Mobile health applications in workplace health promotion: an integrated conceptual adoption framework

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Abstract

Mobile health applications have proved very useful in preventive healthcare. Yet, neither theorists nor practitioners have considered mobile health applications in the context of workplace health promotion. This paper aims to fill this gap by discussing the suitability of mobile health applications as a measure of workplace health promotion and the underlying motivations that drive employees to adopt the use of mobile health applications in the workplace. Drawing on the technology acceptance model, health belief model, and the theory of planned behavior, constructs affecting adoption behavior are identified, relevant propositions are arrived at, and managerial implications are discussed.

1. Introduction

In the 21\textsuperscript{st} century's occupational settings, economic and technical innovations have revolutionized production industries through labor saving devices and automation processes. Thus, fewer workers are engaged in primary
industries, while the number of people employed in sedentary industries has increased tremendously. Most workplaces today are not only sedentary, but also provide easy access to high-calorie foods and beverages. Poor diet and physical inactivity are major risk factors for non-communicable diseases and even more so for so-called lifestyle diseases [1]. Lifestyle diseases are characterized as diseases whose occurrence is primarily a result of people’s daily habits and their inappropriate relationship with their environment [2]. Obesity is an example of a lifestyle disease that generates high costs associated with sick leave, injuries, disabilities, and health care claims [3]. Given the demographic trends in westernized countries as they shift towards an older workforce, preserving employee utility up to retirement age is of paramount importance, as are short-term savings.

2. Mobile health applications: A new avenue in workplace health promotion

1.1. Workplace health promotion

Since employees spend a considerable portion of their waking hours at the worksite [4], the workplace is not only a potentially detrimental setting for people’s general health status, but also a promising setting for health improvement initiatives. Consequently, an increasing number of employers have established workplace health promotion programs. That is, workforce-based initiatives that focus on providing health promotion services to improve employees’ productivity by optimizing employee health [5]. If designed effectively, such preventive measures can be highly useful as both risk factors mentioned above (poor diet and physical inactivity) are lifestyle behaviors that can be modified. Data from a recent meta-analysis on costs and savings from workplace health promotion programs shows that for every dollar spent on such programs, absentee day costs fall by about $2.73 and medical costs even by about $3.27 [6]. Unfortunately, research also shows that on average only 34% of employees participate in health promotion programs that are offered [7]. This number suggests that existing workplace health promotion measures do not necessarily meet employees’ demands and are therefore not widely adopted.

1.2. Mobile health applications

Mobile health applications can help their users to self-monitor and motivate them to enhance their lifestyle in the short- and long-term [8]. Furthermore, mobile health applications have the potential to overcome adherence issues by interacting with the user with great frequency and as he/she is executing the behavior. Behavioral change interventions executed via health apps minimize the necessity of face-to-face interactions and thereby increase cost-effectiveness through pervasive and permanent accessibility. Therefore, an even higher return on investment from workplace health promotion programs may be expected, if these apps are implemented successfully. Even though health apps have been a huge success in the private sector as well as in professional health care [9], they have thus far been neglected in occupational settings.

3. Conceptual framework for the adoption of mobile health applications at the workplace

Hence, we present an integrated conceptual framework (see Fig. 1) that attempts to explain the drivers for the adoption of mobile health applications in the workplace by simultaneously drawing on constructs of the theory of planned behavior, the technology acceptance model, and the health belief model.
1.3. Underlying theories

1.3.1. Theory of planned behavior

The theory of planned behavior is based on the theory of reasoned action [10] [11] and extends it by adding the construct of perceived behavioral control. Thus, actions that are to some degree also determined by factors beyond an individual's voluntary control can be accounted for as well. According to the theory of planned behavior actual behavior is a function of an individual’s behavioral intention and perceived behavioral control. Intention in turn is determined by the attitude (attitudinal beliefs) towards the behavior, subjective norms (normative beliefs), and again perceived behavioral control (control beliefs) [12]. The theory of planned behavior has been widely used in both health promotion and information technology research.

1.3.2. Technology acceptance model

The technology acceptance model (TAM) is also adapted from the theory of reasoned action and aims to explain information technology use in the workplace [13] [14]. It comprises the following constructs: perceived ease of use, perceived usefulness, attitude towards use, behavioral intention to use, and actual use. This model suggests that a user’s decision to adopt an information technology mainly depends on the rational assessment of its perceived usefulness and perceived ease of use. This parsimonious model does not account for influences from social, institutional, and personal control factors [15], or from usage context factors [16]. However, its extensions TAM2 [17], UTAUT [18], TAM 3 [19] do make an effort to overcome these shortcomings and are the predominant models used in predicting the adoption of technological products and services.

1.3.3. Health belief model

The health belief model is one of the most widely used theories in health behavior research and consists of the following dimensions: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action [20]. The concepts of perceived benefits and perceived barriers are very similar in notion to perceived
usefulness and perceived ease of use, respectively. Since the focus of this paper is on mobile applications, in the following the terminology of the technology acceptance model will be used. Therefore, the constructs of perceived benefits and perceived barriers will not be discussed any further.

All these streams of research use behavioral intention as the most important predictor in explaining actual behavior or use, and focus on identifying the determinants of intention. Since behavior research is a matter of high complexity, no single theory manages to cover all important factors. Also, technology acceptance and behavior cannot be treated as generic concepts. Hence, theoretical models have to be modified in order to do justice to a particular target technology and the specific setting in which it is being applied. Therefore, we make an effort to integrate the theories mentioned above into a new conceptual framework that is specific to the use of mobile health applications in the workplace.

2.2. Identification of relevant adoption drivers

In accordance with the theory of planned behavior, we regard actual behavior as a function of behavioral intention and perceived behavioral control. Following Taylor and Todd [15] we consider attitudinal, normative, and control beliefs as direct predictors of usage intention. We further decompose these direct predictors into multi-dimensional underlying belief structures. This approach increases managerial relevance by presenting more specific factors that either managers or application developers have some degree of control over. Finally, we add cues to action as an important moderator in the intention-behavior relation.

2.2.1. Decomposition of attitudinal beliefs

Attitudinal beliefs refer to an individual’s positive or negative affective evaluation of performing a particular behavior. They are suggested to influence behavioral intention directly. Having thoroughly reviewed the literature, we suggest the following set of factors derived from TAM literature, supplemented by two constructs from the health belief model.

2.2.1.1. Perceived susceptibility and perceived severity

Perceived susceptibility is defined as an individual’s perception of his/her own vulnerability to health threats, while perceived severity refers to an individual’s assessment of the degree to which a health threat is serious or dangerous [21]. While the combined effects of perceived susceptibility and perceived severity provide the force to take preventive action [22], perceived usefulness may influence the preferred path of action. The following scenario exemplifies this: Users could initially be presented with information regarding prevalence statistics, symptoms, and consequences of the health threats the mobile health application is targeted against. As soon as there is data entered into or measured by the application, so-called Ecological Momentary Interventions could come into play [23]. That is, “just in time” prompting for behavioral change, based upon predefined conditions. Accordingly, an application can be programmed to monitor every day activities. Based on the values entered or measured, it can proactively present tailored information as to the susceptibility of the user to certain health threats as well as their severity. Then, information can be presented as to how behavior can be modified to reduce relevant risk factors. This proposed application design would serve several purposes: The information presented could motivate employees to take preventive action in general, while the guidance could provide them with a specific course of action.

Consequently, we propose that both perceived susceptibility and perceived severity exert their influence on attitudinal beliefs via perceived usefulness.

2.2.1.2. Perceived usefulness

Perceived usefulness describes the degree to which users believe that using a system enhances their performance [13]. That is, individuals evaluate the consequences of adopting a behavior in terms of how desirable a technology’s effect is. This concept has been suggested to be a key factor in explaining the intention to use advanced mobile
services in general [24] and mobile health systems more specifically [25]. Concretely, mobile health applications in workplace health settings should feature tracking and monitoring functions (e.g., weight, diet, exercise) as these are shown to be both effective health behavior interventions [26] and favored tools of mobile users [27]. Thus, we want to stress that perceptions, rather than objective technology attributes, are suggested to be especially relevant for technology acceptance [28]. Accordingly, software developers should undoubtedly incorporate features that have proven effective, but should also take people’s preferences into account when designing an application.

Following this rationale and the technology acceptance model we propose that perceived usefulness has a positive influence on attitudinal beliefs.

2.2.1.3. Perceived ease of use

Perceived ease of use is defined as the degree to which users believe that the use of an application will be free of effort [14]. Assuming all other things as equal, the easier an application is to use, the more useful it can be. The diversity in employee age at the worksite places special demands on applications and amongst other things requires them to be easy to use to remain viable [29]. Furthermore, the inverse relationship between usage of features and the effort to control them brought to light by Cooper [30] suggests that ease of use is an indispensable determinant of acceptance of mobile applications. To continue with the example mentioned earlier, calorie tracking tools should therefore come with extensive databanks to facilitate access to nutrition and exercise information. Additionally, data input and access features should be customizable so that users can adapt them to their personal preferences.

In accordance with previous research [31], we propose that perceived ease of use has a positive influence on both perceived usefulness and attitudinal beliefs.

2.2.1.4. Perceived enjoyment

According to Davis et al. perceived enjoyment as an intrinsic motivator refers to the extent to which using an application is perceived as enjoyable in itself, aside from its instrumental value [13]. Mobile applications are adopted for both functional and nonfunctional reasons [32]. While medical-technology is about mere functionality, wellness applications should incorporate hedonic features that emphasize the fun aspect of usage [33], since prior research in technology acceptance suggests that attitudinal outcomes such as fun, pleasure and satisfaction result from perceived enjoyment [34] [35]. Also, previous studies have observed a positive relationship between perceived enjoyment and ease of use [36] [37] [38], suggesting that the more enjoyable an application is to use, the less difficult individuals find using it. Hence, calorie and physical activity tracking features of an app should be accompanied by the presentation of nutrition fun facts, for instance. Moreover, it is suggested that a well-designed user interface with visually appealing features makes usage more enjoyable [39]. Similarly, research by Davis and colleagues suggests that perceived enjoyment is an important predictor in information system usage [40].

Therefore, perceived enjoyment is proposed to have a positive influence on both perceived ease of use and attitudinal beliefs.

2.2.2. Decomposition of normative beliefs

Normative beliefs reflect an individual’s perception that significant referrers think that a specific behavior should be performed [11]. Accordingly, individuals may also perform a behavior regardless of their personal attitude towards it, if they think important referrers think they should and if there is sufficient motivation for compliance [17]. Normative beliefs are suggested to influence behavioral intention directly. The construct of normative beliefs is comprised of external and interpersonal influence factors [41].

2.2.2.1. External influences

External influences shall herein be defined as the degree to which employees perceive that the company encourages them to use a technology. External influences include expert opinions, mass media reports and other non-personal information [41]. It is suggested that external influences are crucial for creating awareness and are
therefore particularly important in early stages of adoption, when there are too few users for word-of-mouth to have a significant impact [42]. In the occupational context the equivalent to mass media reports would be a company-wide information campaign. Hence, a company could promote a provided intra-corporate mobile health application through internal and external communication channels. The benefit to facilitating adoption via external influences is the high degree of control those responsible have over them.

Consequently, we propose that external influences have a positive influence on normative beliefs.

2.2.2.2. Interpersonal influences

Interpersonal influences refer to the degree to which employees believe that colleagues and superiors think they should use an application. Interpersonal influences manifest as and travel via word-of-mouth. When the consequences of adopting a new application are unclear, people rely on their social network to help make a decision. [43]. Furthermore, using mobile health applications in the workplace is a form of public consumption and tends to be highly influenced by others as well [44]. Notably, we argue that supervisors may have a positive impact on adoption as they can serve as role models. Middle and lower level management with more frequent interaction with employees can promote applications by displaying interest, commitment, and active participation. Moreover, software developers can enhance the effect of interpersonal influence by equipping applications with “Social Web” (Web 2.0) features that provide a platform within the application for the interactive exchange of experiences. We argue that interpersonal influences will have a greater influence in later phases of adoption, when there are enough users for word-of-mouth to have a meaningful impact.

Accordingly, we propose that interpersonal influences have a positive influence on normative beliefs.

2.2.3. Decomposition of control beliefs

Control beliefs refer to an individual’s belief regarding the accessibility of resources and opportunities required to perform a behavior [45]. They are suggested to be a direct predictor of both behavioral intention and actual use. The notion of control beliefs encompasses two components that account for both cognitive (perceived self-efficacy) and situational resources (facilitating conditions):

2.2.3.1. Perceived self-efficacy

Perceived self-efficacy reflects a person’s confidence in his/her capabilities to successfully perform a behavior [46]. It thereby affects the person’s choice, effort and persistence related to this behavior. Compeau and Higgins coined the term ‘computer self-efficacy’ that captures the notion of perceived self-efficacy, but is specific to computer use [47]. Since smartphones mimic the capabilities of a personal computer adjusted to a mobile phone’s smaller screen and keyboard, this concept can very well be transferred to the use of mobile applications. Indeed, (computer) self-efficacy has been shown to have a significant positive influence on mobile health care systems [25]. Though managers and software developers have rather little control over this particular factor, it must be considered due to its suggested explanatory power in technology acceptance.

Accordingly, we propose that perceived self-efficacy has a positive influence on control beliefs.

2.2.3.2. Facilitating conditions

Facilitating conditions refers to the availability of resources and opportunities necessary to execute a behavior [48]. More specifically, in an occupational context it is the existence of technical and organizational infrastructure to support the use of an information system [18]. This includes objective factors in the implementation context, such as the availability of adequate training and technical support staff [37], management support, and of course the provision of mobile devices on which the health application is preferably already pre-installed. In a nutshell, for individuals to perform a certain behavior they have to discern that they have not only the skills but also the resources to do so.

Consequently, we propose that facilitating conditions have a positive influence on control beliefs.
2.2.4. Cues to action

Herein, cues to action shall be defined as external reminders that assist in retrieving a previously made behavioral intention. That is, even though a person intends and is motivated to perform a behavior, the intention does not necessarily remain in conscious awareness as attention can be directed elsewhere. In a similar vein, Gollwitzer [49] [50] presented evidence that implementation intentions are effective, as they require specification of the time and place for a behavior. These specified environmental cues in turn evoke the behavior when these cues are encountered. Hence, the obstacle of remembering can be passed more easily. Mobile health applications can generate cues by sending push notifications to the display of the device at programmed intervals to remind users to check their caloric intake, for instance. Therefore, once a positive intention towards a behavior is formed, the user’s mobile device, which he/she usually has with him/her, can provide cues to perform the behavior in question regardless of the location. This should lead to an increased transfer of behavioral intention into actual behavior. It must be noted that in this instance performing the behavior of using the health application is assumed to translate into performing the actual health related behavior of monitoring one’s caloric intake.

Accordingly, we propose that cues to action moderate the effect of behavioral intention on actual behavior.

4. Conclusion

The proposed framework contributes to the literature as it explores undiscovered links between health behavior and technology acceptance research and has implications in both theoretical and applied settings.

First of all, the link between perceived severity and perceived susceptibility as general motivators and perceived usefulness as dictating the preferred path of action is new to health behavior and health technology acceptance literature, as is the moderating role of cues to action in the intention-behavior-relationship. Therefore, the proposed model can serve as an important stepping stone in this field of research, be empirically tested, and provide guidance for further research. Mobile health applications are also discussed as a promising avenue for workplace health promotion. They stand to significantly better employees’ general health status as a result of their cost-effectiveness and permanent accessibility. This will especially be the case in sedentary industries, where an increasing number of employees are equipped with smart phones by the company.

Moreover, essential factors influencing adoption are presented, as are examples of how each can be translated into practical application. This will help both managers and application developers in cooperating in efforts to achieve successful implementation.

Hence, application developers get deeper insight into critical determinants that govern the adoption of mobile health applications. As shown, it is initially important to consider antecedents like perceived usefulness, perceived ease of use, perceived enjoyment, and cues to action when designing the user interface and application features in order to establish a solid foundation for a health application. Of course, many of the features described above already exist and mobile health applications are probably already used privately by some employees. Nevertheless, if the concepts mentioned above are kept in mind, certain features can be specifically tailored to the context of the workplace. To give even just one example, the nutritional information of the foods offered at the company cafeteria can be made available right away with the use of a workplace mobile health application.

This paper also provides the impetus for managers to conceptualize new integral health programs that include the concepts introduced. Those responsible in the company can start an information campaign to raise awareness (external influence) and motivate their managers to display active participation to lay the foundation for word-of-mouth transmission (interpersonal influence). Additionally, the necessary resources to allow for adoption have to be provided (facilitating conditions).

Reconciling technology with the organizational context is crucial to the implementation of health apps in occupational settings. Subsequently, improved and fiscally conscious health mobile health applications can be expected to lead to higher employee adoption rates and pave the way for more enterprise effectiveness.
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