTAUT model was found to outperform the eight individual models when tested empirically [8]. The model proved to be a very good tool for testing user acceptance of a new

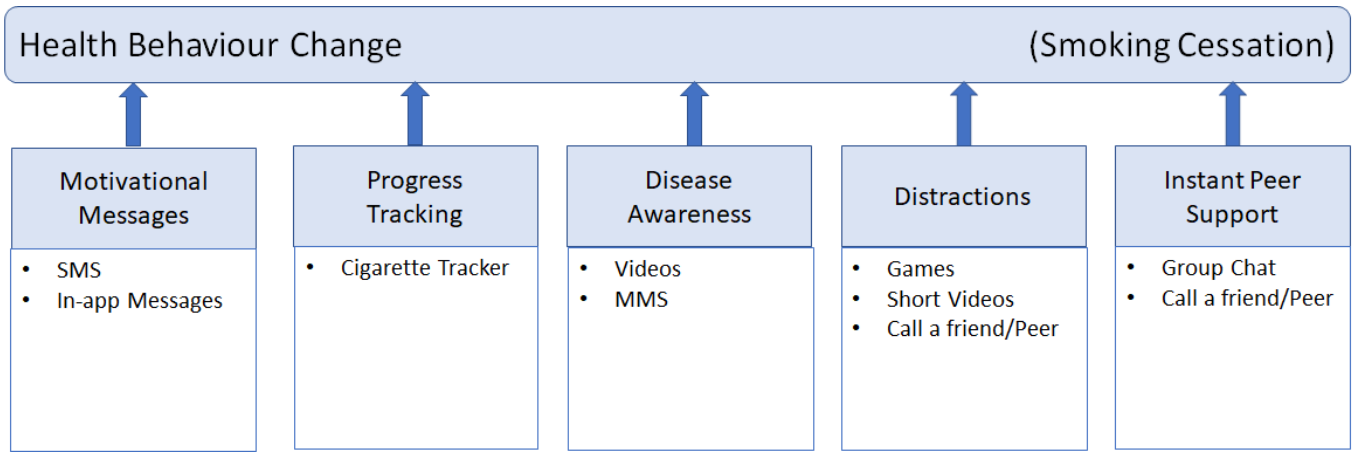

Figure 1: Multi-feature Service design for Smoking Cessation mobile application.

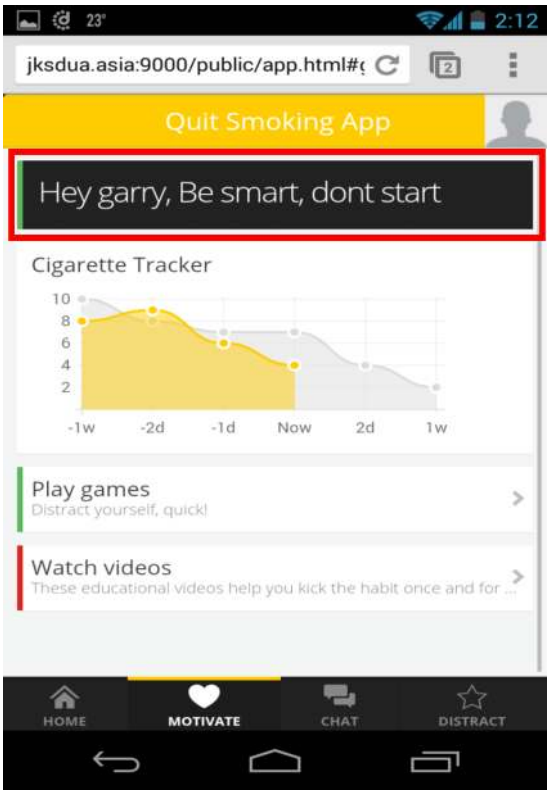

Figure 2: Motivational messages.

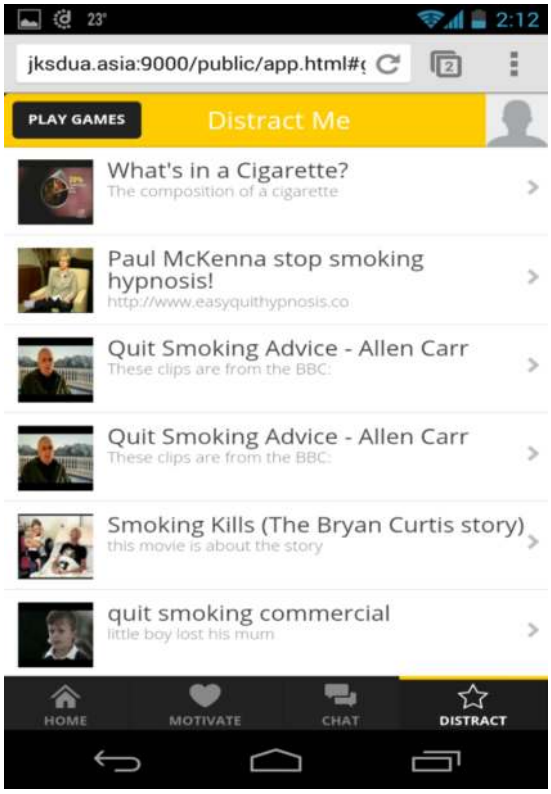

Figure 4: Games and videos for distractions.

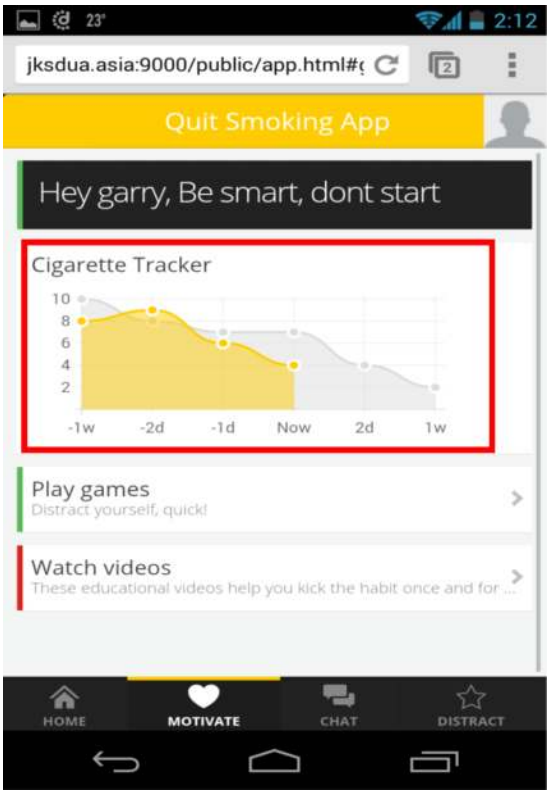

Figure 3: Progress tracker.

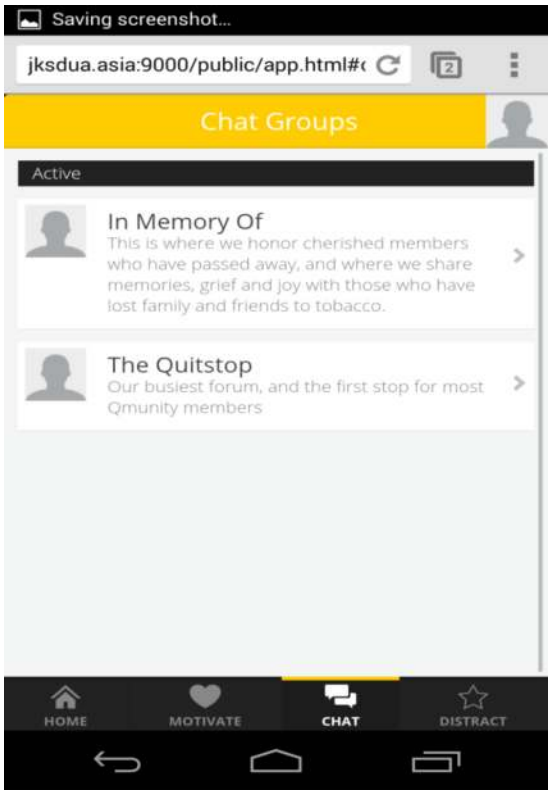

Figure 5: Social chat groups for instant support

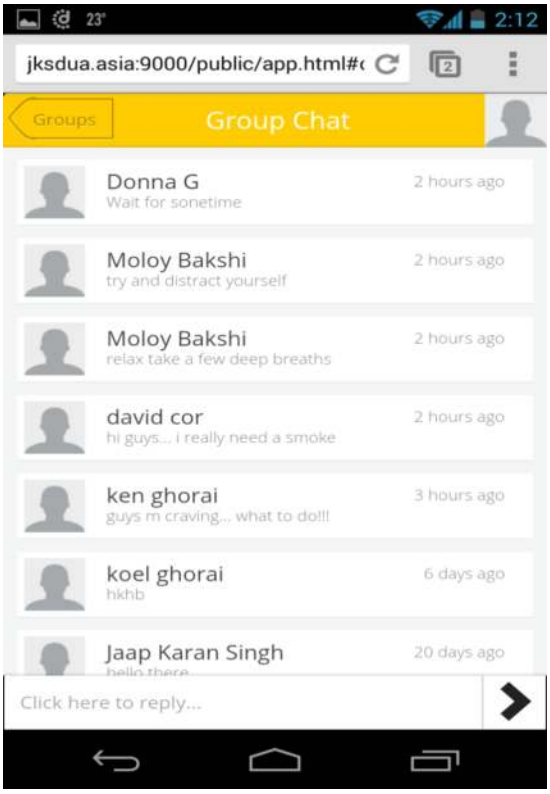

Figure 6: Instant chat messages from peers

technology. Thus, the ***UTAUT model was selected*** for evaluating the factors that impact the user acceptance of the multi-feature mobile application for smoking cessation.

3.1 Research Model and Hypotheses

UTAUT model has been widely used for user acceptance studies in the context of using information system for behavior change as well as technology adoption [16]. Studies have shown that behavior intention will have a positive and direct influence on user behavior [8] and that adoption of a technology is directly influenced by user behavior [17]. Prior studies have well established the relation between behavior intention, use of technology and the usage [8, 12]. Based on previous research, we have selected four direct determinants of usage intention and user behavior namely "Performance expectancy", "Effort expectancy", "Social influence" and "Facilitating conditions". Venkatesh et al. [8] identified four key moderators believed to affect the relationship between key determinants and intention: gender, age, voluntariness, and experience. We first discuss determinants and then present our hypotheses.

Performance expectancy: Performance expectancy refers to the extent to which individuals are convinced by the fact that utilizing the system will help them to achieve benefits in the execution of their job. In the context of smoking cessation, it is the degree to which an individual believes that he or she will be able to quit smoking using the multi-feature service. The root constructs under performance expectancy include perceived usefulness, extrinsic motivation, job-fit and relative advantage. According to Taiwo and Downe's [18] meta-analysis of 37 selected empirical studies, the only strong relationship among the four key determinants and behavioral intention (technology adoption) was between performance expectancy and intention. Furthermore, a study by Naenna et al. [19] found that performance expectancy affected behavior intention in adoption of healthcare information technology. Therefore, we suggest:

H1: Performance expectancy will have a positive influence on behavior intentions to use Smartphone based multi feature service for smoking cessation

Effort expectancy: Effort expectancy is the degree of ease associated with the use of a system or service. Its root constructs are perceived ease of use and complexity. Although the effects of effort expectancy on adoption intentions were weak in meta-analysis [18]. Diño and de Guzman [20] discovered that effort expectancy was the most significant influencer of intentions of adults to participate in Telehealth. Previous research found connections between adults' perceptions of technology ease of use and intention [21]. Effort expectancy is directly associated with expected ease of use. In a study by Pai and Huang [22], it was found that effort expectancy has a positive influence on intention to use healthcare information systems. In case of multi-feature service, if the service is easy for users to use, then they will find it less tedious to use. It will therefore be more likely to be accepted by users. Therefore, we suggest:

H2: Effort expectancy will have a positive influence on behavior intentions to use Smartphone based multi feature service for smoking cessation

Social influence: Social influence is defined as the degree to which an individual perceives that important others believe he or she should use the new technology or service. This means that individuals would be more interested in a service or technology if the people who are important to them think it would help them. For example, if a person is suggested to use a healthcare application by a friend, he will be more willing to try the application based on the suggestion. The root constructs of Social Influence are subjective norm, social factors and image. Meta-analysis reveals significant effect sizes for social influence [18]. Therefore, we suggest:

H3: Social influence will have a positive influence on behavior intentions to use Smartphone based multi feature service for smoking cessation

Facilitating conditions: It is the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the new technology. "Perceived behavior control", 'facilitating conditions', and 'compatibility' are the three sub-determinants of "Facilitating Conditions". All these constructs measure the perception of user regarding the removal of barriers of use. For example, a person using a new technology or service

will feel more comfortable if he believes that there is technical or organizational support. Studies have uncovered a significant association between facilitating conditions and intention [23, 24].

Thus, the fourth hypothesis is:

H4: Facilitating conditions will have a positive influence on behavior intentions to use Smartphone based multi feature service for smoking cessation

Use behavior: The original UTAUT model posits that behavior Intention will have a significant influence on Use behavior which is the degree of technology acceptance or usage by the user. Thus the fifth hypothesis of the study is:

H5: Behavior Intention will have a positive influence on Use behavior

The research model is depicted in Figure 7 below.

3.2 Overview of the Research Model Constructs

The constructs discussed above are expected to have influence on the behavior intention of user for using the multi-feature service. "Use experience" is a specific construct that has been used in the context of a multi-feature service. Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions have been used as the independent variables. Behavior Intention and Use behavior, also referred to as Actual Usage, has been considered as the dependent variables in the model.

4 Questionnaire Design and Sampling

The evaluation of the multi-feature service revolves around an explorative research through an online survey based on the UTAUT framework. The survey was built using Qualtrics (www.qualtrics.com). The questionnaire was based on the pre-tested questions presented in the original UTAUT model. Questionnaires were distributed to a database of online participants through "Mechanical Turk" which is an online tool for organizing web-based surveys. Questions and statements in the survey were related to smoking experience and smoking cessation using a smartphone based multi-feature service. Participants were introduced to the new multi-feature service through an online video and then they were asked to download and use the app. The four sections of the questionnaire were designed to gather information on the following:

- Fitment of participants to the selection criteria.
- Gather answers for analysing the theoretical model and the influence of the constructs and moderators on the acceptance of the service
- Demography, smoking pattern
- Experience with smartphones

4.1 Data Collection

Participants

240 participants were recruited online using Qualtrics survey software. Recruitment was based on the following criteria for participating in the study: (1) Are current smokers, (2) Are 18 years and above and can provide informed consent, (3) Are a Smartphone user, (4) Want to quit smoking. The participants were asked to download and use the multi-feature smoking cessation mobile application, watch a video on how to use the app, try it out and then fill a questionnaire.

Survey instrument

The survey instrument consisted of constructs as mentioned in section 3.1 above. The four constructs included in the model are Performance expectancy, Effort expectancy, Social influence and Facilitating conditions. Additional information such as age, gender, location, kind of mobile phones owned, and duration of use were also collected through the instrument. Questionnaire items were measured using a five-point Likert scale ranging from "strongly disagree" to "strongly agree". The questionnaire was divided into four sections, including the questions for external variables, behavior intention, user behavior as well as demography.

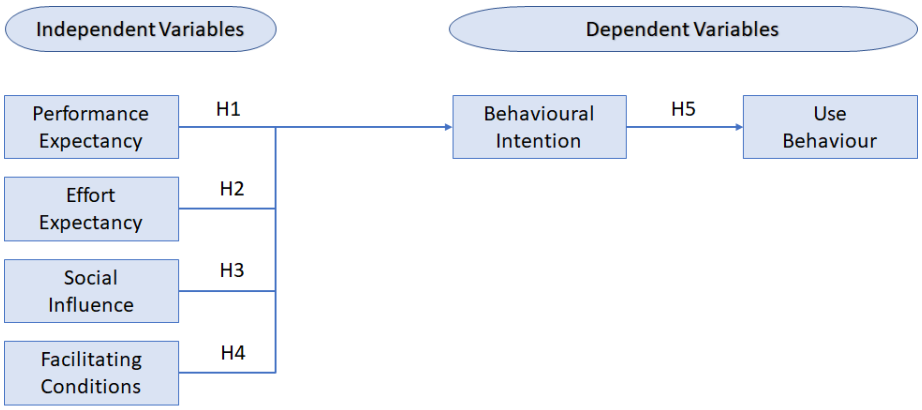

Figure 7: UTAUT model for multi-feature service for smoking cessation.

Data analysis

Statistical Package for Social Sciences (SPSS) version 21 was used for generating descriptive statistics of the variables. The statistical technique Partial Least Squares (PLS) was used for measuring the research model. Structural Equation Modelling (SEM) technique was used for evaluating the relationships in the UTAUT model and for testing the hypotheses among the variables. The reason for selecting SEM is because this statistical methodology allows a hypothesis testing (confirmatory) approach to structural analysis of data that represents a phenomenon [25]. PLS is used for estimating the internal consistency for each block of indicators.

5 Results

5.1 Respondent Characteristics

The online survey was carried out through Qualtrics survey software and respondents were contacted through Mechanical Turk, an online survey platform with respondent database. Out of the 240 surveys that were collected, 225 were usable completed surveys for analysis. 15 surveys out of the 240 surveys collected were incomplete. A snapshot of the demographic information of the respondents has been given in Table 1. Most of the respondents belonged to the age categories 18-25, 26-34 and 35-54. Only 6 of the participants were aged 55 and above. Around 70% of the respondents were male.

In the survey, respondents were also asked about their personal experiences regarding their smoking behavior and smartphone usage. From the survey, it was found that:

- 80% of the smokers had attempted to quit earlier
- Almost 88% of smokers were willing to use mobile phones for smoking cessation interventions
- Questions regarding smartphone usage revealed that almost

Table 1: Demographic information of respondents.

Variable	Scale	Frequency	Percent	Cumulative Percent
Age	18-25	58	25.8	25.8
	26-34	116	51.6	77.3
	35-54	45	20	97.3
	55-64	4	1.8	99.1
	65 or over	2	0.9	100
	Total	225	100	
Gender	Male	158	70.2	70.2
	Female	67	29.8	100
	Total	225	100	
Education	Less than high school	2	0.9	0.9
	High school/GED	14	6.2	7.1
	Some college	37	16.4	23.6
	2-year college degree	27	12	35.6
	4-year college degree	84	37.3	72.9
	Master's degree	59	26.2	99.1
	Doctoral Degree	1	0.4	99.6
	Professional Degree (JD, MD)	1	0.4	100
	Total	225	100	
Earlier quit Attempts	Yes	180	80	80
	No	45	20	100
	Total	225	100	
Years of smartphone use	Less than 6 months	5	2.2	2.2
	6 to 12 months	28	12.4	14.7
	1 to 3 years	144	64	78.7
	4 years or more	48	21.3	100
	Total	225	100	
Use of mobile internet	Yes	222	98.7	98.7
	No	3	1.3	100
	Total	225	100	
Mobile for smoking cessation	Yes	197	87.6	87.6
	No	28	12.4	100
	Total	225	100	

99% of the respondents used internet on their mobile phones

- Majority of the respondents, (~64%) had been using a smartphone for more than 1 year

All respondents in this study were selected because they were active smokers, had a smartphone, wanted to quit smoking and were aged 18 years or above.

5.2 Reliability Verification

Reliability verification was conducted to check the degree to which the instrument is free of random error. This helped in checking the consistency and stability of the measurement. The individual item loading is given in Table 2.

All items except two sub-constructs of facilitating conditions had item loading less than 0.40. Loading for rest of the items range from 0.720 to 0.959. Reliability analysis was conducted through exploring the Cronbach's alpha of the five factors, which exceeded the cut-off value of 0.70 The Cronbach's Alpha should be greater than 0.70 for demonstrating construct reliability [26]. Thus, two items (FC1 and FC4) were removed from the instrument for further analysis. According to the above-mentioned establishment of UTAUT–based framework, "Performance expectancy", "Effort expectancy", "Social influence", and "Facilitating conditions" are the independent variables or exogenous variables, whereas "Behavior intention" and "Use behavior" are the dependent variables or endogenous variables, and the "Behavior intention" is also the intermediary variable.

5.3 Validity Testing

Construct validity is used for finding the degree to which an operational measure correlates with a theoretical concept. A confirmatory factor analysis was conducted for assessing the overall model and examining the convergent and discriminant validity.

Convergent validity: Convergent validity is a function of the association between two different measurement scales which are supposed to measure the same concept and is achieved when multiple indicators operate in a consistent manner [27]. In the confirmatory factor analysis, the Average Variance Extracted (AVE) was considered as a base for convergent validity. AVE was used to calculate the explanatory power of all variables of the dimension to the average variations. Constructs have convergent validity when the composite reliability exceeds the criterion of 0.70 and the average variance extracted is above 0.50. According to Table 2, the composite reliability of the variables was between 0.863 and 0.923 (that is >0.70) and AVE is between 0.647 and 0.863. Thus, all the constructs of the model have convergent validity.

5.4 Model and Hypothesis Testing

Hypothesis testing helped in determining the independent variables that provide meaningful contribution to the explanation of the dependent variables [28]. Hypothesis testing was conducted using Smart PLS which is a SEM (Structural Equation Model) software. The overall model fitting focused on each determinant. The change of each variable path was according to the modification indicators recommended by SEM regard to the data analysis. All variables were adjusted to lift the explanation ability of the model for the use behavior.

The path diagram of the model fitted well with the actual

Table 2: Individual Loadings, composite reliabilities (CR) and AVE.

Construct	Individual Items	Item Loading	Cronbach Alpha	Construct Composite Reliability CR	Construct Average Variance Extracted AVE
Performance Expectancy	PE1	0.846	0.889	0.923	0.751
	PE2	0.86			
	PE3	0.835			
	PE4	0.922			
Effort Expectancy	EE1	0.768	0.818	0.879	0.647
	EE2	0.818			
	EE3	0.901			
	EE4	0.72			
Social Influence	SI1	0.859	0.84	0.893	0.677
	SI2	0.884			
	SI3	0.811			
	SI4	0.729			
Facilitating Conditions	FC2	0.777	0.723	0.863	0.761
	FC3	0.959			
Behavior Intention	BI1	0.921	0.92	0.95	0.863
	BI2	0.947			
	BI3	0.918			

observed data. The structural model with the path coefficients and the R square for the dependent variables is given in Figure 8. According to the figure, R square of the dependent variables behavior Intention is 0.529 and that Use behavior is 0.340. This means that the model explains 52.9% of variance of behavior Intention and 34% of variance of Use behavior. The statistical significance of the path coefficients was calculated through the bootstrap method.

With respect to the key determinants of the multi-feature service, Performance expectancy has the most significant influence on Behavior intention as compared to Effort expectancy, Social influence and Facilitating conditions. Thus hypothesis 1 (H1) which states that performance expectancy, or the degree to which a user believes that the multi-feature service will improve performance for smoking cessation, has a positive effect on behavior Intention a multi-feature service (β=0.374, $p<0.1$) is hence proved. Similarly, Effort expectancy, or the degree of ease of use, has a positive influence on behavior intention (β=0.326 $p<0.01$). Hence, hypothesis H2 is verified. Again, Social influence, or the degree to which a user perceives the importance of others' opinion with respect to using a new service, has a positive effect on behavior intention to use a multi-feature service (β=0.291 $p<0.05$). Hence, hypothesis H3 is verified. Facilitating conditions also has a significant influence on the behavior Intention of user to use the multi-feature service (β=0.285 $p<0.1$). Hypothesis H4 is verified. For hypothesis 5 (H5), from Figure 8 it can be stated that Behavior intention has a significant influence on usage (β=0.368 $p<0.001$).

The coefficient beta value was extracted for the hypothesis testing. Coefficient beta value was compared against $p<0.05$, $p<0.01$ and $p<0.001$. Thus, based on the hypothesis testing we were able to find the factors affect the acceptance of a smartphone based multi feature service for smoking cessation.

Thus, for users of the smartphone based multi-feature smoking cessation app, Performance expectancy, Effort expectancy, Social influence and Facilitating conditions were found to have a significant influence on the behavior intention. This implies that all the factors contribute significantly in attracting the user to use the smoking cessation application.

5.5 Results of the Hypotheses Verification are Summarized Below:

S. No.	Hypothesis	Study assumption	Verified result
1	H1	Performance expectancy will have a positive influence on behaviour intentions to use Smartphone based multi feature service for smoking cessation	Verified
2	H2	Effort expectancy will have a positive influence on behaviour intentions to use Smartphone based multi feature service for smoking cessation	Verified
3	H3	Social influence will have a positive influence on behaviour intentions to use Smartphone based multi feature service for smoking cessation	Verified
4	H4	Facilitating conditions will have a positive influence on behaviour intentions to use Smartphone based multi feature service for smoking cessation	Verified
5	H5	behaviour intention will have a positive influence on "Use behaviour"	Not Verified

Among the 5 hypotheses, four (H1, H2, H3 and H4) were verified. The fifth hypothesis H5 could not be verified as the study could not collect data whether the users were able to quit smoking using the application. Thus, for users of the smartphone based multi-feature smoking cessation app, performance expectancy, effort expectancy, social influence and facilitating conditions were found to have a significant influence on the behavior

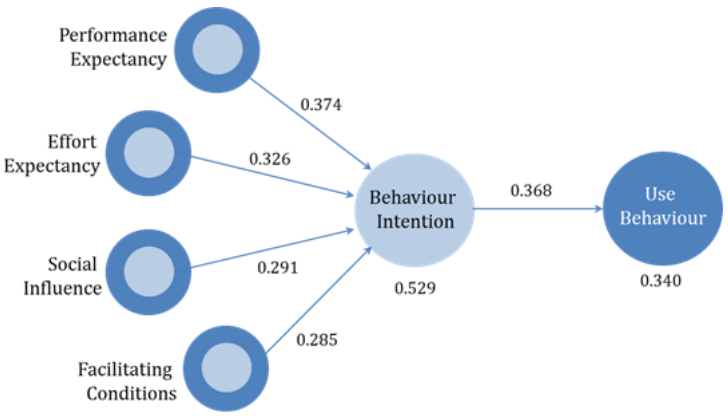

Figure 8: Model testing result.

intention. This implies that all the factors contribute significantly in attracting the user to use the smoking cessation application. Although, the impact of behavior intention on use behavior could not be verified. This would require at least 6 months to 1 year yearlong randomized control trial.

6. Discussion and Conclusion

According to the results of this study, "performance expectancy", "facilitating conditions", "effort expectancy" and "Social influence" will lift the " Behavior intention" which in turn will lift the "use behavior" of the Smartphone based multi-feature service. Again, "Effort expectancy" was proven to be significantly influencing the "Behavior intention". This implied that information system designers and developers should focus on the aspects of technology and service to make them effortless and easy to use to increase the intention to use the smartphone based service for disease management. With increasing costs of healthcare services, easily available and low cost services are in high demand. With the various options that consumers have these days, focusing on service quality and customer requirements is the only way to ensure acceptability and mass scale use of a mobile app intervention for smoking cessation.

This study examined the smokers' acceptance and intended use of the mobile based multi-feature service. Overall, the results suggest that the UTAUT model, even though a reduced version, was able to explain smokers' acceptance and intended use of the innovative service. With growing mobile phone usage for non-communicable disease management and prevention, studying the factors that influence the acceptance and use of mobile healthcare applications is critical for the success of these interventions. The results from this study can be used for strategic planning and designing mobile based interventions for mobile based health care management. From the theoretical point of view, the research contributes to the broad technology acceptance literature by examining the theoretical validity and applicability of the UTAUT model.

6.1 Contribution to Theory

Theoretically, the study extends the Persuasive system design framework by combining the features of the PSD model with that of the Social Cognitive Theory in the context of a multi-feature service for smoking cessation. Methodologically, the study validates that PLS path modelling can be used to estimate the impact of factors affecting the user acceptance of a multi feature service framework and its association with other variables of the model.

6.2 Contribution to Practice

The study provides a smartphone based multi-feature service for smoking cessation through behavior change and this service will be easily accepted and adopted by users if certain factors, as mentioned in the above, are taken into consideration while designing the service. The evaluation showed that users would like and accept a smoking cessation service better for four major factors: (a) If they believe that the use of the service is beneficial (Performance expectancy); (b) If the service is easy to use (Effort expectancy); (c) If others believe they should use the service (Social influence); and (d) If they believe there is sufficient technical support for the service. These factors, if incorporated effectively in the healthcare services, can improve the acceptance of mobile based healthcare application adoption. Overall, the study provides significant contribution to developing a multi-feature service framework that can be used in healthcare and public health programmes for various disease prevention and management like hypertension, diabetes, obesity, depression to name a few. It is a step forward for healthcare service designers for designing behavior change interventions.

6.3 Limitations and Recommendation for Future Work

1. This study has focused on identifying the factors affecting the acceptance of mobile based multi-feature service by potential users, such as smokers. However, this study has not investigated the efficacy of the service in helping smokers quit smoking. This would require a larger scale Randomized Controlled Trial (RCT) with preferably more than 1000 smokers over a period of one year.

2. The sample represents participants mainly from USA and India. There can be limitations in the generalizability of findings to other participants in countries, other than these two.

3. Users with a non-smartphone cannot access all the features of the mobile application. Basic mobiles phones do not provide users the options of playing online games or streaming videos from the internet. This restricts the full utilization of the service.

4. Longitudinal evaluation: It is important to evaluate user's acceptance and performance over time.

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